APPENDIX D.viii:
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PLAYA VISTA ARCHAEOLOGICAL AND HISTORICAL PROJECT

At the Base of the Bluff

Archaeological Inventory and Evaluation along Lower Centinela Creek, Marina del Rey, California

edited by Jeffrey H. Altschul, Anne Q. Stoll, Donn R. Grenda, and Richard Ciolek-Torrello

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ABSTRACT

This report documents the completion of four separate, but interconnected tasks undertaken as part of the Playa Vista Archaeological and Historical Project (PVAHP): (1) subsurface inventory and evaluation of cultural resources in a large portion of Area D; (2) boundary testing of CA-LAN-62; (3) National Register evaluation of two sites, CA-LAN-211/H and CA-LAN-2769; and (4) development of an archaeological treatment plan for CA-LAN-211/H, including the updating of the research design for the PVAHP (hereinafter the prefix CA- will be dropped).

The contextual framework that supports the investigations at Playa Vista is presented in the initial chapters of this report. Previous archaeological inquiries, the results of archival research, paleoenvironmental reconstruction, and soils analysis are summarized. We use the enhanced scope of our knowledge of the past in the Ballona to refine our models and create testable hypotheses which are presented in later chapters.

Archaeological inventory at Playa Vista is made difficult by many meters of fill and standing structures from the Hughes Aircraft era that cover the resources. To overcome these obstacles, we devised a deep testing strategy using a bucket auger and coring technique. Results indicating areas of archaeological sensitivity were further tested by trenching and hand excavation in 1999 and 2001. A nearly continuous band of cultural deposit was discovered along the base of the bluff, prompting an extension of the eastern boundary of LAN-62 toward the western edge of LAN-211/H.

To complete our second task, we tested the cultural deposits at LAN-211/H and LAN-2769 by trenching and hand excavating. Site boundaries for both were estimated; the age, condition and integrity of each was assessed; and the research potential of each was evaluated. Hand excavation at LAN-211/H and subsequent radiocarbon dating revealed at least two temporal components at this site, one possibly dating to the Intermediate period and the other dating to the protohistoric and early historical periods.

LAN-211/H contains a unique and intact cultural deposit. Both shell and glass beads were found, as were large quantities of shell and stone tool debris. Bead data, along with cow bone in the midden, point to occupation during the early historical period, confirming our temporal placement of the site within the contact period of early California history. Patterns for the deposition of invertebrate and vertebrate faunal remains seen at other sites within the Ballona Lagoon Archaeological District (BLAD) are not replicated at this site, indicating a distinct change in cultural practices in the protohistoric from the Late prehistoric period. Significantly, cultural materials from the early historical period have not been found elsewhere in the Playa Vista project area and are rare throughout southern California. Based on its condition and its ability to inform on the research questions concerning human-land relationships, culture history, and settlement patterns in the Ballona, LAN-211/H is recommended to be eligible for listing in the NRHP as a contributing member of the BLAD.

We also tested LAN-2769 using standard trenching and hand-excavation methods. In contrast, this site was found to contain a very sparse deposit of cultural material that has been heavily disturbed by rodents and earth-moving activities during the Hughes Aircraft era and later years. The small amount of material retrieved from the site is deemed redundant and does not contribute to our understanding of the complex cultural dynamics at work in the prehistoric Ballona Lagoon area. Thus, this site is recommended as not eligible for listing in the NRHP as contributing member of the BLAD.

The report concludes with a treatment plan designed to guide data recovery at LAN-211/H. An assessment of the impacts to the site by proposed development is included in this chapter, which also presents our strategy for mitigating any potentially adverse affects to the archaeological deposits. To lay

the foundation for the data recovery at LAN-211/H, we present an expanded research design which outlines directions for interpreting anticipated remains from the protohistoric and early historical periods. Data recovery at LAN-211/H presents a unique opportunity to explore one of the least-well understood eras of occupation of the Southern California Bight.

ACKNOWLEDGMENTS

In 2003, Statistical Research, Inc. (SRI), entered its thirteenth year of archaeological investigation at Playa Vista. This report summarizes our efforts, focusing on the three-and-a-half-year span from the inception of fieldwork at LAN-211/H to the publication of this work. We take this opportunity to thank those people and organizations who made our work in the Ballona possible.

First and foremost, we wish to thank Playa Capital, LLC, for the opportunity to investigate this important area and for their continuing support of our research. We are indebted to Pat Larkin and Bruce Harrigan, who oversaw the implementation of the PVHAP; others involved in permitting and regulatory matters were Marc Huffman and Catherine Tyrrell. For their assistance with scheduling, equipment, and facilities at Playa Vista, we thank Mike Helma, Jay Oldham, Doug Richards, and Dave Chernik.

The lead federal agency for this work is the U.S. Army Corps of Engineers; from their ranks we wish to thank Richard Perry, Roderic McLean, and Stephen Dibble for their professionalism and support. For the past 11 years, the State Historic Preservation Officer has been represented at Playa Vista by various individuals, including Thad Van Bueren, John Sharp, Hans Kreutzberg, and Chuck Watford. We thank them and also those members of the Advisory Council on Historic Preservation who have reviewed this project. Our gratitude is also extended to our peer reviewers Drs. Patricia Martz, Charles Rozaire, and John Johnson for their insights and helpful critique.

Many colleagues and consultants contributed to this report. At Playa Vista, working with professional crews from Psomas and Associates, Group Delta Consultants, Camp Dresser and McKee, and Epics International has been both pleasurable and rewarding. Thanks go to the crews from Foothill Drilling, who proved especially resourceful in accommodating our field needs during bucket augering. We also wish to thank our consultants for their assistance and expert analyses: Manuel Palacios-Fest (ostracodes), Caroline Tepley (core descriptions), Monday Mbila (stratigraphy), Owen Davis (pollen), Richard S. Boettcher (forams), and Stanley A. Kling (diatoms). Thanks also go to Stephen Williams, geomorphologist, for his supervision of the trenching in the early phases of the inventory.

The resources of many archives across the state were tapped for this report, and we are grateful for their cooperation and assistance. The following were especially helpful: Morgan Yates, archivist at the Automobile Club of Southern California; Dr. William Frank, curator of Hispanic, Cartographic, and Western manuscripts at the Huntington Library; John Franklin, collections manager at the UCLA Geography Air Photo Archives; Wendy Teeter, collections manager at the UCLA Fowler Museum of Culture History; Kim Walters and George Kritzman at the Southwest Museum; Paul Wormser, chief archivist at the National Archives, Laguna Niguel; Dr. Errol Stevens, librarian and head of Special Collections at Loyola Marymount University; Chris Coleman, curator at the Natural History Museum of Los Angeles County; Elizabeth Barry, collections managers at the Fairchild Aerial Photography Collection, Whittier College; and Fred Machado and the docents at the Historical Society of Centinela Valley.

We also wish to acknowledge our debt to the Native American monitors at Playa Vista, Mat Dorame, Martin Alcala, Evan Alcala, Sam Dunlap, and Theresa Richau, whose vigilance and assistance have proved invaluable. Working closely with these representatives of the Gabrielino/Tongva people over the years and with the designated "most likely descendant," Robert Dorame, has built a relationship of trust and respect of which all who work at Playa Vista are proud.

Many individuals at SRI participated in the fieldwork portion of this project, including almost all of the staff of SRI's Redlands office. Benjamin Vargas deserves special mention for coordinating the bead, shell, lithic, and faunal analysis; authoring three chapters; creating most of the figures; and compiling the original draft. His help and moral support in the completing the final report were invaluable. Ken Becker implemented the bucket auger program, and Angela Keller supervised excavation and trenching in the project’s early phases. Under laboratory director Bill Feld’s able guidance, Gill Unzueta managed the wet-screen area. Benjamin Vargas directed trenching during later boundary testing. Sincerest thanks to SRI field and lab crew, who all moved a lot of buckets during this project. These include Kholood Abdo-Hintzman, Victor Arvizu, Sara Bholat, Esteban Ceja, Beth Elliot-Hora, Maria Espinoza, Tracy Franklin, Jeff Handlin, Ken Hernandez, Robert Mariani, Michael Mathiowetz, Doug McIntosh, Russell Morse, Ted Perkins, Neil Rhodes, Sharon Rushing, Jay Sander, Ayşe Taşkıran, Dennis Taylor, and Nicole Wallock. We also thank Kathy Carlson for office support, Darcy Wiewall for her assistance with faunal analysis, and Robert Mariani for his expertise with fish remains.

Editing, illustrating, and formatting this report involved the effort of many. The hours of hard work invested to produce a report of this scope are gratefully acknowledged. Artifact illustrations were created by Susan Martin, Amelia Natoli, and Lois Kain. CAD maps and figures were drafted by William Hayden, Benjamin Vargas, and Victor Arvizu. Cindy Elsner Hayward had the ultimate responsibility for all graphics and did her usual excellent job. We are indebted to Gwyn Alcock for formatting and polishing the rough draft and to Toni Tallman and Karen Barber for producing the final report. The patience and careful attention to detail under pressure exhibited by the entire production department was impressive to observe and is clearly the hallmark of a team of first-rate professionals.

Lastly, we gratefully mention the contribution of Malcolm Farmer, a remarkable man who, at the age of 15, recorded many of the Baldwin Hills and bluff-top sites for the first time, creating a corpus of notes, illustrations, and maps that proved invaluable for our research. We deeply appreciate Malcolm opening his home and personal files for our use and for reminding us, by his enthusiasm for the subject at age 88, why we got into archaeology in the first place.

CHAPTER 1

Introduction

Jeffrey H. Altschul, Anne Q. Stoll, and Donn R. Grenda

For thousands of years, people have been drawn to the Ballona Lagoon, a complex, dynamic wetland on the coast of present-day Los Angeles that occupies a low-lying drainage between the Del Rey Hills on the south and the Santa Monica tableland on the north (Figure 1). This once-saturated marshland, former home to countless waterfowl, shellfish, and other wildlife, is now being developed for mixed residential and commercial uses. To comply with federal, state, and municipal laws and regulations pertaining to cultural resources, Statistical Research, Inc. (SRI), prepared a comprehensive research design to explore the prehistory and history of the Ballona Lagoon (Altschul et al. 1991). Implementing the design, the execution of which is stipulated as part of a programmatic agreement between the U.S. Army Corps of Engineers (COE), the California State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation (ACHP), has been the primary objective of the Playa Vista Archaeological and Historical Project (PVAHP) since 1991.

The overarching research objective of the PVAHP is to understand those cultural processes that characterize the interaction between humans and their environment in and around the Ballona Lagoon. Specific goals of the PVAHP include (1) reconstruction of the paleoenvironment of the lagoon through time, (2) identification and evaluation of archaeological and historical resources within the project area, and (3) creation of a program for the proper treatment of those resources found to be eligible for listing in the National Register of Historic Places (NRHP). Progress toward these goals has matched the phased nature of construction at Playa Vista, in increments linked to development schedules. More than a decade of archaeological investigation since the preparation of the research design has produced some revision and a new level of understanding of the archaeological record in the Ballona Lagoon, demonstrated by this volume.

Because of the size and scope of the overall project, the Playa Vista project area was divided into four separate development areas (A–D). This report documents the findings of SRI's subsurface inventory and evaluation program for a large portion of Area D of the Playa Vista project (Figure 2).

Report Goals

To date, SRI has developed and implemented three work plans (Altschul and Ciolek-Torrello 1997; Ciolek-Torrello et al. 1998; Grenda et al. 1999) that covered portions of the first development phase. This report presents the results of implementing the most recent work plan (Grenda et al. 1999). The results presented here focus on three tasks: (1) inventory of those areas where the paleoenvironmental investigations suggested buried intact cultural deposits were likely, (2) boundary testing of the NRHP-eligible CA-LAN-62, and (3) the NRHP evaluation of CA-LAN-2769 (SR-12) and CA-LAN-211/H (SR-13) (hereafter, the prefix CA- is dropped from site designations).

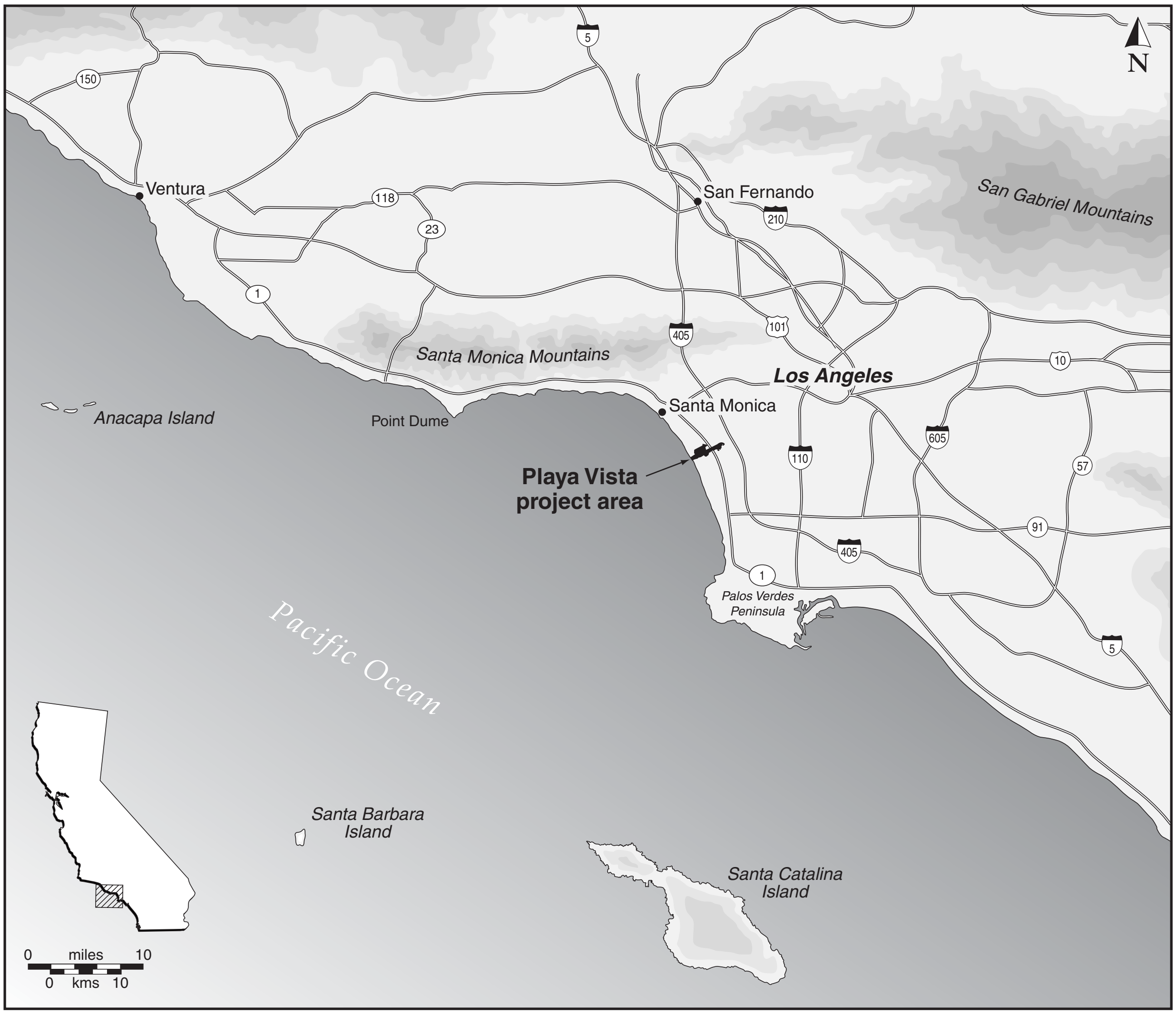

Figure 1. Location of the Playa Vista project area.

Two previously recorded prehistoric sites are included within the tested portion of Area D, LAN-62 and LAN-211. Both were first recorded in the 1940s, and a previously unknown third site, LAN-2769, was discovered in 1990. These sites are located within the Ballona Lagoon Archaeological District (BLAD), an NRHP-eligible district that encompasses the Ballona Lagoon and associated prehistoric archaeological sites around its margins. Created in 1991, the BLAD established the conceptual fabric for examining the archaeological resources in the greater Ballona area collectively, as parts of an adaptive system centered on the lagoonal environment.

The establishment of the BLAD provided a standardized procedure for assessing the relative importance of each site within the district. Once an archaeological site is identified within the BLAD, it must be evaluated to determine whether it is a contributing element of the district. Evaluation is based on an assessment of the site's integrity and its ability to provide information about the research issues described in the PVAHP research design. The parties to the programmatic agreement must determine whether sites found to be contributing elements to the BLAD will be adversely effected by development. The parties then must agree on a treatment plan for each contributing element that minimizes the adverse

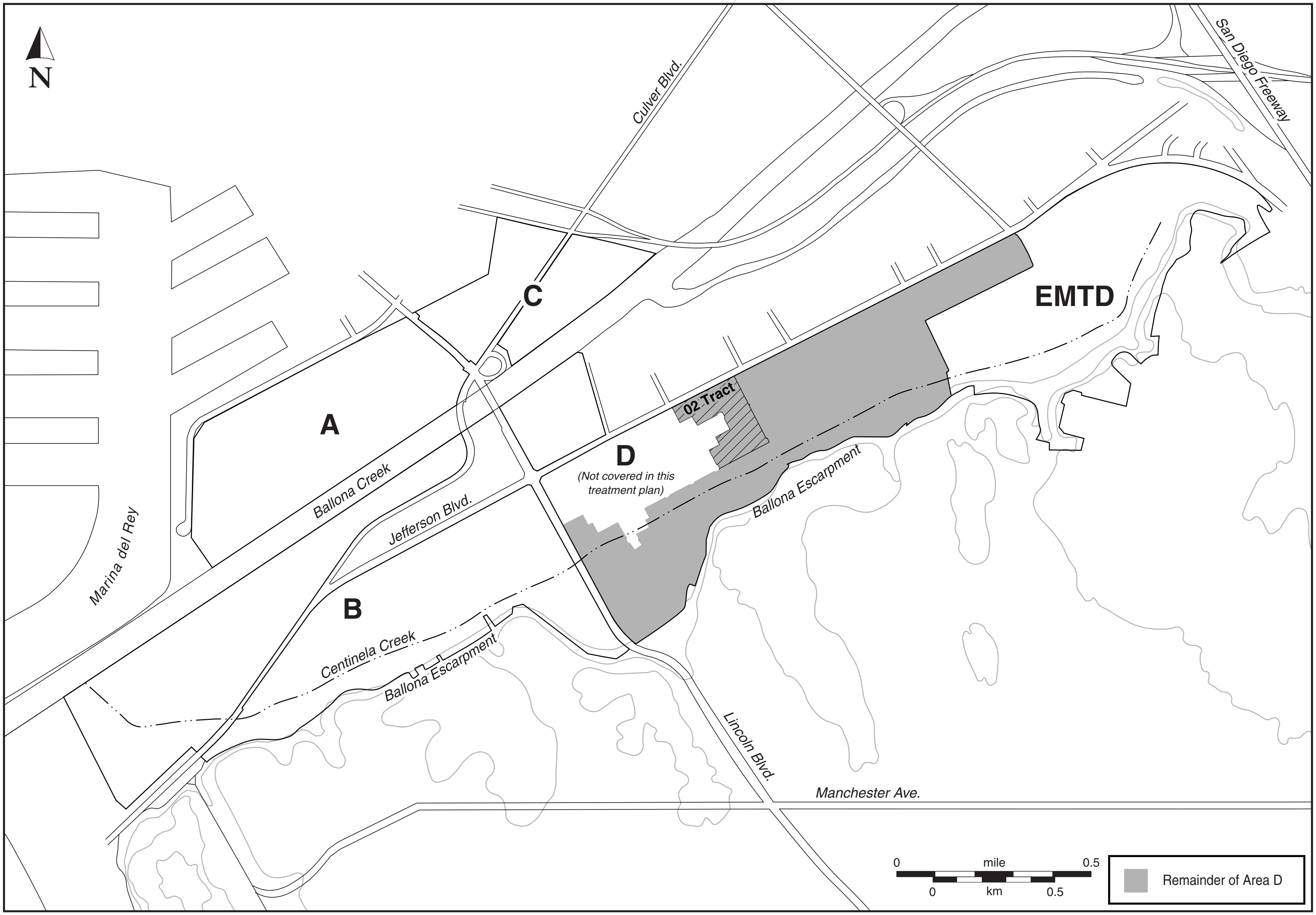

Figure 2. Overview of Playa Vista, showing the current project area, remainder of Area D, and the O2 Tract.

effect, usually by avoidance if possible, and if not, through a program of data recovery, analysis, and curation. Archaeological sites with genuine research value in the Los Angeles area, one of the most built up environments on the planet, are predictably scarce. The BLAD is rare in containing no fewer than six sites—LAN-54, LAN-60, LAN-62, LAN-193, LAN-2676, and LAN-2768—that are of scientific value and have been determined eligible for listing in the NRHP prior to this project. By encompassing these resources within the formal concept of an archaeological district, a broader analytical scope is brought to the research. Using a regional concept, comparisons are made that reflect on the larger issues of cultural chronology and environmental change along the southern California coastline.

Research Objectives

Two principal themes guide archaeological research in the area around Ballona Lagoon: human-land relationships, and the culture history and cultural dynamics of prehistoric settlement. The first theme targets the evolution of the lagoon and its effect on settlement and subsistence patterns over time. The second theme focuses on the role that developing social organization played in the wetlands. Our goal is to reconstruct the structure of human groups as they evolved in response to changes in the natural and cultural landscape. Focusing on the first theme, in 1991, Altschul and his colleagues reasoned that apparent shifts in prehistoric settlement from the bluff tops to the lagoon edge and from east to west along the lagoon edge reflect the variability of critical environmental factors, principally the retreat of the lagoon during progressive siltation and infilling through time. Altschul's original environmental model anticipated that prehistoric sites within the project area would cluster along the course of freshwater Centinela Creek and that their age would decrease as they were located farther west along the retreating resource base (see Altschul and Ciolek-Torrello 1990; Altschul, Ciolek-Torrello, and Homburg 1992; Altschul et al. 1991; Altschul, Homburg, and Ciolek-Torello 1992).

In the ensuing years of research at Playa Vista, we have attained a new understanding of the paleoenvironmental sequence in the Ballona Lagoon (discussed in Chapter 5). The estuarine system was stable by an earlier date than previously thought, ca. 6500 B.P., and open longer. Further, subsequent testing at sites along Centinela Creek revealed a more complex chronological sequence than suggested by the original east-to-west site progression. Late period sites (LAN-62, LAN-211/H, and LAN-2676) do appear to be concentrated at the western end of Centinela Creek; however, Intermediate period occupations (LAN-60, LAN-2768, LAN-193, and LAN-62) extend the entire length of the creek edge, and thus do not conform to the predicted distribution. Clearly, the determinative factors are not yet entirely in focus, and our picture is not complete.

Results

As our understanding of human settlement in the Ballona evolves, our research strategies and expectations change. One task that has proved more complex than anticipated has been establishing the boundaries for LAN-62 and what was thought to be a separate site, designated LAN-211. As defined by previous archaeological work, LAN-62 was among the first to be identified as a contributing element of the BLAD. Excavations at LAN-62 in the late 1980s revealed a deep, multicomponent deposit with two loci, and artifacts and subsistence-related remains in substantial quantities (Archaeological Associates 1988; Freeman et al. 1987; Van Horn 1987). The same researchers saw LAN-211 as a separate deposit, at least 1.5 m thick, dating to late prehistory. They also separated this site into two loci (Freeman et al. 1987:43). Evaluations of both LAN-62 and what was believed to be LAN-211 were included in the PVAHP research design of 1991 (Altschul et al. 1991:194). They were recommended to be eligible for listing in the NRHP (Altschul et al. 1991) (Table 1) as so determined in the programmatic agreement. Although the

Table 1. NRHP Status of Sites in the Project Area (Remainder of Area D)

Site Trinomial (Temporary No.)	NRHP Eligibility	Fieldwork Status	Methods of Investigation	Reference
LAN-62 (SR-15, SR-16)	eligible	testing complete	bucket augers, hand units, trenches, cores	Freeman et al. 1987 Altschul et al. 1991
LAN-211/H (SR-13)	eligible	testing complete	bucket augers, trenches, hand units, cores	this report
LAN-2769 (SR-12)	not eligible	testing complete	bucket augers, trenches, hand units	this report
LAN-1932/H (SR-6, SR-23)	eligible	data recovery complete	surface survey, bucket augers, trenches, hand units	Hampson 1991 Taşkıran and Stoll 2000b
LAN-1934/H (SR-4)	not eligible	testing complete	surface survey, trenches	Hampson 1991

previous testing had been sufficient to establish significance, the sites' dimensions could not be accurately drawn.

Believing that four distinct loci (LAN-62A, LAN-62B, LAN-211A, and LAN-211B) would be found in the area, SRI began systematic subsurface testing in the vicinity of LAN-62 in 1998 (Altschul et al. 1998). We soon realized that site boundaries would be impossible to delineate using traditional methods. With both sites deeply buried by natural alluvium and man-made fill, another discovery strategy was needed. After drilling a series of three-inch cores, our initial conclusion was that both sites extended farther from the bluffs than previously mapped and that they were covered by 2.5–6 m (8–20 feet) of sandy fill. The sites' dimensions were still unclear, however, and questions remained about site structure and integrity. In 1999, a new work plan for archaeological inventory in portions of Area D was created that specifically included a proposal to resolve the boundary issues at LAN-62 (Grenda et al. 1999). An extensive program of subsurface probing was proposed, including drilling cores and bucket augers and digging numerous trenches and test pits. A detailed description of the project methods is presented in Chapter 4.

Foreshadowing here the field results described in Chapter 6, we discovered that there is no real distinction between LAN-62A, LAN-62B, and what had been designated LAN-211A and B. It now appears that LAN-62 is a single very large multifaceted deposit that encompasses all of the original LAN-211 (A and B) and continues around the base of the bluff to the east (see Figure 2). For convenience, we have subsumed all of this archaeological deposit under the designation LAN-62.

Our understanding of LAN-211 has undergone a similar transformation. In 1991, we found no cultural material on the surface in the area where LAN-211 was originally recorded (Altschul et al. 1991:160). Instead, we found the continuation of LAN-62, as described above. Separate cultural deposits were not discovered until trenching began at the site we had originally labeled SR-13, farther east around the base of the bluff. While testing the midden deposit there, an intact portion of a much larger site was exposed under the asphalt-covered parking lot below the bluff. This deposit much more closely matches the original description of LAN-211, which was described by Pence in 1979 as being a rich midden covered by an asphalt parking lot. We conclude that LAN-211 was mislocated on early maps. Our testing results indicate that SR-13 and LAN-211 are the same site. LAN-211/H ("H" indicating the historical-period component)—which has never before been exposed, tested, or evaluated—was found to be a relatively intact, multicomponent site. We recommend that it is eligible for the NRHP and a contributing element of the BLAD (see Table 1). The detailed results of testing at this site are presented in Chapter 6 of this report.

Each project at Playa Vista expands the archaeological knowledge base. Some sites along the base of the bluff appear larger and contain evidence of later occupation than expected. Testing at LAN-62 expanded its borders, whereas LAN-211/H has been revealed as a substantial cultural deposit with good integrity and containing a protohistoric component rarely seen in the Los Angeles Basin. LAN-2769, the small deposit formerly known as SR-12, proved to be an enriched A horizon with scant evidence of prehistoric presence. Without indication of more than ephemeral use, LAN-2769 is not considered eligible for listing in the NRHP (see Table 1). The implications of these discoveries are discussed at length in the succeeding chapters.

Report Organization

This report is divided into 12 chapters. In Chapter 1, we laid the interpretive foundation of this report by presenting the background on the current project. After this introduction, Chapter 2 presents a detailed summary of the prehistoric and historical-period cultural setting and a synthesis of previous research. Chapter 3 recaps the goals of the original research design and explains the strategies we have used to satisfy the regulatory requirements of the project. Chapter 4 presents our field methods, and Chapter 5 introduces the environmental background and presents an analysis of Playa Vista soils and stratigraphy. In Chapter 6 we present a complete discussion of our field results. The next four chapters summarize the results of laboratory analysis. Chapters 7 and 8 present the results of vertebrate and invertebrate analysis, whereas Chapters 9 and 10 contain the analysis of artifacts by material class. Chapter 11 contains the summary and NRHP recommendations, followed by Chapter 12, which presents our treatment plan for minimizing adverse impacts to significant archaeological resources at LAN-211/H, including an impact analysis and research design.

CHAPTER 2

Cultural Setting

Anne Q. Stoll, John G. Douglass, and Benjamin R. Vargas

In this chapter, we review archaeological research at Playa Vista and present an update of our knowledge to set the stage for further investigation. We begin with a summary of the culture history of the California coast, followed by a review of the previous research in the Ballona. We finish with a consideration of recorded impacts to the study area.

Culture History

The cultural chronology for southern California is widely defined here to accommodate data gaps and competing models. Figure 3 presents the most recent synthesis of the various models. These models were based on the results of excavations at major sites throughout the southern California coastal region (Figure 4) over the last seven decades. Selecting the best of earlier regional syntheses (King 1981; Wallace 1955, 1978) and avoiding the pitfalls of ambiguous labels such as "Highland Culture" (Orr 1968), we divide Los Angeles Basin and southern Channel Islands prehistory into five general periods: Paleocoastal, Early, Intermediate, Late, and protohistoric/historical. Additionally, sites in the Ballona (Figure 5) are grouped by topographic location: bluff top, lagoon edge, and creek side (Centinela and Ballona Creeks). Understanding the functional and temporal relationships among these groupings is a focus of our research and guides many of the questions to be explored as we conduct data recovery in the area.

Paleocoastal Period

Spanning prehistory prior to 6500 B.P., the earliest period of human occupation on the Southern California Bight, termed the Paleocoastal period, is understood in only the broadest terms. Sites from this time period are characterized by an abundance of ground stone artifacts, stone ornaments, large, crude projectile points, and charm stones. The people of this early period, often referred to as Paleoindians, located their sites in grassland and sagebrush communities on elevated landforms somewhat distant from the modern shoreline (Vellanoweth and Altschul 2002:100). Erlandson and Colten (1991:3) assert that as many as 75 Paleocoastal sites dating in excess of 7500 B.P. are known from the California coast. They are not found evenly distributed along the coastline, but instead occur in two large clusters. One group ranges from San Luis Obispo south to the northern and western Santa Barbara coast and includes the north coasts of Santa Rosa and San Miguel Islands. The second cluster of early sites is concentrated around the ancient lagoons of San Diego County.

Solid evidence for Paleocoastal sites in the intervening areas of Ventura, Los Angeles, and Orange counties is scant and problematic. Breschini et al. (1992) listed five sites in Los Angeles County that have produced radiocarbon dates older than 7000 B.P. These five are the Malaga Cove site (LAN-138),

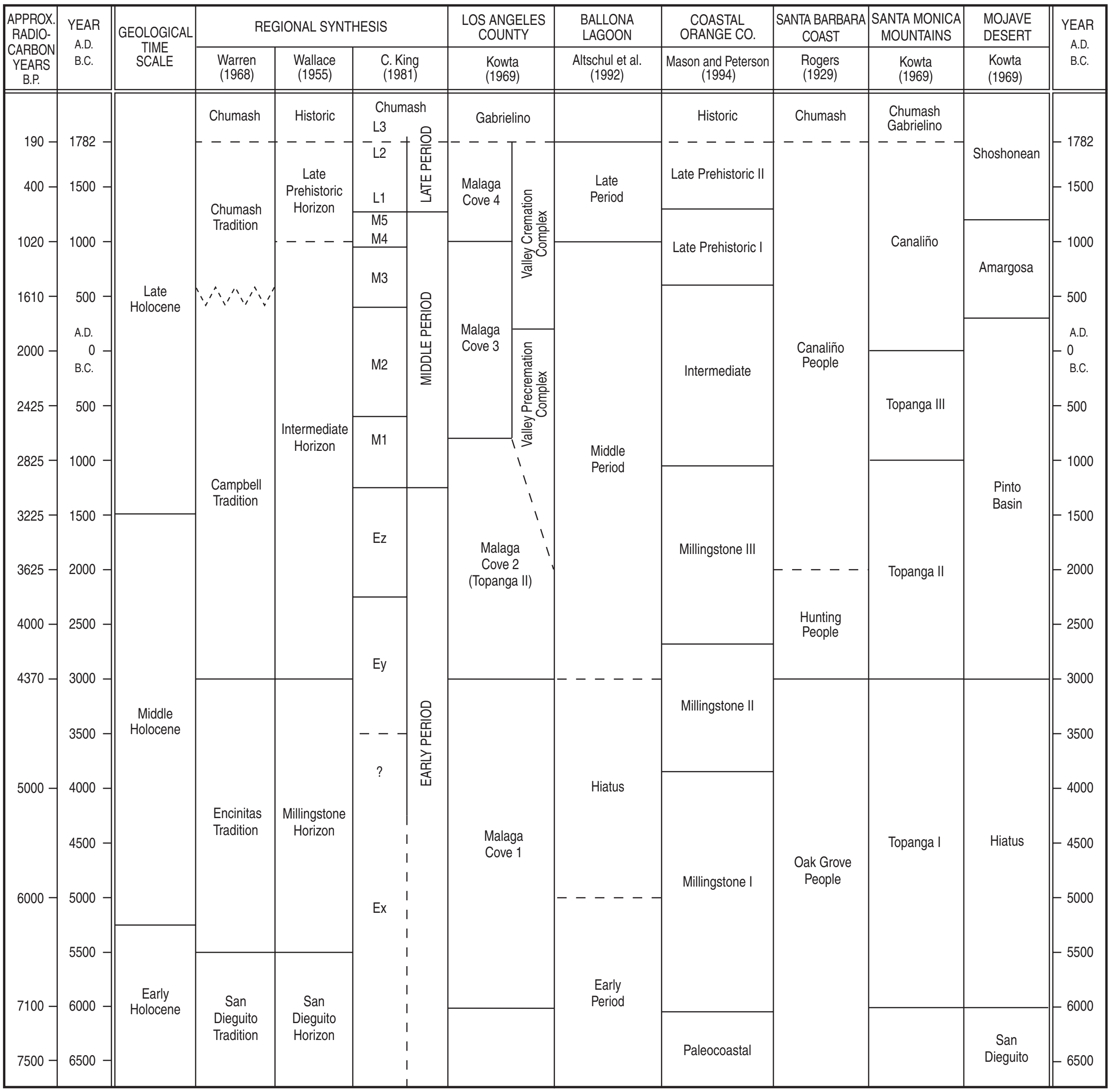

Figure 3. Culture history sequences for southern California.

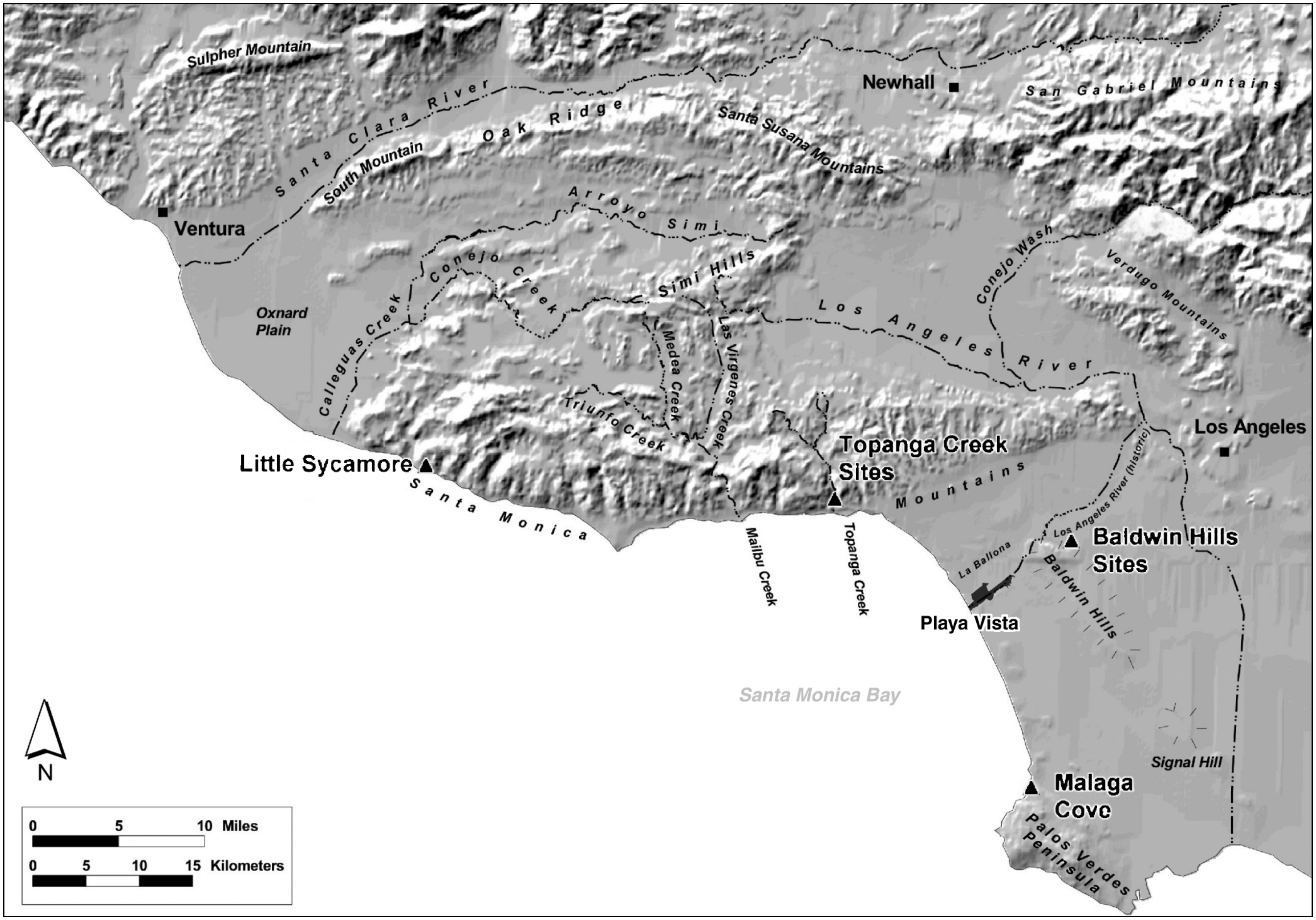

Figure 4. Major archaeological sites in the southern California coastal region.

The exact location of archaeological resources and sites are not subject to public disclosure to prevent harm and unauthorized disturbance of the resources and sites, pursuant Section 5097 of the California Public Resources Code and Section 800.11 of the National Historic Preservation Act, as amended. Therefore, this figure has been excluded.

the La Brea Tar Pits site (LAN-159), the Haverty or Angeles Mesa site (LAN-171), the Los Angeles Man site (LAN-172), and LAN-271. Three of these sites are depicted spatially in Panel A of Figure 6, a map of the Ballona region through time. Questions revolving around the dating of these sites have made their antiquity suspect, however. For example, the early Holocene age of LAN-271 is based on marine shell now thought to have been contaminated by fossil shell (Erlandson 1994:222). A short review of these sites explains the circumstances which have fostered this uncertainty.

Reports of evidence of "Early Man" in Los Angeles were heralded as a major discovery in 1914, when human remains were found in the Rancho La Brea Tar Pits (LAN-159) in general association with the bones of extinct animals (Merriam 1914). Assuming the remains to be contemporaneous with Pleistocene Rancholabrean fauna, this find spawned the sensational notion that human occupation of southern California extended back as far as 34,000 years B.P., clouding serious investigation for years to come. Radiocarbon dates on archaeological materials (Table 2) have brought the range into the more reasonable span of 9000–4450 B.P.; nevertheless, problems inherent in dating bone-collagen extract and in decontaminating samples taken from a tar seep still suggest these dates should be regarded with caution. Contamination of the skeletal material from oil impregnation cannot be ruled out (Erlandson 1994:222).

The discovery of deeply buried human skeletal material by construction workers for the Haverty Company in 1924 at Angeles Mesa (LAN-171) in the Baldwin Hills (Stock 1924) provided more fuel for the debate. Skeletal remains of at least eight individuals—three males, three females and two subadults of indeterminate sex—were uncovered in close association at this site at depths between 5.8 and 7 m (19.03 and 22.97 feet) (Brooks et al. 1990). Bone awl fragments, a quartzite core tool, and some freshwater gastropods were found near the skeletons in the marshy area at the base of the Baldwin Hills. The depth of the finds and the partial mineralization of some of the bones suggested to Stock (1924) that the remains might be Paleoindian; a subsequent amino-acid racemization (AAR) age estimate of more than 50,000 years made some sixty years later seemed to confirm this conclusion (Taylor et al. 1985:137). In 1936, a third discovery of a so-called Early Man was made: a single skeleton, dubbed "Los Angeles Man," was uncovered two miles west of Angeles Mesa (at LAN-172) in a similar stratigraphic context to mammoth bones (Lopatin 1940). By this time, even some of the early skeptics were convinced.

These finds thrust the topic of Early Man in the Los Angeles Basin into an era of controversy from which it has only recently begun to emerge, as more reliable radiocarbon dates have become available. Conducting the first comprehensive, multidisciplinary review of the Angeles Mesa remains, Sheilagh Brooks and her colleagues (Brooks et al. 1990) subjected the bones to new conventional (decay-counting) ^{14}C dating, then obtained a suite of accelerator mass spectrometry (AMS) dates from noncollagen organic bone (osteocalcin) components as a cross-check. Table 2 presents the age initially ascribed to the remains of Early Man at the time of discovery, more-recent AAR age estimates, and the most current revised radiocarbon dates.

The wide range of dates and disparate results depend on the technique used and indicate that dating issues for these sites remain unresolved. Haverty Man No. 4, for example, is apparently anywhere from 3,870 ± 350 to 15,900 ± 250 years old, a span that exceeds an acceptable margin of error for radiocarbon dates. As to their significance, Brooks et al. (1990:80) felt that "the assumption that all of the Haverty skeletons are of similar age also may need to be reassessed," to which Erlandson countered, "It is hard to imagine that the burials are not temporally related" (Erlandson 1994:223). Without additional data about their original context, not likely to be obtained at this late date, or a new series of more reliable dates, the meaning of the Haverty skeletons remains in limbo.

The Malaga Cove site (LAN-138) figures importantly in the discussion of early Holocene adaptions in the Los Angeles area, but its inclusion on the list of Paleocoastal sites is questionable. A multicomponent site located on a bluff overlooking the Santa Monica Bay just north of the Palos Verdes Peninsula, Malaga Cove was "sampled" by collectors such as F. M. Palmer as early as 1906 (Palmer 1906). Two loci at Malaga Cove were first systematically excavated by Richard Van Valkenburgh in 1931–1932 as part of the Van Bergen–Los Angeles County Museum Expedition; however, he never published the

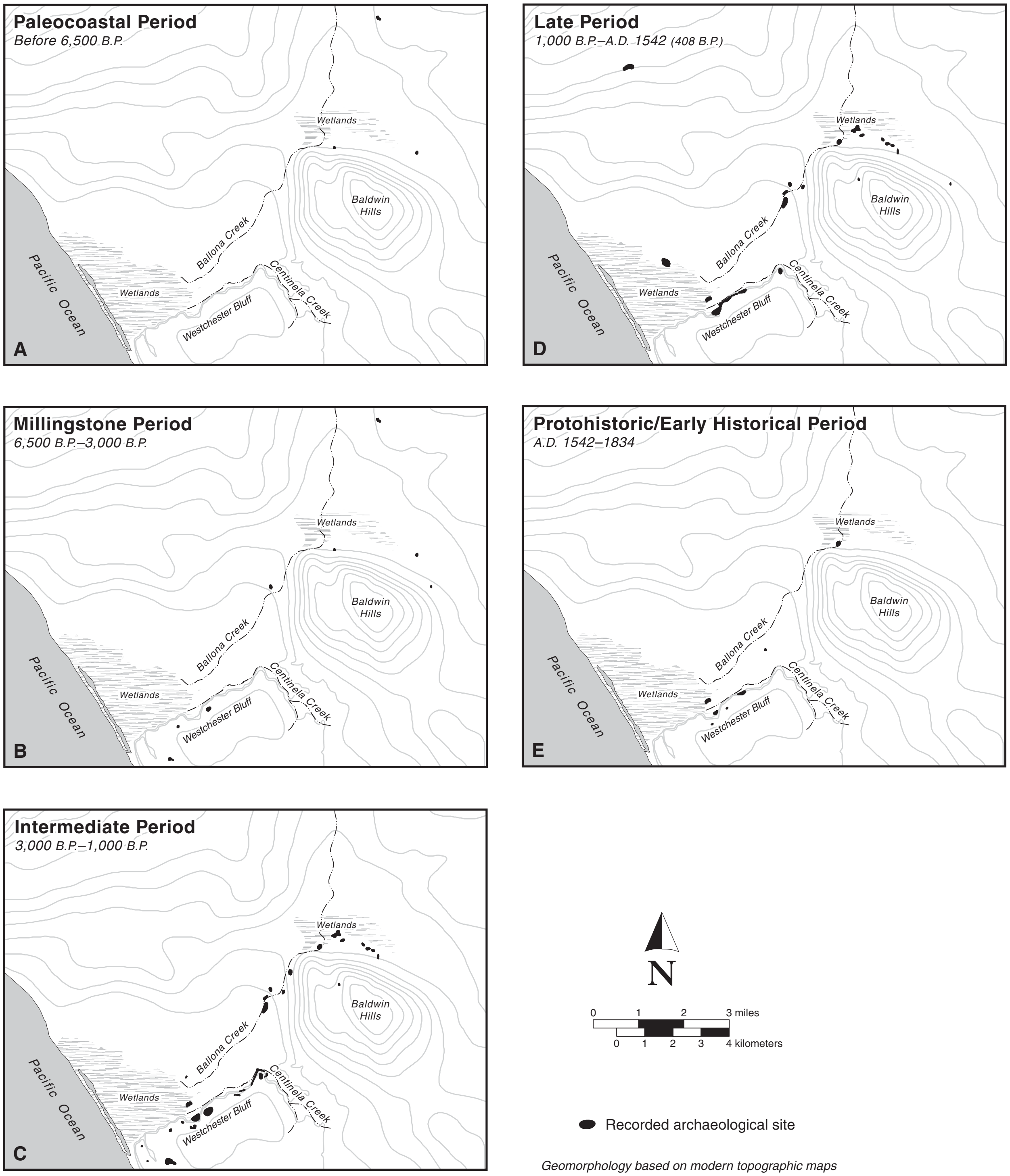

Figure 6. Archaeological site distribution in the Ballona over the last 7,000 years (Panels A–E).

Table 2. Radiocarbon Dates of "Early Man" Sites in the Los Angeles Basin

Material Dated, by Site	Original Date (B.P.)	Revised ^{14}C Date (B.P.)	Citations
LAN-159, La Brea Tar Pits site			
Human skull, skeletal material (Pit 10)	11,000– 34,000	9000 ± 80 (UCLA-1292BB)	Merriam 1914; Berger et al. 1971
Human bone collagen (Pit 10)		12,650 ± 160 (UCLA-1292B)	Dillon and Boxt 1989
Broken wood atlatl dart foreshaft (Pit 67)		4450 ± 200 (LJ-0121)	Payen 1970
LAN-171, Angeles Mesa/Haverty site			
Skeleton #1, organic fraction	4700 ± 600 (AAR)	5280 ± 180 (UCR-1349D)	Brooks et al. 1990
Skeleton #1, osteocalcin		5540 ± 230 (UCR-3083/CAMS-439)	Brooks et al. 1990
Skeleton #2, gelatin fraction	41,000 ± 1500 (AAR)	2730 ± 190 (UCR-3084/CAMS-445)	Brooks et al. 1990
Skeleton #2, osteocalcin		4630 ± 260 (UCR-3087/CAMS-438)	Brooks et al. 1990
Skeleton #3, femur collagen	43,000 ± 500	10,500 ± 2000 (UCLA-1924)	Taylor 1983; Berger and Protsch 1989
Skeleton #4, gelatin fraction	24,000 ± 1,500 (AAR)	3870 ± 350 (UCR-3086/CAMS-440)	Brooks et al. 1990
Skeleton #4, bone		5200 ± 400 (GX-1140)	UCR 1986; Brooks et al. 1990
Skeleton #4, bone		7900 ± 1440 (UCLA-1924A)	Berger et al. 1971; Brooks et al. 1990
Skeleton #4, osteocalcin		12,600 ± 460 (UCR-3088/CAMS-433)	Brooks et al. 1990
Skeleton #4, gelatin fraction		15,900 ± 250 (HA-104B)	Brooks et al. 1990
Skeleton #5, gelatin fraction	22,000 ± 600 (AAR)	4710 ± 190 (UCR-3089/CAMS-441)	Brooks et al. 1990
Skeleton #5, osteocalcin		11,960 ± 500 (UCR-3085/CAMS-437)	Brooks et al. 1990
LAN-172, Los Angeles Man site			
Bone collagen, amino acids	23,600 (UCLA-1430)	3560 ± 220 B.P. (AAR)	Bada 1985; Davis 1976; Lopatin 1940

Note: AAR, amino-acid racemization; CAMS, Center for Accelerator Mass Spectrometry, Lawrence Livermore Nuclear Laboratory, Livermore, California; GX, Geochron Laboratories, Inc., Cambridge, Massachusetts; LJ, University of California, San Diego, (La Jolla); UCLA, University of California, Los Angeles; UCR, University of California, Riverside.

results of this work. As Wallace commented, “It is a great pity that Van Valkenburgh never got around to reporting the results of his investigations, for he found some unique materials and his field notes indicate that he had some good insights into local prehistory” (Wallace 1984:1).

In 1936–1937, Edwin F. Walker of the Southwest Museum began excavation at Malaga Cove (LAN-138) (Walker 1937, 1952). Walker identified four discrete occupational strata in the 28-foot- (8.5-m-) deep sequence; the stratum of interest in the search for Early Man was the lowest of the four, about a meter (3 feet) thick, which he labeled Level I. Walker called the Level I occupants of the site “the Scraper People,” believing them to belong to the Paleocoastal period (Walker 1937), which Wallace (1984) later endorsed by equating them with the San Dieguito culture. Both men based their conclusions on an analysis of the artifacts found—specifically, small chert drills that Walker called “microliths,” worked shells, flaked and core tools, “rude scrapers,” and two crude, leaf-shaped bifaces. Bone and shell artifacts were relatively abundant in Level I, as were shell beads (primarily spire-removed *Olivella*) and bone beads, but milling stones were entirely absent (Walker 1952).

Subsequent radiocarbon dating at Malaga Cove produced a series of dates ranging from 215 ± 80 B.P. (UCLA-1008A) on material from a disturbed area of the site to 7130 B.P. (UCR-1196) on a shell bivalve (Breschini et al. 1992:14). The oldest date was obtained from a shell removed from the sea cliff in an unknown stratigraphic context, throwing its accuracy in some doubt (Erlandson 1994:224). The possibility exists that what Walker labeled as Level I at Malaga was not a discrete deposit. Careful examination of photographs taken during Walker’s excavation (Braun Library, Southwest Museum, Walker Papers, Nitrate Box 17) indicate significant bioturbation in Level II at its contact with Level I. In the absence of radiocarbon dates from a secure stratigraphic context, the antiquity of Level I at Malaga Cove remains in doubt.

Millingstone Period

The Millingstone period, sometimes referred to as the Early period, is currently conceived as a 3,500-year span, beginning with the stabilization of sea levels about 6500 B.P. and ending with the first dramatic increase in regional human population around 3000 B.P. (see Panel B, Figure 6) Although six radiocarbon dates from the Angeles Mesa site extend into the Paleocoastal era prior to 7100 B.P., the majority of dates are significantly more recent, ranging from about 5685 to 3560 B.P. If accurate, these later dates place the Angeles Mesa site (LAN-171) more firmly within the Millingstone period. Other important sites with Millingstone components that helped define the period include LAN-1, known as the Tank Site (Treganza and Bierman 1958), and VEN-1, the Little Sycamore Site (Wallace 1954; Wallace et al. 1956; see Figure 4).

Although probably not representative of the early Paleocoastal period as discussed above, the Malaga Cove site (LAN-138, see Figure 4) was clearly occupied during the Millingstone period. A second radiocarbon date of 6510 ± 200 B.P. (Hubbs et al. 1960:201) obtained from a shell sample (*Chione* sp.) places the lowest levels at the Malaga Cove site at the beginning of the period. Millingstone implements from Malaga’s Level 2 included large amounts of ground stone, cobble hammers, choppers, a few mortars and pestles, large coarsely flaked projectile points, and knife blades; virtually no shellfish or fish remains were found in Level 2 (Walker 1952:51–60).

Wallace, who studied the Malaga Cove site extensively, expressed complete confidence in the antiquity of the site and accepted Walker’s analysis of Level I as belonging to the San Dieguito tradition (Wallace 1955). Wallace further asserted that the shell date of 6510 ± 200 B.P. was recovered from in situ material from Level I (Wallace 1984). Hubbs, however, stated that this shell came from the “next to lowest horizon,” which would have been Level 2 (Breschini et al. 1996:14). The chronological context of Level I remains uncertain.

In 1984, Wallace published what amounted to an archaeological obituary for Malaga Cove and three other important coastal sites in the South Bay district of Los Angeles. He reported that all four had been destroyed by construction projects. Malaga Cove, "the most conspicuous and well-known" of the four, had been first to go, "leveled in 1955 to make way for a residential development" (Wallace 1984:1). Closing his article on an optimistic note, Wallace asserted that, although the South Bay sites themselves were gone, "good opportunities for future research still exist" because the artifact collections and field notes were still available.

Three years later, D. L. True (1987) responded to Wallace's assessment with somewhat less enthusiasm for the value of museum collections. The focus of True's article was to present an abbreviated catalog of artifacts he had recovered from Malaga Cove in the mid- to late 1930s. True's collection, recovered from a stratum he felt was comparable to Walker's uppermost Level IV, consisted of small projectile points, knife-like implements, fish hook blanks, slate files, a few bone tools, and a handful of shell beads. After attempting to piece together the stratigraphy at Malaga Cove and struggling with the site formation issues he encountered, True concluded that his work served "primarily to provide additional descriptive data to a poorly known archaeological situation and add still another level of confusion to the interpretation" (True 1987:281).

The research potential of the Malaga Cove collections remains an open question. No complete report exists of Walker's 1937 excavation, the site boundaries were never defined, the artifacts collected have not been completely analyzed, and too few radiocarbon dates have been run to define the temporal placement of the levels. As one of the few deeply stratified sites ever found in the Los Angeles Basin, LAN-138 deserves a thorough reevaluation.

Millingstone period sites have also been discovered in the Ballona, on the bluff tops above the current project area and east near the Baldwin Hills where ephemeral camps were located near an inland swamp later known as Las Cienegas. Early archaeological surveys of this area identified a series of 15 sites in the upper Ballona with artifact collections that included cogged stones, a few large projectile points, and large numbers of ground stones (Farmer 1934, 1936; Rozaire and Belous 1950). The Angeles Mesa site (LAN-171) is among this group of sites.

Evidence of occupation of the lower Ballona during the Millingstone period is scarce; no sites from this time have yet been found on the lagoon edge where well-developed marshes were then absent. Two sites on the bluff above the lagoon, LAN-61 and LAN-206, have yielded radiocarbon dates that fall within the early Millingstone period. A single uncorrected radiocarbon date of 6750 ± 80 B.P. on a shell valve (*Chione* sp.) recovered from 50–60 cm below the surface at the Berger Street site (LAN-206) is the earliest from any site on the bluff tops (Van Horn and White 1997c:19). Another uncorrected date of 4710 ± 80 B.P. on a shell sample from the Marymount site (LAN-61A) falls within this time frame (Van Horn and Murray 1985). Millingstone period use of the bluff, however, is probably more widespread, as suggested by the surface finds of artifacts such as crescents, discoidals, and Lake Mojave–style projectile points (Lambert 1983).

Van Horn and White (1997c) argued that the occupants of the Millingstone period component (Component A) at the Berger Street site fished and collected shellfish in the nearby Ballona estuary. The paucity of tools and faunal remains in the midden is consistent with a short-lived campsite; presumably individual occupations did not last more than a few weeks at any one time. The picture that emerges is one of brief forays to the lagoon from campsites on the bluff tops overlooking the bay. In small mobile groups, Millingstone period residents of the Ballona exploited nearshore and lagoonal fish and shellfish. The absence of potable water would have discouraged permanent settlement on the bluff. Suitable conditions for permanent settlements might have existed in the Baldwin Hills.

Many questions remain about the Millingstone period in the Ballona. The dating of cultural materials from this period continues to pose a methodological and interpretive challenge. Shell was used for radiocarbon assays at LAN-61 (Van Horn and Murray 1985), and although the species was not identified, it was probably *Chione* sp. Most archaeologists in southern California use this shell for radiocarbon dating because the size of the shell allows a sample to be obtained from a single shell, as opposed to combining shell pieces found in various proveniences. Using this species to identify Millingstone period sites may be problematic, as current studies of mollusks from our coring program indicate that *Chione* and estuarine species were not well established in the wetlands prior to 6500 B.P. Thus Van Horn and his colleagues might have dated occupations coeval with the origin of the marsh or maturation of the estuary rather than the initial human occupation of the Ballona. Although they are few in number, the presence of temporally diagnostic artifacts such as Lake Mojave projectile points, crescents, and discoidals supports the model of human use of the region predating the radiocarbon assays by possibly 2,000 years (Altschul et al. 2003).

Intermediate Period

About 3000 B.P., the Ballona received an influx of settlers. Stability in settlement patterns, economic activities, mortuary practices, and technology suggest that this distinct occupation lasted until around 1000 B.P., defining the Middle or Intermediate period (see Panel C, Figure 6). The Intermediate period at Malaga Cove (LAN-138) is represented by artifacts, such as implements for fishing and sea-mammal hunting, found in the upper portion of Level 3. Intermediate period occupation at Malaga Cove, thought to date to around 1450 B.P., is also characterized by big stone mortars and pestles, abalone shell fishhooks, bone harpoon barbs, chert knives and scrapers, steatite vessels, and shell ornaments. These artifacts mark the beginnings of maritime exploitation at the site (Walker 1952; Wallace 1984).

In the Ballona, 10 Intermediate period archaeological sites have been identified through radiocarbon dating, and is the best documented portion of the prehistoric epoch in the area. Within the Playa Vista project, there are five Intermediate period sites. Four sites, LAN-60, LAN-62, LAN-193/H, and LAN-2768, are located at the base of the bluff along the banks of Centinela Creek, whereas LAN-2676 sits at the lagoon edge. Tested in 1999, LAN-2676 was a short-term resource-processing site located in a disturbed context (Altschul et al. 1998). Outside the Playa Vista property, there are five large midden sites that sit above the Ballona Lagoon (LAN-59, LAN-61, LAN-63, LAN-64, and LAN-206), occupying almost every elevated point along the edge of the Westchester Bluff. These sites contain relatively thick deposits, all of which have yielded radiocarbon dates within the Intermediate period (Altschul et al. 1999).

Two basic questions concerning Intermediate period occupation have guided our research in the Ballona: first, what accounts for the increase in settlement during this period, and second, what is the nature of the relationship between the bluff-top sites and the lowland sites? In pursuit of an answer to the first question, previous researchers have hypothesized that some Intermediate period cultural traits indicate the arrival of people from the desert (Van Horn 1987). These traits include tanged projectile points, cremation of the dead, and a lack of shell artifacts. The preference of stone over shell as a raw material for making beads suggests the presence of people without a strong maritime tradition.

Recent investigations have examined the microlith industry and the presence of desert-style projectile point types during the Intermediate period as expressions of a cultural tradition unique to the Ballona (Altschul et al. 2003). Artifacts referred to as microliths were found at Malaga Cove in Level I (Wallace 1984); these artifacts are scarce at large Intermediate period sites such as ORA-83 in Bolsa Chica (Whitney-Desautels 1986a) or ORA-64 in Newport Bay (Macko 1998). This distribution suggests a directed migration toward the Palos Verdes Peninsula. The question of desert migrations during the Intermediate period has been discussed by several authors (Altschul and Grenda 2002; Altschul et al. 2003; Ciolek-Torrello and Grenda 2001; Koerper 1979; Kowta 1961; Kroeber 1925; Moratto 1984; True 1966; Van Horn 1987, 1990). Most have suggested that an arrival date of around 1450 B.P. is consistent with the data; however, a few have argued for a much earlier migration. Both may be right. It is possible that multiple migrations took place over hundreds, if not thousands, of years.

Contrasting characteristics within the faunal collections serve to illuminate the relationship between Intermediate period bluff-top and lowland sites in the Ballona. At bluff-top sites, faunal collections are dominated by lagoonal fish species with few terrestrial mammals, whereas the lowland sites show the opposite pattern. Also puzzling are the low proportions of estuarine mollusks found at lowland sites, in contrast to bluff-top collections, which show a greater dependence on shellfish.

Several hypotheses have been developed to address the questions raised by the archaeological data (Altschul et al. 2003; Ciolek-Torrello and Grenda 2001). Differences in faunal collections between bluff-top and lowland sites may relate to dating issues. Perhaps the bluff-top sites date to the early part of the Intermediate period, whereas lowland sites date to the latter part. This pattern would be consistent with a maturation of the estuary later in the Intermediate period. Radiocarbon dates from both bluff-top and creek-edge sites, however, do not support this argument: sites in both locations appear contemporaneous.

A second set of hypotheses aimed at explaining differences between the structures of the bluff-top and lowland sites relates to the types and numbers of groups who occupied these areas during the Intermediate period. One hypothesis postulates that two distinct social groups occupied the Ballona at different times of the year as part of their seasonal round. Each of these groups had different adaptations to wetlands, thus explaining the differences in the faunal collections. A second hypothesis suggests that the archaeological record could also be the result of two similar adaptive strategies derived from different settlement systems. Perhaps a single social group, while living permanently at the Ballona, moved its settlements seasonally to exploit various resources. Alternatively, permanent settlers of the Ballona might have been diffused into smaller groups and dispersed along the creek edges and on the bluff tops as part of one social system. In any case, the archaeological signatures might look very similar.

A third hypothesis envisions the archaeological record as the result of decision making by one group who returned to the Ballona seasonally and faced differing environmental conditions that would require residence on either the bluff tops or the creek edges. As historical accounts and records have shown, the highly variable nature of Ballona and Centinela Creeks would have strongly influenced where people would have been able to reside at different times of the year (see Chapter 5, Table 5). It is possible that Intermediate period bluff-top sites represent occupations that occurred when a catastrophic event, such as a flood, inundated the marshlands and flushed the estuaries, making the lowlands uninhabitable and damaging or removing the shell beds and other estuarine species. Ballona dwellers would have been forced to shift their residences to higher ground, or possibly to abandon the area altogether for a time. During drier periods, when estuarine species were reestablished, they would have returned, moving closer to the resources. Ciolek-Torrello and Douglass (2002) discuss this in detail in relation to Great Basin wetlands subsistence and settlement patterns. Similar patterns are evident in the Great Basin, as water levels in wetlands in this region fluctuate.

Although this hypothesis has some appeal, it does not adequately account for the low dependence of Intermediate period populations on estuarine resources and the stark differences between lowland and bluff-top faunal exploitation patterns. These differences might be reconciled if the sites on the bluff were dominated by terrestrial species, whereas the sites along Centinela Creek contained an abundance of riparian species, indicating that people had resided near the resources they targeted. Such is not the case, however; the reverse is true. Bluff-top sites contain mostly lagoonal resources, whereas those sites along the creek edge are characterized by terrestrial species, some of which might have been more plentiful on the bluff.

The answer may be that bluff-top and creek-edge sites were occupied simultaneously during the Intermediate period, perhaps by migrants from the desert. The shift in settlement between Millingstone and Intermediate periods is dramatic. The Ballona, which in the Millingstone period was only marginally attractive to human settlement, experienced intensive occupation in the Intermediate period. Assessing which of these multiple working hypotheses best explains the archaeological record of the Intermediate period will be the focus of additional research.

Late Period

The Late period, beginning around 1000 B.P. and ending with European contact in A.D. 1542, was a time of tremendous population growth along the southern California coast (see Panel D, Figure 6). A greater number and variety of sites have been found that date to this period than from any other time in prehistory. The Late period component at Malaga Cove (LAN-138), Level IV, consisted of a midden more than 4.5 m (15 feet) thick containing large quantities of small, leaf-shaped projectile points; steatite bowls; mortars and pestles; bone tools; shell fishhooks; and ornaments of bone and shell (Walker 1952). Late period sites elsewhere in the Southern California Bight include fully developed villages with complex site features, suggesting a corresponding differentiation within the social system. In the Ballona, Late period sites are few, and no village sites have been discovered. Until recently, our understanding of the Late period in the Ballona wetlands was based on an analysis of relatively small sites on the periphery, such as the Hammack Street site (LAN-194) and the Admiralty site (LAN-47). Only LAN-47, located at the edge of the Ballona Lagoon, has been systematically excavated (Altschul, Homburg, and Ciolek-Torrello 1992).

Data recovery at LAN-47 revealed an occupation typical of the Late period throughout coastal California. Nearshore and estuarine species were most numerous in the faunal collection and the lithic material was dominated by flake core, split-cobble, microlith, and bipolar technologies. However, the nature of life in the Ballona cannot be assessed adequately from just one site. As Altschul et al. (2000:13) stated, "the study left larger issues surrounding Late period settlement and culture untouched. In particular, issues of settlement population or permanence have not been addressed."

Within the Playa Vista project area, settlement appears to have moved westward along the base of the bluff in the Late period. This is the setting for LAN-211/H, located on the truncated foot slope of an alluvial fan at the base of the bluff. From the preliminary analysis of artifacts found during testing, it appears that both LAN-211/H (Stoll and Taylor 2000) and LAN-1932/H (Taşkıran and Stoll 2000a, 2000b) span the transition between the Late and protohistoric periods. Both sites contain flaked glass and glass trade beads as well as stone tools and may hold important clues about the persistence of indigenous populations into historical times.

Another larger Ballona area site, the Peck site (LAN-62), also contains Late period components. One hypothesis suggests that this site and LAN-211/H each represent a distinct locus of a single Late period community. That they are spatially segregated may reflect that social distance, although decreasing, was still apparent. The two sites may represent two social groups that were evolving into becoming a single social entity. As the size of the social group increased, the need for a political hierarchy might have emerged. Support for distinctions in social position are meager, but intriguing. Of the 67 shell beads recovered from LAN-62 in 1998, 10 were typed as *Olivella* wall disc beads (Altschul et al. 1998), which King (1974:86–87) associates with burials of political leaders at the Medea Creek cemetery (LAN-243).

Earlier excavation at LAN-62 (Peck 1947; Van Horn and Murray 1984) suggested that this site holds the key to answering many of our research questions about the Late period. The presence of a well-developed midden, a wide range of artifacts and faunal remains, and the presence of burials all suggest it may have been a village site. If future excavation confirms this hypothesis, the Ballona may fit the model popular for the Late period: that of a restricted area rich in natural resources that supported aggregated villages with 100 or more inhabitants and with small associated campsites and specialized-activity loci nearby.

If the deposit at LAN-62 represents the remains of a village, then there may be evidence to support the model of a LAN-62 community with distinct loci. Altschul and his colleagues (2003) have suggested that distinctions between loci could represent social complexity, with a hierarchy based on location within the Ballona. Another possibility is that the various site locations represent specialized-activity loci, but that the population is the same social or lineage group. Future work at LAN-62 should answer many of these questions.

Protohistoric and Early Historical Periods: Native American Occupation

The line between the Late and protohistoric periods is admittedly an arbitrary one. Protohistory is defined as beginning with European contact in A.D. 1542 and proceeding through the establishment of the Mission San Gabriel in 1771, when direct and recurrent contact began between the Gabrielino and the Spanish (Lightfoot and Simmons 1998:140) (see Panel E, Figure 6). The early historical period (also known as the Mission period) follows, dating from 1771 until secularization in 1834.

The protohistoric period is arguably the least-documented interval in all of southern California prehistory. A distinct time bias against remains from this period can be seen in the work of some early archaeologists, such as Edwin Walker, who actively pursued Early Man, but disregarded later occupants. Walker summarized the protohistoric and early-historical-period evidence he found at Malaga Cove in a single sentence: "Level 4 reached the historic stage as shown by the presence, at its very top, of a few small glass trade beads of the type introduced by Spaniards at the beginning of the 19th century" (Walker 1952:68). Similarly, scant evidence—three glass trade beads—of protohistoric occupation of the bluff tops overlooking the Ballona was found at LAN-63 (Van Horn 1987). Below the bluff, the finds are more numerous: glass trade beads and early-historical-period shell beads were recovered during testing at LAN-211/H, LAN-1932/H, and LAN-2676. Radiocarbon dates from LAN-2676, a disturbed site located at the edge of the lagoon, suggest that a portion of this largely Late period midden dates between A.D. 1450 and 1660 (Altschul et al. 1998). Although there was no Late period occupation on the bluff, a substantial occupation along the edges of Centinela Creek and the Ballona Lagoon might have been present during protohistoric times.

Sa'angna and Guaspita

Fueling the debate surrounding protohistoric and early-historical-period occupations in the Ballona has been the search for the Gabrielino villages of Sa'angna and Guaspita, reputedly located in the area. Anthropologist Alfred Kroeber (1925:Plate 57), placed the Gabrielino name "Sa'an" at the shoreline near modern Playa del Rey (Figure 7), based on information from "an old Luiseño informant" that Sa'an was located "at Ballona" (Kroeber 1907:143–144). J. P. Harrington's informant located "Saa'an" at the old Machado Ranch, farther inland in modern Culver City (McCawley 1996:61). It has never been clear from these sources whether the reference was to a geographic place-name for the general area, or to a specific habitation site. The next to publish was W. W. Robinson (1939a), who learned in an interview with long-time Ballona resident Cristobal Machado that there were two settlements of Native American laborers on the Rancho La Ballona, one near the Machado residential complex and the other at the base of the bluff below present-day Loyola Marymount University. Machado also told Robinson that the word "Guacho," sometimes written "Huacho" and shown on the eastern border of the rancho on the 1839 *diseño* (Figure 8), was a Native American term meaning "high place." Robinson felt this word referred to the Westchester Bluffs, on the southern edge of the Ballona (Robinson 1939a:104). Recent research has shown a connection between Guacho or Huacho and the Gabrielino place-name "Guaspita" (McCawley 1996:63). However, after Robinson, ethnohistoric inquiries left the existence and location of Guacho an open question, researchers choosing instead to focus on the possible location of Sa'an in the Ballona.

Robinson was followed in 1952 by John R. Swanton. In his massive volume on the Indians of North America, Swanton (1952:491) interpreted Kroeber's mention of Sa'an to indicate the location of an actual village. Ten years later, Bernice Johnston (1962), in her study of the Gabrielino, tried to reconcile Swanton's interpretation with Machado's information and what she knew of the archaeological evidence. Johnston argued that

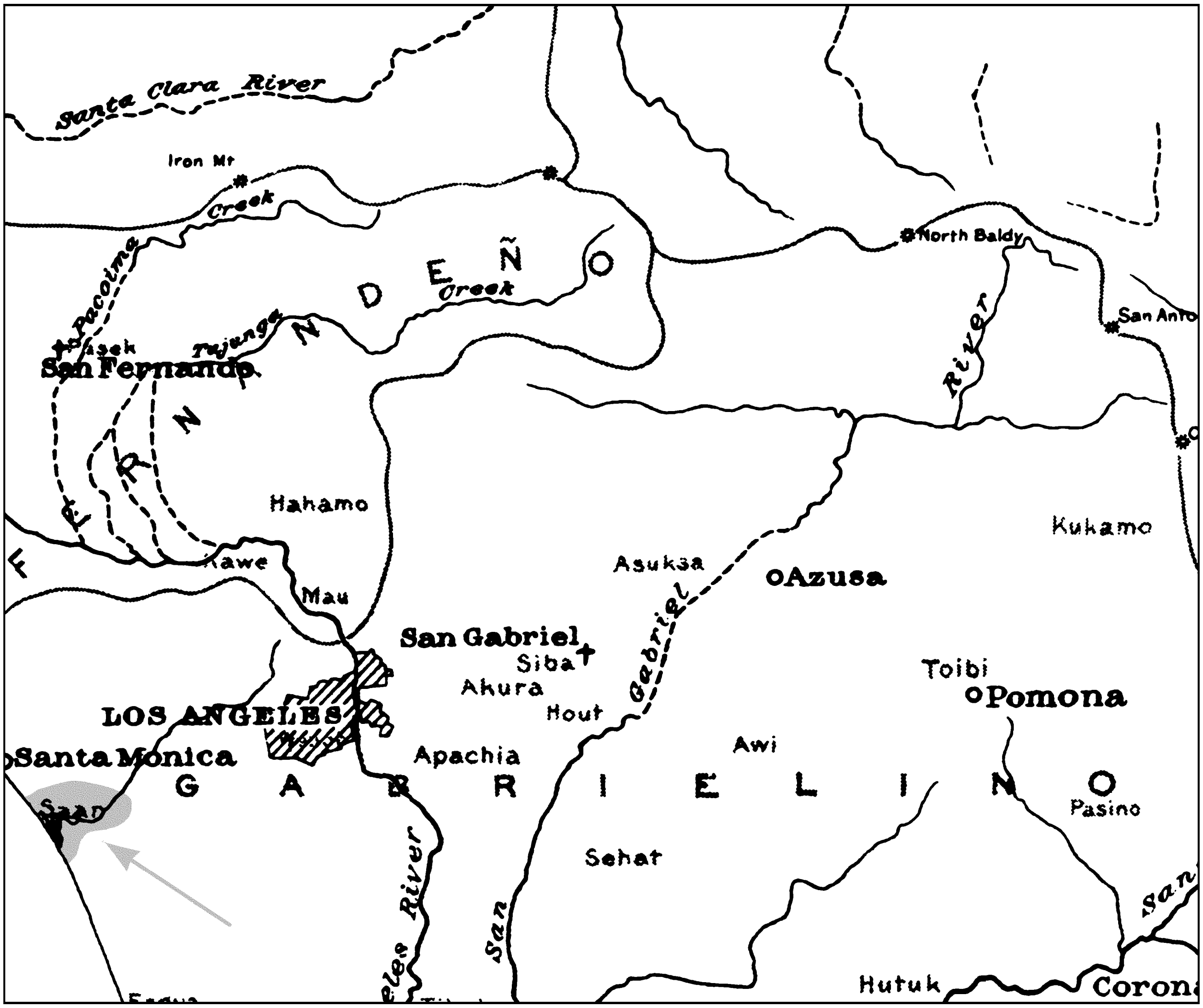

Figure 7. Location of Sa'an near the Ballona, adapted from Native Sites in Part of Southern California (Kroeber 1925:Plate 57).

> [the *rancherías* reported by Machado] were the late survivors of settlements of which archaeological surveys have found the remains of at least 14 along Ballona Creek and the bluffs to the south. One of these could perhaps have been the traditional village, *Sa-an,* root-name of a village placed by Swanton on the coast south of Santa Monica [Johnston 1962:94; emphasis in original].

Although Johnston (1962:94) conceded that "*Sa-an* does not seem to appear on the Baptismal Registers" as the name of a village, she placed "Sa'angna" on the Westchester Bluffs on her map of the Gabrielino settlements at the time of the Portolá expedition (Figure 9). It was she who added the Gabrielino locational suffix, -*gna*, to Sa'an, thereby changing what was probably a simple regional referent into the name of a specific village. Her only mention of Guacho was to repeat Robinson's information.

With the switch from geographic place-name to village, the search began for the village site of Sa'angna (Altschul et al. 2000). In 1983, King and Singer proposed to test the Peck site (LAN-62), located at the base of the Westchester Bluffs on the east side of Lincoln Boulevard, as the purported site

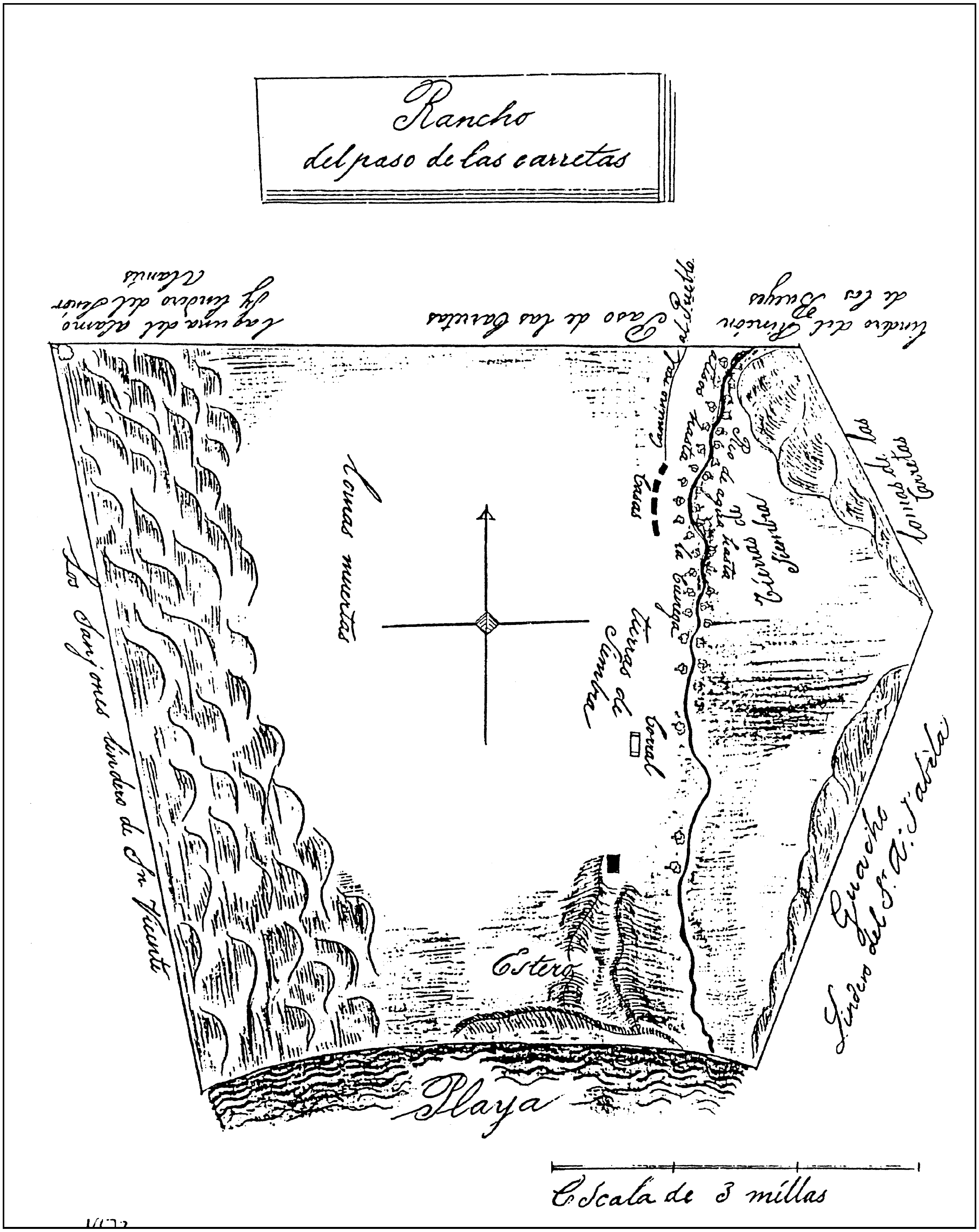

Figure 8. Location of Guacho on the 1839 *diseño* for the Rancho La Ballona (courtesy of the California State Archives, Sacramento).

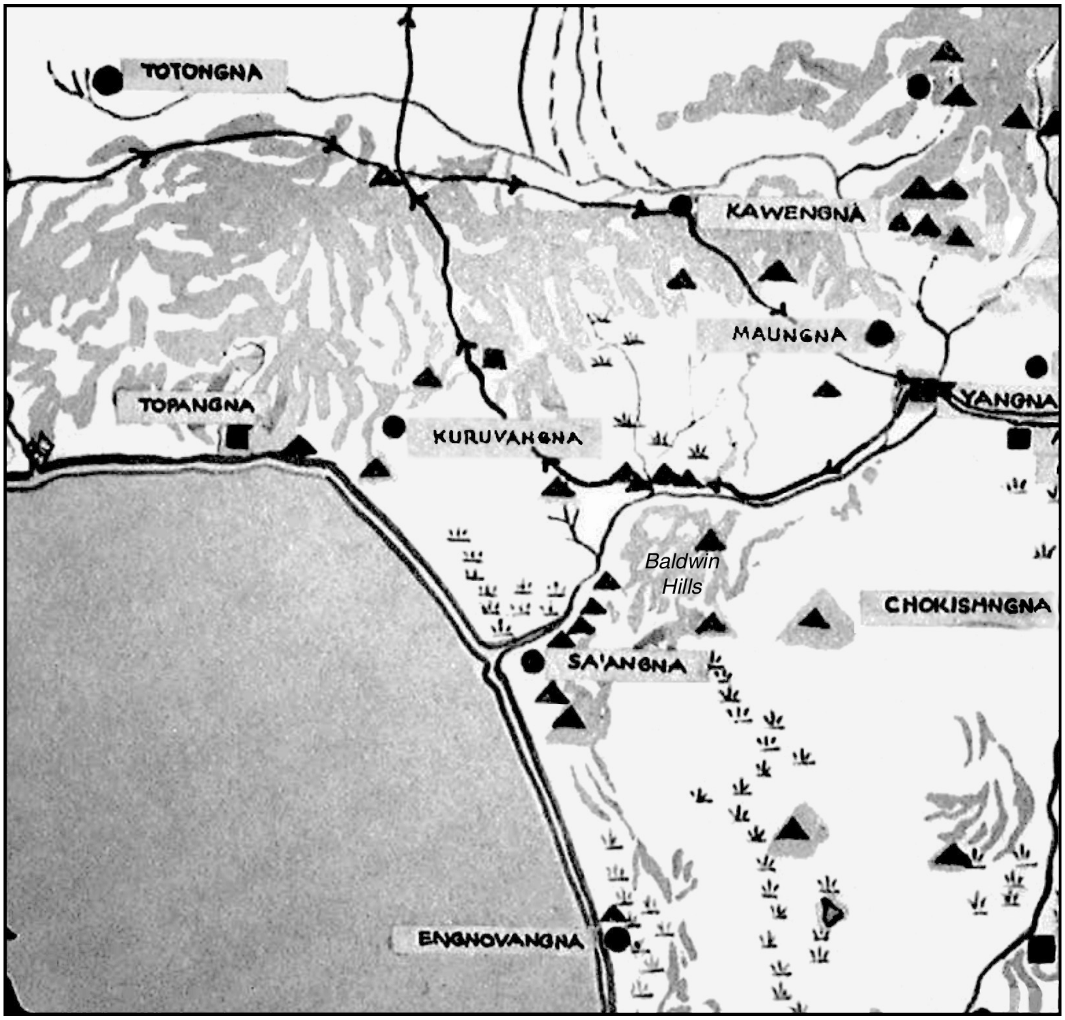

Figure 9. Location of Sa'angna, adapted from Map of the Gabrielino Area at the Time of the Portolá Expedition (Johnston 1962).

of "Suangna" (King and Singer 1983). These investigators added another layer of error when they mistook Sa'angna for "Suangna," an ethnographically known village located just north of the modern city of San Pedro. The results of their search were inconclusive.

The most thorough recent publication on the Gabrielino is *The First Angelinos* by William McCawley (1996). In this work the author examined the issues surrounding a community he labeled "Saa'anga," noting the multiple contradictory statements in the historical and ethnographic records. McCawley seemed to side with Johnston when he stated Saa'anga was located in the vicinity of Ballona Creek. He also introduced an additional source of information, the notes made in the 1930s by J. P. Harrington. According to Harrington (1978:195), the "old Machado Ranch at La Ballona was Saa'an, location of Saanat, pitch, tar" (McCawley 1996:61). Although no historical sources found to date describe tar seeps near Ballona Creek, natural oil reservoirs were likely present in the Baldwin Hills, the location of an active oil field. If Saa'anga was located at the "old Machado Ranch," its location would be east of the Playa Vista project area at the base of the Baldwin Hills, possibly the site of LAN-58. Known as the Machado site, this archaeological deposit was located on a rise of ground near the north bank of Ballona Creek, approximately 76 m (250 feet) southeast of the original Machado ranch house at 4910 Overland

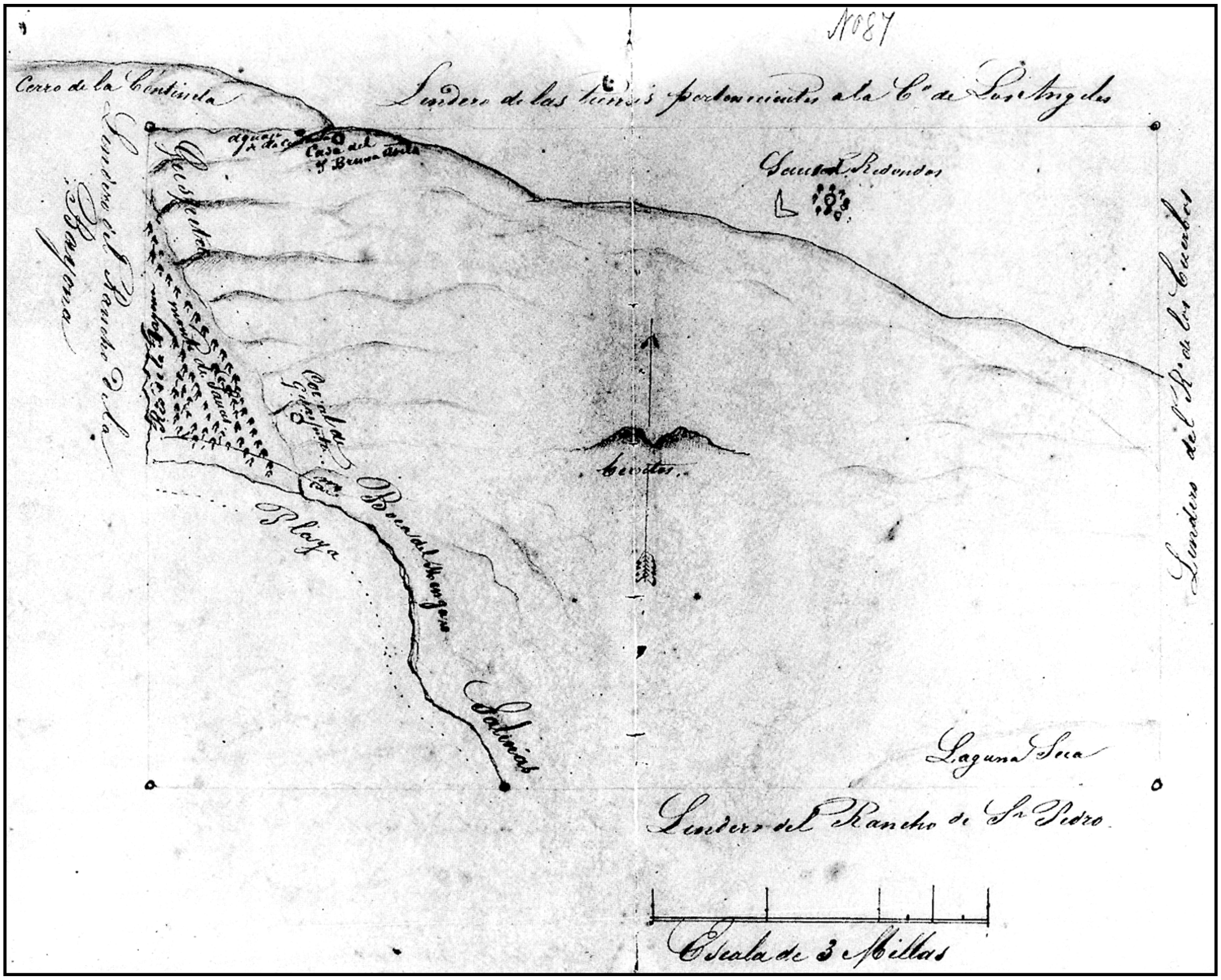

Figure 10. *Diseño* for the Rancho Sausal Redondo. Note the location of Guspita and Coral de Guspita in the upper left corner of the map (courtesy of the California State Archives, Sacramento).

Avenue, Culver City. As recorded by Rozaire and Belous (1950), LAN-58 was a village or campsite located a few hundred yards from a warm spring. The site was said to contain numerous artifacts, including mortars, bowls, whole pestles, metates, large blades, and two cogged stones. The former Machado ranch house on Overland Avenue is now gone, and the lot is covered by a multistory apartment building.

McCawley continued his discussion of Gabrielino communities in the Ballona with a section on the place-name "Waachnga." He commented that the listed variant spellings—Guasna, Guashna, Guaspet, Guachpet, Guashpet, and Guaspita—"provide an important clue to the location of this community" (McCawley 1996:61). Guaspita was the name given to a land grant received by Antonio Ignacio Ávila, which later was combined with the Salinas land grant to become Rancho Sausal Redondo, present-day Westchester. McCawley included a copy of the *diseño* for the Rancho Sausal Redondo (Figure 10), which shows the names "Guspita" and "Coral de Guspita" on the bluff overlooking the "Rio de la Bayona" (Ballona Creek) in essentially the same location as the word "Guacho" is shown on the *diseño* for the Rancho La Ballona (see Figure 8). McCawley (1996:63) suggested that "Guaspita was derived

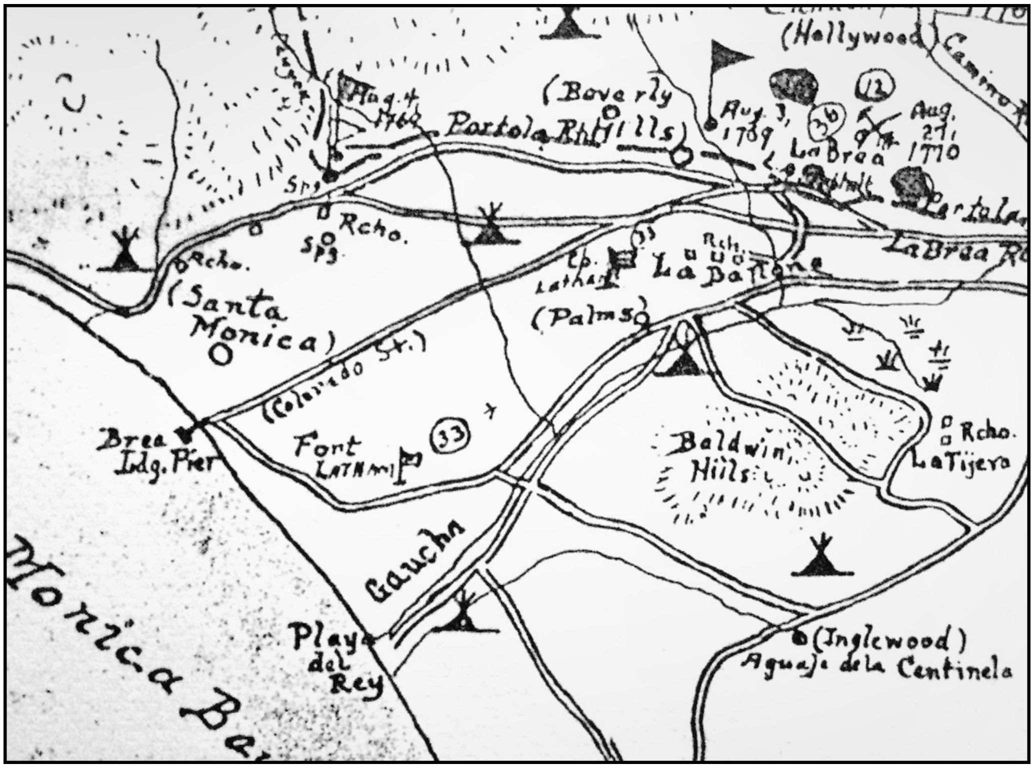

Figure 11. Location of Guacha (adapted from the 1937 Kirkman-Harriman Pictorial and Historical Map, Charles Von der Ahe Library, Loyola Marymount University).

from the earlier Gabrielino placename" of Waachnga and that the grant for Sausal Redondo included the site within its boundaries. Although he seemed to be supporting the placement of Guaspita on the bluff tops overlooking the project area, McCawley cautiously left the question of its exact location unresolved.

Evidence for the location of Guaspita in the Ballona continues to mount. A copy of the 1937 Kirkman-Harriman map, recently located at Loyola Marymount University, also shows the label "Gaucha" (or Gaucho) with the symbol for an "Indian settlement" nearby, apparently west of Lincoln Boulevard (Figure 11). The line of the cliff is not shown, but both Centinela and Ballona Creeks are clearly depicted. The symbol for the Indian settlement is placed alongside Centinela Creek, whereas the word "Gaucha" (probably a misspelling of Guacha, also rendered as Guaspita) floats to the north out in the Ballona.

Chester King (1992, 1994) provided additional information on Guaspita in his work on Native American place-names in the Santa Monica Mountains. King mentioned Guaspita in connection with an important Gabrielino village he called "Comigranga" (also written as Comicraibit, Comicrabit, and possibly Johnston's [1962] Coronababit), which was most likely located in the vicinity of present-day Santa Monica. Citing his research on San Gabriel Mission records, King stated that some of the men who lived at the villages of Comicranga and Guaspita had names with Chumash suffixes and were interrelated with the Gabrielino by marriage. About Guaspita, he reported that "this important village had a large number of ties to Catalina Island (Pimunga). No other mainland villages had as many ties with the Island" (King 1992:28). He also noted that Guaspita might have been located "near the mouth of Ballona Creek because this location would be consistent with its apparent importance as a port town, the presence of Chumash names, and its many ties to Comicraibit" (King 1992:29). In this work, King presented data on the number of people recruited by the San Gabriel Mission from villages located west of "Yanga," near the Pueblo in downtown Los Angeles. Interestingly, recruitment at Comicranga and Guaspita, which began in 1790, peaked at the same period, between 1803 and 1805, then dropped to zero in 1819. Probably not coincidentally, 1819 was the same year that the Machado and Talamantes brothers began grazing cattle in the Ballona. With the arrival of permanent ranching activities in the Ballona, the process of mission recruitment was apparently halted. King suggested that more research in the San Gabriel Mission records may prove fruitful for research into Chumash names among the Gabrielino and may reveal more about mission recruitment in the Ballona as well.

To date, few of the presumed Gabrielino settlement locations have been tested archaeologically. The exception is the bluff top above the Playa Vista project area. One of the most thorough excavations conducted in the area to date claimed to have eliminated the part of the bluff top west of Lincoln Boulevard as the location of Guaspita. As part of their West Bluff project, Van Horn and White (1997a, 1997b) examined the question of a protohistoric or early-historical-period site on the bluff. Although they found three glass trade beads dating to the late eighteenth and early nineteenth centuries at the Del Rey site (LAN-63),Van Horn and White felt the Westchester Bluffs were not plausible candidates for the location of a Gabrielino village. The Del Rey and Bluff (LAN-64) sites were characterized by poorly developed middens, suggesting temporary use. Further, radiocarbon dates indicated that the main use of the sites occurred during the Intermediate period, between 2,000 and 1,500 years ago, many years before the arrival of glass trade beads in California. Van Horn and White (1997a:5) concluded their argument against the presence of a village on the bluff top by stating,

> While it is true that a few Late Prehistoric and Protohistoric artifacts have been found on the bluff tops, these are relatively rare and usually occurred on or near the surface. No doubt, the bluffs experienced some pedestrian traffic throughout their prehistory and one must assume that Late Prehistoric and/or Protohistoric people residing below the bluffs at local sites such as LAN-62 and LAN-211 would have traveled the bluff tops from time to time. But there can be no question regarding Late Prehistoric occupation of the West Bluff [*editor's note:* LAN-63 and -64] property. Indeed, it is abundantly clear that by around A.D. 1,000 prehistoric occupation was concentrated at lagoon-side sites below the bluffs.

The hunt for Sa'angna farther north in the Ballona lowlands received renewed attention in the late 1980s and early 1990s during investigations at the Admiralty site (LAN-47), located in Marina del Rey (Altschul, Homburg, and Ciolek-Torrello 1992; Dillon et al. 1988; Stickle 1988). Much of the interest surrounding this site centered on its possible connection to Sa'angna. Through radiocarbon dating and artifactual material, Altschul, Homburg, and Ciolek-Torrello (1992) demonstrated that LAN-47 had been abandoned by A.D. 1200, more than 550 years before the Portolá expedition, and thus could not be Sa'angna. Politics overruled science, however, and the Los Angeles Cultural Historical Commission declared the Admiralty site to be Sa'angna, Historic-Cultural Monument No. 490 (City of Los Angeles Cultural Affairs Department 1994).

As part of the PVAHP, John Johnson (1991) reviewed the literature pertaining to ethnohistoric villages in the Los Angeles area. Regarding Sa'angna, Johnson (1991:1) stated,

> All the speculation regarding *Sa'angna* is apparently based on Kroeber's and Johnston's publications, which were in turn based on very late ethnographic research (probably from a single Gabrielino consultant, Jose de los Santos Juncos, who was interviewed by both Kroeber and Harrington in the early twentieth century). I have searched to no avail for *Sa'angna* in the lists of Gabrielino village names recorded in mission registers (Merriam 1968; Munoz 1982). My suspicion is that *Sa'angna* is either (1) simply a Gabrielino place-name instead of a village or (2) is the Gabrielino name for a settlement of Indian laborers associated with one of the Spanish/Mexican ranchos in the Ballona vicinity.

In sum, direct evidence of use of the Ballona and the Westchester Bluffs during the protohistoric period is quite sparse. Although documentary sources suggest that several settlements did exist during the early historical period, archaeological confirmation of such sites has not yet occurred. Excavation at LAN-211/H promises to fill the data gap for this temporal period in the Ballona.

Historical Period: Euroamerican Occupation

The broad sequence of events for the historical period (A.D. 1771–1941) in the Ballona has become well established through repetition in published sources. Until recently, lingering gaps between known significant dates have resisted the probe of historical research. As the outline of Ballona history is fleshed out through continuing archival discoveries, new areas of interest are presented for examination.

Although the location of the ethnographic Gabrielino village of Guaspita remains in doubt, the facts of Hispanic and Euroamerican immigration into the area are well established. The term "Hispanic" is used in this context to refer to the Spanish-born missionaries, to the ethnically mixed soldiers and immigrants who arrived from what is now Mexico to settle in the pueblo, and to the European-influenced culture introduced by these eighteenth-century arrivals to southern California.

When Mission San Gabriel (Figure 12) was founded in A.D. 1771, a point of no return was reached for all indigenous people in the Los Angeles Basin, as a tidal wave of social change soon overwhelmed their world. The Spanish government supported the establishment of the missions of Alta California as the preliminary step toward the subjugation, civilization, and ultimate colonization of the country. The Gabrielino were first welcoming, then resistant, but neither stance changed the outcome. The success of the padres is reflected by the more than 7,000 baptisms recorded at the Mission San Gabriel between 1771 and 1820 (Munoz 1982:5). The mission fathers worked tirelessly to both entice and compel all Native Americans to relocate onto mission lands in San Gabriel, where they were baptized and put to work as field hands and domestics.

With the rise of the Hispanic mission and rancho systems, the Gabrielino began to abandon their camps and village sites. Disease and cultural upheaval forced the native population into steep decline, and the survivors merged with other displaced populations. Between 1781 and 1831, the mean death rate was 95 per 1,000 individuals, compared to a mean birth rate of 44 per 1,000. Mean life expectancy at birth was only 6.4 years (McCawley 1996:197). Hugo Reid, a Scotsman married to a Gabrielino woman, wrote in 1852 that the result of this period of turmoil was a massive migration of the remaining Gabrielino away from their traditional homeland, many resettling as far north as Monterey (Heizer 1968). The impression has long been given in the literature that, except for the well-known pockets of aboriginal settlement around a few large ranchos and the expanding pueblo, the Los Angeles Basin was essentially empty of native peoples by the late 1850s. As will be discussed later (see Chapter 12), archaeological investigations in the Ballona at LAN-211/H may prove useful in testing this supposition.

As native Californian lifeways slipped more and more into the past, the future became the domain of Hispanic settlers newly arrived from Mexico. A scant 10 years after the founding of the Mission San Gabriel, the settlement named Pueblo de Nuestra Señora la Reina de Los Angeles was begun on the plain near what became known as the Los Angeles River. Eleven families arrived in 1781 from Sonora and Sinaloa to begin the community. Sixteen years later, the patriarch of the Machados, José Manuel, a soldier-guard stationed at Santa Barbara, moved with his large family to the growing pueblo. They were followed shortly thereafter by the Talamantes family, and these two families were to become closely associated with the Ballona over the next century. José Manuel's fifth son, José Agustín Antonio Machado, was three years old when the family moved to Los Angeles. Agustín, as he was generally known, and his close friend, Felipe de Jesus Talamantes, were employed as young men to care for the family stock herds. At times, they were accompanied on their horseback treks by their brothers, Ygnacio Machado and Tomás Talamantes, forming a partnership of four that would last for many years (Robinson 1939a).

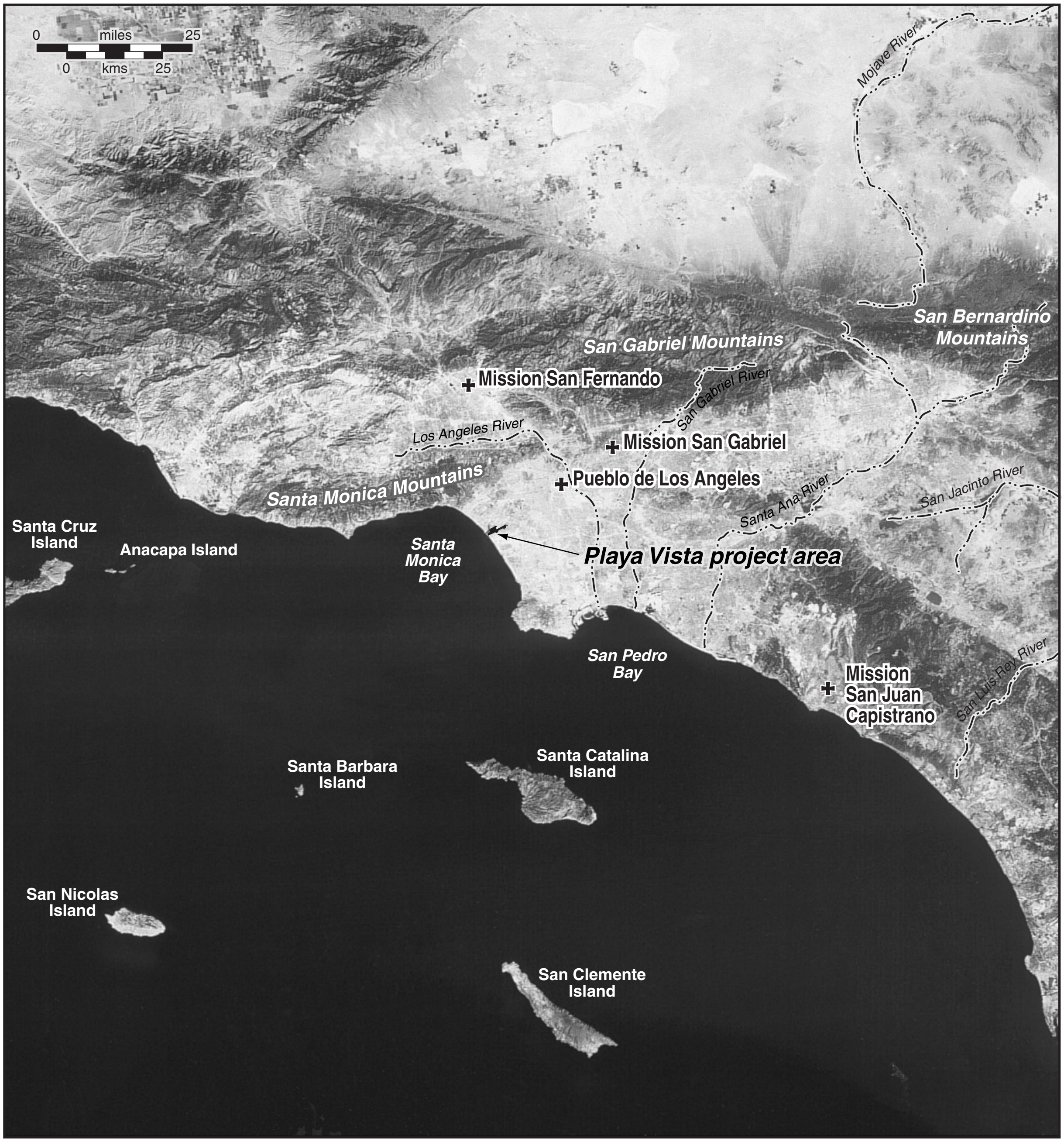

Figure 12. Satellite photograph of a portion of the Southern California Bight, with locations of land features and missions.

The Hispanic community of Los Angeles grew quickly, and soon the need to find new grazing lands for horses and cattle became acute. The Machados and Talamanteses found the land to the southwest in the Ballona to be attractive, in part because its distance from San Gabriel had kept it outside the mission's land claims. Beginning about 1819, with Alcalde Joaquin Higuera's blessing and a permit from the military commander, José de la Guerra y Noriega, the Machado and Talamantes brothers moved their stock to the area now known as Culver City. In their petition of September 19, 1839, for the grazing land that became the Rancho La Ballona (Marie 1955:52), the men stated, "we occupied, with our grazing stock, houses and other interests, the place called "Paso de las Carretas," but more generally known by the name of "the Ballona." Paso de las Carretas (or Wagon Pass) has been interpreted as corresponding to the low place between the sand hills known as the Ballona Gap. Of the road running through the Paso de las Carretas, Robinson shows it as following the path of today's Washington Boulevard (Robinson 1939a:105) (Figure 13). The common interpretation states that "the *paso* fronted on the sea astride the *rancho*'s northern boundary" (Rolle 1952:147). The term "Ballona" might have been derived from "ballena," or whale in Spanish. Although whales are not mentioned in the historical record, killer whale bone has been found in Ballona-area archaeological sites, such as at LAN-63 (Colby 1987a). Alternatively, Ballona may have derived from Bayona, the Spanish birthplace of the Talamantes family.

The statement in the grant petition referring to their occupation of the Ballona has led researchers to assume that because the brothers were grazing cattle there, the Machado and Talamantes families must have lived in the Ballona in 1819. In these early years, only one of the four ranchers, Agustín Machado, lived on the land, and he was at most a part-time resident. Documentary sources state that Agustín raised his family at his principal residence in the pueblo of Los Angeles, not in the Ballona. The first adobe that he ordered built on the Rancho La Ballona was constructed in about 1821, just northeast of present-day Overland Avenue; it was washed away in a flood about a year after its completion. The second adobe, built later in the 1820s, was located near what is now the intersection of Overland Avenue and Jefferson Boulevard (Wittenburg 1973:19); the adobe is no longer standing. Its location, entirely outside of the Playa Vista project area, is generally considered the core of the Rancho La Ballona community.

During the 20 years between 1819 and 1839, the Machado and Talamantes families made good use of their rancho, stocking it with "large cattle and horses and small cattle" and improving it with "vineyards and houses and sowing grounds" (Robinson 1939a:108). Among the crops planted were grapes, corn, pumpkins, beans, and wheat (Wittenburg 1973). Rancho La Ballona became a legal entity on November 27, 1839, when its 13,920 acres were granted to Agustín and Ygnacio Machado and Felipe and Tomás Talamantes by Governor Alvarado (Cowan 1977:18). At the time of this grant, only Agustín Machado maintained a residence on the rancho; the Talamantes brothers had established adobes on the nearby Rincon de los Bueyes, and Ygnacio Machado had moved in 1834 to the rancho he later claimed, the Aguajé del Centinela, west of Inglewood's Centinela Springs (Robinson 1939a:109). An adobe built ca. 1833 and known today as La Casa de la Centinela represents the first *Californio* occupation of this rancho (Robinson 1939a). Located on Midfield Avenue in Westchester, it is currently the home of the Centinela Valley Historical Society. Other ranchos near the Ballona were Sausal Redondo (Antonio Ignacio Ávila, claimant) adjacent to the south, and Ciénega ó Paso de la Tijera (Vicente Sanchez, claimant), 3 miles east of the project area (Cowan 1977). An adobe reputedly built about 1823 and belonging to this later rancho was used prior to World War II as the Sunset Fields Golf Club clubhouse (Parks 1928; Grenier 1978). The adobe still stands, much modified, at 3725 Don Felipe Drive, Los Angeles, and is currently occupied by the Consolidated Realty Board of Southern California, Inc.

The identity of the workforce on these Los Angeles Basin ranchos, and particularly on the Rancho La Ballona, is of special interest. The historical record clearly indicates that the Machados and Talamanteses had help with the work on the Rancho La Ballona and are likely to have given positions of authority to relatives or hired retainers. Cristobal Machado, interviewed by Robinson in the 1930s and "whose memory goes back to Indian days," recalled that "the work of the ranch was done by the local Indians, one group of whom had their huts among the sycamores not far from Agustín's home, while another group

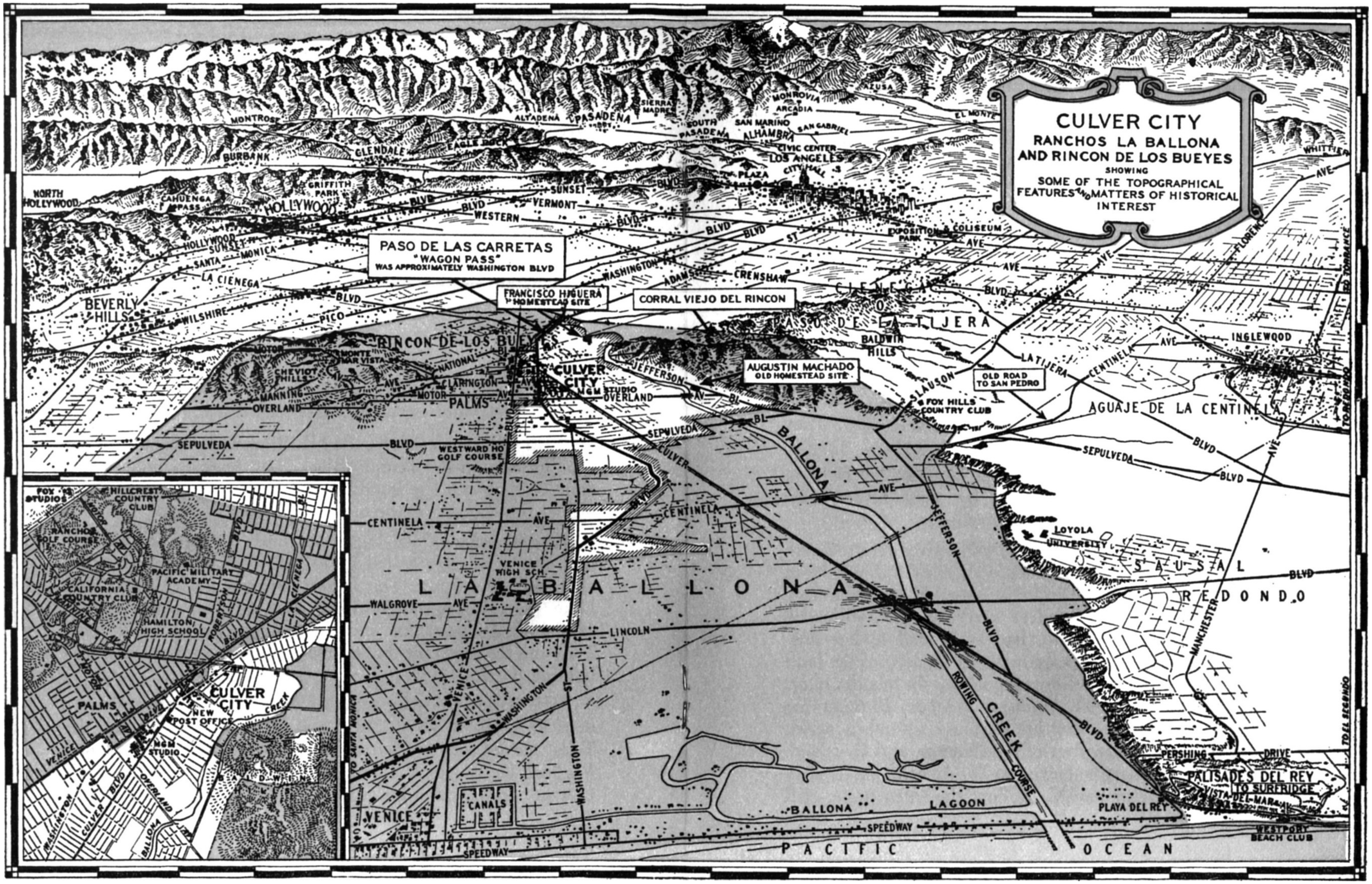

Figure 13. Outline of the Rancho Paso de las Carretas, also known as the Rancho La Ballona, superimposed on a 1939 map of the Culver City area (adapted from Robinson 1939a).

had their village against the hills beneath the present-day Loyola University" (Robinson 1939a:108–109). This latter location would place the settlement not only within the project area, but possibly at the site of LAN-211/H. No known map, not even the 1839 *diseño* of the Rancho La Ballona (see Figure 8), shows the exact location of these dwellings at the base of the bluff, although other residential structures are indicated.

At the conclusion of the Mexican-American War in 1848, Alta California was ceded to the United States, and four years later, in October 1852, the Hispanic families owning Rancho La Ballona filed their claims with the Land Commission for the confirmation of their grant. At first, the Machado and Talamantes families had smooth sailing: on February 14, 1854, the board upheld the Rancho La Ballona grant, and the U.S. District Court upheld the decision on appeal (Robinson 1939b).

The Talamantes family members did not long enjoy their ownership. The insolvency of Tomás Talamantes in 1855 and the death of Felipe in 1856 necessitated the division of their shares of the ranch and the dissolution of the Talamantes/Machado partnership. During this same period, Agustín Machado prospered. In addition to owning a large tract of land in the pueblo of Los Angeles near his town home (Wittenberg 1973:21), Machado increased his landholdings in what is now Riverside County by buying up two large cattle ranches, building adobes, and establishing family members in them. In the summer of 1855, he purchased three leagues of the Rancho Santa Rosa on what is today known as the Santa Rosa Plateau and built an adobe there, which is still standing (Nature Conservancy 2002). In 1858, Machado purchased La Laguna Rancho from Abel Stearns, a 13,339-acre property that included Lake Elsinore. At least one of the adobes Machado built on this rancho became a Butterfield stage stop (Gould 1936:46). The ranch operations were managed by his eldest son, Juan Bautista Machado; other family members also participated (Fred Machado, personal communication 2002).

By the time Agustín Machado died in 1865, he had become one of the wealthiest men in Los Angeles. His estate covered thousands of acres and included livestock, orchards, and numerous adobe dwellings. He also had control over uncounted numbers of Native American workers on his ranchos. Occasionally these were mentioned in contemporary documentation; a report from 1861 mentions native laborers living near La Laguna and "the excellent camp ground near the Machado adobe" there (Gould 1936:47). Native workers are described at La Laguna in some detail by Charles Nordhoff in 1873 (Nordhoff 1873:150). At the time of his visit to La Laguna with "Senor M." (Machado), the native residents of the rancho lived in "open shanties" within a few feet of the adobe. The Lake Elsinore and Santa Rosa Plateau areas fall within the traditional territory of the Luiseño, and the Machado family clearly lived in close association with Luiseño people.

Recent research in the Federal Population Census has revealed there could have been a connection between the Machado's Luiseño ranch workers and Rancho La Ballona (National Archives, Laguna Niguel, California, 1900 Census, T623, Roll 90). In 1900, an Indian Population Census of the "Ballona township" counted a total of three individuals, all of whom were born in Luiseño territory (two in Temecula and one at San Luis Rey). These three were employed in the Ballona township, spoke no English, and could have been brought to the Ballona by the Machados to work on one of their large farms or dairies. It is interesting to note that no Gabrielino individuals remained in the Ballona at this date.

After the death of Agustín Machado in 1865, the boundaries had still to be settled (Rolle 1952:154). Numerous heirs were granted small parcels, most of which were sold within a decade. To resolve a dispute over the boundary between Rancho La Ballona and Rancho San Vicente y Santa Monica on the northwest, the Machado heirs ended up in court. Fortunately for historical researchers, the resolution of the legal disputes required the heirs to hire professional land surveyors to map the rancho boundaries. The original maps and notes created by Henry Hancock and George Hansen during their surveys and resurveys of Rancho La Ballona have been preserved and are available for study.

The surveyors' 1868 map of Rancho La Ballona (Huntington Library, San Marino, California, Solano-Reeves Collection, Folder 12) contains useful information about land use at this time, although no development of any kind is shown within the portion covering the Playa Vista project area

(Figure 14) The surveyors' notes indicate a total of 13,919.46 acres of the rancho was divided among the heirs of Agustín Machado. Eight of the Machado heirs were named specifically and each received an allotment; a separate portion, titled simply "allotment of the heirs of Agustín Machado" consisted of 4,224.16 acres located at the base of the bluff. This portion of the rancho covers most of the Playa Vista project area, including the site of LAN-211/H. The surveyor's notes on this map describe a division of the heirs' allotment into four types or classes with total acreage for each class. First- and second-class lands, comprising 446.70 acres and 479.80 acres respectively, were deemed "irrigable" and adequate for agriculture. The largest portion of the heirs' allotment, 2654.04 acres, was designated third-class "pasture land" and included part of the Playa Vista project area; "land in the bay," the fourth-class land, covered 643.62 acres of the heirs' allotment. At the time of this survey, a large standing body of water occupied the westernmost portion of the rancho, hence the designation, "land in the bay."

The final patent to the Rancho La Ballona, with the partitions as decreed by the U.S. District Court and laid out by George Hansen in 1868, was issued on December 8, 1873. Title to the rancho was confirmed to the heirs of Agustín Machado, long after the death of the four original grantees. A further subdivision of the rancho was accomplished in 1875, after many lawsuits, with the estate of Agustín Machado receiving the largest allotment (Altschul et al. 1991).

The first settlement on the Rancho La Ballona was represented on the 1868 map by two small structures south of Ballona Creek and well to the east of the Playa Vista project area on land allotted to Andrés, José Antonio, Rafael, and Cristobal Machado. This small beginning near Ballona Creek slowly evolved into the community of "Machado," which, by 1880, was occupied by families of cattle- and sheepherders and diary farmers. The Machado brothers operated a dairy of some two hundred cows and produced "about 150 pounds of cheese per day" on the Rancho La Ballona at this time (Wilson 1959: 136). As pointed out by previous research (Altschul et al. 1991), it is likely that Machado had no distinct community center but rather was a scattering of residences along both sides of Ballona Creek beginning about one and one-half miles northeast of the project area. The location of Machado on later maps shifted with the arrival of the California Central Railroad in 1887, which used the name for one of its rail line stops (Adler 1969).

The land boom of the 1880s heavily affected the areas around the Ballona but only lightly touched that part of the rancho in the project area. Throughout the 1890s and into the early 1910s and 1920s, as the old ranchos were bought up and subdivided by new Euroamerican owners, the cities of Santa Monica, Playa del Rey, Palms, Culver City, Inglewood, Westchester, and Venice were platted and the land quickly sold off. These cities now form a circle of dense development surrounding the open space of the Playa Vista project area. The area west of what is today Lincoln Boulevard remained marshland, interspersed with small bodies of standing water; it, too, was extensively used. Through the years, the wetlands saw numerous recreational uses, such as duck hunting (Robinson 1939b:n.p.); boat racing, and automobile racing during the 1910s when a race track called the Motordrome was in place (Osmer 1996:20); and sightseeing by tourists brought by the Pacific Electric Line to Playa del Rey beach (Robinson 1939a:119).

By the 1920s, several important earth-moving projects in the Ballona had been undertaken. By 1923, channelization of upper Ballona Creek had been completed as far as Lincoln Boulevard (Foster 1991). About a year later, a trunk sewer line was laid along the bluff above the project area, followed by a maintenance road graded along the length of the line some years later. Another major project, construction of Lincoln Boulevard to the north and down the bluff, was in progress in December of 1927, as shown by an early Automobile Club photograph (Figure 15). An oblique aerial taken February 4, 1929, also shows recent grading on the slope of the road (Figure 16). Rectangular structures shown in the foreground of this photo are possibly either a pig farm or plant nursery in the area of LAN-62. All three of these construction projects buried and possibly destroyed unrecorded archaeological deposits.

The 1920s also saw the beginning of the oil boom in the Ballona. Highly profitable oil wells sprouted from the wetlands in what was known as the Venice Oil Field. In 1930, there were 325 wells in operation

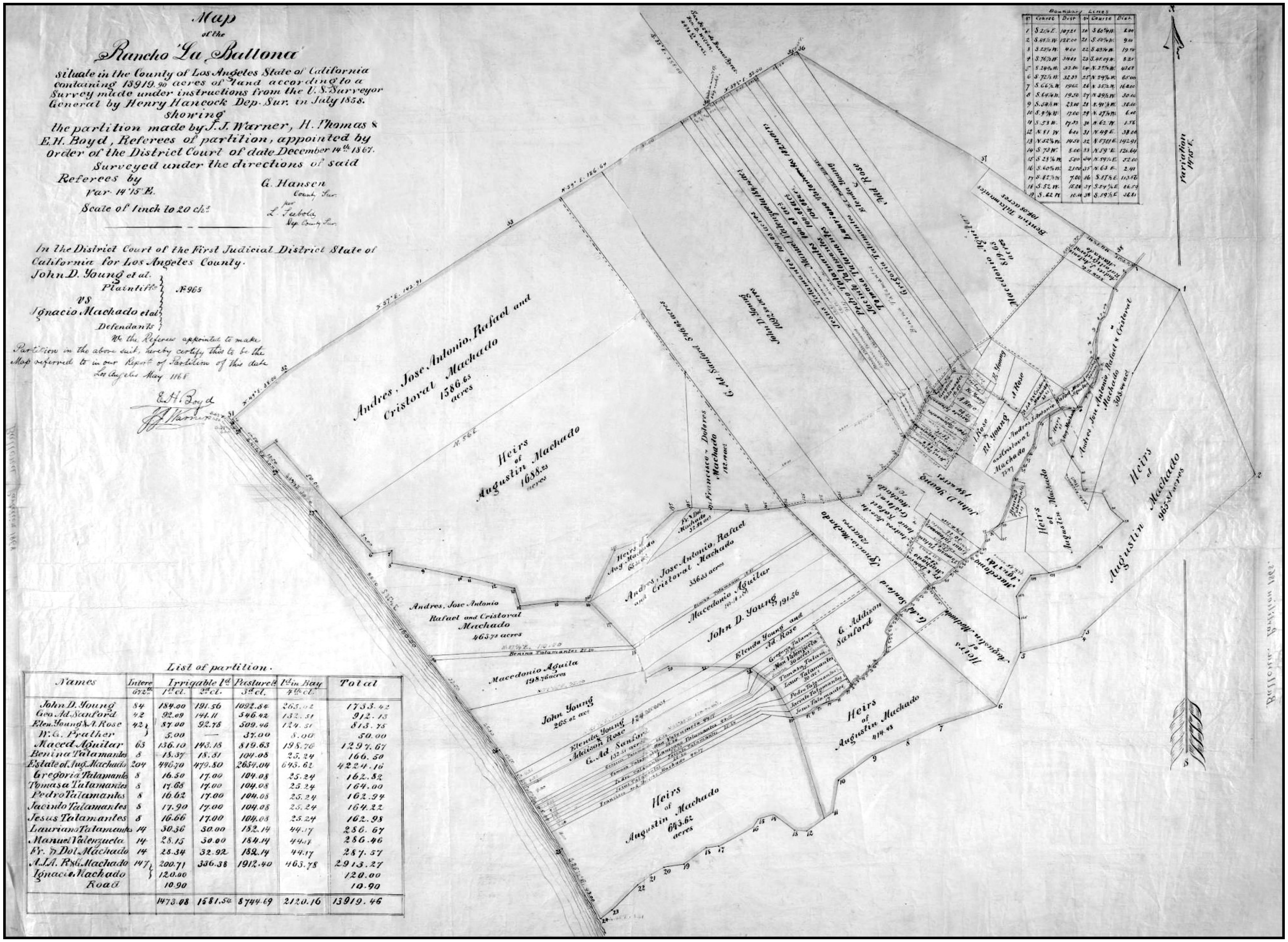

Figure 14. 1868 partition map of the Rancho La Ballona, showing the Machado heirs' allotments (reproduced by permission of the Huntington Library, San Marino, California).

Figure 15. 1927 view to the north during grading for Lincoln Boulevard above the Lincoln Gap (courtesy of the Automobile Club of Southern California Archives).

Figure 16. Oblique aerial photograph taken February 4, 1929, northeast view, showing Lincoln Boulevard and LAN-62 (Spence photograph, courtesy of the UCLA Department of Geography).

in the Ballona (Spalding 1930); most were dismantled by the 1960s. Later in the 1930s, methane gas wells joined those drilled for oil, and several were dug near what is now the intersection of Imperial and Sepulveda Boulevards (Foster 1991:1).

Throughout the 1920s and 1930s, a community of ethnic Japanese farmers leased land within the project area for growing produce (see Figure 16). According to Frances Kitagawa (Altschul et al. 1991: 83), who grew up in the project area on a celery farm, their holdings covered the area from north of Jefferson to the bluff on the south, and from Lincoln Boulevard in the west to a point east well beyond the project area. These farmers built homes and outbuildings on the project area and cultivated the land until March, 1942, when the entire ethnic Japanese population of the West Coast was relocated to detention camps (Altschul et al. 1991:84).

Hughes Aircraft Company Period

In 1940, the Ballona's most famous owner, Howard Hughes, Jr., found the empty land at the base of the bluff an ideal spot to further his moviemaking ambition (Altschul et al. 1991:86). His purchase of the land in 1941 began an era of intense development at the Ballona that lasted until 1986. With the outbreak of World War II, Hughes' interest in the property shifted to industry, and the area became the new home of his business, the Hughes Aircraft Company. The Culver City plant (a misnomer, as it was never located within the city limits) grew from a handful of wooden buildings in 1941 to become the center of a cutting-edge aerospace production facility by 1953. Hughes personally oversaw the construction of structures to house all phases of the industrial process, including administration, research and development, fabrication and manufacture, hangars and storage buildings, and all support facilities. One of the giant hangars became the birthplace of the Hughes H-4 Flying Boat, otherwise known as the Spruce Goose, the world's largest all-wood airplane. Hughes was especially adamant about the design of the runway, which was not paved in asphalt until after he relinquished active control of the business in 1953 (Altschul et al. 1991). Employment at Hughes Aircraft Company rose steadily from 621 in 1941 to 7,259 in 1959, when the company reorganized and separated into several new divisions (Greenwood and Associates 1991). In the mid-1980s, the property was sold and the buildings emptied. The landscaping of the project area was meticulously maintained until final abandonment in 1986. In 1991, 22 of the original company structures, representing the heart of the Hughes Aircraft Company domain, were recorded in detail and eligibility determinations for listing in the NRHP were prepared (Greenwood and Associates 1991).

The establishment of Marina del Rey in the 1960s led to a further evolution of the area into a recreational destination. Today, the region boasts a diverse economy, ranging from movie production to light industry. The Westchester Bluffs have become fashionable and desirable as an upscale residential development close to the booming commercial heart of the South Bay corridor.

Previous Impacts to the Study Area

Hundreds of years of human use inevitably scarred the Ballona; nevertheless, impacts to such a dynamic landscape are sometimes hard to decipher. Within the Playa Vista project area, intensive testing with cores and bucket augers can be insufficient to demonstrate whether archaeological deposits are intact. For example, based on a series of cores and bucket augers at LAN-2676, we argued that the site was intact (Altschul et al. 1998). Later hand excavations at the site, however, demonstrated that it had been mechanically flipped or moved from a nearby location, or both. Although we had anecdotes about sites being moved (e.g., Peck 1947), this was SRI's first direct field documentation that massive earth-moving activities had taken place at Playa Vista.

As a result of our finds at LAN-2676, it became clear that we must reconstruct past land modifications in the Playa Vista area. Overlying a naturally complex environment, land-altering activities were sometimes so extreme as to have moved entire archaeological sites, such as LAN-2676 and LAN-1932/H. In the process of disturbing the land, many of these activities not only destroyed prehistoric sites but also created historical ones (Hampson 1991).

Documents were examined specifically for evidence of impacts to the Playa Vista project area east of Lincoln Boulevard, south of Bluff Creek Drive (formerly Teale Street), and directly below the bluff. The results are presented to examine the issue of site integrity at Playa Vista. In general, badly disturbed or damaged sites are likely to have lost their integrity and have become ineligible for listing in the NRHP; thus, an assessment of postoccupational impacts is essential. In this chapter, we divide these land modification activities into three types of impacts: those from Rancho La Ballona in the historical period, from farming and early industry following the end of the rancho, and from the Hughes Aircraft Company.

Impacts during Rancho La Ballona

Until recently, the only written account of habitations within the Playa Vista project area prior to the arrival of Japanese celery farmers in the 1920s was the reference to "brush-and-mud huts" made by Native American ranch hands "against the hills beneath the present-day Loyola University" mentioned by Robinson (1939a:104). No further information about these huts has been found in any other source, nor have the huts appeared on any known map or in any historical photograph. The source of this information, Cristobal Machado, would have had to have been a very old man in 1939 to have seen these huts himself. Attempts to verify this account continue.

Recently, however, new information about three structures at the base of the bluff in the 1870s was located in the archives at the Huntington Library in San Marino. Surveyor George Hansen's field maps and notes from 1875 contain a description of his resurvey of Henry Hancock's original boundaries of the Rancho La Ballona (Huntington Library, Solano-Reeves Collection, Box 5, No. 87). Hansen's longhand, pencilled notes detail his survey of the southern border of Rancho La Ballona and include careful drawings and sketch maps of the land below the bluff between survey stakes. To create Figure 17, Hansen's field information are superimposed onto a map made circa 1895 of the boundary between the ranchos Sausal Redondo and Ballona (Solano-Reeves, Box 25[10], Huntington Library). The survey points on this map match Hansen's 1875 stations.

According to notes that accompany the sketch maps, on November 12, 1875, the survey crew began chaining at "the largest rock on the point of the hill" (their Station 5) and headed west toward the ocean. After careful examination of earlier notes in the sequence and a cross-check with surveyors' stations recorded on other maps (for example, Figures 10 and 11 in Altschul et al. 1991), it is clear that this "point of the hill" (Station 5) corresponds to the bluff at LAN-2768, near Playa Vista's gate on Bluff Creek Drive, off Centinela Avenue. As the surveyors measured the distances between stations, their landmarks were described in the notes and shown on the accompanying drawings. Due north and slightly west of Station 5, an unlabeled rectangular structure was shown on a sketch map. The notes described this as "the brushhouse of Jose Armiendo" (or possibly "Armiendz"). A short distance west, opposite "the mouth of Cañada," another rectangular structure was indicated, which the notes labeled as "the Mais house." A dashed line representing a road also was mapped south of the structures, closer to the base of the bluff. A third feature of this drawing is another line parallel to the bluff north of the road, which the text suggested was a fence line.

Continuing west toward the ocean, between Stations 6 and 7 (and closer to the latter), a drainage off the bluff was described in the notes as "Cañada del Coral de Barranca" and labeled "Coral de Barranca"

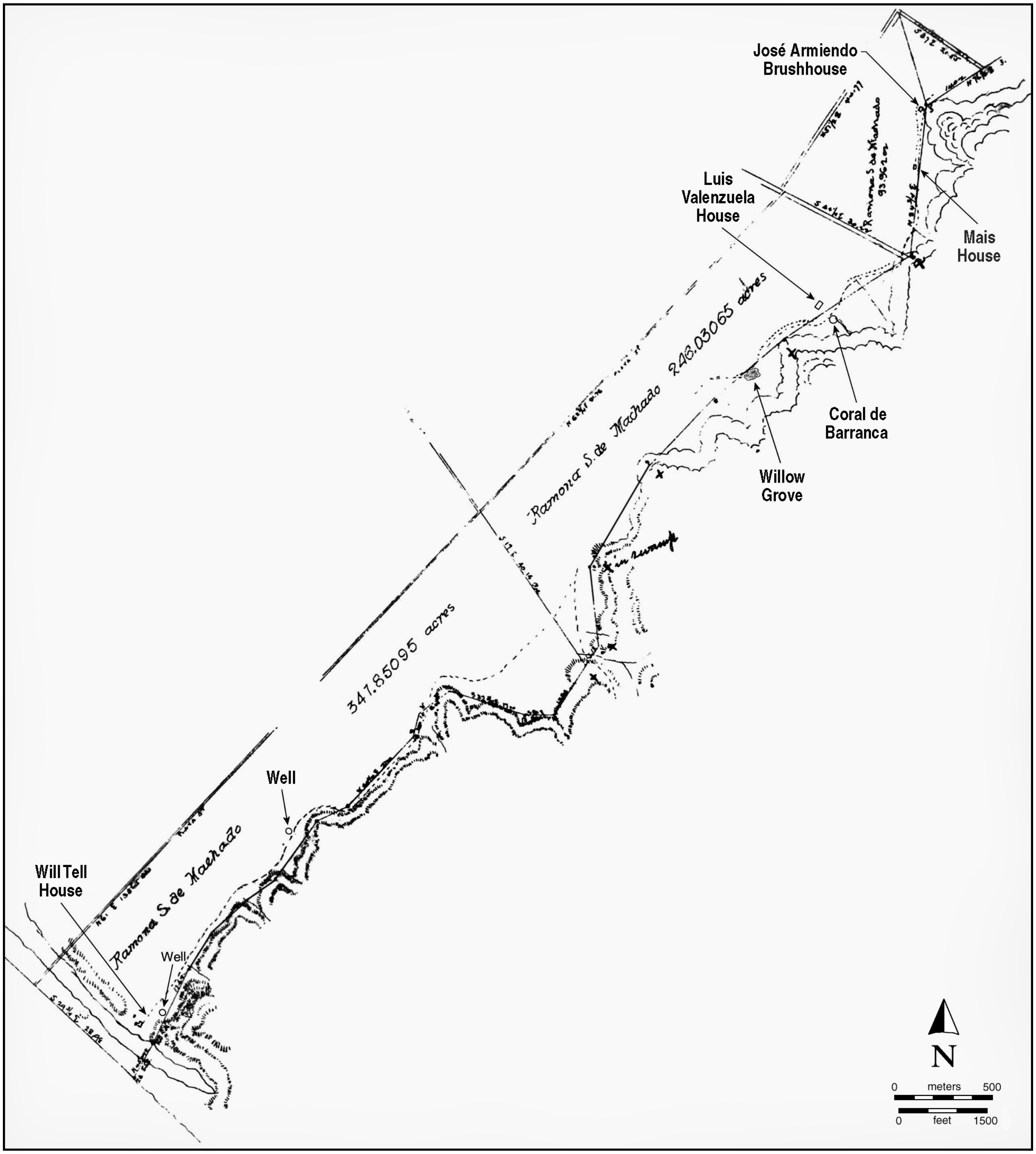

Figure 17. 1875 survey data superimposed onto a draft of the border between Ranchos Sausal Redondo and Ballona, ca. 1895 (reproduced by permission of the Huntington Library, San Marino, California).

on the drawing. Opposite and slightly west of this corral was the “house of Luis Valenzuela,” simply labeled “Luis Valenzuela” on the drawing. As they surveyed to the west, they crossed numerous drainages. A willow grove was depicted on the next notebook page, which covered the distance between Stations 7 and 9; no structures were shown. The fourth notebook page illustrated the area between Stations 9 and 14. This stretch contained the location of LAN-62 and the section of bluff now traversed by Lincoln Boulevard. Hansen’s drawing of the bluff was especially detailed here and provides significant new information about the original, natural appearance of the bluff.

A trail meandered west through all four note pages to the beach, but no additional structures were depicted. The end point of this leg of the survey was Station 23, at “Will Tell’s house” on the beach at what is now Playa del Rey. Will Tell, an opportunistic promoter during the 1870s, filed for a preemptive claim to 150 acres near the mouth of Ballona Lagoon in 1871. Advertising his claim as “Will Tell’s Seashore Resort,” he was never able to gain title to the land. The heirs of Agustín Machado began legal proceedings to have him removed as a squatter (Robinson 1939a:116), and although believed to have moved to Santa Monica around 1874, these survey notes suggest the house was still thought to belong to him in 1875. This house was destroyed by a storm in 1884 (Wittenburg 1973:53).

These 1875 survey notes provide the first documentary evidence that at least two, possibly three, residential structures existed below the bluff prior to 1928. Furthermore, names are associated with these structures, thereby presenting an interesting challenge: who were Jose Armiendo and Luis Valenzuela? Could they have been the Gabrielino or Luiseño ranch hands described by Cristobal Machado? Were they Hispanic vaqueros working for the Machados? Were they perhaps illegal squatters like Will Tell, yet to be evicted by the newly legal owners of the Rancho la Ballona? And what is meant by the “Mais house”? “Mais” could refer to a barn or storage shed for maize or corn, or it could be a proper name. More documentary research is necessary, but archaeology may be better able to resolve this question, as the scant documents may not be up to the task.

These earliest land alterations might have consisted of the construction of small buildings, dirt roads, fences, trash dumps, and other modifications. Although important archaeologically, they probably made relatively minor impacts to the prehistoric landscape.

Impacts from Farming and Early Industry

The first large-scale historic land modifications occurred during the latter part of the historical period. Recorded activities on the property include truck farming, construction of ranch and farm structures, oil and gas development, railroads, channelization of Ballona Creek, road construction, and infrastructure improvements such as the Los Angeles sewer system. Development immediately adjacent to the project area included initial dredging of Port Ballona and construction in the communities of Santa Monica, Playa del Rey, Inglewood, Culver City, and Westchester. At the time these communities began to grow, Loyola University was also established on the bluff directly above LAN-211/H. Historical maps and photographs from the 1920s and 1930s show structures at the base of the bluff. The U.S. Geologic Survey topographic map of the area, surveyed in 1923 and “culture revised” in 1930, depicted at least nine buildings within the project area, seven of which are located at the base of the bluff (Figure 18).

During this period, the title to most of the property in the project area was held by Joseph Mesmer, who leased it to several Japanese families for agriculture. Because these farmers were not citizens and did not own the land, they are difficult to track through documentary sources. About 10 to 15 Japanese families lived scattered along the south side of Jefferson Boulevard between Lincoln Boulevard and the east end of the project area. Each house had its auxiliary storage shed and other outbuildings. A descendent of one of these families indicated that Japanese farmers were living below the bluff from the 1920s to 1942; however, a second source maintained that the dwellings below the bluff in the 1930s represented a Mexican settlement called “Little Tijuana” (Altschul et al. 1991:83).

Figure 18. 1930 culture revised U.S. Geological Survey (USGS) topographic map, Venice quadrangle, showing at least nine structures below the base of the bluffs in the Playa Vista project area.

An oblique aerial photograph looking south at the bluff in 1929 shows the area near LAN-211/H (Figure 19). A long, low structure that may be a celery shed or some other structure is clearly visible, along with at least nine additional buildings, several of which appear to be habitations; these structures cover the majority of the site area of LAN-211/H. A fenced corral or yard, perhaps for animals, is shown near the center of the photograph. The land around these structures has been brushed, and several roads are shown, clearly impacting the natural terrain at the base of the bluff. Also visible is evidence of a recent erosional episode that had cut three significant runoff channels into the bluff. The original track of the Los Angeles sewer, built circa 1924, is also visible along the bluff face. It is important to note that Cabora Drive, the sewer access road along the alignment, did not exist at this time.

A second oblique photograph of the base of the bluff at almost the identical angle taken in 1946 presents an interesting contrast (Figure 20). The large white "L" (in "Loyola University") that was so prominent in 1929 is barely visible in 1946 due to the growth of vegetation. Structures visible in the early shot below this "L" are gone in the later view, presumably removed by the Hughes Aircraft Company. Only two structures are shown below the base of the bluff in 1946, a long, low shed-like building and another long building, perhaps a garage, with an open side facing north. This photograph confirms that, although farming on the property continued into the early years of Hughes Aircraft Company's development, associated structures south of Bluff Creek Drive (formerly Teale Street) were demolished. Also visible in this later photograph is the sewer access road known today as Cabora Drive. Considerable shaping of the bluff was clearly required to construct this road.

By compiling the data from all of the documentary and photographic resources discovered to date and registering it as closely as possible to the bluff line, we have created a composite map showing the location of all known structures near the LAN-211/H project area as of 1956 (Figure 21). The result shows the extent of potential impact to the area at the base of the bluff from historical-period activity. There are two implications of historical-period occupation of the study area: first, intact archaeological deposits dating from this later occupation of the area could be encountered during construction, and, second, historical-period use may have disturbed underlying prehistoric archaeological deposits. Both of these possibilities present important areas of consideration in our investigations into the past at Playa Vista.

Impacts from the Hughes Aircraft Company

Documentary history at Playa Vista enters the modern era with the business ventures of Howard Hughes. Having developed his aviation empire through the 1930s, Hughes purchased what is now known as Area D south of Jefferson and the adjacent portion of Area B in January, 1941 (Los Angeles County Recorder, Map Book 332:1939-46). His initial plans were to pursue his movie interests, but by 1941, he was looking for a new facility for his aircraft division, the Hughes Aircraft Company, which was beginning to win contracts and needed a larger plant. Hughes ended up shifting the orientation of the region's economy when he built the Culver City facility to manufacture military aircraft (Altschul et al. 1991).

Construction of the facility resulted in rerouting Centinela Creek, the construction of a major industrial complex in the southeast portion of Area D, and the filling of the wetlands (often with nearby archaeological site material) to construct a runway in the northwestern portion of Area D. Construction of the industrial complex and runway resulted in massive land modification (Peck 1947). Undulating areas were flattened, terraces were cut, and adjacent rills filled. Large areas were then covered with asphalt and concrete. Other important land modifications during this period include the construction of Cabora Drive along the bluff, massive development of the surrounding residential communities (including the bluff top), construction of Marina del Rey, and road and freeway construction.

Figure 19. 1929 oblique aerial photograph, looking south at the bluff showing structures near LAN-211/H (Spence photograph, courtesy of the Air Photo Archives, UCLA Department of Geography).

Figure 20. 1946 oblique aerial photograph, looking south at the bluff showing structures near LAN-211/H (Spence photograph, courtesy of the Air Photo Archives, UCLA Department of Geography).

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The impacts of Hughes Aircraft Company on the project area have been profound and all-encompassing. Plant buildings, offices, a cafeteria, a jet runway, parking lots, test sites, equipment sheds, a helipad, maintenance shops, a shooting range, aircraft hangars, a health center, roads, rail spurs, and flood control channels were constructed on the site, most between 1941 and 1953, Howard Hughes's active years with Hughes Aircraft Company.

A Historic Property Survey of the original Hughes Aircraft Company complex was prepared by Historic Resources Group (HRG) in 1991 (HRG 1991). Detailed histories of 22 structures were compiled, and evaluations were prepared for 17 of these that were built during the prime period of significance, 1941–1953. Of these 17 buildings, HRG found that 15 contributed to the significance of a potential NRHP historic district. A second report included the NRHP nomination for the district—now named the Howard Hughes Industrial Complex (HHIC)—and documentation for Historic American Engineering Record (HAER) No. CA-174 (Greenwood and Associates 1991). The core of the HHIC encompasses resources of exceptional importance in aviation research and development in southern California during World War II and the years that followed.

The structures that currently cover portions of LAN-211/H were not included in the survey for the HHIC, and their exact dates of construction are not known. At the time of the HHIC evaluation, the area west of Building 45 (Figure 22) contained a number of auxiliary structures, including the gun range, the salvage yard, and the company test sites. Also located on the west end was the Hughes Employee Store, where employees received discounts on assorted merchandise. The store was closed in 1979, and the building was later demolished.

Five of the remaining structures noted in 1991 west of Building 45 are still extant (see Figure 22). The westernmost standing building was formerly referred to as the salvage yard. Run by Hughes Aircraft Company employee Bill Fry, it was used to store the two Caterpillars that kept the company gravel roads level (Altschul et al. 1991). East of this west-facing building is an adjacent asphalt parking lot ringed on three sides by open-sided buildings. These long, shallow wooden structures were used for storage; in the late 1990s, they contained flat theater-type set panels, attesting to recent use of the Hughes Aircraft facilities by the movie industry. At the east end of this paved area is Building 23, a well-constructed lath-and-plaster structure which was boarded up years ago. The outside of Building 23 is essentially intact, although the inside has been vandalized. Appended on the north to the more solid portion of Building 23 is a wooden storage shed. All of these structures have been emptied of their original contents in anticipation of their demolition.

Adjacent to the west side of Building 23 is a cement-lined rectangular pit approximately 9.1 m long, 3.6 m wide, and 1.5 m deep (30 by 12 by 5 feet). The metal housing for a hydraulic pedestal, possibly part of a truck scale, is at the bottom of this pit. The presence of this pit and other garage-like structures in the vicinity confirm that this area was constructed and used for storage, repair, and maintenance by Hughes Aircraft Company.

To the east of Building 23 is another, smaller, paved open area that appears to have been a parking lot. As will be discussed in Chapter 6, the intact portion of LAN-211/H was discovered below this pavement. White lines have been painted on the asphalt surface so that it could be used as an outdoor basketball court. To the east of this lot is a second, unpaved, fenced area choked with castor-bean plants and other weeds that was known fondly at the time of our excavation as "the jungle." During the Hughes Aircraft era, this area was designated the "gun range" and used to test machine guns and grenade launchers (Altschul et al. 1991:108).

In addition to these observable impacts to the site area of LAN-211/H, subsurface features, such as monitoring wells and assorted sumps from Hughes Aircraft Company's tenure, are known to be located in the area around Building 23. Monitoring wells C-41, C-57, C-58, and C-59 are located west of Building 23; monitoring well C-61 is due south; and wells C-5, C-39, and C-60 are to the east. On the west side of Building 23, there are two leakage-collection sumps in a paved, open area, and on the building's south and east sides, there are three general sumps, a waste oil sump, and a storm drain sump (Dave

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Chernik, personal communication 1999). This last feature was probably bisected during the trenching of LAN-211/H.

Previous Archaeological Research

We have established our research perspective by presenting an overview of the cultural and historical sequence at Playa Vista. In the following section, we present a summary of previous archaeological research. The topic has been comprehensively treated in other SRI publications (Altschul et al. 1991; Altschul et al. 1998; Altschul and Grenda 2002; Grenda et al. 1999).

Until the latter half of the twentieth century, archaeological work in the Ballona was undertaken by amateur collectors. F. M. Palmer (1906), a Redondo Beach dentist, was the first investigator to explore the numerous prehistoric sites in the region and write about his discoveries (Wallace 1984). In his "Report on Researches," published after he excavated in the Redondo Beach area, Palmer noted "a number of lesser villages that were situated at points of vantage, for about seven miles, along the coast line of this part of the Southern California mainland" (Palmer 1906:24). From this, it appears that he might have been aware of sites in the Ballona.

Six years later, Nels Nelson (1912) made the first professional archaeological overview of sites in the Ballona, during a brief visit to southern California. Funded by the American Museum of Natural History's Department of Anthropology, Nelson undertook a survey of prehistoric "campsites" and "refuse heaps" from Topanga Canyon to the southern limits of San Diego Bay. Reaching the Ballona, Nelson surveyed at the base of the bluff in the westernmost portion of the Playa Vista project area, in the vicinity of Area B. He found no sites in this area, which corresponds with our survey findings (Altschul et al. 1991). Additionally, Nelson reported on "Site No. 4," "a refuse heap situated at the mouth of a small ravine opening north on Centinela Creek about 3 miles northeast of Port Ballona." Port Ballona was located at the inlet of Ballona Lagoon, near the modern town of Playa del Rey. Nelson's description of Site No. 4, limited as it is, appears to correspond with the recorded location of LAN-62. Nelson did not personally observe this site; rather, he based his report on the observations of a hunter living halfway between the archaeological site and Port Ballona. Nelson recorded the presence of a large accumulation of material, including human skeletal remains and other assorted artifacts. Nelson's 1912 report is the first known published reference to archaeological sites in the Ballona.

Although interest in Early Man brought scientists to the upper Ballona in the 1920s, this decade was relatively quiet for archaeology west of the Baldwin Hills. In 1931, Arthur Woodword, of the Natural History Museum of Los Angeles County, directed the Van Bergen–Los Angeles County Museum Expedition to explore sites in the Los Angeles area, including the famous Malaga Cove site (LAN-138) (Wallace 1984). Work in the field was done by Richard Van Valkenburgh, an astute archaeologist who was employed by Woodward at the museum between 1930 and 1935 under the sponsorship of the State Emergency Relief Act. Van Valkenburgh also conducted ethnographic work for the museum during that time (King 1992:4). By the mid-1930s, the Natural History Museum's collections included a number of artifacts from at least three sites in the Playa del Rey–Ballona area, including mortars, manos, shell, projectile points, and worked stone (Woodward 1932).

For many years, and continuing through the 1930s, local doctor F. H. Racer of Lomita made collections from sites along the coast (Wallace 1984:1). He mounted many of the artifacts in his collection and housed them together with items from other parts of the world in a small "museum" behind his residence. He also maintained a catalog, describing the artifacts and the sites at which they were found. When Dr. Racer died in 1961, his collection passed to his daughter, who permitted only a single, two-hour viewing of the material before putting the entire collection up for sale (Bates 1963:47). The subsequent fate of Racer's collection is unknown. An unpublished manuscript by Racer (1939) documented the sites he explored in what he called the Harbor District, which included the Ballona area. A site that Racer called No. 15, located at the "west end of Centinalia *[sic]* and Jefferson Streets," may correspond to LAN-2768 or, alternatively, to LAN-62. Racer glowingly described the richness of the project area and bluff-top sites in the 1930s:

> Several years ago a man from Inglewood trucking black earth for green houses uncovered a great number of whole or broken mortars, pestles, and other artifacts. These were given to his neighbors and scattered. On the top of the hill above this find was a settlement of several acres. Quantities of broken shells, arrow heads and knives, manos and burned stones. The owner of this field has found several mortars and others have found other artifacts. Several fragments of steatite [were found]. There are several camp grounds on top of the same bluff west of Loyola University. Several steatite vessels were found when the road department excavated a site just west of Loyola [Racer 1939:5].

During this period, another researcher, Malcolm Farmer, began making notes on sites in the Ballona area. Farmer, a boy just 16 years old at the time, with his friend Eugene Robinson—who was loosely affiliated with the Southwest Museum—began a survey of sites in Playa del Rey, along the bluff tops, and in the Baldwin Hills area along Ballona Creek, looking for Early Man (Farmer 1934). Farmer talked with landowners and surveyed on foot those areas where he expected to find cultural remains. His notes were partially copied and later incorporated into the data used by Charles Rozaire to create the first official site records for the area (Farmer 1936; Rozaire and Belous 1950). Table 3 lists the sites recorded by Farmer, Rozaire and Belous in the Ballona area and their current status.

Subsequently, Farmer and Robinson went to work for Edwin Walker of the Southwest Museum on the Malaga Cove site (LAN-138), near Palos Verdes Peninsula. Given their special interest in finding the most ancient remains, Walker put the two young men to work on digging Level I (Malcolm Farmer, personal communication 2001). Most researchers who have studied Farmer's map of site locations in the Ballona (Figure 23) (Farmer 1936) have assumed that the site he labeled as No. 4, apparently located at the base of the bluff in an alluvial fan pocket, was LAN-62. During a recent interview, however, Farmer maintained that he did not explore the area below the bluff in the 1930s and that he never saw LAN-62 (Malcolm Farmer, personal communication 2001). We now believe that Farmer's Site No. 4 most likely refers to LAN-1018, the Helipad site, which was located partway up the Lincoln Boulevard grade (Altschul et al. 1991:16). Farmer did not believe that this was an archaeological site; rather it was a fossil shellbed. Test excavations at LAN-1018 led to a similar conclusion (Peak and Associates 1990). This site has since been destroyed by modern construction.

In keeping with the practice of the times, Farmer collected artifacts during his 1936 survey, which he turned over to the Southwest Museum for curation. Among the items recorded from the Baldwin Hills area are pestle and metate fragments, manos, soapstone and granitic bowl fragments, cogged stones, flaked stone scrapers, smoothing stones coated with asphaltum, hammer stones, stone knives, and shell fragments. Tracings and sketches of some of these items are included with his notes. Unfortunately, collections made by others at this time were not so well documented. In 1939, some 200 artifacts from LAN-193/H (possibly LAN-62) were donated by Ralph Beals to the archaeological research facility at the University of California, Los Angeles (UCLA) (Accession 1, Department of Anthropology records,). No notes of when or how these artifacts were obtained or any additional provenience documentation accompanied this donation, which included projectile points, beads, tarring pebbles, and bone fragments. The complete collection was catalogued by staff at UCLA; however, in 1970, the diagnostic items were loaned out to a visiting professor named Heath Taylor (Accession 1 Catalog, Department of Anthropology Records, UCLA) and all attempts to secure their return have been unsuccessful.

Table 3. Status of Sites Recorded by Farmer and Rozaire and Belous

Site No. (LAN-)	Farmer (1934, 1936)	Rozaire and Belous (1950)	Current Condition
53	not surveyed	recorded	destroyed by school
55	not surveyed	recorded	destroyed by dump
56	not surveyed	recorded	unknown (L.A. sewer line through it)
57	not surveyed	recorded (not seen)	possibly under park
58	not surveyed	recorded (not seen)	destroyed by gravel pit in 1920
59	Playa del Rey #1	recorded	destroyed by housing (1991)
60	Playa del Rey #2	recorded	portions intact
61	Playa del Rey #3	recorded	destroyed by LMU (1999)
62	not surveyed	recorded	intact
63	Playa del Rey #5	recorded	intact
64	Playa del Rey #6	recorded	intact
65	Playa del Rey #7	recorded	destroyed by housing
66	Playa del Rey #8	not recorded	destroyed by beach club
67	Baldwin Hills #1	not recorded	destroyed by housing
68	Baldwin Hills #2	not recorded	destroyed by industrial plants
69	Baldwin Hills #3	not recorded	destroyed by housing
70	Baldwin Hills #4	not recorded	destroyed by housing
71	Baldwin Hills #5	not recorded	destroyed by housing
72	Baldwin Hills #6	not recorded	destroyed by housing
73	Baldwin Hills #7	not recorded	destroyed by housing
74	Baldwin Hills #8	not recorded	destroyed by various developments
171	not recorded	recorded (not seen)	unknown (L.A. sewer line through it, 1924)
172	not recorded	recorded (not seen)	unknown (storm drain through it, 1936)
1018	Playa del Rey #4	not recorded	possibly destroyed by helipad

In addition to Farmer's materials, the Southwest Museum houses several additional small collections of artifacts from the Ballona area. Very little information is associated with these finds, and the larger ground stone artifacts have been commingled with other unlabeled artifacts in a basement storage area at the Museum known as the Stone Room. At some point during the 1930s or early 1940s, Mr. F. R. Johnson conducted an excavation of "a camp in the Baldwin Hills near Playa del Rey" and collected several stone artifacts that he donated to the museum in 1944 (Collection Card 948-G-110, Southwest Museum files). The collection of Dr. Emory Thurston, made in 1958, appears to include at least one item from the Ballona area. Five artifacts from the Farragut School site (LAN-53) collected by Charles Rozaire are also among the museum's collections.

The Southwest Museum also houses specimens collected by Stuart L. Peck. In 1942, "due to the limitations on automobile travel during the War," Peck, who was working for the museum at the time, was looking for a site to excavate that was closer to home than the prehistoric campsites he was

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accustomed to exploring in the Mojave Desert (Peck 1947). The site he chose was LAN-62, which he called the Mar Vista site, "one of several . . . at the base of the bluff on the southeast shore of the tide flat." He believed that it was "ideal" because its location was convenient for him and because the major portion of the site had already been excavated by the Hughes Aircraft Company "for fill for a runway extension." Thus, he felt it would be "easy to get a picture of the stratification." Between 1945 and 1946, Peck worked at LAN-62, excavating numerous "prospect holes" and three trenches of unrecorded depth and length. He encountered a single complete, undisturbed inhumation—flexed, lying on its right side, with head to the east—and a number of cremations. A range of artifacts was recovered, including ground stone bowls, stone tools, faunal remains, and ornaments. Some of Peck's discoveries, including shell, grinding stones, and two stone bowls, were given to the Southwest Museum in August 1946.

The quantity of material recovered suggested to Peck that LAN-62 was a year-round habitation or village site. Moreover, based upon this site's stratigraphy, Peck argued for two distinct periods of occupation at LAN-62, both prehistoric because of the lack of Spanish trade goods. The earlier of these two resident groups buried their dead; used metates, manos, and small mortars with short, cylindrical pestles;

ate shellfish; hunted with rather crudely shaped chert implements; and used large shells for dishes. Significantly, Peck believed the presence of red jasper implements in this lower level suggested trade or contact with desert tribes. According to Peck, the people who later occupied the site cremated their dead; used large, deep mortars and basket mortars; made stone bowls, shell beads, and implements and ornaments of bone; used asphaltum; obtained soapstone for bowls and amulets and obsidian through trade; and also ate shellfish (including a large proportion of scallops and cockles), fish, small animals, and birds. Peck suggested that this later group of people might be associated with the Canalino, prehistoric residents of the Channel Islands. Peck's two-culture model outlined here, although lacking solid chronological control, may serve as a useful framework for future research at LAN-62.

Following Peck's excavations, Dorothy Luhrs visited the project area and reported her observations to the Natural History Museum of Los Angeles County (Luhrs and Ariss 1948, cited by Freeman et al. 1987). Luhrs was followed by a series of amateur archaeologists, primarily collectors. According to Rozaire and Belous (1950), Culver City resident Oscar Schulene collected artifacts from a number of sites in the area between 1947 and 1949. Focusing his efforts on LAN-62 after Peck's investigations were complete, Schulene not only recovered a number of artifacts, he also excavated 15 human burials, all of which were flexed and lying on their sides. Rozaire and Belous were allowed to examine Schulene's collection; however, its location now is unknown.

William Deane was another avid collector who created a large collection from the project area during the 1940s. His artifact collection was documented and photographed by Marlys Thiel (1953), who interviewed him at his Torrance home in 1953. Deane told her that although the bulk of his collecting near the Hughes Aircraft plant was done in 1947, he had continued to add a few objects each year after that. He gave a rough provenience for the artifacts in his collection. Items from "east of Lincoln Blvd.," an area which perhaps covers LAN-62 and LAN-211/H, included projectile points, shaft straighteners, abalone shell, bone tubes, a metate, four human skulls, and a deer whistle. The current disposition of Deane's collection is also unknown.

In 1950, two graduate students at UCLA, Charles Rozaire and Russell Belous, visited the Playa Vista project area to obtain information for a term paper on Ballona Creek archaeology. From the site forms they prepared as part of their projects, they showed their familiarity with Malcolm Farmer's survey, as they attempted to relocate many of his sites. Many Playa Vista sites were first formally recorded by these two students. Professional archaeologists returned to the area in 1982, conducting a series of quick surveys with negative results (Dillon 1982a, 1982b; Dillon et al. 1983; King and Singer 1983). These were followed by projects headed by David M. Van Horn and his associates, which took place primarily in the late 1980s in the area above and below the bluff (Archaeological Associates 1988; Freeman 1991; Van Horn 1984, 1987, 1990; Van Horn and Murray 1984, 1985; Van Horn and White 1997a, 1997b, 1997c; Van Horn et al. 1983; Freeman et al. 1987).

The special focus of Van Horn and his associates' work below the bluff was an exploration of LAN-62. While describing their work as "testing via trenches and test units" (Van Horn et al. 1983), none of Van Horn's excavations penetrated the midden: all testing stopped at the interface between the site material and overlying fill levels. Their research (Archaeological Associates 1988) indicated that LAN-62 is deeply buried by modern fill associated with the activities of the Hughes Aircraft Company and construction of the sewer and associated access road (Cabora Drive). Most important, their testing suggested that much of the site may be intact.

In the southern portion of LAN-62, Van Horn and his colleagues excavated a total of 7 wedges and 12 trenches using heavy machinery; his team also hand-dug a 1-by-1-m unit and a 2-by-2-m unit. The average depth of the seven wedges was approximately 3.5 m, whereas the trenches averaged 4–5 m in depth. The 2 units were excavated into the floor of the wedges and reached a depth of 130 cm. Van Horn estimated that midden in the southern portion of the site averaged 1.5 m in thickness, and that there were 5,500 m^3 of cultural deposit.

In the northeastern portion of the site, Van Horn and his associates excavated a total of 20 trenches, 5 wedges, and 6 1-by-1-m test units. Hand-excavated units were dug into the floors of the trenches, reaching an average depth of 90 cm below floor level. Midden material was estimated to average about 0.9 m in depth, with a total volume of approximately 1,050 m^3. As previously noted, however, none of the trenches in either the northern or southern area penetrated into the midden; mechanical excavation was stopped at the contact zone. Recovered from the hand excavations was a wide array of materials, including stone artifacts, bone tools, shell beads, fire-affected rock (FAR), shell, and faunal remains. The combined information from all of these test excavations tended to confirm Peck's reconstruction: LAN-62 was a permanent or semipermanent habitation site with possibly two temporal components. Questions exist as to the antiquity of LAN-62, but most of the time-sensitive artifacts date to the Late or protohistoric periods.

Previous research at LAN-62 has demonstrated the importance of the site, even though we lack certain knowledge of the site's size and integrity. Copious amounts of modern fill overlying LAN-62 have made resolution of these issues difficult. Van Horn and his associates argued that the deposit should be considered two separate sites, LAN-62 and LAN-211. We argue, in contrast, that the site is essentially continuous along the base of the bluff and should be subsumed under a single site trinomial, LAN-62. Only more work at this site will fully reveal its nature.

History of LAN-211/H

The first recorded description of the site later designated LAN-211/H was made by Dorothy Luhrs in 1948 during the Natural History Museum of Los Angeles County survey (Luhrs and Ariss 1948, quoted by Freeman et al. 1987). Luhrs designated the site "LA:3" and noted on her survey form that the deposit covered an estimated area of 45.7 by 121.9 m (150 by 400 feet). Luhrs stated that

> [LA:3 contained a] considerable quantity of abalone shells, clam, oyster. Fragments of stone bowl, pestles, hammering stones. Human toe bones, evidence unmistakable [of] potting 2'–5' [0.6–1.5 m] deep (thru overburden of varying depths) and approximately 25' [7.6 m] long. Piles of abalone shell and broken stones on pits and dump. Black soil 6'+ to 10" [sic] [1.8 m+ to 25.4 cm] deep on hillslope. The Centinela Creek flows 20' [6.1 m] to the north. Major portion of the site is on what appears to be estuary or stream terrace. [Luhrs and Ariss 1948, quoted by Freeman et al. 1987:6].

No further documentation of the site occurred until June 5, 1953, when an official site record for LAN-211/H was created by an unnamed person (probably Hal Eberhart) at the Archaeological Survey at UCLA (UCLA 1953). The recorder equated LAN-211/H with LA:29, a different Natural History Museum site. The UCLA site record contains no mention of Dorothy Luhrs or LA:3. Information used to complete the form was obtained by UCLA student Marlys Thiel (1953) when she interviewed William Deane of Torrance in May 1953 for a student paper. Thiel apparently never saw the sites herself. According to the site record, LAN-211/H was located "on a terrace . . . 2200 feet [670.6 m] east of Lincoln Boulevard" on land owned by Howard Hughes. It was also reported that the attitude toward excavation was "impossible." Thiel reported that Deane had a large artifact collection which he allowed her to photograph. Deane described the site (which he called "Site No. 1") as having "very hard packed soil . . . many broken pieces of mortars and pestles" (Thiel 1953). He made similar observations about his "Site No. 2," which we now know is LAN-62. Clearly, Deane considered the two sites to be distinct from one another but located in a similar setting along the base of the bluff.

In 1979, R. L. Pence, a trained archaeologist, attempted to relocate LAN-211/H. He observed a small area of shell and lithic detritus between an asphalt-paved parking lot and an underground fuel storage complex (Pence 1979), in the approximate location described in the Thiel and Deane (UCLA 1953) site record. The map on file at the Archaeological Information Center, which we used to place LAN-211/H in the 1991 research design (Altschul et al. 1991), is consistent with this location.

Confusion subsequently arose when David Van Horn and his associates began their archaeological investigations along the base of the bluff (Archaeological Associates 1988; Freeman et al. 1987). Despite a diligent search, they were unable to locate LAN-211 at the location Pence reported. They reported being uncertain whether any intact deposits survived or had ever existed at the Pence location. Instead, they found intact deposits buried beneath recently deposited fill at a location along the base of the bluff northeast of LAN-62 and some 121–150 m (400–600 feet) west of Pence's location. They transferred the designation LAN-211 to this site and, because they found two distinct deposits, divided it into two smaller loci, LAN-211A and LAN-211B. After a similar investigation, Freeman et al. (1987) also divided LAN-62 into two parts, labeled "A" and "B."

In 1990, when Altschul and his colleagues began a new survey of the area below the bluff, they found themselves confronted by confused site labels and uncertain site boundaries. To resolve the questions, additional boundary testing was planned. Like Freeman et al. (1987), our tests (see Chapter 5) failed to uncover evidence of substantial cultural deposits in the vicinity of LAN-211A that was comparable to Luhrs's site LA:3 or Thiel and Deane's description of LA:29. Instead, we found sparse deposits and cultural materials redeposited in fill. We also found a fairly continuous distribution of intact material all the way from LAN-62A to LAN-211A and encompassing LAN-62B and LAN-211B. LAN-211, as identified by Freeman et al. (1987), appeared to us to be an extension of LAN-62B. As a result, we decided to simplify the situation and combine all four loci—LAN-62A, LAN-62B, LAN-211A, and LAN-211B—into a single site, which we termed LAN-62.

By contrast, we discovered that site SR-13, which we had initially encountered in our 1990 survey, is a substantial intact deposit containing a diversity of materials similar to that documented by Luhrs (Luhrs and Ariss 1948, quoted by Freeman et al. 1987) and Thiel and Deane (Thiel 1953; UCLA 1953). SR-13 is also the only such deposit at the base of the bluff east of Lincoln Boulevard that is distinct from LAN-62. In our judgment, by its setting and contents, SR-13 is the best candidate for LAN-211 as it was originally recorded. Although it is located some distance (1,219 m [4,000 feet] east of Lincoln Boulevard) from the original recorded location of LAN-211(UCLA 1953), SR-13 is within the area in which Deane collected. Thus, in this report, we have reassigned the site number LAN-211/H to our survey location SR-13.

LAN-211/H and Research on the Protohistoric and Early Historical Periods

There are four sites in the Ballona that have been found so far to contain protohistoric components; LAN-2676, LAN-194, LAN-1932/H, and LAN-211/H. These four sites present a rare opportunity to explore the archaeological signatures from these later periods. Interpretive models for protohistoric sites often target site function and formation processes; those for the Ballona also test the extent of interconnection among local and regional protohistoric sites. The examination of early-historical-period sites can illuminate the differences between aboriginal and mission neophyte sites during the so-called Contact or transition period. Using archaeological, ethnographic, and historical data, we have formulated testable scenarios for protohistoric and early-historical-period occupation of the Ballona. These scenarios and the corresponding expectations for the archaeological record are presented in Chapter 12. The evidence for protohistoric and early-historical-period occupation at two of these sites is summarized below.

LAN-1932/H (formerly SR-23) was a disturbed multicomponent protohistoric and historical-period site located north of LAN-211/H within the boundary of the former Hughes Aircraft Company runway, now destroyed by construction activity. The historical-period component of LAN-1932/H, first discovered in 1990, was tested by Greenwood and Associates in 1991 (Hampson 1991). Consisting of a secondary deposit of mainly household refuse that dated from the mid-1940s through the mid-1960s, the site lacked integrity or scientific potential and was deemed not eligible for listing in the NRHP. While monitoring construction grading in the area in February 1999, a protohistoric deposit was discovered under the historical-period refuse, prompting further evaluative testing by SRI. Results of testing at LAN-1932/H were discussed in two monitoring reports (Taşkıran and Stoll 2000a, 2000b) and are briefly summarized in Chapters 9 and 10 in this report. Protohistoric cultural materials were restricted to a thin layer of organic soil between 10 and 15 cm thick. No archaeological features were discovered during testing. The evidence suggests that the protohistoric portion of LAN-1932/H was transported from the base of the bluff, probably from LAN-211/H, and redeposited as sifted fill during the Hughes Aircraft era. The complete results of the testing at LAN-1932/H are in preparation.

To date, a single archaeological site in the Ballona, LAN-194, the Hammack Street site (originally thought to be an Early Man site) has been found to have remains of early-historical-period occupation. Excavated by Chester King (1967), LAN-194 contained a large number and variety of European manufactured items, particularly glassware, metal items, mission ware ceramics, and horse and cattle bone. From the ceramic data, King concluded that the date range of the site was between A.D. 1825 and 1850. King believed that LAN-194 probably represented an encampment of Native American laborers who either worked at the Rancho La Ballona or possibly raided cattle and horses from this location. He also reported observing the persistence of some traditional practices in food-gathering and technology, as indicated by the presence of shellfish, fish, and pronghorn remains; stone tools; and projectile points. He noted also that the amount of domesticated animal remains in the faunal collection was relatively high and the bones showed the marks of European-style butchering.

SRI's work at LAN-211/H and LAN-1932/H revealed a distinctly different archaeological signature from those deposits found at the Hammack Street site. Other than the presence of glass trade beads and a few fragments of cow bone, neither of these two sites showed heavy European influence. At LAN-211/H, for example, no metal, mission ware, or imported ceramic artifacts have been identified.

Because much of the evidence for protohistoric and early-historical-period sites in the Ballona is enigmatic or from unclear contexts, we have looked to other areas of the Southern California Bight to supplement our data and to aid in developing models for the protohistoric period.

Coastal Area Research

In searching for comparable sites for our research, we sought well-documented archaeological contexts containing both protohistoric and early-historical-period components that were clearly defined and well-distinguished from one another. Well-reported sites meeting these requirements from any part of southern California are quite scarce, however. The implicit assumption that archaeological sites left by other indigenous southern California groups such as the Luiseño, Juaneño, or Chumash are comparable to contemporaneous Gabrielino sites is generally accepted, though untested. The body of literature produced by studies of the Chumash are frequently cited, being the most prolific and accessible (for example, Arnold 1983, 1987a; Gamble 1991; King 1981).

One of the more famous sites with both protohistoric and early-historical-period components is Helo', a Chumash village site located on Mescalitan Island in Goleta Slough, adjacent to the campus of University of California, Santa Barbara (Gamble 1990, 1991). Fr. Juan Crespi, who first documented the island settlement, described it in 1769 as a densely populated village. Its population increased further shortly after the construction of nearby Mission Santa Barbara, as refugees arrived, often driven from their home villages by epidemics or fleeing mission rule. Archaeological investigations in the 1980s revealed deep deposits and clear stratigraphy at the site. During the analysis of the shell beads, researchers discovered they were able to differentiate marks made during protohistoric-period bead drilling from historical-period bead production, in which iron needles were used for drilling stringing holes. Using this dating technique, King concluded that most of the shell beads recovered from the excavations were manufactured between A.D. 1750 and 1803 (King 1990b:63, cited by Gamble 1991:275). Further evidence for the protohistoric period was found when an examination of the midden revealed the skeletal remains of cows but the absence of introduced domesticated plants. Examining the plant remains, researchers observed that no change had occurred in the choice of collected species from those preferred during the prehistoric period. This blending of traditions is indicative of a transition period such as the protohistoric. Gamble concluded that Chumash subsistence behavior was not greatly altered until missionization in the historical period, when Chumash household production units changed from extended to nuclear in terms of size and organization (Gamble 1991:443, 445).

Excavations at San Buenaventura Mission (VEN-87) in the city of Ventura revealed both protohistoric and historical-period Chumash occupation at the site (Greenwood 1976). The small number of shell beads found, which dated to the Medea Creek period (A.D. 1500–1782), suggested minimal use of the area during the protohistoric period; however, the beads were of particular interest because they were made from *Olivella biplicata,* the shell type commonly used as shell money. By the end of the Medea Creek period (corresponding roughly to the end of the protohistoric period), shell beads had been replaced by Venetian glass beads (Greenwood 1976:131).

As previously discussed, excavations were undertaken during the early 1950s at Malaga Cove (LAN-138), at what many thought was the site of Chowigna, a Gabrielino village located on the sand dunes above the cove, on the northern edge of Palos Verdes Peninsula (Walker 1952). Chowigna was a flourishing Gabrielino community at the time of Spanish contact in 1542. Although Walker's deep stratigraphic excavations did penetrate significant cultural deposits at the site, scant evidence of either a protohistoric or historical-period component was found, restricted to a few glass trade beads in the upper portion of Stratum 4 (Walker 1952:68). A connection between LAN-138 and Chowigna remains unproven.

Significant numbers of glass trade beads were recovered from Arroyo Sequit, a coastal Chumash shell mound located at the mouth of Arroyo Sequit Canyon, adjacent to the Pacific Ocean on the far western edge of Los Angeles County (Curtis 1959). Excavated by Freddie Curtis in the late 1950s, the site was occupied during the protohistoric period, though only briefly as indicated by the absence of significant stratigraphy. In contrast, 216 glass trade beads and 1 European coin dating to 1700 suggested a substantial historical-period component. Questions about the integrity of this site persist, however; the presence of a historical-period can found below a burial that was adorned with glass trade beads indicates substantial postdepositional disturbance (Curtis 1959:124–125).

Finally, protohistoric components were also contained in the coastal communities of Las Flores Creek and Horno Canyon located along a dry river channel within Camp Pendleton (Byrd 1996). This area straddles the boundary between the Luiseño and Juaneño cultural groups (Byrd 1996:9). Several calibrated radiocarbon dates from the sites extend into the protohistoric period (A.D. 1450–1685 and 1420–1660) (Byrd 1996:309). Also, ceramics (primarily Tizon Brown Ware) found at the sites may indicate protohistoric occupation. At the time of the first Spanish contact and ethnohistoric documentation, Fr. Crespi noted the use of a variety of ceramic forms in the area. Evidence from several northern San Diego County sites (Byrd 1996) suggests this ceramic type does not predate ca. A.D. 1500–1600.

Inland Area Research

The search for well-documented archaeological sites containing protohistoric and early-historical-period components in inland southern California has yielded several examples. Most reports indicate that useful stratigraphic distinctions, however, are often obscured, even under the most rigorously controlled excavation conditions. For example, although the Serrano village site of Yukaipa't (SBR-1000) in San

Bernardino County contained glass beads and ceramics, the protohistoric and early-historical-period components were difficult to distinguish from among the four components at this site (Grenda 1998).

Tahquitz Canyon, a Cahuilla site (RIV-45) located in the mountains behind Palm Springs, has been extensively studied and may contain evidence of occupation during the protohistoric period (Bean et al. 1995). King disputed this, however; his analysis of shell bead types suggested that the site dates to the early historical period. Regardless, Tahquitz Canyon remains among the best studied sites in this part of southern California. Also in the Palm Springs area is the site of Yamisevul (RIV-269) (Altschul and Shelley 1987). Although only known through test excavations, Yamisevul is an extensive multiethnic Serrano and Cahuilla village that was occupied between A.D. 1876 and 1890.

Further west, the Perris Reservoir area contains evidence of occupation dating to the protohistoric period. At the Oleander Tank site (RIV-331), beads characteristic of late contexts, from A.D. 1500 to 1700, were found (O'Connell et al. 1974:159), whereas ceramic artifacts from the Peppertree site (RIV-463) suggested use after A.D. 1650 (O'Connell et al. 1974:160). Interestingly, artifacts associated with the Spanish settlement of southern California are completely lacking in this area (Wilke 1974).

Several small sites at Rancho Las Flores, near Hesperia, contain both protohistoric and early-historical-period (ca. A.D. 1550–1819) components (Altschul et al. 1989; Chambers Group 1990). These sites include artifacts such as glass trade beads, metal knives, abalone shell ornaments, and *Olivella* beads and disks. These goods could have been traded into the area via the vast exchange network that was in place by the early 1500s: their locations are very close to the Mojave Trail between the Colorado river and the Pacific coast (Altschul et al. 1989).

In western Riverside County, the Luiseño village sites of Temeku and Walker Ranch also contain early-historical-period and protohistoric components (Freeman and Van Horn 1990; McCown 1955). Temeku, near Temecula, is known to have been a subsidiary rancho of the San Luis Rey Mission in the late eighteenth century, and trade goods, including 40 glass trade beads and 11 *Olivella* shell beads, were found at this site. Although the early-historical-period occupation of the site is well documented, the stratigraphic relationship between these deposits and earlier artifacts is poorly understood, and no absolute dates for the site were obtained. Walker Ranch (RIV-333) was considered by Freeman and Van Horn (1990) to be the principal Luiseño village of the Paloma Valley. A wide variety of artifacts and features were discovered at the site. Distinct loci suggest that activities were spatially segregated. The inferences are weakened somewhat by the millennia-long occupation.

In conclusion, interest in the process of culture change guides most of the efforts to understand prehistory in the Southern California Bight. Investigations into the more recent end of the cultural spectrum have lagged, however, primarily due to the lack of archaeological materials identifiable to the protohistoric and early historical periods. Sites known to contain deposits dated to these periods are few, and rarely is the protohistoric component of such a site discrete or clearly definable. Generally, sites containing protohistoric components also have significant prehistoric components, and the two often cannot be differentiated due to postdepositional processes. Further, studies of Native American and European interaction in California have long been dominated by work at sites in and around missions. The research focus of these studies has been either on the effects of enculturation on neophyte populations living at a mission or on aboriginal settlements located adjacent to a mission complex. Few researchers have attempted to look beyond the missions to make quantitative or qualitative comparisons with contemporaneous Native American sites.

In summary, for the Ballona area, LAN-211/H is an extremely rare, if not unique, archaeological resource. Along the coast, there are a number of sites that do have clear early-historical-period components, but these tend to be large village sites that are not analogous to LAN-211/H. Documented inland sites with protohistoric components also tend to be large habitations, although some may be comparable in age with LAN-211/H. In short, LAN-211/H may offer the best opportunity to study a nonmission Native American labor camp, and as such, is a valuable archaeological resource.

CHAPTER 3

Research Design and Historic Contexts

Donn R. Grenda, Anne Q. Stoll, and Jeffrey H. Altschul

This chapter contains our strategy to assess the eligibility of archeological sites within the BLAD for inclusion in the NRHP. We first present a summary of the regulatory requirements, followed by a review of the research design included in the 1999 work plan and implemented during this inventory and testing project. We conclude with our assessment of site eligibility based on relevance to the historic contexts developed for the PVAHP.

Management Framework

Since its inception, the Playa Vista project has had a complex legal history. For the project to proceed, the applicant needed a variety of permits and approvals from federal, state, and municipal agencies. From the COE, the applicant had to obtain a permit to fill wetlands as required under Section 404 of the Clean Water Act. This permitted action requires the COE to comply with the National Environmental Policy Act and Section 106 of the National Historic Preservation Act (NHPA). The proposed development also meets the criteria of an action as defined by California Environmental Quality Act, which is administered by the City of Los Angeles. Various components of the project also require permits from the California Coastal Commission issued under the California Coastal Act.

Each of these laws requires the regulatory agency to consider the effects of the project on significant cultural resources. What constitutes a “significant” cultural resource and how project effects on these resources are treated vary among the laws. Instead of trying to comply with each law individually at every archaeological and historical site at Playa Vista, state and municipal agencies agreed in 1991 to accept Section 106 compliance standards for the project. Because federal law is much more stringent than state and municipal statutes, the treatment of significant cultural resources at Playa Vista is more comprehensive and more involved than would be required if there was no federal involvement.

Under Section 106, the COE must take into account the effect of the proposed undertaking on cultural resources included in or eligible for listing in the NRHP. Thus, the first step is to identify cultural resources within the area of potential effects, and second, to evaluate the significance of the resources to determine whether they are historic properties—that is, NRHP eligible. To complete the required evaluation, the criteria for inclusion in the NRHP are specified, a plan of work outlining the necessary steps and research goals of the testing is implemented, and test excavations and analyses are carried out. The properties are then recommended as either eligible or not eligible for listing in the NRHP. The effects of the project on the significant resources—historic properties—are assessed and mitigation measures selected and implemented to resolve any adverse effects.

On unusually large or complex projects, such as this one, or one that requires numerous individual requests for comment under Section 106, an alternative to a case-by-case review of site eligibility is a programmatic agreement. A programmatic agreement outlines a review process specific to a particular project that streamlines the Section 106 process. In 1991, a programmatic agreement for the Playa Vista development project was entered into by the COE, the California SHPO, and the ACHP; two organizations representing Gabrielinos signed as concurring parties (Programmatic Agreement 1991). The programmatic agreement was extended in 2001 and is now set to expire in 2011.

In addition to Section 106, the Playa Vista project must comply with state law covering the discovery and disposition of human remains and associated grave goods (California Health and Safety Code 7050.5 and California Public Resources Code 5097.98). Pursuant to these statutes, after human remains were encountered during excavations at LAN-193/H in August 2000, the Native American Heritage Commission (NAHC) officially designated Robert Dorame, Tribal Chairperson for the Gabrielino Tongva Indians of California Tribal Council, as "most likely descendant" for the Playa Vista project. Archaeological work in the BLAD complies with a written plan of action submitted by the Gabrielino Tongva tribe (Dorame 2000) that includes the results of consultation and provides for the disposition of affected materials excavated intentionally or discovered inadvertently.

Research Design

A research design outlining a three-component approach for identifying and evaluating cultural resources in Area D was included in the 1999 work plan (Grenda et al. 1999). The first component was to inventory those areas where paleoenvironmental investigations suggested that buried intact cultural deposits were likely. The second component consisted of boundary and integrity testing at LAN-62 to establish the site boundaries and integrity of the site by mechanical means as a prelude to data recovery. The third component called for the evaluation of two prehistoric archaeological sites—SR-12 and SR-13—discovered during the initial 1990 survey of the property (Altschul et al. 1991). SR-12 has been given the site designation LAN-2769, and SR-13 is now the "new" LAN-211/H.

The present concern with the Playa Vista property focuses on the evaluation phase of the investigation. LAN-211/H was recorded nearly 30 years ago and ground visibility was less than optimal; however, the site record and report clearly indicate that the site may be NRHP eligible. The goal of our research design was to outline a research strategy that would provide the data required to make an eligibility determination. Part of that strategy requires that we first define "eligibility." Four broad criteria (a–d) are used in the evaluation of eligibility, as defined by NHPA and its implementing regulations (36 CFR 800):

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, association, and:
> (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
> (b) that are associated with the lives of persons significant in our past; or
> (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic value, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> (d) that have yielded, or may be likely to yield, information important in prehistory or history.

There is also a general stipulation that the property be 50 years old or older, although exceptions to this rule exist (see 36 CFR 60.4, Criteria Considerations a–q). The eligibility of a resource for nomination to the NRHP may be based on any of the four criteria for nomination. The HHIC was determined eligible for listing in the NRHP under Criteria a, b, and c; the BLAD, in contrast, was determined NRHP eligible under Criterion d.

The potential of LAN-211/H and LAN-2769 to yield information on the historic contexts and thus meet eligibility requirements for listing as contributing elements in the BLAD was tested using bucket augering, mechanical trenching, and manual excavation techniques. The methods used were considered most effective to determine the surface and subsurface characteristics of the sites, their condition of preservation and the extent of postdepositional disturbance, and whether these sites can provide sufficient data to answer a suite of research questions. Analyses of these data are then outlined to provide the necessary information for the COE to review the NRHP-eligibility recommendation.

Historic Contexts

Briefly, the issue of site eligibility is ultimately one of significance (see Butler [1987] for a discussion). Historic contexts provide a basis for judging a property's significance and, ultimately, its eligibility under the four criteria (Little et al. 2000). As noted by Hardesty and Little (2000:14)

> The concept of historic context has two meanings. First, a historic context can be understood as an organizing structure for interpreting history that groups information about historic properties that share a common theme, place, and time. Second, a historic context can be interpreted as those patterns or trends by which a specific occurrence, property, or site is understood and its meaning within prehistory or history made clear.

There are four general steps to creating historic contexts (Hardesty and Little 2000:14): (1) identify the theme, time period, and geographic limits; (2) assemble existing information and synthesize the information; (3) define property types; and (4) identify further information needs. In essence, a theme is the equivalent of a research problem, and a historic context is developed by placing the theme or problem in an appropriate setting in both time and space. The context is linked to tangible cultural resources by the concept of a property type (National Park Service [NPS] 1986:7).

> A property type is a grouping of individual properties based on a set of shared physical or associative characteristics. Physical characteristics may relate to structural forms, architectural styles, building materials, or site type. Associative characteristics may relate to the nature of associated events or activities, to associations with a specific individual or group of individuals, or to the category of information about which a property may yield information.
>
> Of particular importance to archeological properties is the fact that property types can be based upon our predictions of what resources likely existed at a given place and time in history and our expectations of what their likely condition is today [NPS 1986:8].

To evaluate the NRHP eligibility of sites found within the BLAD, SRI must determine if a site contributes information to any of the regional research questions we have developed for the district. These questions are grounded in the prehistory and history of the area and in previous scientific investigations. Once these questions are posed, we must determine whether contributing data are found at the site, and analyze their adequacy, integrity, context, and relevance to the research questions. Finally, based on analysis of the data obtained during testing, we will determine whether the site has the potential to yield important information—that is, whether data from it can address the research questions. If the answer is "yes," then SRI will recommend that the site is NRHP eligible.

Research questions are built on current data and theoretical orientation, and are supported by the cultural and historic context of the site. The resultant research framework permits the investigator to identify gaps in understanding of regional culture history, and explain how data from the site may be able to full in such gaps. Two broad historic contexts were first framed in the PVAHP research design (Altschul et al. 1991): (1) culture history and cultural dynamics and (2) prehistoric adaptations and a changing environment. Only one property type—middens—was defined for the BLAD. As Altschul et al. (1991:165) stated:

> All recorded sites consist of midden deposits, representing numerous occupations and reoccupations that occurred over periods of hundreds, if not thousands, of years. Instead of viewing each archaeological site as a separate property, it is more accurate to view the entire lagoon and escarpment as a locus of prehistoric settlement. From this perspective, it is the study of adaptation to the lagoon that is significant: a site's ability to contribute to that study is in essence the best measure of that property's National Register eligibility.

Culture History and Cultural Dynamics

Our first research theme examines culture change through time. The preliminary chronological sequence for the Ballona, as adapted from Moratto (1984) by Altschul et al. (1991), broadly covered culture history from 6500 B.C. to A.D. 1800. Our initial goal in designing this sequence was to achieve comparability by applying the traditional temporal categories, such as the Millingstone horizon, to the evidence of human activity found in the project area. As our knowledge of cultural markers and chronology has grown, our research interest has extended to address questions of greater regional significance. The topic of a desert to coast migration during the Intermediate period has moved to the forefront as issues of mobility, sedentism, and population aggregation are examined (Altschul and Grenda 2002). Formal stone tools are additional support for a desert tie with the Ballona (see Appendix C). The variety of projectile points found at bluff-top sites by Van Horn (1990), collectively labeled Marymount points, suggests a desert connection (Ciolek-Torrello and Grenda 2001). Refinement of the area's chronology continues. Recent discovery of protohistoric and early-historical-period artifacts at LAN-211/H has extended the era of known Native American occupation of the Ballona. Gabrielino village evolution and the process of acculturation at early-historical-period sites in the Ballona join the list of research issues to be addressed by archaeological investigations in the PVAHP.

Human-Land Relationships

Our second research theme focuses on human activities in relation to their surroundings. The human-land relationship theme considers the ways in which people adapt and interact with their environment as they pursue necessities such as food, shelter, trade, and territory and how these individuals are, in turn, affected by the changing environment in which they live. In an effort to examine issues within this second research topic, a program of coring and trenching was undertaken by SRI throughout the Ballona. The result was a preliminary paleoenvironmental reconstruction, summarized in Chapter 5, which is still being refined and which continues to aid our archaeological interpretations. Excavation of more than 400 continuous cores within the Playa Vista project area provided the base material for detailed stratigraphic and chronometric analyses and for paleoenvironmental studies of foraminifera, siliceous microfossil, ostracode, pollen, and mollusks (Boettcher and Kling 1999; Brevik et al. 1999; Davis 2000; Palacios-Fest

2000). Our preliminary model of lagoon development indicates that the wetlands were a highly complex system that contained changing landforms. Some areas of the marsh shifted from inhabitable to uninhabitable and back again. Except where coring revealed that no stable surfaces existed during the Holocene (e.g., in Track 49104-03 and the Freshwater Marsh), relatively intensive testing was required to find areas likely to contain archaeological deposits.

When sufficiently refined, a full paleoenvironmental reconstruction will yield a series of synchronic "snapshots" that represent moments in prehistory. Testable hypotheses are generated by superimposing evidence of human activity onto these snapshots. For example, geotechnical coring established that bay conditions in the Ballona were dominant by an early date, perhaps by 6500 B.P. (Davis 2000; Palacios-Fest 2000). What resources were available in the lagoon at this time? Is there any evidence that people used these resources? To date, only a single site in the lower Ballona area, LAN-206, is known from this period, and it was located on the bluff top overlooking the lagoon (Van Horn and White 1997c).

Three thousand years later, by the Intermediate period, not only were large areas of the bluff top occupied, but sites also appeared below the bluffs along upper Centinela Creek, not far from the lagoon edge (Altschul et al. 1998; Grenda et al. 1994). During the Late period, roughly 1000 B.P., settlement shifted again and the bluff tops were abandoned (Ciolek-Torrello and Grenda 2001). One model to explain these shifts targets the profound change in the ecology of the Ballona Lagoon, from an open saltwater bay to a sediment-choked freshwater wetland. With the lagoon reaching maturity during the Late period, the area should have remained attractive to humans in terms of resources; however, for some as-yet-unknown reason, the bluff tops were no longer inhabited. A major focus of current paleoenvironmental research is an assessment of how productive the estuary and environs would have been at various times in their evolution. Although also examining the cultural implications of environmental change, previous archaeological investigation in the Ballona concentrated on the lagoon edge and the upper Centinela Creek area (Altschul et al. 1999). In this report, SRI's focus shifts to lower Centinela Creek and the base of the bluffs.

Patterns of similarity and dissimilarity between sites in the Ballona Lagoon present themselves for future research. When sites are grouped primarily by their location and proximity to resources, are new, insightful interpretations of the data suggested? Beyond the simple dichotomy between bluff-top sites and those at the base of the bluff (Altschul et al. 1998; Altschul et al. 1999), the relationship of those at the base to those farther north at the lagoon edge can be explored. The intent of testing at LAN-2676 was to compare data from sites along Centinela Creek with data obtained from a site along the edge of the former lagoon. Unfortunately, the data from all three sites north of Bluff Creek Drive—SR-24, LAN-1932/H, and LAN-2676, termed the "Runway Sites"—have apparently been blurred by the construction of the Hughes Aircraft Company runway.

Expanding on earlier models (Altschul and Ciolek-Torrello 1990; Altschul et al. 1999), a division of the PVAHP into west and east halves, corresponding to the lower and upper reaches of prehistoric Centinela Creek, produces a distinct grouping of sites. At the heart of the western group is the area currently occupied by the Lincoln Boulevard incline up onto the Westchester Bluffs. This naturally indented landform was probably terraced alluvium in prehistory, providing easy, stepped access between the bluffs and the lagoon below. Located at a strategic position just east of the Lincoln Boulevard gap is LAN-62, the largest site in the Playa Vista project area, which might have been a prehistoric village. This grouping places LAN-62 at the center of a cluster of important archaeological sites, including LAN-61, LAN-63, LAN-64, and LAN-211/H. These sites, when considered collectively, form a "community," with LAN-62 as its hub. Located farther from the center, LAN-1932/H, LAN-2676, and LAN-2769 may be outlying settlements. These LAN-62 community sites also need to be compared to the upper Centinela Creek sites, LAN-60, LAN-193/H, and LAN-2768. Although the role of LAN-211/H within the LAN-62 community complex remains an open question at this point, given that LAN-211/H is intact, its chronometric and stratigraphic components may contain the answers. LAN-211/H may represent a later phase in the evolution of that community, or it may stand alone as an independent settlement in time and space.

This holistic approach to understanding the evolution of settlement in the Ballona focuses on the concept of a prehistoric community versus dispersed settlements, as examined against the backdrop of environmental change in the Ballona. This approach examines the past in terms of intrasite relationships and interactions, going beyond site attributes and formation processes.

With the theoretical and procedural framework established by this and the previous two chapters in Part I , we now move the report narrative into Part II, the presentation of field data. Chapter 4 presents our field methods; Chapter 5, our current paleoenvironmental reconstruction and soils and stratigraphic analyses; and Chapter 6 is a complete discussion of our field results.

CHAPTER 4

Methods

Benjamin R. Vargas and William Feld

The work plan (Grenda et al. 1999) outlined a three-component approach for identifying and evaluating cultural resources in Area D. This chapter details the methods used to satisfy each of the three components of the work plan. The first component was a discovery phase devised to target areas of potential archaeological sensitivity as suggested by paleoenvironmental reconstruction. The second component consisted of boundary testing at LAN-62, accomplished through two series of trenches. The third component of the 1999 work plan called for the testing and evaluation of two possible sites, then known as SR-12 and SR-13, now LAN-2769 and LAN-211/H, respectively.

Field Methods

Two major obstacles impede a traditional approach to evaluating archaeological resources at Playa Vista. First, the fluvial geomorphology of the Ballona Lagoon is such that cultural resources, particularly those sites near the lagoon edge, have been buried by sediment from floods and natural deposition from Ballona and Centinela Creeks. At the base of the bluff, soil eroding from the steep bluff face has covered archaeological deposits below. Second, archival research (discussed in Chapter 2) and the discovery of numerous fill deposits indicate that modern and historical-period modification of the landscape has been extensive. Traditional methods of archaeological site discovery, such as pedestrian survey or shovel testing, are inadequate; accordingly, SRI devised new techniques for locating deeply buried deposits and analyzing disturbed contexts. The methods described in this section represent the refinement of our strategy, as employed over our decade-long involvement with the PVAHP.

Component 1: Discovery

Bucket augering was used in Area D as a primary means of defining archaeological site boundaries. The bucket auger is a reliable tool for determining presence or absence of cultural materials. Figure 24 shows the location of excavated bucket augers in Area D. Backhoe trenching followed bucket augering; trenches were used to expose soil stratigraphy so that internal site structure could be examined.

Bucket Augering

Mechanical bucket augering was used at Playa Vista to locate subsurface archaeological sites in areas where the depth of fill material and the presence of pavement and improvements made backhoe trenches and hand excavation impossible. SRI Project Director Christopher Doolittle first used bucket augers in the vicinity of the HHIC, with its numerous standing structures, buried utility lines, and large paved areas

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Figure 25. Bucket auger equipment used during inventory of Area D.

(Altschul et al. 1999). The results were generally successful, and SRI continued to use the technique in other sections of Playa Vista.

A bucket auger is a specialized drill rig that excavates and retrieves soil using a hinged bucket drill bit; it is usually used for geological sampling. Mounted on a truck, a hollow-stemmed bucket auger reaches depths of more than 18.3 m (60 feet) below the ground surface. Two different sizes of buckets (12 and 16 inches in diameter) were used in the discovery phase (Figure 25).

Before fieldwork began, we designed a sampling grid with targets placed at 50-m intervals in a pattern across Area D (see Figure 24). This grid was staked off by survey personnel from Psomas, Inc., with unit numbers and elevations indicated at each stake. After augering began, it became clear to supervising archaeologist Kenneth Becker that the grid pattern could not always be followed; buried utilities, subsurface hazardous materials, and the presence of buildings or other Hughes-related features required moving stakes to alternative locations, which were subsequently mapped by Psomas personnel.

Once a testing location was selected, the crew positioned the truck over the stake and leveled it to the immediate surface. A relatively level surface is needed for the rig, which limited its usefulness on the slopes in the project area. The bucket was then rotated in a counterclockwise direction and lowered while mechanical force was applied. An SRI staff archaeologist was present at all times, making observations and taking depth measurements at regular intervals. After drilling for about half a meter, the rig lifted the filled bucket, the hinged lower jaw was dropped, and the sample dumped into a wheelbarrow; drilling then resumed. The SRI archaeologist inspected the soil and made notes on soil color, texture, content, and relative depth. Usually, the first levels penetrated by the bucket auger were either highly disturbed or consisted of modern fill material. Sterile alluvial bluff sands in the upper levels were also typical in some areas; these soils were not sampled. When intact soils were reached, we collected and tagged 40–100 liters of soil (2–5 buckets) for wet screening. All soils that were dark in color (possibly indicating an anthrosol) or that contained artifacts or ecofacts were sampled for wet screening. We assigned provenience numbers to each sample that corresponded to stratigraphic units identified during augering. After drilling, the auger shafts were backfilled with remaining excavated materials or, in some cases, with bentonite chips.

Limitations in the collection technique appeared when unconsolidated alluvial bluff sands or other loosely compacted fill materials were encountered; these sediments usually collapsed the shaft sidewalls, making it impossible to determine the depth of the excavation and often mixing various stratigraphic units. We made numerous attempts to counter this problem, which was especially troublesome at the toe of the slope at LAN-62. In shallow augers, water could be pumped into the unit to stabilize the walls, which increased the recovery. However, most attempts to sample in very sandy substrates failed.

In general, under the best of soil conditions, a minor amount of mixing takes place during excavation with a bucket auger. Because of the composition of soils and the way the rig operates, some materials from upper stratigraphic layers are mixed with those of lower levels. We attempted to compensate for this problem through close supervision by the monitoring archaeologist, who maintained a log noting such disturbance. Although bucket augering will never replace trenching or hand excavation for the amount or quality of data retrieved, the technique does provide reliable and accurate information on the presence or absence of deeply buried cultural deposits.

After augering, we wet-screened and processed the collected and tagged samples, a procedure described fully in "Laboratory Methods," below. The presence or absence of materials was then plotted onto the overall PVAHP map. Results of the bucket augering program are presented in Chapter 6.

Component 2: Boundary Testing

Trench excavation in Area D served two purposes. First, we used trenches to define the boundaries of potential sites located during the 1990 survey (Altschul et al. 1991) and by the bucket augering program. Through trenching, we were able to assess visually the size, depth, and integrity of these cultural deposits. Secondly, trenches were used to define soil stratigraphy within particular sites and in the project area generally. Trenching was directed and monitored by SRI staff.

1999 Trenching

In August and September 1999, 17 trenches of varying lengths and depths were placed along the base of the bluff to explore the extent of LAN-62 (Figure 26). We employed a standard backhoe fitted with a 2-foot bucket with a flat edge (Figure 27). Trench depth generally did not exceed 1.6 m, allowing field personnel to enter them safely. In some cases where these depths were exceeded, observations were made from the ground surface. Project Director Angela Keller monitored the crew and created the site map and work records. Dr. Stephen Williams interpreted the strata during this phase of trenching (Figure 28). While the work progressed, the monitoring crew recorded stratigraphic levels, described soils, and made general observations.

2001 Trenching

Between October 8 and 26, 2001, Project Director Benjamin Vargas monitored the mechanical excavation of an additional 22 trenches and 7 approximately 1-by-1-m test units between the western boundary of LAN-211/H and the eastern boundary of LAN-62. Dr. Jeffrey Homburg recorded and described soils,

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Figure 27. Trenching at LAN-62.

Figure 28. Documentation of stratigraphy in test trenches at LAN-62.

interpreted depositional contexts, and checked the stratigraphic profiles drawn of the trenches in the field.

The trenches along the periphery of LAN-62 were placed 25 m apart, whereas those within the riparian corridor were placed roughly north-south at 50-m intervals (Figure 29). Though varying in length and depth, all 22 trenches were approximately 1 m wide. A backhoe with a 3-foot-wide blade was used to remove 10–20 cm of soil per pass. SRI excavated to the soil level below the strata containing cultural materials, unless we encountered the water table. The project director frequently stopped excavation to investigate soil anomalies or to collect artifacts. Soil thought to contain cultural materials was sampled and wet screened, as described later in “Laboratory Methods.” The field crew took notes and photographs during trench excavation and made detailed stratigraphic soil profiles (Appendix A). Some of the loose soil at the base of the bluff proved unstable and required shoring; trenches that could not be entered safely were recorded from the surface.

Seven test units were mechanically excavated into the sidewalls of trenches where intact cultural materials had been identified. These test units were excavated using a 3-foot-wide flat backhoe blade that removed soil in 20-cm lifts, or levels. In each 20-cm level, 16 20-liter (5-gallon) buckets were filled (the approximate equivalent of two 10-cm levels in a 1-by-1-m unit). These units were excavated into potentially intact, culture-bearing soils. Each excavation level was assigned a unique provenience number. The buckets of recovered soil were transported to the SRI water-screening facility for processing. Screening and processing at the PVAHP is described below, in “Laboratory Methods.”

Component 3: Test Excavation at LAN-211/H and LAN-2769

Testing at LAN-211/H and LAN-2769 delineated the vertical and horizontal dimensions of these sites and allowed us to characterize their content and integrity. We used three techniques to test these sites: bucket augers, backhoe trenches, and manually excavated test units. The controlled sample gathered was sufficient to gain the needed information while leaving most of these sites intact.

In the first phase of testing, SRI used the bucket auger, as described above, to determine the presence of cultural materials (i.e., artifacts or ecofacts). Culturally modified soils were recovered in 5-gallon buckets and wet screened as described in “Laboratory Methods” below. The bucket auger was especially useful in areas where access for the backhoe was restricted, such as near the office trailers formerly located at LAN-2769. After analyzing the bucket auger results, we planned a series of backhoe trenches to test the site boundaries of LAN-211/H (Figure 30) and LAN-2769 (Figure 31). SRI dug a total of 10 trenches: three at LAN-211/H (T-6, T-10, and T-11) and seven at LAN-2769 (1-1, 1-2, 1-3, 1-4, 1-5, 1-13, and 1-14). We used the same methods described above: trenches of varying lengths were excavated, and important stratigraphic information was recorded by field personnel, and stratigraphic soil profiles were drawn for those trenches that appeared to contain cultural deposits or features indicating disturbance.

Based on the results from the augers and trenches, SRI placed manual excavation units at both sites. At LAN-211/H, we dug 17 1-by-1-m units. Hand units were placed in four discrete areas (see Figure 30) to test different portions of the site. Units were excavated singly or in blocks of either two or four units. Units 1 and 2 were 1-by-1-m units; Units 3 and 4 were 1-by-2-m blocks. The four-unit excavation block containing Units 5–8 did not penetrate site sediments before reaching the limits of safe excavation. Unit 10 was then placed in the center of the floor of this block and was excavated to sterile sediment, creating a stepped excavation. Unit 9 was excavated as 2-by-2-m block, whereas Unit 11 was a 1-by-2-m block. All materials were wet-screened and processed as described below in “Laboratory Methods.”

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At LAN-2769, SRI dug three blocks containing a total of nine 1-by-1-m units; Units 1 and 2 were excavated as 2-by-2-m blocks, each containing four 1-by-1-m units. Unit 3, a 1-by-1-m unit, was placed in the center floor of Unit 2. All materials were wet-screened and processed as described below in "Laboratory Methods."

Testing at both sites was complicated and restricted by the presence of standing structures, paved areas, and underground utilities. Access was restricted in the lower portions of LAN-211/H in the parking lot due to potential soil contamination; cross-trenching in Trench 11 was halted for this reason. The soil type at LAN-211/H also presented a challenge when hand excavation began. On the southern, upslope portion of the site, the covering of alluvial material from the bluff above measured more than 2 m and was very loosely compacted, requiring stabilization. As the units were dug into the hillside, hydraulic shoring was used to hold the sand in place so that field crew could excavate safely (Figure 32). At LAN-2769, access was denied in some areas because of underground utilities and subsurface instability.

Figure 32. Shoring in units at LAN-211/H.

Soils Analysis

The study of soils and stratigraphy is based primarily on observations made during fieldwork. Field observations included drawing profiles of excavated units and selected backhoe trenches and, at a minimum, recording information on the color and texture of the matrix. Typically, additional recorded information included the presence or absence of artifacts and the presence of various types of disturbance and structures that would indicate the environment of deposition or soil development. At LAN-211/H, Dr. Steven Shelley recorded most of the stratigraphy, and Dr. Jeffrey Homburg recorded detailed descriptions of the soils in selected units and trenches; this information is presented in the next chapter and in appendixes to this report. At LAN-2769, the stratigraphy was recorded by the crew excavating the individual units. Drs. Williams, Homburg, and Shelley described the sediments in the trenches west of LAN-211/H.

Laboratory Methods

Under the direction of SRI's laboratory director, William Feld, SRI's staff processed the materials from the excavations, completed an initial inventory, and began the basic artifact catalog. The following section describes the screening, sampling, sorting, transmitting, and cataloging activities. Analytical methods for the various artifact classes and paleoenvironmental studies are detailed in Chapters 6–9.

Screening

The first stage of laboratory processing occurred in the field: collected materials were tagged with their field proveniences and brought in buckets to SRI's wet-screening facility at the Playa Vista project area. Under the supervision of Mr. Feld, the matrix was screened through 1/8-inch mesh with pressurized water to dissolve and remove the soil matrix. The residue that remained in the screens after washing—usually small rocks, shell fragments, and artifacts—was then sun-dried, rebagged, and sent to the SRI laboratory in Redlands for inventory and sorting. Diagnostic artifacts observed during excavation and selected for special analysis (e.g., pollen wash) were not subjected to field washing. Artifacts generally arrived in the laboratory clean of most of their surrounding matrix, dry, and ready for sorting. After initial sorting, additional cleaning was only done as necessary for any particular analysis.

Four-mil reclosable plastic bags containing all materials from a given provenience—including rocks and gravel—were transported to the laboratory. Laboratory technicians used a provenience list to keep track of samples to be sorted and made careful notes of anything unusual and any problems they encountered during the sort. Double checks at each step ensured that all proveniences were processed correctly.

Sorting

Basic laboratory sorting for LAN-211/H was a two-step process. Bulk field materials were sorted by size, then by material type. To obtain a size sort, each provenience was screened through a series of four nested screens (2 inches, 1 inch, 1/2 inch, and 1/4 inch). The fraction larger than 1/4 inch was then sorted by basic material type, with the different size classes kept separate. For LAN-211/H, the basic material types were bone, charcoal, FAR, lithics, shell, worked bone, worked shell, and "other." Technicians were instructed to show any materials from the "other" category (seeds, wood, asphaltum, ochre, etc.) to the laboratory director or project director before inventorying. Materials categorized as FAR, lithics, other, worked bone, and worked shell were counted; bone, shell, and charcoal were weighed. All materials were bagged and tagged separately by provenience, size, class, and material type and were boxed by material type.

Laboratory technicians sorted all materials that passed through the 1/4-inch screen into discrete collections of bone, lithics, shell (hinges only), worked bone, worked shell, and "other." FAR, charcoal, and nonhinge shell fragments were separated in this size class. Bagging, tagging, and recording were done as for the larger materials.

As soon as we understood that LAN-211/H was a protohistoric/early-historical-period site, Project Director Benjamin Vargas required that all historical-period materials be recovered as well. New material type categories were added, including glass, ceramic and metal. The new procedure was used for the four units identified for analysis, which are listed below.

The final fraction, known as "dreck," including unsorted materials, rocks and gravel, were returned to their original bags, labeled, boxed, and stored with the rest of the collection. The partially sorted dreck that was smaller than 1/4-inch was bagged separately but put into the original, larger, dreck bag. SRI inventoried the dreck; all materials were retained for future reference in SRI's laboratory storage area.

Inventory

SRI collected the information acquired during sorting (size class, material type, count, or weight) by filling out artifact tags (placed inside each bag) and inventory forms, which were then entered into the catalog database. After data entry was complete, the laboratory director reviewed the inventory and checked for errors and inconsistencies. He also compared the inventory to the field provenience data to be sure that all proveniences were sorted properly. Once all errors had been corrected, the database became available for analysis. One of its first uses was to generate summary reports on the data for use in planning and budgeting the next phase of work.

Analysis

With the initial inventory complete, the quantity of shell and faunal materials collected required that SRI establish a sampling strategy for each site before analysis could begin. For LAN-211/H, the project director identified 34 proveniences for analysis (Table 4). These were chosen to obtain a representative sample from all areas excavated at the site. We selected five units (Units 4, 6, 9, 10, and 11) for analysis, including at least one unit from each of the four sampled areas. The upper three levels of Unit 4, a 1-by-2-m unit, and upper two levels from Unit 6, a 1-by-1-m unit, were eliminated from analysis when analysis of soil profiles revealed them to be recent alluvium or slope wash. The top two levels of Unit 11, a 1-by-2-m unit, were not analyzed for the same reason. Only the south half of Unit 4 was included in the analytical sample, to keep the sampled volume consistent. Unit 6 was chosen from one of the four-unit blocks for analysis; after the first two levels were discarded, the results from Levels 3 through 9, Unit 6, were combined with results from Unit 10, a 1-by-1-m unit excavated into the floor of the four-unit block, to represent the unit to its base. In other words, results from Units 6 and 10 were combined to form a single analytical unit, in order to provide a continuous column of site sediments. All levels chosen for analysis were excavated in arbitrary 10-cm increments in 1-by-1-m units. The level depths and strata encountered in each unit are discussed in Chapter 6 and presented in Table 10.

Table 4. Bone and Shell Analytical Samples from LAN-211/H

Units	Provenience Designations Sampled	Levels
Unit 4, south half	42, 43, 44, 45, 148, 152, 153	4–10
Unit 6 (upper levels, Unit 6/10)	53, 60, 64, 68, 72, 76, 80	3–9
Unit 10 (lower levels, Unit 6/10)	84, 85, 86, 87, 96, 97, 98	1–7
Unit 9, southeast and southwest quadrants	90, 91, 101, 102, 103, 104	1–3
Unit 11, south half	136, 142, 144, 146, 151, 155, 157	3–9

No sampling strategy was used for analysis of stone artifacts or beads: all lithic materials and all beads recovered were analyzed. For LAN-2769, three 1-by-1-m units were selected as the analysis sample: the southeast quadrant of Unit 1, the southeast quadrant of Unit 2, and Unit 3. Results are presented in Chapter 6.

The laboratory director was responsible for making sure that sampled materials reached the appropriate specialists for analysis. The completed sample inventory maintained at the SRI office also functioned as a tracking system for shipments to analysts. Artifacts were counted by both laboratory technicians and individual specialists to cross-check the numbers, improve the reliability of the data, and ensure the complete transfer of collections to the analysts.

SRI staff specialists then conducted their analyses. Provided with an inventory printout for the materials they received, analysts were instructed to check off bags as they analyzed them and to record any comments. Nonartifactual items were discarded at the analyst's discretion, after being recorded on the inventory log sheet. The laboratory director collected these log sheets on completion of the analyses and all data were later entered as updates into the computerized catalog record. The few shell samples taken for radiocarbon dating were destroyed as part of the analytical procedure. This was also noted in the catalog database.

CHAPTER 5

Environment, Soils, and Stratigraphy

Steven D. Shelley, Jeffrey A. Homburg, Antony R. Orme, and Eric C. Brevik

This chapter presents the environmental background, followed by a discussion of the soils and stratigraphy identified in the trenches and test excavations conducted in Area D of the project area. We begin with a discussion of the environmental setting of the Playa Vista project area. The results of the paleoenvironmental investigations conducted as part of the PVAHP are presented, followed by historical and modern characteristics of the Ballona wetlands. The paleoenvironmental reconstruction is then supplemented with stratigraphic and geochronological data to develop a temporal framework for the base of the bluff at LAN-62, LAN-211/H, and LAN-2769. Here, we identify and interpret natural earth processes associated with the formation and alteration of the archaeological record and reconstruct how the landscape evolved over time during different occupations (Homburg and Ferraro 1998:47).

Environmental Background

The Ballona Lagoon formed in a drowned river valley in the Southern California Bight occupying a low-lying gap between sandy uplands. The Ballona Gap is bounded to the southeast by the Del Rey Hills and tectonically uplifted cliffs known as the Ballona Escarpment, to the east by the Baldwin Hills, and to the northwest by the Santa Monica Mountains. Collectively, the wetlands and adjacent uplands are termed the Ballona. The sites reported here are located at the base of the Westchester Bluffs, the local name for a western portion of the Ballona Escarpment. Reconstruction of the evolution of the Ballona sets the stage for generating hypotheses and explaining human adaptation to this complex, dynamic coastal environment. This landscape reconstruction is crucial for testing hypotheses about site function, site distribution, community evolution, and population density.

Paleoenvironmental Reconstruction

SRI's reconstruction efforts have revealed that the prehistoric Ballona Lagoon was a rich but highly variable resource through time. As freshwater, brackish, and saltwater wetlands met, salinity levels rose and fell; habitable landforms emerged, subsided, and were inundated; and plant and animal species emerged, flourished, and disappeared. These changes were usually gradual, but catastrophic storms, floods, tsunamis, and earthquakes also affected the environment, which in turn affected human land use in the Ballona. Human adaptive responses to the evolving lagoon and wetlands were also complex. Placing environmental events in time reduces the number of interpretive variables and provides a framework for evaluating the cultural deposits.

A paleoenvironmental reconstruction of the Ballona was conducted as part of the PVAHP. This reconstruction is based on stratigraphic, radiocarbon, and paleoecological (mollusks, pollen, ostracodes, foraminifer, and diatoms) data obtained from about 200 cores, combined with observations and analysis of archaeological trenches, test excavations, and cores. These data were used to prepare a paleogeographic model for the last 7,000 years (Figure 33).

At the end of the Pleistocene, what is now known as Ballona Lagoon was open marine coastline. Deep sediments seen in cores from the Ballona include sand and gravel overlain by thick silt and clay (Poland et al. 1959). These strata are consistent with marine sands formed by the Pacific Ocean between ca. 15,000 and 7000 B.P. (Brevik et al. 1999). This period was typified by global fluctuations in sea level and regional transgressions of the Pacific Ocean.

At 7000 B.P., sea level globally was about 10 m below present levels, and possibly 12–15 m below. The Pacific Ocean would still have been transgressing across the coastal/estuarine floodplain of the Ballona Creek/Los Angeles River system. This drainage system probably bifurcated into numerous tributaries among freshwater marshes, while mudflats and sand bars would have characterized the land-sea interface. There is no reason to suppose that the sea penetrated any farther inland than the small estuarine wedge shown in Figure 33. The shoreline at 7000 B.P. was at least 500 m offshore, and possibly more than 1 km, from its current location. The Los Angeles River flowed into the estuary for much of the last interglacial/glacial cycle, as indicated by the massive submarine fan-delta off the coast. This does not exclude other outlets (i.e., to Long Beach) because the river is known to have changed course frequently during early historical times. The Westchester Bluffs were cut into the northern edge of the massive Pleistocene aeolian dune field that had accumulated downwind in response to the winnowing of the fan-delta and floodplain during the last glacial stage (and perhaps earlier). Erosion of the bluffs was caused by the Los Angeles River being pushed against the south edge of its floodplain by its own distributary deposits, as occurred historically with the Los Angeles and Tujunga Rivers in the San Fernando Valley. Marshy, vegetated areas rapidly developed in the eastern and southern portions of the bay, and these expanded with increased sedimentation (Brevik et al. 1999:9). Ostracode analysis from the Ballona reveals high sedimentation rates from ca. 6580 to 4600 B.P. (Palacios-Fest 2000). Palynological analysis of soil cores dating to this period also indicates an expansion of the salt marshes, suggested by the dominance of amaranth pollen (Davis 2000:12). Native populations probably fished, hunted, and collected wild plants across the broad floodplain around 7000 B.P., but the bluffs provided better drained landforms for establishing more permanent sites. Sites on the floodplain would have been submerged as sea level continued to rise.

By 5000 B.P., the marine transgression was nearing its eustatic end, as the continental ice sheets had largely disappeared in response to global warming. Thus it is reasonable to invoke a broad "Ballona Bay" at this time with ocean waters covering the Los Angeles River/Ballona Creek distributaries. Deep water at the coast, however, would have precluded the growth of extensive barriers at this time, although shoaling and subtidal bars were likely occurring just offshore of the present coastline because of the significant change in wave energy due to refraction. More likely, mid-bay bars and spits developed in "Ballona Bay" at the null point where seasonal fluvial processes were countered by perennial wave and derived current processes in the outer bay. We have little evidence for this, other than observations of such bays elsewhere, but it is significant that the underlying fluvial gravels in the Ballona aquifer rise to within 20 m of the surface in the location shown and could have provided a foundation for spit growth. Such sites may have been favored by fishing communities because they represented dry land amid marsh, mudflats, and open water. The mid-bay bar near LAN-61 may also have been favored by alluvial fan deposition. The salt marsh around the outer bay was probably limited in extent at this time because sedimentation reaching the intertidal zone would have been quite marginal. The open coastline was still probably 100–200 m seaward of the bluffs because much of the bluff erosion has continued since 5000 B.P., until they were stabilized by historical-period housing developments. The presence of oysters of 6,220 ± 80 RCYBP at -4.72 m in Core 1B reflects open estuarine conditions then in existence in the outer bay. Oysters were also found at shallow depths of -1.6 to 1.8 m in core 100 at 4790 ± 120 RCYBP. The presence of horn snail at -2.05 m and 4900 ± 140 RCYBP at Core 61 indicates intertidal conditions here.

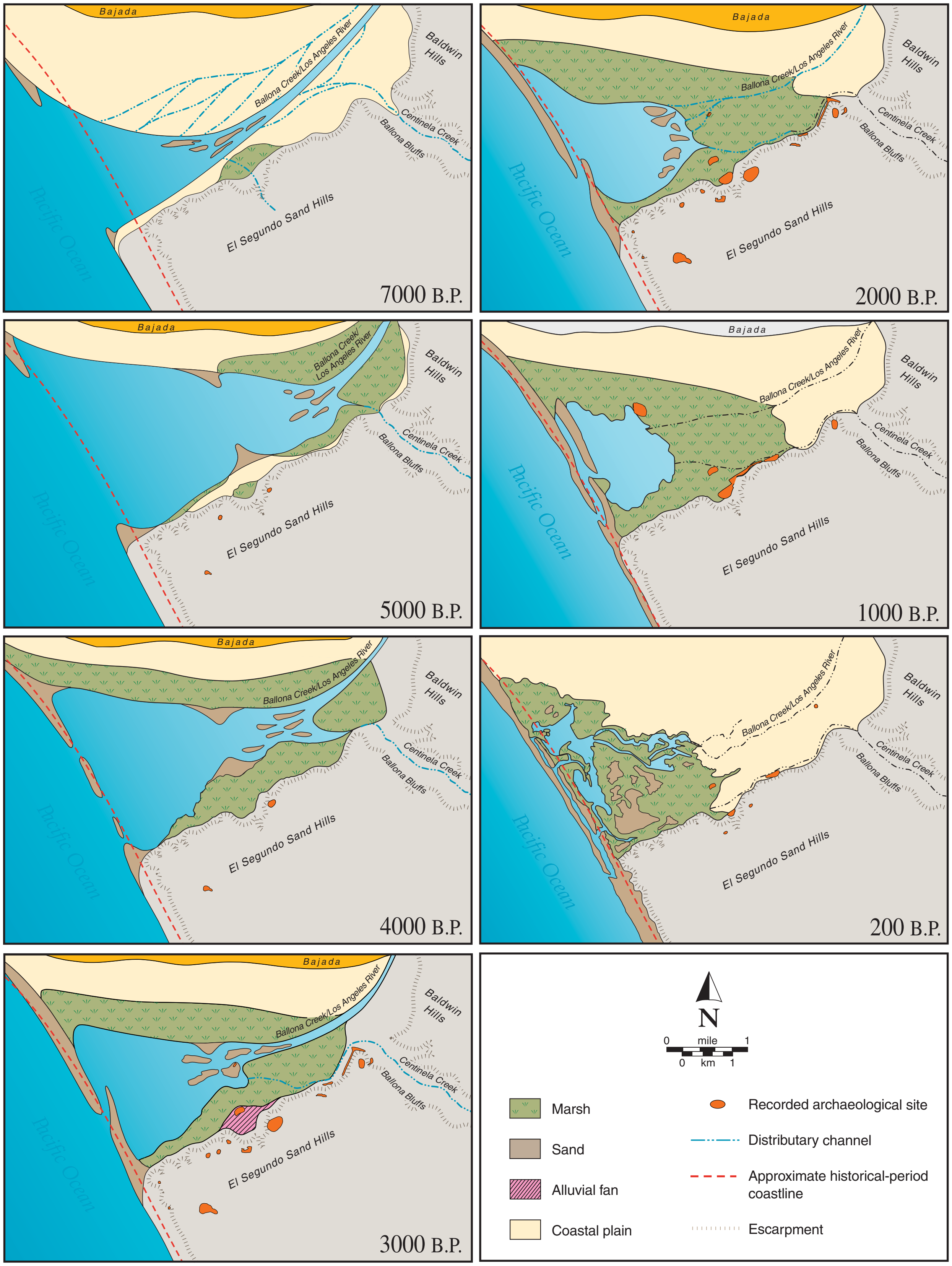

Figure 33. Holocene evolution of the Ballona Lagoon.

By about 4000 B.P., the eustatic transgression had ended. Subsequent changes in the configuration of "Ballona Bay" were attributable to: (1) fluvial sediment inputs from the Los Angeles/Ballona/Centinela Creek which would have caused alluviation of the inner bay in the form of longitudinal middle ground (intertidal) bars and mudflats; (2) salt marsh accretion on supratidal areas around the fringes of the outer bay, with mid-bay bars favoring leeward accretion; (3) marine/estuarine sedimentation in the outer bay, but still limited by the bay's broad dimensions such that intertidal sedimentation was essentially marginal; (4) growth of a nearly continuous beach spit-barrier across the mouth of the outer bay; (5) continued compaction and possible tectonic subsidence; and (6) hydroisostatic depression of the coastal zone generally, and the shelf area in particular, with hydroisostatic loading accounting for as much as 1 m/1000 yr of subsidence relative to fixed inland datums. Soon after 4000 B.P., oyster and jackknife clams disappeared entirely from the bay and were replaced by horn snails. Horn snails are much more tolerant of fresh water, so this shift marks a significant increase in freshwater inputs (Shelley 2001:14). A radical shift in the ostracode population also signaled this change, as a freshwater ostracode assemblage replaced the marine assemblage at around 4200 B.P. (Palacios-Fest 2000:26).

By 3000 B.P., the inner bay that formed in response to the initial transgression would have been largely erased beneath intertidal deposits of sand and mud, thereby restricting open water to the former outer bay. The coastal plain to the north expanded as supratidal fluvial (flood) and aeolian sediment accumulated and pushed the coastal plain/salt marsh interface southward. Salt marshes probably extended farther south from the north shore, as intertidal bars and mudflats extended westward from Ballona Creek. As in earlier times, much of this scenario would depend on the importance of discharge and sediment from Ballona Creek. If this creek still accommodated the Los Angeles River, at least intermittently, rates of accretion and shoreline progradation, as well as reworking during major floods, would have been much greater. If the creek did not receive Los Angeles River inputs, the area would have settled into a more passive state similar to that in historical times.

By 2000 B.P., the coastal plain (supratidal fluvial and aeolian sediments) continued to encroach on the salt marsh along the northern margin. The salt marsh was somewhat more extensive, extending to cover much of the bay beyond the north shore and at the creek mouths. The barrier and bluff shoreline on the open coast was probably still about 50 m seaward of the present. An extensive intertidal, unvegetated mudflat developed in the bay (lagoon).

By 1000 B.P., salt marsh islands and intertidal mudflats had become more extensive. The open coast shoreline was probably near its present location but, as earlier, there would have been perhaps a 100 m wide backshore between the sea and the bluffs. A double barrier that is depicted later in historical maps is inferred to have formed by this time. Double barriers are found along many coasts and they have different origins, including (1) diversion of drainage by a single encroaching barrier; (2) multiple barrier encroachment in a sediment-rich environment; (3) floodwaters breaching an inner barrier but then diverted by a new barrier formed from the floodwater sediment: (4) subsidence; and (5) human interference. For the next millennium, increasingly high volumes of water flowing through Ballona and Centinela Creeks, which led to accelerated sedimentation, the spread of marsh and wetland areas, and a corresponding decrease in the area of open water in the lagoon (Brevik et al. 1999:10). This conclusion is confirmed by pollen data, which indicate that before 3000 B.P., the species present in abundance were those that thrived in open, brackish water (such as *Ruppia, Botryococcus, Pediastrum,* dinoflagellates, and foraminifera), whereas after 3000 B.P., shallow-water species such as cattail and tule *(Typha-Sparganium* and *Cyperaceae)* became more numerous (Davis 2000:26). By 1000 B.P., sedimentation had caused the Ballona Lagoon to shrink to a small remnant of its former expanse.

The configuration of the Ballona was mapped in the 1893 U.S. Coast Survey (Figure 34). By about 200 B.P., sediments had filled much of the lagoon and a complex of sandy islands and extensive salt and freshwater marshes developed throughout much of the former lagoon. The north shore of the lagoon move slightly southward as the coastal plain to the north continued to expand.

This paleogeographic reconstruction provides a model for explaining the evolution of cultural land-use patterns in the Ballona. A major uncertainty in the reconstruction is the extent to which subsidence has influenced the nature, elevation, and distribution of marine, estuarine, and floodplain deposits. Subsidence may be due to compaction caused by dewatering and degassing of sediment, especially in the wetlands rather than marine and floodplain deposits, and locally to tectonism. Thus an estuarine deposit now found at 15 m below sea level may have been deposited originally at 12 m or so. Additional data are needed to further refine this model. Ideally, we need more subsurface evidence for the following: (1) the Core 1B area should be penetrated deeper to determine the depth of the underlying fluvial gravels from the late Pleistocene landscape; (2) petroleum drilling logs should be retrieved to define the entire late Pleistocene land surface; and (3) additional cores should be extracted from the northern part of the basin and another deep core from the basin center.

Biota

During times of low flow, Ballona Lagoon would have been a complex of brackish tidal outlets, freshwater runoffs, marshy pools, mud flats, and sandy islands, bordering an area of open water partially enclosed by a double barrier sand spit. The Ballona Lagoon is an estuary; that is, "a semi-enclosed coastal body of water with an open sea connection, where: (1) seawater is measurably diluted by the river drainage; (2) fluvial and marine sediments co-occur; and (3) marine and continental . . . fauna and flora co-exist" (Palacios-Fest 2000:4). The 1893 map (see Figure 34) depicts how this area appeared during a late stage of its evolution, prior to historical-period modifications over the last century. The Ballona still supports diverse species of marine and terrestrial mammals, invertebrates, and avian fauna, as well as several floral communities. An intensive survey of vegetation in the Ballona region conducted in 1981 identified three habitats and six plant communities that were representative of those that would have existed prehistorically (Gustafson 1981:Bo-1–Bo-29). Pickleweed saltmarsh, mudflat, and saltflat plant communities of the estuary contrast sharply with the freshwater willow and marsh habitat, and the coastal dune and coastal sage plant communities that dominate terrestrial landscapes. Inhabitants of LAN-211/H and LAN-2769 had access to all of these communites, but the freshwater habitat would have been central to their existence.

> Centinela Creek supports a riparian willow community that includes red willow *(Salix laevigata),* arroyo willow *(S. lasiolipis),* cottonwood *(Populus fremontii),* wire rush *(Juncus balticus),* toad rush *(J. bufonius),* field sedge *(Carex praegracilis),* and spike rush *(Eleocharis macrostachya* and *E. montevidensis).* The dominant freshwater marsh species found in the lower reaches of Centinela Creek include bulrush *(Scirpus californicus, S. onlneyi,* and *S. robustus),* spike rush *(Eleocharis macrostachya* and *E. montevidensis),* and cattail *(Typha domingensis* and *T. latifolia)* [Gustafson 1981:Bo-4–Bo-7].

Most of these species were used by the local inhabitants, the Gabrielino (McCawley 1996), but traces of these plants can be difficult to detect archaeologically. Another problem has been the failure of a number of large archaeological studies in the general project area include paleobotanical analyses (e.g., pollen, phytoliths, and carbonized macrobotanical remains).

Hydrology

Historically, the main freshwater sources for the Ballona Lagoon were the Ballona Creek/Los Angeles River and Centinela Creek systems. The combination of fresh water from these drainages and tidal flow

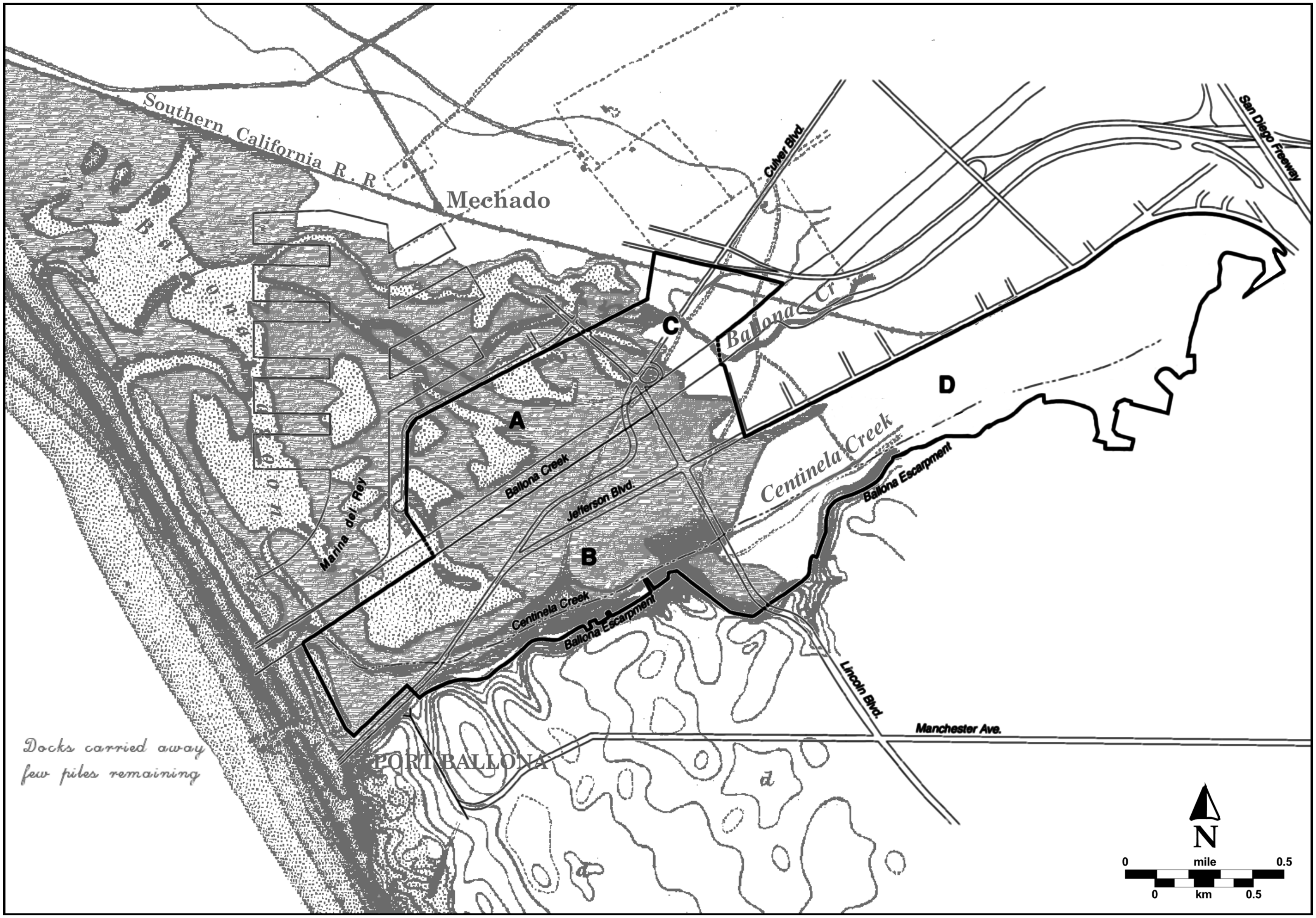

Figure 34. 1893 Coastal Survey Map overlaid with project area boundaries.

from the Pacific are what marks the Ballona as an estuarine lagoon. Episodic flooding changed the course of Ballona Creek, the larger of the two drainages, and drastically altered the biotic communities of the Ballona at various times. Johnston (1962:78) provided a telling description of the area: "During the winter rains the swampy delta became a vast inland sea from the higher ground of Culver City to the ocean. The Gabrielinos called this by their general name for any bay, *pwinukipar,* meaning 'it is full of water,' but in summer, they identified this area as a place where 'the water has departed.'"

Ballona Creek, occupying a remnant channel of the Los Angeles River, drains about 230 km^2 (90 square miles) of the Los Angeles Basin (USGS 2002). Independent of periodic contributions from the Los Angeles River, the Ballona Creek watershed draws from the series of canyons draining the south side of the Santa Monica Mountains, now channelized into the Sawtelle-Westwood and Benedict Canyon runoff-capture systems (Gumprecht 1999:229). Prior to modern channelization, Ballona Creek flowed into the lagoon in the approximate location of the intersection of Lincoln and Culver Boulevards. Ballona Creek was improved in stages, with its course and banks kept in a natural state until the 1920s. A concrete lining to channelize the entire length of Ballona Creek was completed in 1935 (Altschul et al. 1991:76). Tectonic activity through the gap forced underground water to the surface, thereby creating marshy areas that attracted prehistoric settlement (Poland et al. 1959:12).

During past floods, Ballona Creek frequently carried overflow from the Los Angeles River. As noted previously, the Ballona channel was the primary route of the Los Angeles River prior to the 1820s (Johnston 1962). Historical records are corroborated by offshore bathymetry, which indicates that a large submarine delta fan exists that could only have been produced by a substantial drainage over a long period of time, one larger than what could have been created by sediments carried by Ballona Creek alone. Table 5 lists the major historically documented floods of the Los Angeles River when the channel shifted (Gumprecht 1999; Newmark 1984). Archival and geomorphological data indicate that the Los Angeles River discharged into Ballona Creek, both historically and prehistoricaly. Highly variable channel configurations characterized this environmentally dynamic region through time. Coping with catastrophic conditions, such as those caused by flooding, must have been a vital component of local cultural adaptation. A 1938 aerial photograph shows extensive flooding in the Ballona during even a relatively minor flood (Figure 35).

Although draining a much smaller area, Centinela Creek was a much more reliable freshwater source for prehistoric inhabitants than the typical flashy flows of the Ballona Creek/Los Angeles River system. The numerous archaeological sites that dot its historical course are a clear indicator of the attractiveness of its riparian area. Centinela Creek is spring-fed from the Baldwin Hills to the southeast. Prior to historical-period channelization, it was a perennial drainage that flowed into the Ballona along the base of the Westchester Bluffs. Kew (1923:157) noted that:

> Before the city of Inglewood obtained its water supply from the wells at Centinela Spring, a stream carrying one hundred and twenty-five inches of water [3.125 ft^3/second or approximately 1,404 gallons/minute] issued from this spring, and flowed down Centinela Creek, forming these channels, which are now nearly obliterated. During wet weather it was even possible to row a boat up to the spring from Playa del Rey.

Within the gap, both Centinela and Ballona Creeks were subject to "lateral stream migration" during their histories (Brevik et al. 1999:13). Comparison of historical topographic maps and aerial photographs shows how the channels migrated over the last century. Similar channel migrations undoubtedly occurred throughout prehistory as well. For example, the 1893 survey of the area (see Figure 34) showed that Centinela Creek ran near the base of the Westchester Bluffs, whereas later photos show it had meandered northward to near LAN-1932/H. To delineate and date the major channel migrations relative to known and buried archaeological deposits of different ages would require much more extensive subsurface geoarchaeological investigations.

Table 5. Historically Documented Floods Affecting the Los Angeles River and Ballona Creek

Date	Description	Flood and Overflow Drainage
1815	Los Angeles River captured Ballona Creek and changed course into Santa Monica Bay until 1825	Santa Monica Bay
1825	Los Angeles River changed course and cut a new channel back to San Pedro Bay	Los Angeles Harbor (east basin, at the end of Terminal Island)
December 1859	Los Angeles River was impassable for months, river bed shifted a quarter mile	San Pedro Bay
1861–1862	"Greatest of all floods"[a]; Los Angeles River overflowed, split in two below Vernon, widespread inundation	Santa Monica Bay; one branch overflowed to Ballona Creek
January 1868	Los Angeles River overflowed; San Gabriel River cut a new channel to Alamitos Bay, and its old channel became part of the Rio Hondo, draining into the Los Angeles River	San Pedro Bay
January–February 1884	three major floods in three weeks; tremendous property loss; 97 cm (38 inches) of rain in the season; El Niño season	San Pedro Bay; overflow to Santa Monica Bay and Ballona Creek
January 1886	Los Angeles River crested 0.6 m (2 feet) higher but flood was of shorter duration than that in 1884	San Pedro Bay; overflow to Santa Monica Bay and Ballona Creek
December 1889	Los Angeles River overflowed, cut a new channel 3.2 km (2 miles) east, joined with the Rio Hondo and San Gabriel Rivers	San Pedro Bay and Alamitos Bay; overflow to Ballona Creek
February 1914	"Most damaging in history" to that time[b]; river channel shifted again; 12,000 acres inundated; tremendous property damage; El Niño season	Los Angeles Harbor via Dominguez Creek; overflow to Ballona Creek
January 1916	Los Angeles River jumped its banks and created new channel 91 m (100 yards) to south near Vernon; floodwaters join Rio Hondo	Los Angeles Harbor; most overflow to Long Beach Harbor
January 1934	overflow destroyed 1,000 houses in Venice and along Ballona Creek; Los Angeles River overflowed north of Long Beach	San Pedro Bay; overflow to Ballona Creek
March 1938	"Most damaging flood in LA history"[c]; Los Angeles River discharged more than twice the 1914 peak; major flooding along Ballona Creek	San Pedro Bay; major runoff flooding in Ballona Creek

[a] Newmark 1984:309
[b] Gumprecht 1999:167
[c] Gumprecht 1999:215

The exact location of archaeological resources and sites are not subject to public disclosure to prevent harm and unauthorized disturbance of the resources and sites, pursuant Section 5097 of the California Public Resources Code and Section 800.11 of the National Historic Preservation Act, as amended. Therefore, this figure has been excluded.

Stratigraphy

We observed the same basic stratigraphy in archaeological excavation units, trenches, and profiles along the entire base of the bluff. Three sedimentary facies were recorded in the area investigated: hill slope, alluvial fan, and alluvial plain. In the highest landscape position is the hill-slope facies, which is divided into two slope elements, the back slope and foot slope (after Ruhe 1975). In at least two locations, ravines have cut through the hill slope, causing alluvial fans (alluvial fan facies) to form below where there is a dramatic change to a lower slope gradient. Most of the archaeological deposits investigated were associated with the alluvial fan facies. In the lowest landscape position, the alluvial plain facies merges and interdigitates with the floodplain deposits of Centinela Creek and Ballona Creek.

Deposition is the dominant process in all three facies, except on the back-slope portions of the hill-slope facies, where erosion and sediment transport are the dominant geomorphic processes. A complicating factor in the stratigraphy is the extensive human modification of the landscape during the last century. Extensive mechanical excavation and redeposition of fill have altered all of the archaeological sites investigated along the base of the bluff. These modifications are so widespread in some cases that it is very difficult to distinguish historical-period and modern deposits from natural deposits.

Hill-Slope Facies

The hill-slope facies marks the northern edge of the Westchester Bluffs and occupies the highest position in the landscape on the Playa Vista property. In the area of LAN-211/H, the northern edge of these hills forms a steep, east-west-trending bluff. In elevation, the base of the bluff rises from 4.5–6 m to more than 45 m above mean sea level (AMSL) on the summit over a horizontal distance of about 30–40 m. The back-slope position of the hill-slope facies rises at approximately a 40-degree angle. The steep back slope makes the bluff susceptible to mass wasting caused by soil creep, sheet wash erosion, and gullying. Catastrophic slope failures can result from landslides and debris flows, especially in the winter rainy season. Tectonism and loss of vegetation caused by grass fires or long-term drought can help to initiate or accelerate natural erosional processes. Abundant evidence of slope failure and slumping is visible along the much of the bluff face. Steep slopes and geomorphic instability would have made the back slope of the hill-slope facies an unsuitable setting for human occupation. The foot slope at the base of the bluff is the gentle slope below the backslope. The foot slope has undergone some erosion, as indicated by occasional rills and gullies that have been filled in and erosional lag deposits, but the dominant geomorphic process has been deposition.

The lower back slope along the entire length of the bluff was modified when a sewer line and the overlying access road was constructed over seven decades ago. This sewer line appears on plan maps of the area as early as the late 1920s (David Chernick, personal communication 2000) and it is clearly shown on a 1929 aerial photograph (see Figure 19). Construction of this sewer line involved building an artificial bench and excavating a long trench on the back slope of the bluff. A narrow access road for Cabora Road (formerly Sewer Line Road) was built between 1929 and 1945 over the sewer line. To stabilize the sewer and road, earthen fill was placed to form an artificial berm that covers the back slope below the sewer, and in some places, alluvial fans that are crossed. Soil material from the construction might have been the source of some strata found at LAN-211/H and LAN-2769.

Alluvial Fan Facies

At several natural breaks in the bluff south of LAN-211/H, ravines and gullies have formed where there has been headward erosion on the shoulder slope and back slope. Alluvial fans composed of sediment eroded from the bluff have accumulated at the base of these ravines and gullies. Sediments in the alluvial fan facies are typically brown, pale brown, or yellowish brown and dominated by sand. The color and texture of these sediments clearly shows that they are redeposited from the Pleistocene dunes and sheets of sand that cap the bluff to the south. Examination of historical aerial photographs of the project area show that periods of heavy rainfall caused deposition of fan alluvium to form below the ravines and gullies.

In the project area, prehistoric and early-historical-period archaeological sites are concentrated in and on the alluvial fan. From west to east, LAN-62, LAN-211/H, LAN-193/H, and part of LAN-2768 are all associated with this fan alluvium. A major reason that human occupations favored these locations is the elevated position and better drainage of these fans than nearby lowlands to the north. The fans that merge with the river alluvium below are characterized by higher silt and clay contents, poor drainage, as indicated by the greenish and grayish colors that resulted from gleying, caused by significant water-logging for parts of the year. Saturation has resulted in anaerobic (without oxygen) conditions, which has caused iron in the soil to be reduced. By contrast, alluvial fan soils have much better drainage, so reddish, brownish, and yellowish colors result from oxidizing conditions that are dominant here. Darker brown colors mark soils with high organic matter contents, and these colors can mask the pigmenting effects of iron oxidation and reduction.

Lincoln Boulevard ascends the bluff through a large, amphitheater-like ravine in the project area, known locally as the Lincoln Gap. Natural sedimentary infilling of the Ballona covered the lower portion of this fan with alluvium deposited by the Ballona Creek/Los Angeles River and Centinela Creek systems (Brevik et al. 1999). Bucket auger data indicate that this fan may extend another 400 m north, buried below the historical-period surface, where the fan alluvium interfingers with river alluvium on the floodplain. Backhoe Trench 2-9 was excavated on this fan to document and identify the northeastern boundary of LAN-62. The fan surface was altered extensively by farming activities in the last century, including leveling and plowing. Agricultural modifications are visible in historical-period photographs - (see Figure 16 for an example). The fan at LAN-62 was large enough that flooding never completely covered it, so deposition of sediments was limited to low-lying parts of the fan. By contrast, smaller fans were typically covered by fresh deposits during major storms and flood events.

The alluvial fan east of LAN-211/H is located at the base of an unnamed ravine. This ravine once extended at least 400 m south of the face of the hill slope, but Loyola Marymount University filled the ravine to make it nearly flush with the bluff face. In 1938, an alluvial fan extended nearly 200 m north of the ravine and about 120 m to the east and west, forming the classic fan shape landform.

In the 1950s Hughes Aircraft Company, former owner of the Playa Vista project area, excavated the northern two-thirds of the alluvial fan to build several buildings, roads, and a parking lot. This excavation left the southern part of the alluvial fan as a bench-like remnant that initially appeared artificial, as with the fill placed in the ravine farther up slope. Subsequent excavations and examination of the stratigraphy revealed that this bench represented an intact part of the fan. This interpretation is supported by a combination of historical photographs and maps, preserved archaeological deposits, and most important, the presence of at least one moderately developed soil within the fan deposits.

Alluvial Plain Facies

Prior to extensive modification of the hydrology in the Ballona during the early 1900s, two streams flowed through the area, as previously discussed. The larger of the two streams, Ballona Creek, now discharges directly into the ocean because the channel of Ballona Creek is lined with concrete, which keeps it from flowing into the Ballona Lagoon as it did before historical modifications. Before the creek was fully channelized in 1935, it drained into the Ballona Lagoon to the north of its current channel. The channel of the smaller stream, Centinela Creek, is also now lined with concrete to where it empties into Ballona Creek east of Lincoln Boulevard. Historical maps show that prior to channelization, Centinela Creek flowed across the southern part of the Playa Vista project area, near the base of the bluff but skirting the north side of the fans, and then discharged into Ballona Lagoon near the existing Lincoln Boulevard–Bluff Creek Drive intersection. Both streams were prone to flooding, which at times was so extensive that the entire Ballona below the bluffs was covered with water. The alluvial plain facies consists of sediments associated with this extensive floodplain.

The surface of alluvial plain facies is relatively flat to gently sloping and low lying. Deposition is the dominant process, although localized erosion has occurred in places. The most dramatic form of deposition occurred as overbank flood deposits carried by major storm surges, which are now largely controlled by channelization. Massive deposits of sand and fine gravel are found in the overbank deposits near the streams, and finer-grained sediments, mainly silt and clay, characterize deposits further from the channels. Both coarse- and fine-grained, alluvial sediments were documented in Trench 11 at LAN-211/H (see Figure 51).

The floodplain has aggraded due to both major and minor flooding. In areas where the alluvial plain facies is undisturbed (that is, not modified by historical-period or modern earth-moving activities), there is typically a weakly developed soil that is about 1 m thick, consisting of an A horizon that is black to dark brown and usually sandy loam in texture. When moist, this soil appears massive, but when dry, a weakly developed subangular blocky structure is visible. In places, this soil also contains chunks of charcoal, roots, and root casts and apparently formed beneath marsh vegetation. Underlying the A horizon is a greenish gray to pale green silty deposit that is usually several meters thick. This silt is a distinct depositional unit, with an upper contact that is usually abrupt.

The alluvial floodplain was readily available for human use throughout much of the year. Seasonal winter rains and muddy surfaces would have made it more difficult to traverse, but it was dry most of the time and the abundant plant resources made it very attractive to human exploitation. Small numbers of artifacts are scattered in these deposits and they have been documented while monitoring grading operations for the Playa Vista development. These scattered artifacts attest to the generalized prehistoric use of this surface.

Summary

The stratigraphic context was documented through observation and analysis of subsurface excavations along the base of the bluff at Playa Vista. A repetitive pattern of distinctive sediments and soils was identified, divided in three lithostratigraphic facies: the hill slope, alluvial fan, and alluvial plain facies. These facies vary in their archaeological significance and potential for buried cultural deposits. Archaeological deposits are strongly associated with the alluvial fan deposits and the foot slope deposits of the hill-slope facies. Scattered cultural remains are associated with the alluvial plain deposits.

Soils Observations and Interpretations

This section presents observations and analyses made during SRI's inventory and evaluation of the remainder of Area D. Backhoe trenches were excavated at three archaeological sites: LAN-62, LAN-211/H, and LAN-2769. Detailed trench descriptions and profiles are included in Chapter 6.

Stratigraphy in the Area of LAN-62

The three facies described in the previous section were documented in 45 trenches that SRI placed to identifiy the boundaries of LAN-62. We describe the stratigraphy exposed in the trenches in terms of the soil/sediment morphology and type of deposit: artificial fill, fluvial deposits, and colluvial/alluvial deposits.

Trenches in the LAN-62 area (see Figures 26 and 29) frequently exposed one or more layers of artificial fill that contained a wide variety of modern and historical-period artifacts. Chunks of concrete, brick fragments, wire, and rusted metal were commonly found, and bone, glass, and wood fragments were found less frequently. Aerial photographs show extensive land modification in this area after Howard Hughes took possession of the property in 1941. Most of the artificial fill was apparently the result of earth-moving activities associated with the Hughes Aircraft Company.

Fluvial deposits were observed at the bottom of a number of trenches, represented by a series of greenish deposits of silt or loam. In three trenches (Trenches 1-3, 1-4, and 1-5) (see Table A.2), the greenish silts are capped by brown or black silt or sandy loams that represent marsh deposits where A horizons formed on the foot slope. Chunks of charcoal and small roots were found in this A horizon. In Trenches 1-4 and 1-5, the green silt is covered by a brown sandy loam that was tentatively interpreted as a weakly developed A horizon. This sandy loam may represent the first deposition of the hill-slope facies on the fluvial deposits of the alluvial plain facies. In Trench 1-5, this A horizon is covered by a dark brown deposit of sand that is highly laminated and that contains many small, shallow channels. A similar sequence was noted in Trench 11 at LAN 211/H.

Most of the trenches between LAN-62 and LAN-211/H were placed in colluvial/alluvial deposits in the foot slope of the hill-slope facies. Deposits in some of these trenches have A horizons (Trenches 1-7, 2-2a, 2-2b, 2-6, and 2-7) that are relatively undisturbed. These A horizons typically consist of dark brown or grayish brown sandy loams. These are similar in texture and color to strata where archaeological deposits have been identified along the base of the bluff.

Stratum Descriptions

The stratigraphy between LAN-62 and LAN-211/H consists of five distinct strata, four of which were observed below the bluff. A comparison of the strata at LAN-62 and LAN-211/H is presented in Table 6. Stratum 1 consists of artificial fill associated with construction activities. Stratum 1g is a brown (10YR 4/3) sandy loam that contains large chunks of concrete and asphalt. (Note: All Munsell colors are for dry soil.) The lower contact for this stratum is abrupt and truncates both Stratum 1h and Stratum 3d, which indicates that it was placed on a mechanically truncated surface marking an unconformity. Lenses of sediment that contain artifacts and that are similar in color and texture to Stratum 3d, the intact cultural layer, were mixed into this stratum due to historical-period earth-moving activities. Stratum 1h appears to have originated in this manner.

Stratum 2, was not visible in this area. Stratum 3d marks a buried A horizon (2Ab) of a weakly developed soil. It is a very dark brown (10YR 3/2) sandy loam that contains a relatively dense

Table 6. Summary of Strata and Facies at LAN-62 and LAN-211/H

Stratum and Facies (Landform)	LAN-62 Strata	LAN-211/H Strata
Stratum 1: Modern, artificial fill		
Alluvial plain (toe slope)	—	1a–f
Hill slope (toe slope)	1g, h	—
Stratum 2: Modern and historical-period alluvium and colluvium		
Alluvial fan (bench)	—	2a–d
Stratum 3: A horizon of moderately developed soil		
Alluvial fan (bench)	—	3a, b
Alluvial fan (toe slope)	3d	3c
Alluvial plain (toe slope)	—	3c
Stratum 4: B and C horizons of moderately developed soil		
Alluvial fan (bench)	—	4a–f, 4h–p
Alluvial fan (toe slope)	4t	4g, 4q–s
Stratum 5: C horizons of moderately developed soil		
Alluvial plain (toe slope)	—	5a–c
Alluvial fan (toe slope)	—	5d

concentration of artifacts, including shells and flaked stone. The stratum has been heavily bioturbated by the burrowing activities of rodents. Contact with the underlaying Stratum 4 is wavy to irregular due to bioturbation, possibly combined with mechanical disturbance as well. If this contact has been disturbed mechanically, Stratum 3d almost certainly represents redeposited cultural material similar to the lenses in Stratum 1. It is more likely, however, that this contact has resulted mainly from rodent burrowing, as is extremely common on this alluvial fan. Stratum 3, although highly mixed in places, does not appear to represent redeposition from elsewhere on the fan.

Stratum 4 is a layer of laminated, pale brown (10YR 6/3) sand deposited on alluvial fans at the base of the bluff. The oxidized colors indicated these deposits originate from the Pleistocene aeolian deposits on the bluff top to the south. These deposits contrast sharply with alluvium elsewhere in Ballona where waterlogging has caused gleying, which results in greenish to grayish colors due to reduced iron in the sediment. No artifacts were found in the profile of Stratum 4.

Stratum 5d is a deposit of stratified layers of sand that represents fluvial deposition. The relatively high landscape positions suggests that this sediment mainly consists of material eroded from up slope on the bluff and the alluvial fan.

Stratigraphy at LAN 211/H

Testing at LAN-211/H indicates the cultural deposits here are limited to the alluvial fan facies (Figures 36 and 37). The largest intact portion of the site is associated with a bench created when the Hughes Aircraft Company removed part of the alluvial fan to construct buildings and a parking lot. Most test units (Units 3–7, 10, and 11) were excavated on this bench (see Figure 22). Cultural deposits were located in the upper part of a moderately developed A horizon that is about 1 m thick. The sequence of the five strata is relatively consistent in all test units.

Stratum Descriptions

Stratum 1 consists of artificial fill material. Stratum 1a is an asphalt layer built on parking lot and road surfaces that was identified only in the backhoe trenches and in Unit 9. The asphalt usually overlies a bed of yellowish brown decomposed granite (or grus) that was designated Stratum 1b. Decomposed granite was used extensively by Hughes Aircraft Company as a base for roads, parking lots, and runways throughout much of the Playa Vista property, so Stratum 1b dates to the 1940s or later. Trenches were

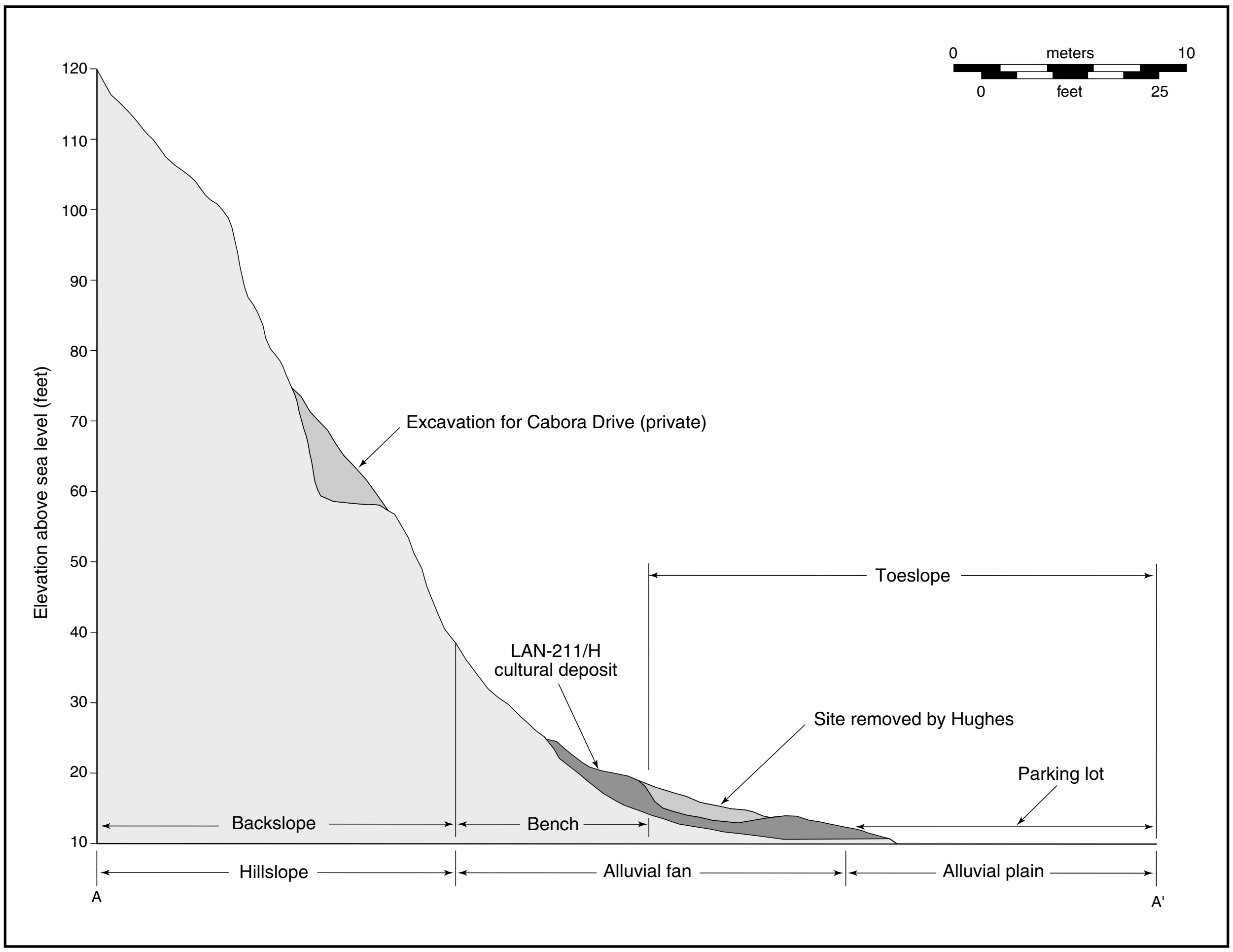

Figure 36. Reconstructed geomorphic cross section of LAN-211/H.

The exact location of archaeological resources and sites are not subject to public disclosure to prevent harm and unauthorized disturbance of the resources and sites, pursuant Section 5097 of the California Public Resources Code and Section 800.11 of the National Historic Preservation Act, as amended. Therefore, this figure has been excluded.

excavated by Hughes Aircraft Company for various underground utilities. These trenches were backfilled with a variety of materials, including gravels (Strata 1b–f), and, in some cases, mixtures of local sediment redeposited from elsewhere (Stratum 1f). The best example of this sequence was noted in Trench 11 (see Table A.4).

Stratum 2 is a mixture of modern and historical-period alluvium and colluvium. Unlike Stratum 1, Stratum 2 is not the product of human activity. All three layers in Stratum 2 consist of fine sandy loams that were designated C subhorizons because they appear to represent naturally redeposited material that is too young for any soil development. Stratum 2a was found only in Units 3 and 4. This stratum is similar in color to the A horizon material of Stratum 3, but it likely represents material washed down from the slope. Stratum 2a is a historical-period deposit that probably represents material redeposited from up slope when the sewer line was built on the bluff face in the early 1920s or, more likely, slope wash from the denuded hill slope. It is uniformly thick across the surface of Units 3 and 4, and the contact with the underlying Stratum 2b is relatively smooth and abrupt. Stratum 2b dates to the twentieth century, as indicated by abundant steel wire nails and rusted steel wire in the matrix. Lenses of culturally sterile sand and thin layers of clay were found at the upper and lower contacts of this stratum. The position and abrupt, irregular boundaries of Strata 2b and 2c suggests that these lenses are the result of mechanical disturbance. Stratum 2b likely postdates construction of the sewer line up slope. Stratum 2c is a fine sandy loam with an abrupt, wavy to irregular boundary, which indicates that it was eroded or mechanically altered prior to deposition of Stratum 2c.

Stratum 3 contains most of the artifacts and it corresponds to the upper horizon of a moderately developed soil. In Units 3 and 4 on the bench, this stratum underlies Stratum 2. In Units 1 and 2 at the edge of the bench, Stratum 2 was either removed during the excavation of the parking lots and building pads or else was never present. The latter is more likely the case. Stratum 3a in Units 1–4 and Stratum 3b in Units 5–8 and 10 are similar in color and texture, located in the same position on the bench, and in both cases are buried under Stratum 2. The A horizon is up to 1 m thick in places, with weak to medium subangular blocky structure.

Stratum 4 contains a moderately developed soil found in the alluvial fan facies and extending downslope to the alluvial toe slope. This soil developed in fan alluvium, but it appears to predate the cultural deposits found in other strata at LAN-211/H. A few artifacts were noted in Stratum 4, but these remains likely represent materials translocated from above by extensive bioturbation. An A horizon was noted in Stratum 4 in most excavation units on the bench in the upper alluvial fan deposit and in fan alluvium in Trench 11 that laps onto the stream alluvium on the floodplain below. Some of the krotovina in Stratum 4 contained sediment and occasional artifacts translocated from Stratum 3. The B and C horizons of Stratum 4 contained no artifacts, so there has been little mixing in the lower part of Stratum 4.

Clay- and iron-rich lamellae were noted in the B horizon of Stratum 4 in Units 1 and 2 (see Table A.5). Lamellae are clayey bands that initially mark bedding planes of fine-grained sediment. The thin deposits of clay can migrate downward by illuviation as clay in suspension is translocated in a sandy matrix during episodic wetting events during the rainy season. Variations in pore continuity through the soil cause differences in the wetting front when the soil is saturated, and clay is concentrated into ribbon-like bands at the wetting front (Figure 38). The processes and time span needed for lamellae formation are poorly known, but they probably take several millennia to form in this climate due to the low rainfall. These lamellae are significant archaeologically because they are a clear indicator of geomorphic stability and they suggest that this fan is several thousand years old.

Stratum 5 marks a C horizon, a zone with no soil development, that is composed almost entirely of fan alluvium lacking artifacts. It may be correlated with the C subhorizons noted in Stratum 4. This deposit is typically pale brown (10YR 6/3) in color and sandy to silty in texture, occasionally some admixed fine gravel. Sediments are usually weakly bedded and well sorted. The lack of soil development in Stratum 5 suggests the sediments were deposited relatively quickly with no intervals of geomorphic stability.

Figure 38. View of Unit 1, LAN-211/H, with lamellae visible at the bottom of unit.

Discussion

The sedimentary sequence for LAN-211/H is complex. The basal deposit in the site area is a greenish, silty fluvial deposit associated with the alluvial plain facies. This silt represents sediment deposited either in shallow water or marsh. Overlying this silty deposit was an extensive alluvial fan deposit (alluvial fan facies) associated with the ravine on the south edge of the site. The sandy loam of the lower fan deposit probably accumulated relatively rapidly because no buried soils were found in the lower fan that would indicate periods of geomorphic stability.

Deposition rates on the fan eventually slowed and stabilized enough for a soil to begin forming, prior to human occupation. An A subhorizon (Strata 4c, 4o, 4p, 4e, and 4 g) with a very low density of artifacts was found in most excavation units, but these remains are like the result of bioturbation. Extensive krotovina were documented in all units and some of these contain Stratum 3 sediment with occasional artifacts. A series of clay-rich lamellae was observed in Stratum 4, which indicates the fan was stable for an extended period of time, perhaps for several millennia before human occupation of the fan.

LAN-211/H was occupied about the time the fan surface stabilized and the rate of aggradation slowed. Stratum 3, the upper A subhorizon is located entirely in the fan alluvium and it is the primary cultural stratum. Some time after Stratum 3 was deposited, fluvial deposits from Stratum 5 from the alluvial plain facies buried the northernmost fan alluvium, as shown in the area of Trench 11. Stratum 5 is a series of alternating beds of sand and silt that represent individual flooding episodes. In Trench 11, Stratum 5a contains fluvial sands separated by thin silt layers that appear to originate from Stratum 3. We conclude that this location is where flooding caused the deposition of courser overbank sediments dominated by sand, probably from Centinela Creek.

In the 1920s the sewer line and overlying access road were built, thus disturbing the base of the back slope. Some material from this construction now obscures part of the foot slope on the alluvial fan. In the late 1940s Hughes Aircraft Company excavated a large part of the alluvial fan to level the area for a parking lot, road, and buildings. A composite map shows the topography of the LAN-211/H area prior to grading by Hughes Aircraft Company (Figure 39). The 1941 map shows the fan visible in the 1938 aerial photographs. An overlay of the photograph with the current topography shows that as much as 3 m (10 feet) of sediment was graded and removed, resulting in a bench that is a remnant of the previous alluvial fan. Historically, the ravine on the bluff face was filled, slope runoff was channelized, and vegetation was planted to slow erosion. During the last two decades, as facilities at the base of the bluff were no longer being maintained, colluvial slope wash deposits have begun to bury parts of the asphalt road and parking lot. Alluvial fan deposition is still in progress.

Stratigraphy at LAN-2769

All trenches and excavation units at LAN-2769 were placed on the foot slope of the hill-slope facies and the deepest trenches reached underlying deposits of the alluvial plain facies (Figures 40 and 41). Where the foot slope meets the back slope, the cultural deposits are relatively intact. A weakly developed soil horizon indicates at least a brief period of geomorphic stability when the site was occupied and perhaps after it was abandoned. Extensive modern disturbance was documented in all of the test units. A large part of the foot slope was removed to create an asphalt parking lot and this activity probably destroyed part of the site, because artifacts extended to the edge of the excavated slope. SRI excavated five trenches in the parking lot just north of the bluff. Details of the stratigraphy are presented in Table A.2.

The first stratum encountered in all five trenches consisted of an asphalt cap below one or more layers of modern fill. The fill varied from trench to trench, but wire and rusted metal were common, along with chunks of concrete and brick fragments. Trench 1-1 was unusual in that it also contained fragments of aircraft parts. All of this fill appears to postdate 1941, the beginning of Hughes Aircraft Company's occupation of the property.

The bottom stratum of all five trenches consisted of fluvial deposits, the deepest of which are deposits of greenish silt or loam. The greenish color indicates the sediments are gleyed due to waterlogging in a marsh deposit, which is further indicated by the presence of small aquatic gastropods. The fill in Trenches 1-1 and 1-2 directly overlies this layer, almost certainly indicating mechanical excavation of the area prior to placing the fill there.

The greenish silt in Trenches 1-3, 1-4, and 1-5 was capped by brown or black silt or sandy loams that mark weakly developed A horizons in the marsh deposit. In Trench 1-3 the green silt is overlain by a black loam containing chunks of charcoal and small roots that is clearly a marsh soil. In Trenches 1-4 and 1-5 the green silt is covered by a brown sandy loam that was interpreted as a possible weakly developed A horizon. This sandy loam may represent the first deposition of the hill-slope facies over the alluvium of the alluvial plain facies. The A horizon in Trench 1-5 was covered by a series of laminated, dark brown sand with small, shallow channels. Here, the fluvial deposits appeared to grade to the hill-slope facies, similar to the sequence observed in Trench 11 at LAN-211/H.

Stratum Descriptions

Four distinct depositional strata were observed at LAN-2769. Stratum 1 consists of artificial fill added to the site during earth-moving activities associated with construction. Stratum 1a is the asphalt layer on the parking lot surface. The asphalt layer in Unit 1 capped a brown sandy loam fill that contained a cow bone

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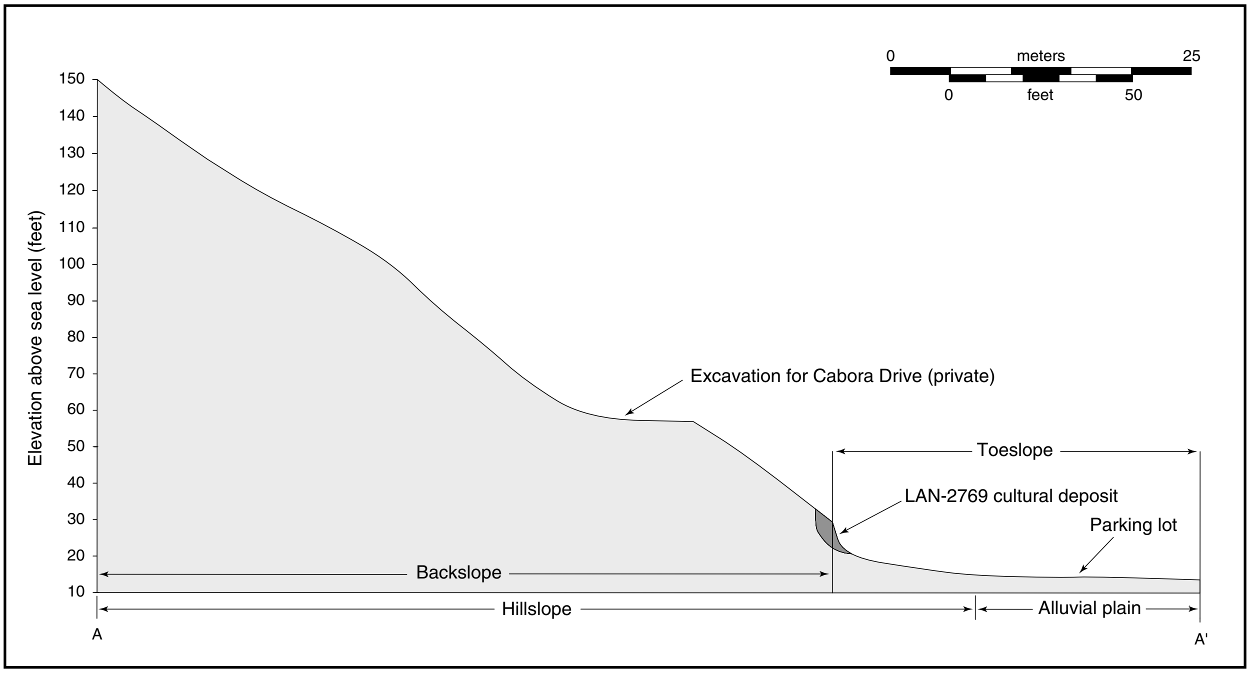

Figure 40. Reconstructed geomorphic cross section of LAN-2769.

and glass fragments. Aerial photographs show that this parking lot was in use by Hughes Aircraft Company during the 1970s. Strata 1b–f are all modern deposits containing a variety of modern artifacts.

Stratum 2 is the upper A horizon (A1b) of a weakly developed soil buried beneath several layers of Stratum 1. Stratum 2 is heavily bioturbated, which makes interpretation of its origin and age difficult. It was interpreted as being an in situ A horizon, but it may be A horizon material that was redeposited from up slope. It is similar to Stratum 3, which it overlies, although it is lighter in color, with light grayish brown (10YR 6/2) in Stratum 2 as compared to dark grayish brown (10YR 4/2) in Stratum 3. Stratum 2 lacks prehistoric artifacts, suggesting that it was deposited after the site was occupied.

Stratum 3 is the in situ lower A horizon (the A2b subhorizon) of a weakly developed, buried soil. It was given a separate stratum designation from the overlying A subhorizon because it contains a low density scatter of artifacts that represents the cultural deposit of LAN-2769. Like Stratum 2, it was also heavily bioturbated.

Stratum 4 is the C horizon, a zone that lacks soil development and that is relatively unweathered. It lacks artifacts except where rodent burrows are filled with material from the overlying Stratum 3 matrix. Stratum 4 consists of brown to yellowish brown sand or sandy loams that represents material washed from the back slope to the south.

Discussion

The sedimentary sequence at LAN-2769 is as follows. Initial deposition at the site and immediately around it consists mainly of alluvium from the alluvial plain facies. The site area is largely at or just above the water table, which has resulted in gleyed sedimentary deposits dominated by silt. The last layer in the alluvial plain facies is a soil formed in marshy conditions that is typically black and contains charcoal chunks and small roots. No evidence of occupation was associated with any of the alluvial plain facies. At some point in time, probably in the last 3,000–4,000 years B.P. judging from the age of nearby

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archaeological sites, the rate of fluvial deposition slowed to the point where material eroding off the bluff began to extend the hill-slope facies northward over the marsh. Weak soil development in the excavation units suggests that this initial extension of the hill-slope facies was rapid. Eventually the rate of deposition slowed to the point where the surface of the foot slope was stabilized, resulting in the development of a weak soil that was associated with human occupation.

Slow deposition of colluvium and continued soil development probably continued after the site was abandoned prehistorically. The landscape remained geomorphically stable until the 1920s, when the sewer line was built and the back slope was disturbed. After 1941, construction activity by Hughes Aircraft Company removed portions of the foot slope to level the area for use as a parking lot. During the 1980s and 1990s, the area was no longer being maintained, and erosion of the back slope was accelerated. The result was renewed colluvial deposition on the foot slope, with an accumulation of sand and silt extending onto the asphalt parking lot.

CHAPTER 6

Field Results

Benjamin R. Vargas

The work plan for the inventory and evaluation of Area D (Grenda et al. 1999) had three objectives: (1) to inventory areas likely to contain buried deposits, (2) to determine the boundaries of LAN-62, and (3) to evaluate the NRHP eligibility of LAN-211/H and LAN-2769. This chapter summarizes the fieldwork accomplished under the work plan. It includes the results of 129 bucket augers, 45 mechanically excavated trenches, and 33 manually excavated test units.

Ultimately, the inventory and evaluation strategy outlined in the plan was successful in defining the boundaries of sites within Area D and in obtaining sufficient information to assess the potential eligibility of resources for listing in the NRHP as contributing elements of the BLAD. We originally planned to obtain all data necessary to accomplish the work plan's goals in a five-month field season between May and September of 1999. Analysis of the results, however, indicated that we were still unable to define the precise boundaries of LAN-62. Accordingly, we returned to the field for additional trenching in October 2001 and secured the necessary data to accomplish this task.

The organization of this chapter follows the three-part strategy of the work plan. First, we present the results of the inventory using the bucket auger; included in this section is the summary of boundary testing of LAN-62. The results of testing at LAN-211/H and LAN-2769 follow. Data are described and summarized in this chapter; they are presented in their entirety in tabular form in Appendix A.

Bucket Auger Inventory

The results of the bucket-auger inventory of Area D are the subject of this section. These bucket-auger data are augmented by the results of SRI's monitoring of bore holes, or cores, excavated in 1999 by Group Delta Consultants, Inc. (Group Delta), for environmental testing (Taşkıran and Stoll 2000b). Although soils from cores were not screened, coring logs provided by Group Delta helped identify intact soils and fill materials. Group Delta cores are identified in chapter figures by a "B" preceding their number.

Following the bucket-auger testing, mechanical trenching and excavation was conducted along the base of the bluff. Trenches were placed to test the integrity of prehistoric cultural materials discovered by the bucket augers and to refine the three-dimensional boundaries of LAN-62, tentatively identified through the auger results.

SRI excavated 129 bucket augers in the discovery phase of the Area D inventory (see Figure 24). Of this total, 55 augers penetrated cultural material; of those, 24 augers contained cultural materials considered to be in situ, 19 recovered cultural materials in questionable stratigraphic context, and 12 encountered cultural material in fill strata (Figure 42). In order to classify the auger results, recovered remains were grouped by artifact or ecofact class (marine shell, bone, lithics, and historical-period artifacts). We based our initial assessment on a simple presence or absence of artifacts within recovered materials. Later, we refined our assessment by developing a ranking system. In many cases, it was obvious that the auger hit intact cultural material: a combination of lithic and faunal material was

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recovered, and the stratigraphic context was good. The results from other augers were more difficult to interpret and required having either a faunal or a lithic specialist review the recovered material while consulting the recorded stratigraphic data. After a second review, we made our final determinations, which are summarized in Table 7. Based on stratigraphic integrity, the presence or absence of cultural materials, and their relative proportions within a given sample, auger results were assigned to one of the following six descriptive categories, based on the predominant soil type:

Category 1. Prehistoric deposit in native soils. Soils in this category are intact and contain cultural materials such as lithic artifacts, marine shell, and bone. This category includes areas of in situ archaeological site deposit. Category 1 soils were found in 24 bucket augers (see Table 7).

Category 2. Possible prehistoric deposit in native soils. Soils in this category contain shell, bone, lithic artifacts, or a combination of all three. The depositional integrity of these cultural materials, however, is suspect. Category 2 soils were found in 19 bucket augers (see Table 7).

Category 3. Prehistoric cultural materials in fill. Some bucket augers encountered prehistoric cultural materials in secondary contexts. In such instances, shell or other cultural material was found in layers identified as modern fill. This fill matrix was often characterized as coarse sand, which may have originated from the Westchester Bluffs or from the alluvial fan at LAN-62. Category 3 soils were found in 12 bucket augers (see Table A.6).

Category 4. Nonsite in fill. This category is composed of soils used as construction fill. These were generally recognized by the presence of modern or historical-period debris (often construction rubble, such as fragments of concrete and brick). Soils of this type are highly variable and can include alluvium and colluvium. In some cases, fill soils were seen in the upper levels of bucket augers, while the lower levels were intact, but contained no cultural material. These auger results were grouped with the Category 4 soils, as the fill was the dominant feature. Category 4 soils were found in 49 bucket augers (see Table A.6).

Category 5. Nonsite in native soils. This category refers to intact soils that do not contain cultural materials. Most often, these silts and clays represent buried marsh deposits that typically contain a large amount of decomposing organic material and small gastropods. Category 5 soils were found in 24 bucket augers (see Table A.6).

Category 6. Unknown. The final category of "unknown" was created in earlier work at LAN-62, where soft, sandy soils caused the bucket auger shaft to collapse before a clean sample could be obtained. Some of these augers may contain prehistoric cultural materials but will require further evaluation when upper fill layers are removed. Only a single bucket auger (BA 88) was classified as *entirely* Category 6. The results of three additional bucket augers were affected by the collapse of the lower shaft walls, but other soils were present above the collapsed areas that permitted classification in another category.

After classification, bucket auger results containing Category 1 and 2 soils were subjected to additional analysis. To this group were added comparable data from cores drilled by Group Delta for soils testing. We created three schematic profiles of portions of the project area by sequencing the grouped augers to represent strata both horizontally and vertically. These soil schematics indicate which soils contain cultural materials and generally where the intact, culture-bearing (Category 1) soils are located. These profiles are a discovery tool, not a full reconstruction of the geomorphology of the project area.

Table 7. Bucket Augers Containing Cultural Materials (Category 1 and 2 Soils)

Bucket Auger	Soil Category	Site	Auger Depth in Meters (feet)			Deposit Depth in Meters (feet)			Lithics (n)	Vertebrate Fauna Wt. (g)	Invertebrate Fauna Wt. (g)
			Top	Bottom	Total	Top	Bottom	Total			
2	2	LAN-2676	4.02 (13.2)	−0.4 (−1.3)	4.42 (14.5)	0.85 (2.8)	0.21 (0.7)	0.64 (2.1)	—	< 1	2
4	2	LAN-2676	3.75 (12.3)	0.12 (0.4)	3.63 (11.9)	1.25 (4.1)	0.7 (2.3)	0.55 (1.8)	—	8	4
6	2	LAN-2676	3.51 (11.5)	−0.12 (−0.4)	3.63 (11.9)	0.67 (2.2)	0.27 (0.9)	0.4 (1.3)	—	11.5	< 1
10	2	LAN-2676	3.81 (12.5)	−0.18 (−0.6)	3.99 (13.1)	0.76 (2.5)	0.37 (1.2)	0.4 (1.3)	—	5	< 1
18[a]	2	LAN-2676/ LAN-62	2.56 (8.4)	0.64 (2.1)	1.92 (6.3)	1.13 (3.7)	0.73 (2.4)	0.4 (1.3)	—	< 1	< 1
30	1	LAN-2676	3.81 (12.5)	−0.3 (−1.0)	4.11 (13.5)	0.76 (2.5)	0.4 (1.3)	0.37 (1.2)	—	< 1	61
54[a]	1	LAN-62	5.76 (18.9)	−0.73 (−2.4)	6.49 (21.3)	2.1 (6.9)	0.88 (2.9)	1.22 (4.0)	1	< 1	5
71[a]	1	LAN-62	5.24 (17.2)	−1.13 (−3.7)	6.37 (20.9)	2.01 (6.6)	1.68 (5.5)	0.34 (1.1)	1	2	29.5
75[a]	2	LAN-62	3.38 (11.1)	−0.03 (−0.1)	3.41 (11.2)	2.01 (6.6)	−0.03 (−0.1)	2.04 (6.7)	1	9	79
77[a]	1	LAN-62	3.40 (11.17)	−1.78 (−5.83)	5.18 (17.0)	1.82 (5.97)	−1.14 (−3.73)	2.96 (9.7)	38	34	80.5
81[a]	1	LAN-62	2.98 (9.78)	−0.07 (−0.22)	3.05 (10.0)	1.91 (6.28)	0.66 (2.18)	1.25 (4.1)	14	20	29
85	2	LAN-62	3.08 (10.09)	−0.28 (−0.91)	3.35 (11.0)	2.19 (7.19)	1.0 (3.29)	1.19 (3.9)	—	< 1	—
89[a]	2	LAN-62	3.88 (12.73)	0.59 (1.93)	3.29 (10.8)	1.53 (5.03)	0.62 (2.03)	0.91 (3.0)	4	1	< 1
93[a]	2	LAN-62	4.05 (13.3)	0.03 (0.1)	4.02 (13.2)	2.32 (7.6)	1.77 (5.8)	0.55 (1.8)	6	20	< 1
99[a]	1	LAN-62	3.78 (12.41)	−0.03 (−0.09)	3.81 (12.5)	1.89 (6.2)	1.13 (3.71)	0.76 (2.49)	7	13	1
103	1	LAN-1932/H	2.65 (8.7)	1.13 (3.7)	1.52 (5.0)	2.35 (7.7)	2.04 (6.7)	0.3 (1.0)	1	< 1	2
104	1	LAN-1932/H	4.38 (14.38)	0.57 (1.88)	3.81 (12.5)	2.31 (7.58)	1.49 (4.88)	0.82 (2.7)	3	5	26
107[a]	2	LAN-62	3.9 (12.79)	0.12 (0.39)	3.78 (12.4)	2.22 (7.29)	1.12 (3.69)	1.1 (3.6)	9	2	1
115	1	LAN-1932/H	4.20 (13.78)	0.12 (0.38)	4.08 (13.4)	1.76 (5.78)	0.69 (2.28)	1.07 (3.5)	3	< 1	—
117[a]	2	LAN-62	4.16 (13.66)	0.81 (2.66)	3.35 (11.0)	4.16 (13.66)	2.18 (7.16)	1.98 (6.5)	6	6	3
121	1	LAN-1932/H	2.71 (8.9)	1.34 (4.4)	1.37 (4.5)	2.26 (7.4)	1.65 (5.4)	0.61 (2.0)	—	1	< 1
122	1	LAN-1932/H	3.95 (12.97)	−0.50 (−1.63)	4.45 (14.6)	2.49 (8.17)	2.06 (6.77)	0.43 (1.4)	1	1.3	8.55
127[a]	2	LAN-62	4.26 (13.96)	−0.32 (−1.04)	4.57 (15.0)	4.26 (13.96)	1.66 (5.46)	2.59 (8.5)	4	2	7
136	2	LAN-62	4.20 (13.79)	1.03 (3.39)	3.17 (10.4)	4.2 (13.79)	2.59 (8.49)	1.62 (5.3)	11	3	< 1
138	1	LAN-1932/H	2.77 (9.1)	1.71 (5.6)	1.07 (3.5)	2.32 (7.6)	2.01 (6.6)	0.3 (1.0)	1	—	—
146	1	LAN-1932/H	3.99 (13.1)	1.71 (5.6)	2.29 (7.5)	2.62 (8.6)	2.01 (6.6)	0.61 (2.0)	—	14	3

Bucket Auger	Soil Category	Site	Auger Depth in Meters (feet)			Deposit Depth in Meters (feet)			Lithics (n)	Vertebrate Fauna Wt. (g)	Invertebrate Fauna Wt. (g)
			Top	Bottom	Total	Top	Bottom	Total			
152	2	LAN-211/H	7.32 (24.0)	4.51 (14.8)	2.8 (9.2)	5.39 (17.7)	5.27 (17.3)	0.12 (0.4)	—	< 1	< 1
176[a]	1	LAN-211/H	4.52 (14.84)	−2.64 (−8.66)	7.16 (23.5)	4.52 (14.84)	1.14 (3.74)	3.38 (11.1)	5	< 1	< 1
192	1	LAN-211/H	3.99 (13.1)	1.77 (5.8)	2.23 (7.3)	3.69 (12.1)	2.04 (6.7)	1.65 (5.4)	1	< 1	< 1
201[a]	2	LAN-211/H	4.42 (14.5)	0.98 (3.2)	3.44 (11.3)	4.02 (13.2)	1.98 (6.5)	2.04 (6.7)	—	< 1	< 1
202	1	LAN-211/H	4.45 (14.6)	1.01 (3.3)	3.44 (11.3)	4.3 (14.1)	2.77 (9.1)	1.52 (5.0)	8	< 1	33
210[a]	2	LAN-211/H	4.48 (14.7)	1.16 (3.8)	3.32 (10.9)	2.68 (8.8)	2.19 (7.2)	0.49 (1.6)	1	—	< 1
211	1	LAN-211/H	4.57 (15.0)	0.0 (0)	4.57(15.0)	4.42 (14.5)	2.9 (9.5)	1.52 (5.0)	1	< 1	4
220[a]	2	LAN-211/H	3.35 (11.0)	0.61 (2)	2.74 (9.0)	2.44 (8.0)	1.83 (6.0)	0.61 (2.0)	1	6.9	< 1
221[a]	2	LAN-211/H	4.27 (14.0)	1.22 (4)	3.05 (10.0)	2.87 (9.4)	2.23 (7.3)	0.64 (2.1)	—	1	8.4
230[a]	2	LAN-211/H	3.99 (13.08)	−0.91 (−2.97)	5.03 (16.5)	3.99 (13.08)	1.43 (4.68)	2.56 (8.4)	1	< 1	< 1
231[a]	1	LAN-211/H	3.96 (13.0)	−0.52 (−1.7)	4.48 (14.7)	2.32 (7.6)	1.16 (3.8)	1.16 (3.8)	2	6	26
211(O2)[b]	1	LAN-1932/H	3.26 (10.7)	1.52 (5.0)	1.74 (5.7)	2.56 (8.4)	1.89 (6.2)	0.67 (2.2)	1	< 1	4
212(O2)[b]	1	LAN-1932/H	2.87 (9.4)	1.49 (4.9)	1.37 (4.5)	2.5 (8.2)	1.8 (5.9)	0.70 (2.3)	4	4	9
213(O2)[b]	1	LAN-1932/H	3.38 (11.1)	1.19 (3.9)	2.19 (7.2)	2.35 (7.7)	1.62 (5.3)	0.73 (2.4)	1	< 1	14
214(O2)[b]	1	LAN-1932/H	3.35 (11.0)	1.58 (5.2)	1.77 (5.8)	2.62 (8.6)	2.01 (6.6)	0.61 (2.0)	3	< 1	17
219(O2)[b]	1	LAN-1932/H	5.76 (18.9)	1.98 (6.5)	3.78 (12.4)	2.35 (7.7)	1.68 (5.5)	0.67 (2.2)	3	< 1	< 1
223(O2)[b]	1	LAN-1932/H	5.0 (16.4)	0.94 (3.1)	4.05 (13.3)	2.07 (6.8)	1.77 (5.8)	0.30 (1.0)	1	—	1

[a] 12-inch bucket, all others are 16-inch buckets.
[b] Bucket augers in the Playa Vista O2 Tract.

Schematic soil profiles were created for three loci within Area D: (1) near the northern boundaries of LAN-62, (2) in the west end of Area D, north of LAN-62, and (3) in LAN-62 along the base of the bluff. We selected these three areas for detailed discussion because of the high number of Category 1 and 2 strata they contained and because these areas will be impacted by planned development.

Boundary Testing at LAN-62

Boundary testing at LAN-62 was accomplished by bucket augering and mechanical trenching. As discussed, portions of the bucket auger lines along the base of the bluff and in the west end penetrated the previously mapped borders of LAN-62. Bucket auger and core data that traced a curved line along the base of the bluff (see Figure 42) passed through LAN-62. Data from the western boundary of LAN-62 near Lincoln Boulevard (Bucket Augers [BAs] 1 and 8 and Group Delta Core B131) indicated substantial Category 1 cultural deposits 1.5–3.0 m thick, topped by about 3 m of fill material or alluvial deposits (Figure 43). Moving east from these augers, the bottom of the LAN-62 site deposit dropped away, following the contour of the buried landform. Moving north down the alluvial fan (BA 54), a corresponding drop in the depth of the deposit was observed. In the next four augers (BAs 71 and 77 and Group Delta Cores B126 and B127), site-bearing strata were encountered at depths ranging from 2.4 to -1.14 m AMSL. The cultural deposit noted in two of these augers (BAs 71 and 77) is substantial, from 2.75 to 3 m thick. Mechanical trenching undertaken in this area revealed similar results.

Continuing the bucket auger sequence to the northeast (BAs 81–136) along the foot of the bluff (Figure 44), a cluster of mostly Category 2 soils was encountered in at depths of approximately 60 cm to almost 3 m AMSL. Interestingly, a drastic difference in the density of artifacts was seen when the soils from BA 81 were compared to those recovered from adjacent auger, BA 85. BA 85 contained no lithic artifacts and insignificant amounts of bone and shell (less than 1 g of each), whereas BA 81, approximately 47 m to the southwest, contained 15 lithic artifacts, 13 g of marine shell, 3 g of bone, and 1 worked bone artifact. The difference in artifact density suggests that LAN-62 is not homogeneous.

Continuing the transect to the northeast, BAs 89–136 showed a corresponding rise in artifact density, suggesting that more of the cultural deposit had been crossed. This pattern of increasing artifact density to the northeast reflects the continuation of LAN-62, clearly seen in the bucket augers except where a substantial amount of historical-period disturbance clouded the picture. BAs 89–136 all contained cultural material (lithics, shell, and bone) at depths from 0.61 to 2.44 m AMSL, overlain by historical-period material. In BAs 93, 99, and 107, SRI recovered prehistoric artifacts from the fill layer, as well as from the native soils below, suggesting that the deposit was mixed.

The presence of prehistoric cultural materials in these mixed fluvial, colluvial, and fill sediments is likely the result of historical-period farming activities that have disturbed the original landforms. Deep plowing would have repeatedly churned culture-bearing soils, creating a homogenous layer of fluvial sediments and anthrosols. In this case, the Category 2 soils in Figure 43 represent a site surface that was plowed, then buried. Aerial photographs of the LAN-62 area show that the large alluvial fan was farmed during the historical period, altered by road building along Lincoln Boulevard in the 1920s, and later disturbed by Hughes Aircraft Company–related construction activity (see Chapter 2). Elevated landforms were truncated and cultural materials were either redeposited or simply removed and used as fill elsewhere. Category 2 soils may also have become mixed when culture-bearing alluvial and fluvial sediments on the eastern margin of LAN-62 were displaced by the action of nearby Centinela Creek. Numerous small channels that could have displaced cultural materials were observed in this area during trenching. The line of bucket augers and cores in Figure 43 sits very near the edge of the historical marsh and outlet of Centinela Creek.

The next three augers to the northeast (BAs 144, 152, and 160), spaced at 50-m intervals, revealed a distinct change in subsurface conditions. BAs 144 and 152 contained no lithic material and very little

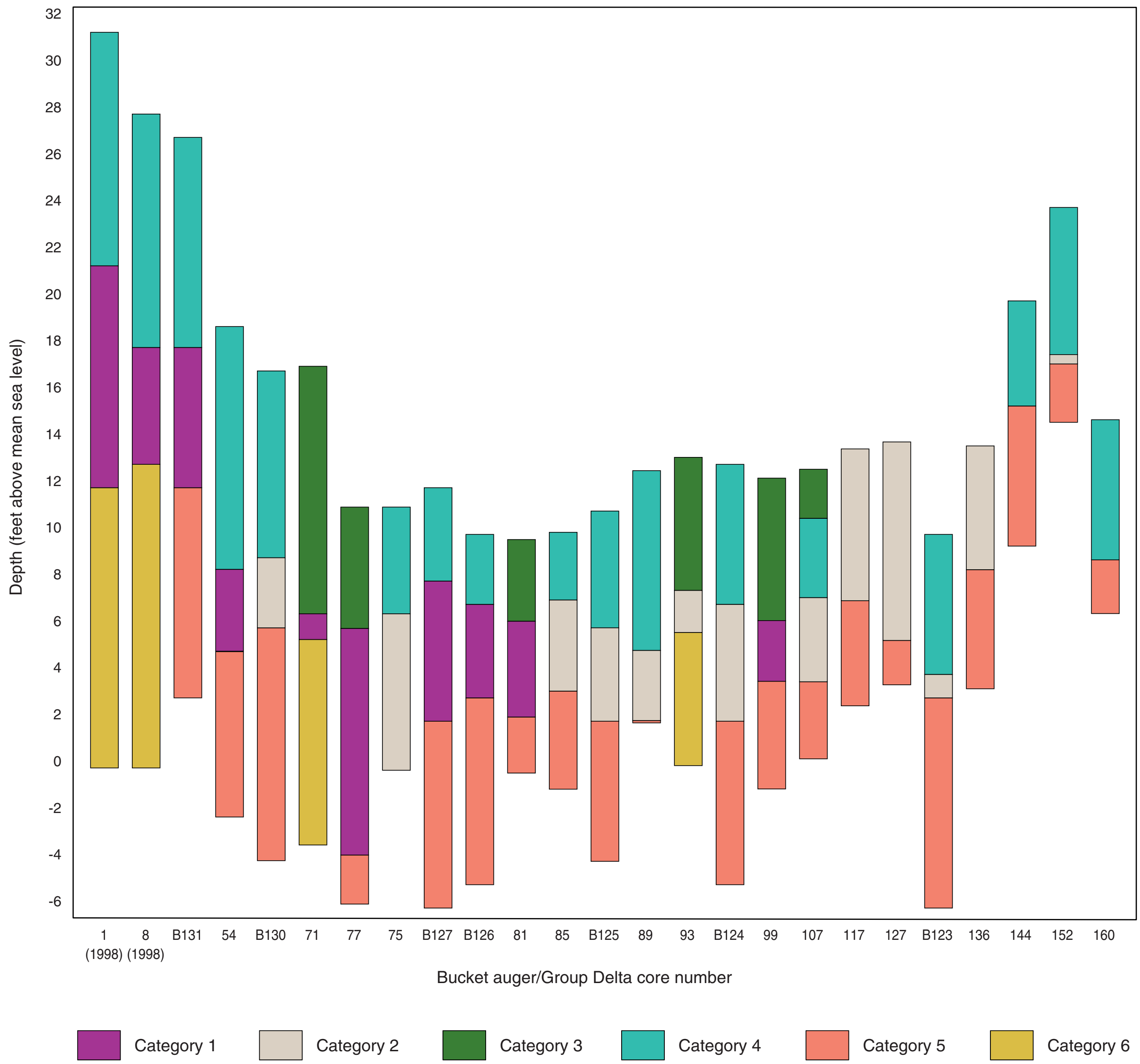

Figure 43. Schematic soil profiles of bucket augers and cores placed along the northern boundary of LAN-62.

Figure 44. A portion of the area at the base of the bluff tested by bucket augering and trenching.

marine shell or bone, and BA 160 recovered no cultural material. Initially, the lack of cultural deposits in this area was puzzling, as the augers were placed near the mapped western boundary of LAN-211/H, and, 100 m east of BA 160, BA 176 penetrated a sparse, intact cultural deposit. The likely explanation is that BAs 144, 152, and 160 were drilled into a disturbed area. All three contained large amounts of historical-period debris and fill soils in their upper levels.

In the central area of LAN-62 near BAs 93, 99 and 107, results from the bucket augers were mixed. Comparing BA 77, located in the most dense portion of the site, with BA 99, located almost 400 m northeast, is instructive. Both augers penetrated intact soils and recovered cultural materials; their contents, however, differed significantly. BA 77 contained 69 g of marine shell, 20 g of bone, 32 lithic artifacts, 1 shell bead, and 1 worked bone artifact, whereas BA 99 contained less than 1 g of shell, 2 g of bone, 3 lithic artifacts, and no worked shell or bone. A pattern of mixture—sparse deposit adjacent to pockets of high density, overlain by historical-period debris—is typical along the base of the bluff in the eastern portion of LAN-62.

We conclude that disturbance is responsible for the mixed distribution of cultural material along the base of the bluff. Those augers displaying high densities of cultural materials on the southwest end of the project area encountered intact portions of LAN-62. To the northeast, the augers hit what appeared to be small pockets of cultural material in lesser concentrations, interspersed with sterile disturbed areas. These "islands" of intact culture-bearing material are primarily the result of historical-period and modern activity in the area. Numerous subsurface utility lines, structural remains, and other types of disturbance probably created this artificial pattern.

West End of Area D, Northwest of LAN-62

Seventeen bucket augers were placed in the western end of Area D northwest of LAN-62; seven of these (BAs 33, 18, 42, 32, 50, 51, and 80) were south of the street now known as Bluff Creek Drive, whereas the remainder were drilled north of Bluff Creek Drive (see Figure 42). Our research interest in this area centered on questions about the northern boundary of LAN-62 and the southern boundary of LAN-2676. Of the 17 augers analyzed, none showed clear evidence of intact cultural deposits; however, six augers (BAs 2, 4, 6, 10, 18, and 30) contained potential site material at a depth ranging from 0.21 m (0.689 feet) to 1.25 m (4.1 feet) AMSL.

This group of bucket augers revealed important information about the amount and composition of the modern fill placed on the western end of Area D (Figure 45). South of Bluff Creek Drive, 1.82 m of fill was noted, whereas north of Bluff Creek Drive, native soil was covered by as much as 3.65 m of fill. In the five augers south of Bluff Creek Drive (BAs 32, 33, 42, 51, and 60), native soils identified as marsh or upper marsh deposits contained no archaeological deposit; however, cultural material was discovered in the upper fill layers. No consistent pattern was noted in the vertical location of this material. A minor amount of marine shell recovered from BA 18 suggested that soil in this vicinity may be intact, although probably not culture bearing, as no artifacts were recovered.

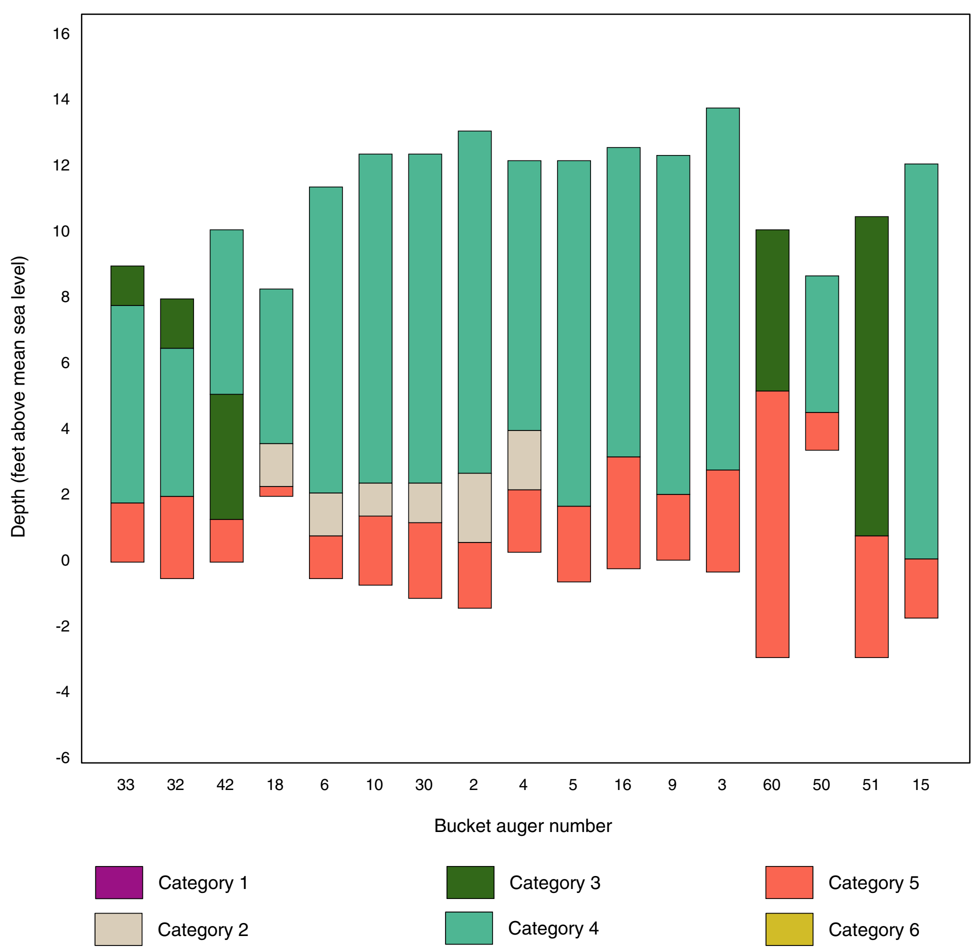

Figure 45. Schematic soil profiles of bucket augers and cores placed in the western end of Area D.

Soil profiles for augers north of Bluff Creek Drive (BAs 2–6, 9, 10, 15, 16, and 30) indicate that their contents were very similar. This area contained an even greater amount of fill surcharge, as much as 3–3.35 m in places. Although no artifacts were noted, BAs 2, 4, 6, 10, and 15 yielded a small amount of marine shell from intact native soil. In BAs 4, 6, and 10, we recovered various species of marine shells that are not found together naturally. For example, the rocky shore species *Mytilus* sp. (mussel) was found in the same stratigraphic layers as *Chione californiensis* (Venus clam, a lagoon species), suggesting that the association of these two different types of shells result from human predation. We encountered no cultural materials in BAs 3, 5, 9, and 16, although intact soil was reached.

Given the distribution of Category 2 soils in bucket augers in this west-end transect, we conclude that site material possibly originating from LAN-62 trends north from the bluff toward the boundaries of LAN-2676. Cultural deposits apparently follow the flow of the alluvial fan that developed at the base of the Lincoln Gap. Oblique and overhead aerial photographs show this area under cultivation in the 1920s, prior to the purchase of the area by Howard Hughes (see Figure 16). An account from 1947 describes the transport of soil from LAN-62 to the area near LAN-2676 when the Hughes Aircraft Company raised the elevation of the runway (Peck 1947:2). The faint archaeological signature present in these bucket augers may be the result of historical-period or modern movement of soil. This would account for the results in BAs 32, 33, and 42, for example, where cultural materials were found within and superimposed over fill layers. Alternatively, these augers may have reached the intact remainder of sparse cultural deposits at the outer boundaries of LAN-62 or LAN-2676. The bucket-auger data reveal the differences between the soil types and show that a break exists between them, whether natural or man-made.

Testing along the Base of the Bluff in LAN-62

A third set of 18 augers and two Group Delta cores were place south of Bluff Creek Drive to test the extent of LAN-62 in this narrow portion of the site. This discussion includes five previously discussed bucket augers (BAs 71, 75, 77, 81, and 85) and one Group Delta core (B131).

Bucket Augers and Cores

Of the 20 tests (18 bucket augers and 2 Group Delta cores) placed around the northern and northwestern boundary of LAN-62, 4 encountered intact cultural deposits, 1 hit native soils with possible site material, 3 were culturally sterile, and 12 encountered cultural materials in stratigraphic layers identified as either modern or historical-period fill (see Figure 42). Figure 46 details the bucket augers and monitored Group Delta cores excavated near LAN-62, plotted with elevations AMSL. Fill layers containing construction debris, such as broken concrete and brick, are pervasive. BAs 20, 33, 34, 36, 42, 51, 52, 60, and 62, uncovered prehistoric cultural materials mixed with construction debris and other modern and historical-period trash. Of varied composition, the thickness of these Category 4 deposits range from approximately 50 cm (BA 33) to 4.5 m (BA 62).

In the augers drilled in open areas or "flats" just south of Bluff Creek Drive (BAs 20, 28, 33, 34, 36, 42, 50, 51, 52, 60, and 62), cultural materials were found consistently mixed with fill layers. No clear pattern between culture-bearing soil and fill deposits is suggested by the schematic for these bucket augers. Only those augers drilled on the toe of the slope encountered in situ cultural material. BAs 54, 71, 77, and 81 revealed Category 1 soils interpreted as an intact portion of LAN-62. The number of artifacts in these four bucket augers was generally high and the thickness of the cultural deposit varied, as did the depth at which it was encountered.

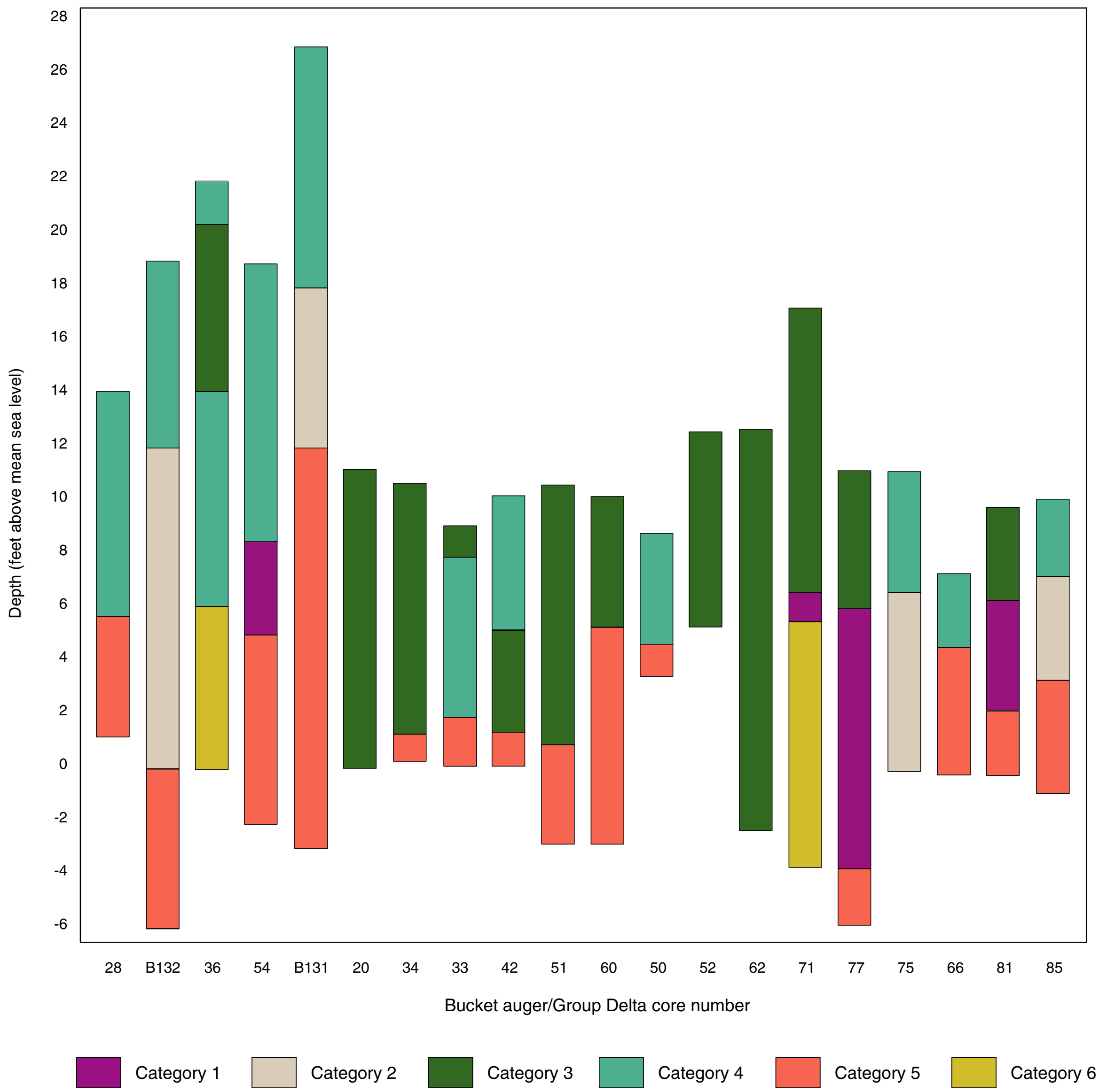

Figure 46. Schematic soil profiles of bucket augers and monitored Group Delta cores along the base of the bluff in LAN-62.

Trenches Excavated in 1999

Results from the bucket augers near LAN-62 and the discovery of intact materials farther east guided the next step in boundary testing. Seventeen trenches were placed along the base of the bluff in LAN-62 to clarify results of bucket augering (see Figure 26). Initial results indicated that some areas at the base of the bluff contain intact soils but do not contain cultural materials, whereas at other locations, cultural materials were recovered from highly disturbed contexts. Most of these trenches were placed in the toe slope of the bluff and all but one encountered intact soil strata. Five trenches (Trenches 1-7, 2-A, 2-B, 2-6, and 2-7) exposed A horizon soils that appeared undisturbed and were labeled as potentially anthropogenic. These A horizon soils along the toe slope are typically dark brown or grayish brown sandy loam, similar in texture and color to those strata that have produced archaeological deposits at known sites.

As described earlier, two augers placed at the base of the bluff in the eastern extension of LAN-62 (BAs 75 and 77) encountered a substantial cultural deposit. Trench 2-9 was placed between the two, south of the large retaining basin, on the northeast portion of the alluvial fan on which most of LAN-62 is located. Measuring 3.5 m long by 1 m wide, Trench 2-9 was excavated to a depth of 4.5 m. The stratigraphic soil profile (Figure 47) presents a 3-m section of this trench. Layers of modern fill, colluvial and alluvial deposits, and redeposited materials were superimposed on a weakly developed A horizon (2Ab). Stratum 3d, a very dark brown (10YR 3/2) sandy loam, contained a relatively large number of artifacts in profile, including marine shell and flaked stone. The contact with underlaying Stratum 4 was wavy and irregular, the result of bioturbation or mechanical disturbance.

Trenches in the eastern portion of LAN-62 also exposed layers of intentional fill that contained a wide variety of modern and historical-period artifacts. Most common were chunks of concrete and brick, though wire and rusted metal were also noted, and occasionally bone, glass, or wood fragments were observed. Some of this fill may have been imported during the Hughes Aircraft Company era from an unknown off-site location. Other fill soils observed within LAN-62 containing cut cow bone and bottle glass may be associated with the historic farmstead at LAN-1934/H or early farming activity that predates the Hughes Aircraft Company era.

After completing the first 17 trenches in 1999, we reasoned that modern and historical-period land use during the past 100 years had created a “swiss cheese” effect in the area below the bluff. Mapping the location and size of each remnant cultural deposit proved difficult: a single bucket auger or trench provides only a narrow observational window from which to infer the nature of the subsurface deposits. We found that by moving only 10–20 m in any direction often resulted in completely different, even contradictory, results. Despite mixed stratigraphic information, the bucket augers and trenches convinced us that intact cultural deposits were present in a discontinuous line from west to east along the base of the bluff. Deciphering the extent and sequence of fill episodes in the project area became a priority.

Trenches Excavated in 2001

In 2001, brush clearing and removal of construction debris at the base of the bluff provided an opportunity to test our “swiss cheese” model and to refine our initial results in areas that had previously been inaccessible. SRI excavated an additional 22 trenches and 7 approximately 1-by-1-m test units in the area west of LAN-211/H and within the eastern extent of LAN-62 (see Figure 29). Results of these tests are summarized here; the data are presented in tabular form in Appendix A.

Of the 22 trenches excavated, all but 7 encountered Category 1 soils containing intact prehistoric cultural materials. The depths and thicknesses of cultural deposits varied, as did the amount of cultural materials within them. In general, deposits were sparse and recognized only after artifacts were seen in trench backdirt or when excavated soils were wet screened. The depths at which cultural deposits were reached ranged from only 20 cm, to more than 2 m below the ground surface. Generally, cultural materials were found within A horizon or transitional A-C horizon soils. At those locations at the base of the bluff where the toe slope pushes out into the alluvial plain, the cultural deposit was clearly definable and often near the surface. As the distance from the base of the bluff increased, the cultural deposit dipped, with the top strata having been truncated by historical-period or modern grading activity. In many cases, the same A horizon soils that were cut were later used as fill material. This process is recorded in the alternating bands of A horizon and fill sands seen in many of the fill layers.

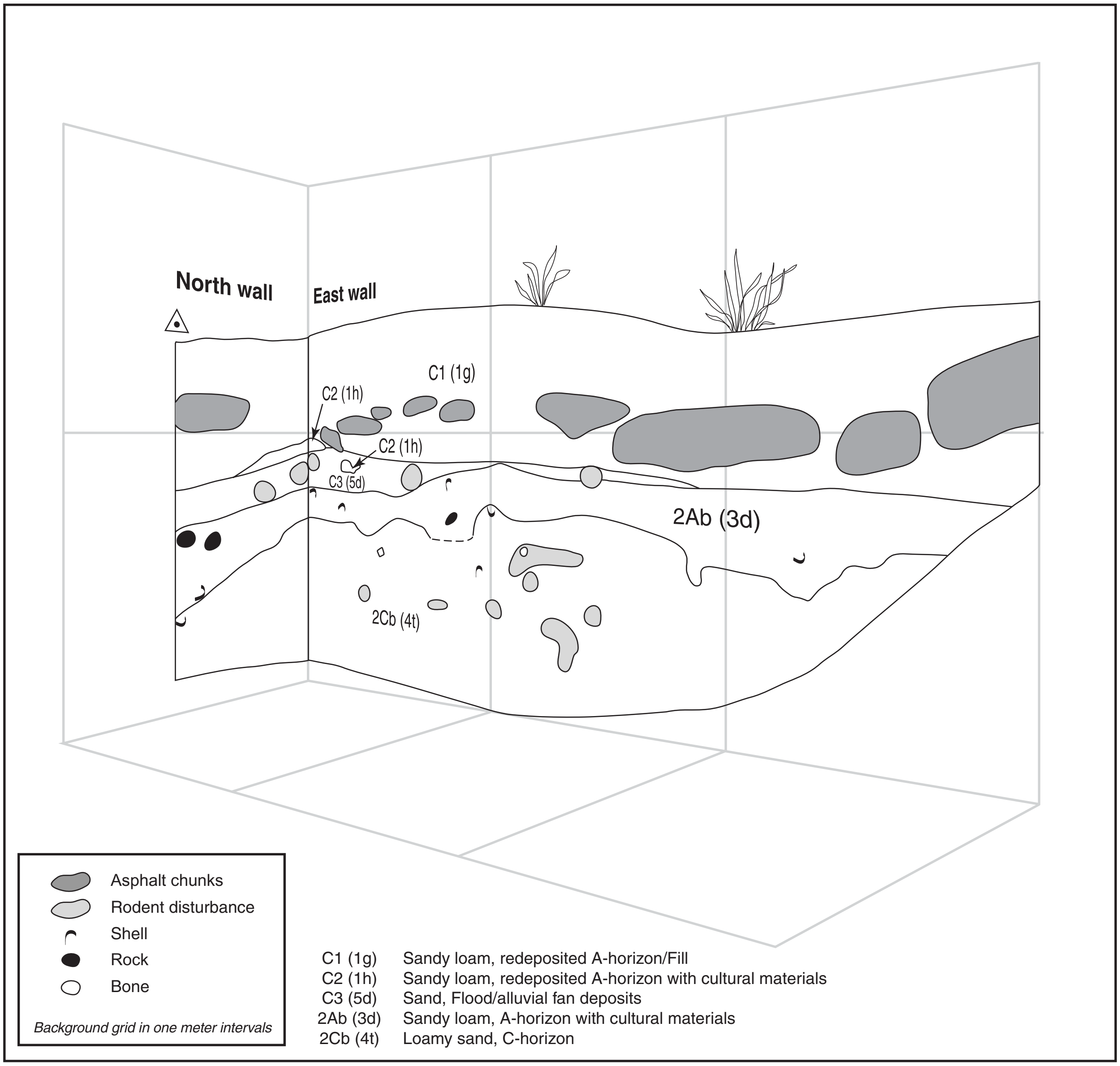

Figure 47. Stratigraphic soil profile of Trench 2-9.

To facilitate analysis, the area being tested at the base of the bluff was broken into three sections: central, eastern, and western. In the central section evidence of modern and historical-period alterations was pronounced. Trenches 103, 104, and 114 contained significant amounts of Category 4 soils, consisting of fill deposits containing historical-period debris such as ceramics, glass, metal, and other materials to depths of over 3 m below surface. We surmise that a large historical-period refuse dump was cut into A horizon soils in this central area. The cut A horizon soils, which contained prehistoric cultural materials, were then used as fill, producing the bedding seen in these trenches. This pattern was especially evident in Trenches 105 and 106, where a thin (50-cm) intact cultural deposit was found approximately 2.5 m below a bedded fill layer.

All trenches in the central portion were relatively distant from the toe slope of the bluff. To the east and west of this central section, intact cultural deposits grew thicker and were encountered at shallower depths below the ground surface; for example, in Trenches 107 and 113. Progressing out from the base of the bluff, buried A horizon soils, often containing cultural materials, either sloped away gently or were mechanically truncated.

In the eastern portion of the tested area, Trenches 101, 102, and 118–122 contained prehistoric cultural materials in varying densities and proportions. The depths of the deposits varied from only 20 cm to slightly more than 2 m below the ground surface, while the thickness ranged from 50 cm (Trench 121) to more than 2.5 m (Trench 102). In the southern ends of Trenches 101, 102, and 118, intact anthropogenic A horizon soils were found at shallow depths. In Trenches 101 and 102, this deposit gradually sloped to the north, where it was truncated and covered with fill. In Trench 118, the A horizon soils followed a similar slope, then were cut abruptly, resulting in a thick, short band of intact material confined to the southern end of the trench. The profile from Trench 101 provides an example of the stratigraphy seen in this area (Figure 48).

In Trenches 119, 121, and 122, we observed buried A horizon soils containing sparse cultural deposits below relatively thick C horizon soils and fill. In Trench 121, the cultural deposits were encountered 2 m below the surface, whereas in Trench 122, cultural deposits began at 1 m below surface. In Trench 119, a sparse deposit was found in a transitional A-C horizon recorded at nearly 2 m below surface; we feel this cultural material was likely transported by bioturbation from an upper A horizon stratum that was truncated in the past. At the far eastern end of the project area near LAN-211/H, Trenches 115, 116, and 117 penetrated a series of fill deposits that extend to depths of over 1.5 m below the surface before reaching the water table. Whereas the fill could contain prehistoric materials, no intact cultural deposits are present.

In the western portion of the testing area, intact A horizon strata containing prehistoric cultural materials were found in three trenches (Trenches 109, 110, and 111). These three trenches had several features in common; first, in all three, the intact, culture-bearing A horizon was encountered at approximately 1 m below surface and continued to unknown depths; secondly, in all three the A horizon was heavily bioturbated; and lastly, the A horizon soil in all three was observed buried below a series of B horizon soils. The soil profile from Trench 111 exemplifies this stratigraphic pattern (Figure 49). This stratigraphy could have resulted when A horizon soils originally at the surface were removed and reworked by historical-period farming or modern construction activities.

Continuing with trenches in the western section, both Trenches 108 and 112 exposed intact A horizon Category 1 soils below a 1.0–1.5-m layer of fill material. Cultural deposits were not noted in the A horizon soils in either trench. Groundwater, however, was encountered at approximately 2 m below the surface and prevented sampling of the A horizon soils. Upper marsh deposits indicating the presence of standing water in the past were noted below the A horizon strata in both trenches.

We made the following observations as a result of trenching below the bluff:

1. In all cases, intact cultural deposits were found within A horizon or buried A horizon soils.

2. The depth and thickness of the cultural deposit varies widely across the project area. As trenches approached the base of the bluff, the intact cultural deposits are thicker and closer to the surface.

3. As distance from the base of the bluff increases, the likelihood that cultural deposits are disturbed or completely removed increases.

4. In all cases, fill materials overlay native soil strata.

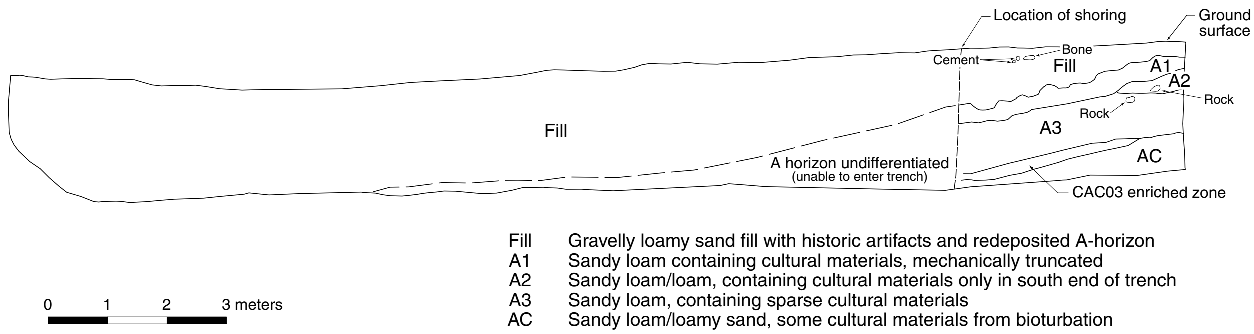

Figure 48. Stratigraphic soil profile of the east wall of Trench 101.

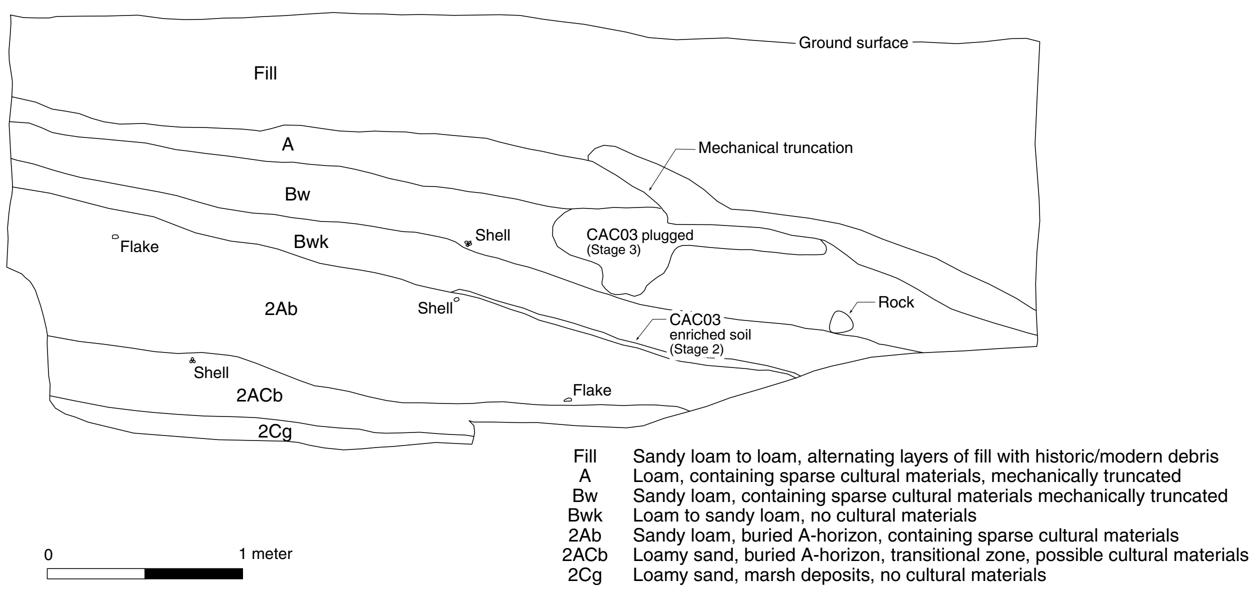

Figure 49. Stratigraphic soil profile of the west wall of a portion of Trench 111.

5. The thickness of the fill deposits varies across the project area, as does the amount of historical-period and modern debris within them.

6. Within the fill, there are bedded layers of A horizon soils and sandy soils, likely the result of local earth-moving activities.

7. When A horizon soils are observed in fill strata, they contain prehistoric cultural materials such as lithics and marine shell.

Mechanically Excavated Units

Although the SRI trenches successfully exposed cultural deposits, we needed more data to characterize them adequately. Seven approximately 1-by-1-m test units were excavated into the trench walls in areas where cultural deposits were noted. Because the excavation depth and the instability of fill materials made the trenches unsafe to enter, these test units were excavated into potentially intact, culture-bearing soils using a 3-foot-wide, flat backhoe blade in 20-cm lifts, or levels. In each 20-cm lift, 16 5-gallon (20-liter) buckets were filled (the approximate equivalent of two 10-cm levels in a 1-by-1-m unit). Although some mixing of soils occurred, adequate samples of each stratigraphic layer were obtained; these samples were screened and stored for analysis. A summary of the materials and qualitative assessments of the amounts recovered from these seven excavation units is presented in Table 8.

These test units confirmed that historical-period materials in fill overlay intact prehistoric deposit across almost the entirety of LAN-62. In Unit 2, the presence of large amounts of historical-period and modern construction debris indicate that the upper A horizon soils as well as the lower 2Ab series were likely redeposited. Historical-period debris—ceramics, glass, metal, and other materials—was found in the fill; modern construction debris, such as concrete, asphalt, metal, plastic, and wood, was also common. No distinct features or strata could be identified that related to either historical-period or modern use; the debris appeared blended in a layer of introduced material throughout the testing area.

On the extreme eastern and southwestern portions of the site and as close to the base of the bluff as the equipment could reach, intact prehistoric material was seen very near the surface; in these areas, only a very thin lens of historical-period debris covered prehistoric cultural material. Farther out from the bluff, the historical-period disturbance increased in thickness.

The cultural deposits we observed in the trenches and excavation units varied and no features were encountered. In addition to the data summarized in Table 8, we made several observations about the contents of the seven excavation units. An intact prehistoric cultural deposit, measuring approximately 2 m in thickness and yielding cultural materials, was found in Unit 1. A very large amount of faunal material and the highest number of flaked stone artifacts recovered from a single 20 cm level were encountered in Unit 3. One shell bead was recovered from a probably disturbed context in the uppermost level of Unit 4; moderate amounts of historical-period and modern debris were also found in the uppermost level. A relatively thick (nearly 1 m) cultural deposit found in the buried A horizon strata in Unit 6 contained a small quantity of lithic artifacts and almost no faunal material. The most interesting find, a leaf-shaped chert biface, was recovered from Unit 6, Level 3. Residue observed on one end suggests this tool may have been coated with ochre, or possibly hafted and used as a knife or other cutting implement. In Unit 7, cultural materials appeared concentrated in the upper A1 stratum, and dispersed lightly with depth into lower A horizon and transitional strata. We observed that the amount of cultural material recovered was relatively low in this area, considering the amount of soil excavated. The amount of invertebrate fauna recovered was also low, which is puzzling given the proximity of these deposits to both the shoreline and the lagoon.

Table 8. Summary of Units Excavated during Boundary Testing at LAN-62

Unit	Adjacent Trench	Total Depth below Surface	Sample (m^3)	Lithics	Faunal Remains	Historical-Period Materials	Intact Deposit
1	102	2.5 m (8.2 feet)	2.0	abundant	abundant	sparse	yes
2	111	2.2 m (7.2 feet)	1.6	moderate	abundant	abundant	no
3	106	2.8 m (9.2 feet)	0.2	abundant	abundant	abundant	yes
4	108	1.9 m (6.2 feet)	1.0	sparse	sparse	moderate	yes
5	121	2.1 m (6.9 feet)	0.4	sparse	sparse	none	yes
6	122	2.5 m (8.2 feet)	1.2	sparse	sparse	abundant	yes
7	118	2.3 m (7.5 feet)	2.0	moderate	moderate	sparse	yes

Summary of Inventory Results

Bucket augers and trenches were successfully used in this inventory phase to locate prehistoric cultural materials in Area D. Bucket augers drilled near the northwestern portion of the project area recovered cultural materials in redeposited and disturbed soils, whereas those placed near LAN-62 and LAN-211/H encountered intact subsurface cultural deposits. The amount of fill overlying intact soils in the vicinity of LAN-62 varied considerably, as did the depths and thicknesses of intact cultural deposits.

Trenching and test unit excavation refined our subsurface model of the site area below the bluff. Despite evidence of extensive historical-period and modern disturbance, intact prehistoric cultural deposits were located in a discontinuous band between the previous boundaries of LAN-62 and LAN-211/H, prompting the extension of LAN-62 to the east (see Figure 42.) Found in A or transitional A-B or A-C soil horizons, the cultural deposits are generally sparse, vary in thickness from 50 cm to 2.5 m, and contain relatively low densities of lithic artifacts, marine shell, and vertebrate fauna. Anthropogenic soils were encountered anywhere from a few centimeters below surface to more than 2 m deep. The water table was encountered at fairly shallow depths, and in some cases, may saturate soil horizons containing cultural materials. As the distance from the toe slope of the bluff increased, intact prehistoric deposits decreased.

As a result of the bucket auger and trenching program, a discontinuous prehistoric deposit has been recorded along the remaining toe slope of the Ballona Escarpment. Further, a dense midden exists at the core of the site at the west end, with less-dense midden lining the banks of Centinela Creek. The data also confirm that a portion of LAN-62 was disturbed by agricultural land use and Hughes Aircraft Company–related construction activities. Despite this disturbance, there may be highly localized "islands" of prehistoric cultural materials in the northeast portion of the site that have survived intact. SRI's testing resulted in an extension of the boundaries of LAN-62 approximately 950 m to the east toward LAN-211/H. The vertical and horizontal dimensions have been accurately defined; we now estimate that the total dimension of LAN-62 as currently mapped is 1.04 km^2 (258 acres).

Evaluation of LAN-211/H and LAN-2769

The second task outlined in the work plan was to evaluate the potential eligibility of LAN-211/H and LAN-2769 for listing in the NRHP as contributing elements of the BLAD. These two sites, discovered during the 1990 survey and designated at that time SR-12 and SR-13, appeared as organically enriched soil horizons observed near the base of the Westchester Bluffs. Three possibilities were offered to account for these deposits: They could represent (1) natural A horizons on the bank of Centinela Creek, (2) secondary cultural deposits that had washed down from the archaeological sites on top of the bluff or that were bulldozed into the bluff, or (3) intact cultural deposits reflecting prehistoric use (Altschul et al. 1991). Only in the case of the third alternative would they be considered significant; their eligibility would hinge on their integrity and scientific importance. The results of testing and evaluation are presented here.

LAN-211/H

When LAN-211/H (formerly known as SR-13) was rediscovered in 1990, it was initially described as:

> a narrow band of undisturbed, unvegetated soil at the extreme lower edge of the bluff slope. In the vicinity of SR 13, the base of the bluff slope has been truncated leaving an unobscured profile that is approximately 1 m in height and 100 m in width. For a 75 m extent, soil exposed in the profile consists of a dark, organic silty sand. The soil extends from the top of the exposure to the bottom, indicating that the midden is at least 1 m thick and probably more. SR 13 is an intact, thick midden deposit (Altschul et al. 1991:155).

When testing began nine years later, the appearance of the site was substantially the same. The slopes in the general site area were vegetated with ice plant (*Carpobrotus edulis*), and the deposit at the base of the bluff was entirely covered by asphalt. To assess the integrity of the deposit and to establish the extent of intact materials, subsurface investigation was necessary. A multiphased strategy was designed that included bucket augering, trenching, and manual excavation of 1-by-1-m test units. Although the presence of buried utilities, standing structures, and potentially contaminated areas limited where we could auger and trench, sufficient work was completed to offer a stratigraphic interpretation of the site. Subsequent construction monitoring in the vicinity has helped to clarify site boundaries. Bucket augering, trenching, and manual excavation produced abundant data; the test sites are shown on Figure 30 and summarized in tabular form in Appendix A.

Our test excavations confirmed that LAN-211/H is a complex mix of disturbed and intact deposits. In the following sections, we present our test results, including our interpretation of site structure and stratigraphic relationships. The analyses of specific artifact and ecofact types found in the site deposits are discussed in subsequent chapters.

Mechanical Excavation

To test the proposed boundary of LAN-211/H, we used bucket augers, backhoe trenches, and hand excavation. Methods and procedures were the same as those previously discussed in Chapter 4. Three trenches and 11 augers were excavated in the paved parking area below the deposit identified in the inventory to test the site's extent (see Figure 24). Using the same classification system (Category 1–6

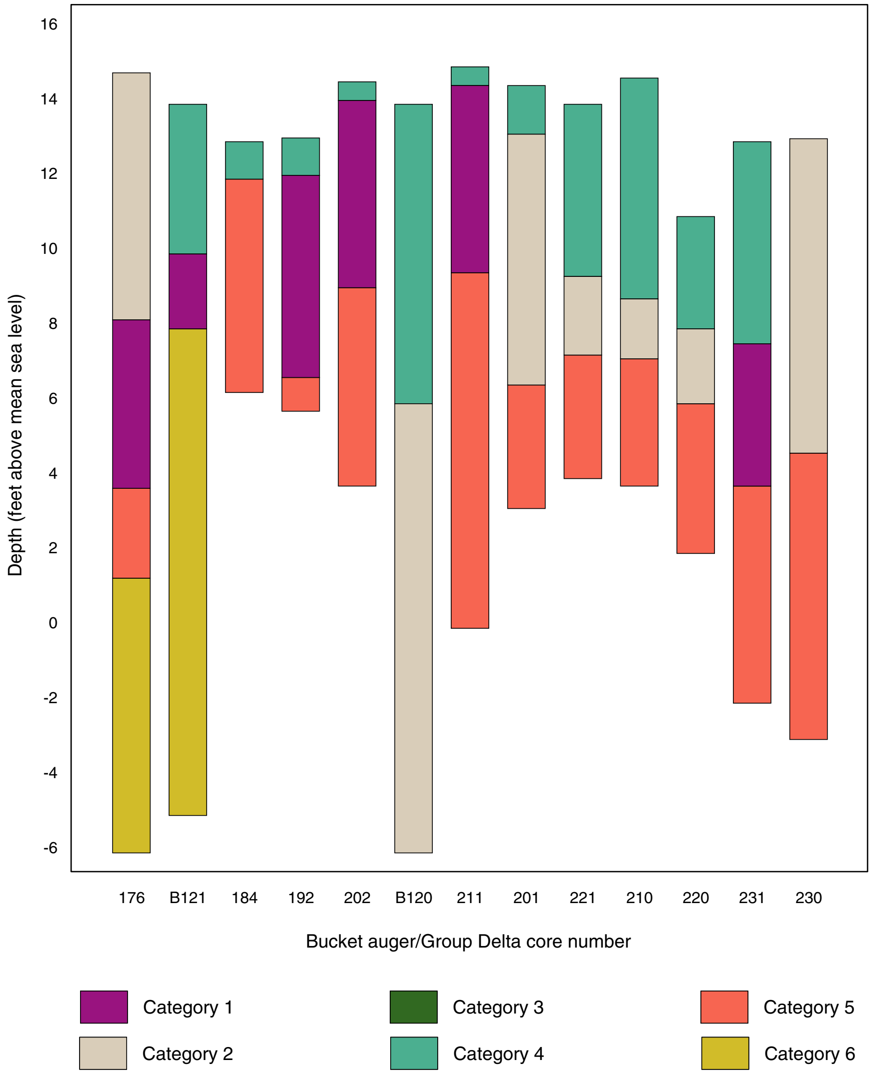

Figure 50. Schematic soil profiles of bucket augers placed in LAN-211/H.

soils), a schematic representation of the stratigraphy at LAN-211/H, as represented in bucket augers, is shown in Figure 50.

Although prehistoric cultural materials encountered were sparse, the bucket augers indicated the presence of a subsurface archaeological deposit with good stratigraphic integrity. Five of the 11 bucket augers (BAs 176, 192, 202, 211, and 231) and 1 Group Delta core (B121) placed in and near LAN-211/H contained cultural materials in soils thought to be intact (Category 1 soils). Screening of the samples through $^{1}/_{8}$-inch mesh recovered lithic artifacts and vertebrate and invertebrate faunal remains. Additionally, five bucket augers (BAs 201, 210, 220, 221, and 230) and one Group Delta core (B120) produced sparse amounts of cultural materials in soils that were likely intact (Category 2). Only BA 184 contained no identifiable cultural materials. Clearly, cultural materials exist below the paved parking lot at LAN-211/H.

BAs 202 and 211 were very similar in the depth and thickness of the cultural deposit and the amount of fill that capped it. BAs 221, 210, and 220 revealed possibly intact site materials of varying thicknesses at similar elevations, capped by equivalent amounts of fill. BAs 201 and 230 also reached possibly intact cultural materials of similar thickness at comparable depths. The amount of fill observed varied significantly as the augers moved north from the base of the bluff into an area of relatively flat topography. Whereas little or no fill appeared in augers spaced about 50 m apart and roughly equidistant from the bluff base (i.e., BAs 176, 184, 192, and 201), augers placed on flat ground but farther east (BAs 210 and 211) penetrated about two-thirds of a meter of fill before reaching possible site soil. Closer to the base of the bluff, we observed a more pronounced archaeological signature, with slightly higher densities of cultural materials found in intact stratigraphic contexts (in BA 202, for example).

The bucket auger data indicated that much of LAN-211/H was disturbed. The "swiss cheese" effect seen elsewhere along the base of the bluff is typical at this site. Historical-period and modern disturbance has created large pockets or "holes" in an otherwise widely dispersed, but intact, buried archaeological deposit; in some areas, the reverse may be true: the intact deposit may be the "hole" or "island" which is surrounded by disturbed fill. When small-area tests such as cores or augers hit one of these holes, readings that are abruptly different from adjacent areas result. This effect underscores the limitations of bucket augering as a testing technique. Bucket augers were successful in locating subsurface cultural materials and in disclosing potential locations for further testing; however, to evaluate the integrity of these deposits, fill materials had to be removed and backhoe trenches excavated to achieve the necessary subsurface exposure.

Trenches

We continued our testing at LAN-211/H by digging three backhoe trenches (Trenches 6, 10, and 11) of varying sizes and depths into presumed boundary areas (see Figure 30). Results were mixed; the trenches exposed a relatively thick, intact archaeological deposit in one area, possible anthropogenic soils in another, and heavily disturbed materials at the third location. No obvious pattern for the distribution of cultural materials was observed; their preservation was apparently the result of some areas having escaped historical-period disturbance. Detailed information on stratigraphic interpretations is presented in Chapter 5 and in tabular form in Table A.4.

Trench 6 was excavated perpendicular to the bluff edge into an asphalt driveway near the western boundary of LAN-211/H, approximately 20 m west of BA 176. Trench 6 was 11 m long, 1 m wide, and reached a depth of 3 m below the ground surface. Cultural materials were not observed in this trench, although the 2Ab soil horizon looked very similar to other anthropogenic soils seen elsewhere. Trench 6 was most useful in identifying the western boundary of LAN-211/H.

Trench 10 was placed to clarify the stratigraphic integrity of the area just east of BA 184. The augers on either side, BAs 176 and 192, both exposed cultural material, whereas BA 184 contained none. Trench 10 was 10 m long by 1 m wide and was excavated to a depth of 3.5 m below ground surface. Trench 10, excavated into an area known as the "salvage yard" during the Hughes Aircraft Company era, penetrated a paved surface in which traces of numerous backfilled potholes and old excavation pits were visible. Several standing structures and subsurface intrusions from Hughes Aircraft Company–era activities remain nearby. The stratigraphic sequence seen in the wall of Trench 10 was relatively simple—dark gray marsh deposits overlain by 2.5 m of mixed fill. No cultural materials were identified in either the fill soils or in the marsh deposits. The abrupt contact with the underlying marsh deposits indicate that the upper soil layers were removed to the depth of the marsh sediments some time in the past, after which a layer of fill material was deposited. The fact that this area has been graded and leveled would suggest that, if prehistoric deposits ever existed in this portion of the site, they were removed historically.

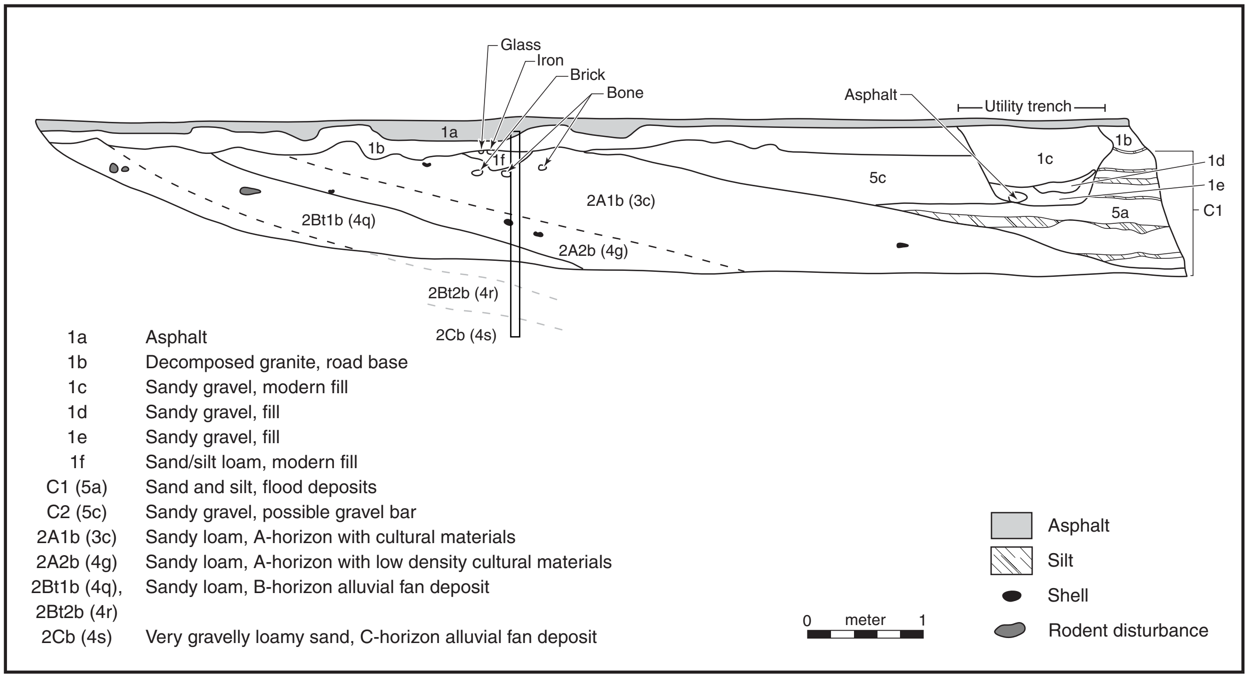

Figure 51. Stratigraphic soil profile of the southwest wall of Trench 11, LAN-211/H.

Trench 11, 26 m long by 1 m wide, was excavated to a depth of 2.25 m below ground surface. Trench 11 penetrated a relatively thick cultural deposit as well as historical-period and modern features, exposing a complex stratigraphic sequence (Figure 51). In the southern half of the trench, the upper 20–30 cm (Strata 1a and 1b) are in direct contact with the cultural deposit, identified in soil horizon 2A1b (Stratum 3c) and soil horizon 2Bt1b (Stratum 4q). Stratum 3c is an intact A horizon containing numerous fragments of marine shell, large mammal bone, ground stone, lithics, concentrations of charcoal, and other prehistoric cultural materials. Intrusive historical-period materials, such as brick, were also found but appeared to be confined to the upper portion of this layer.

Two concentrations of bone, located about 2 m apart in this trench, were recovered and analyzed. One concentration contained fragments of cow and deer, a vertebrae from a yellowfin tuna, and unidentified large mammal bone. The second, smaller concentration contained a mixture of large and small bone. Both these two concentrations may be remnants of the same feature separated by Trench 11. Unit 9 was placed in the east wall of this trench to explore the extent of this feature. The surrounding soil matrix was described as a very dark gray sandy loam and quite distinct from the overlying strata (Figure 52). The lower portion of this stratum graded into Stratum 4g, which was similar in composition to Stratum 3c, but contained less cultural material. Those cultural remains recovered were likely the result of heavy bioturbation in these two strata.

The natural slope of the alluvial fan facies occupied by prehistoric people is illustrated in the stratigraphic profile and photographs of Trench 11 (see Figures 51 and 52). At the southern end of the trench, Stratum 3c was truncated at some time in the past, probably by agricultural activity or Hughes Aircraft Company–related construction. Certainly the A horizon would have continued up the slope, and it probably would have contained a cultural deposit. This section of site material was likely used elsewhere on the property as fill. It is quite possible that the cut-away portion of this site was transported north, where it was later identified as the protohistoric component of LAN-1932/H in a secondary context. Maxwell (Chapter 7) however, argues that the faunal collections from these two sites are quite different

Figure 52. View of the southwest wall of Trench 11 and south wall of Unit 9, LAN-211/H.

and suggestive of distinct origins. Fine-grained mineralogical analysis such as that conducted at LAN-2676 (Mbila and Homburg 2000) is needed to resolve this question.

In the northern portion of Trench 11, the sloping Stratum 3c (lower culture-bearing stratum) came in contact with the 5c-C1 stratum (alluvial fan deposits without artifacts). The well-sorted sands and silts in Stratum 5 are interpreted as representing historical-period flood deposits which would have been deposited in shallow standing water, such as that seen in a photograph taken during a flood event in 1952 (Figure 53). Given that such flooding episodes have continued into modern times, we can assume that repeated shallow flooding took place during prehistory and into the historical period.

At approximately the middle of Trench 11, evidence of a historical-period or modern intrusion was seen (Figure 54). At some point in the past, likely during the 1940s or 1950s, a cross trench approximately 1 m wide and 1 m deep had been excavated into the parking lot, cutting into the 5c-C1 stratum. This intrusive trench (Figure 55) showed layers of gravel and sand; this feature may represent a drainage ditch from Building 23 to the immediate west. No materials were collected from this small feature, which appeared to be related to Hughes Aircraft Company–era activity.

Trench 11 provided important stratigraphic information about LAN-211/H. The results illustrated the highly variable nature of the disturbance at this site and along the base of the bluff in general. The discovery of an intact cultural deposit more than 1 m thick was a significant discovery and required further investigation.

Figure 53. Oblique aerial photograph taken in 1952, showing flood waters across the project area (Spence photograph, courtesy of the Air Photo Archives, UCLA Department of Geography).

Figure 54. View of the northwest wall of Trench 11.

Figure 55. Close-up view of Trench 11, showing intrusive cross-trench.

Manual Excavation

Hand excavations into the identified cultural deposits at LAN-211/H were conducted to provide fine-grained geomorphic data and to obtain a controlled sample of the midden deposit. Eleven units from five separate blocks of varying sizes were excavated at LAN-211/H. Most of the excavation blocks were subdivided into 1-by-1-m excavation units. Excavation proceeded in 10-cm arbitrary levels, except when large amounts of alluvial sediments overlay the cultural deposit; these were removed in increments larger than 10 cm.

Current evidence indicates that LAN-211/H is located entirely on or within the alluvial fan facies. Most of the test units (Units 3–7, 6/10, and 11) were excavated into a bench likely created when the Hughes Aircraft Company removed part of the alluvial fan to build Building 23, its associated structures, and the parking lot. The archaeological deposits were found in the 1-m-thick upper A horizon of a moderately developed soil topped by a substantial layer of fill. Most excavation took place on a sloped surface, and in two instances, the depth needed to reach the cultural deposits required shoring to comply with safety standards set by the California Occupational Safety and Health Administration. Shoring braces and panels blocked large sections of wall stratigraphy from view, hampering field interpretation (see Figure 32).

The test excavations at LAN-211/H provided data for a preliminary reconstruction of geomorphic trends and identified in situ cultural deposits and their stratigraphic context. This section briefly describes selected unit excavation blocks and introduces data pertinent to the interpretation of the cultural deposit. The site map (see Figure 30) details the locations of all excavation units and shows their placement within the site boundaries and their relationship to the local topography. Detailed stratigraphic interpretations are presented in Chapter 4 and in tabular form in Table A.5.

Figure 56. View showing bluff, artificial terrace, and Building 23, facing west.

Units 1–4

Units 1 and 2 were each 1-by-1-m units placed side by side to form a north-south 1-by-2-m block on the edge of the slope overlooking the eastern end of the salvage yard at Building 23. These units were placed above the artificial cut in the slope where LAN-211/H was first discovered during the 1990 survey (Figure 56).

A heavy growth of ice plant (*Carpobrotus edulis*) covers the slope and excavators noted heavy rodent disturbance on the ground surface. Excavators at Unit 1 cleared ice plant from the surface and removed approximately 60 cm of topsoil from the unit before beginning excavation. The stratigraphic profile of Units 1 through 4 shows the steep slope on which the units were placed (Figure 57). Unit 1 was excavated through stratigraphic layers interpreted as predominantly C horizon materials with alternating bands of lamellae (Bt horizon), which developed in an alluvial fan setting (see Chapter 5). A sparse cultural deposit approximately 80 cm thick was encountered in Unit 1.

At LAN-211/H, Stratum 3 corresponds with the uppermost A horizon of a moderately developed soil (see discussion, Chapter 5). Stratum 3 soils generally include cultural-bearing deposit. No Stratum 3a soils were excavated from Unit 1, although artifacts were recovered, likely the result of heavy bioturbation. Unit 2, placed higher on the slope, was excavated in 50-cm increments (as opposed to the 10-cm increments used in Unit 1). As a result, the excavation levels crosscut the strata and the raw counts and weights of artifacts are misleading; artifact density is a better proxy. A deposit of Stratum 3a soil approximately 90 cm thick was excavated in Unit 2, most of it in Level 1. The overall cultural deposit in Unit 2 was 1.5 m thick.

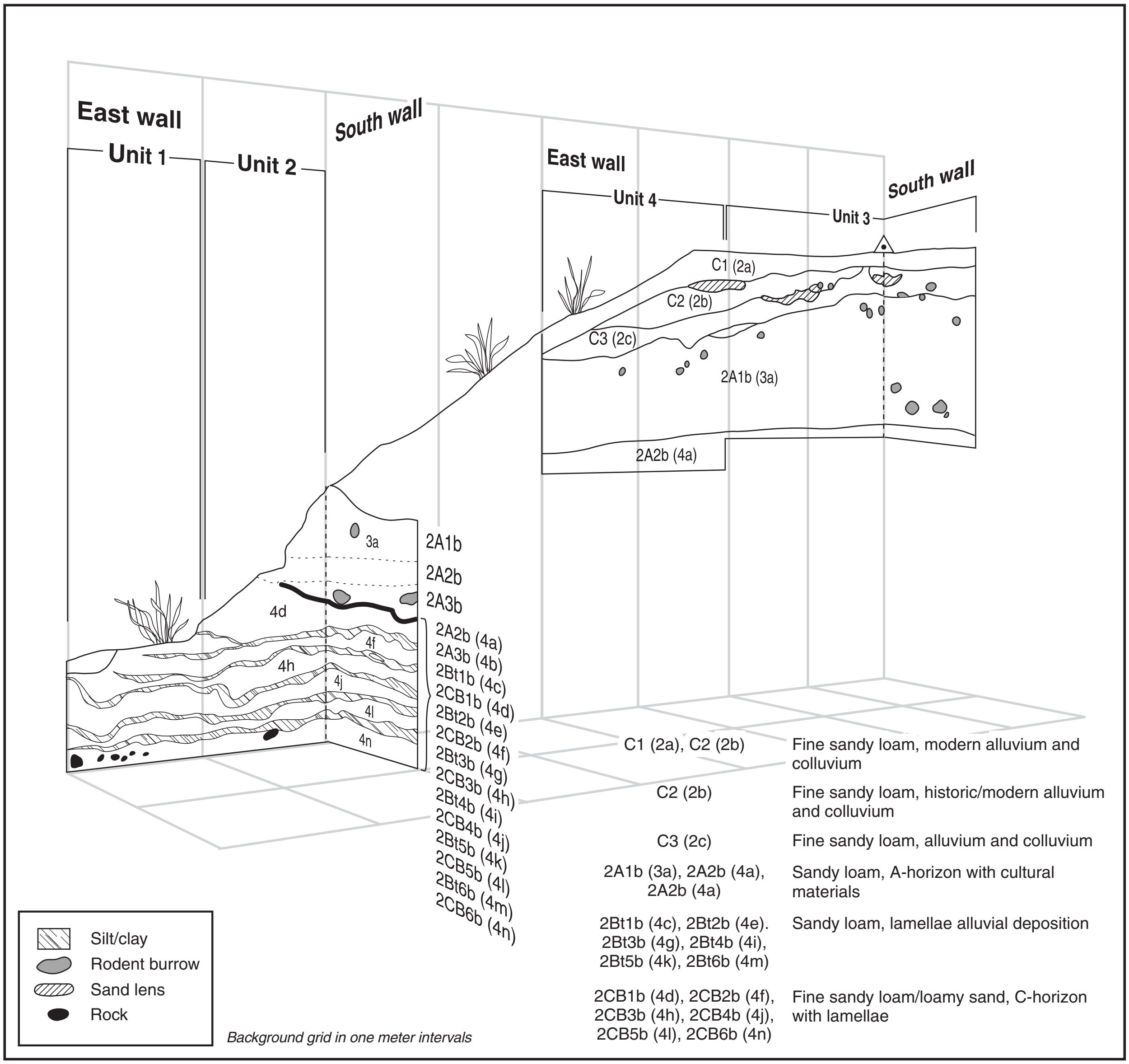

Figure 57. Stratigraphic soil profile of Units 1–4, LAN-211/H.

Compared to other excavation units at LAN-211/H, a relatively small amount of cultural material was recovered in Units 1 and 2. This may be because a large portion of the site was apparently truncated for agricultural purposes or for Hughes Aircraft Company–era activities. Units 1 and 2 appear to be at the edge of this artificial cut. Lamellae were observed in the sidewalls of these units, indicating a stable surface on the fan for some time.

After completing Units 1 and 2, we determined that continuing the line of units south into the slope might reveal more of the cultural deposit and would aid in establishing the site's stratigraphic integrity. For safety purposes, a small balk approximately 2 m wide was left unexcavated between Units 1 and 2 and Units 3 and 4. Units 3 and 4 were both 1-by-2-m units oriented north-south and placed progressively higher up the slope (Figure 58). Unit 3 was excavated in 10-cm increments with provenience maintained for the entire 1-by-2-m unit to a depth of 120 cm below datum. After this depth, the 1-by-2-m unit was

Figure 58. View of east wall of Units 3 and 4, LAN-211/H.

divided into two 1-by-1-m subunits, each of which was excavated in 10-cm-deep levels. This procedure continued to the bottom of the unit at a depth of 2 m below datum.

The excavation strategy for Unit 4 was similar; the first three levels were excavated in 50-cm increments with provenience maintained for the entire 1-by-2-m unit. After a depth of 150 cm below datum, the 1-by-2-m unit was divided into two 1-by-1-m subunits which were excavated in 10-cm increments to a depth of 2.2 m below the datum.

Levels 1–3 in Unit 4 do not align with the same levels in Unit 3. To compare artifact densities between Units 3 and 4, it is more useful to view these densities in relation to stratigraphic layers (Table 9). Unit 3, which was consistently excavated in 10-cm increments, was selected as the proxy for artifact density in this portion of LAN-211/H. The lower three levels of Unit 4 were viewed as a continuation of Unit 3. A clear pattern emerged; artifact density increased with depth into Stratum 3a. The upper levels of Unit 3 contained sparse amounts of cultural materials that were probably the result of bioturbation bringing materials upward. Moving lower in the profile, artifact densities peaked in Levels 7 and 8, below which they began to drop off, with some minor fluctuations. Stratum 3a contained a fairly substantial midden deposit with some structure which continued into Stratum 4a. Stratum 4 represented the B and C horizons of the moderately developed soil on the alluvial fan. The artifact density data are consistent with a midden deposit that has been dispersed vertically through the continuous action of bioturbation. The lack of features within these excavations made it difficult to identify specific living surfaces. There was a concentration of cultural materials between 70–120 cm which may reflect such a surface in approximately the upper middle portion of Stratum 3a.

Table 9. LAN-211/H Artifact and Ecofact Densities

Level, by Unit	Size (m)	Strata	Soil Horizon	Depth (m)	Volume (m^3)	Lithic Artifacts		Vertebrate Fauna		Invertebrate Fauna	
						Count	Density (/m^3)	Weight (g)	Density (g/m^3)	Weight (g)	Density (g/m^3)
Unit 1											
1	1 × 1	4d, 4e	2CB1b, 2Bt2b	0.68–0.85	0.09	19	211.11	9	100.00	—	—
2		4d, 4e	2CB1b, 2Bt2b	0.85–0.95	0.10	6	60.00	6	60.00	1	10.00
3		5d, 4e	2CB2b, 2Bt2b	0.95–1.05	0.10	9	90.00	4	40.00	7	70.00
4		4f–h	2Bt3b, 2CB3b, 2Bt4b	1.05–1.15	0.10	9	90.00	3	30.00	1	10.00
5		4g–i	2CB3b, 2Bt4b, 2CB4b	1.15–1.25	0.10	3	30.00	—	—	3	30.00
6		4h, 4i	2Bt4b, 2CB4b	1.25–1.35	0.11	4	36.36	3	27.27	2	18.18
7		4i, 4k	2CB4b, 2Bt5b	1.35–1.45	0.10	5	50.00	—	—	—	—
8		4k, 4l	2Bt5b, 2CB5b	1.45–1.55	0.10	—	—	—	—	—	—
9		4m, 4n	2Bt6b, 2CB6b	1.55–1.65	0.10	—	—	—	—	—	—
10		4n	2CB6b	1.65–1.75	0.10	—	—	—	—	—	—
Unit 2											
1	1 × 1	3a	2A1b	0.45–0.95	0.26	23	88.46	21	80.77	2	7.69
2		3a, 4a, 4c, 4d	2A1b, 2A2b, 2Bt1b, 2CB1b	0.95–1.45	0.30	30	100.00	31	103.33	6	20.00
3		4d–h, 5d	2CB1b, 2Bt2b, 2CB2b, 2Bt3b, 2CB3b, 2Bt4b	1.45–1.95	0.49	16	32.65	22	44.90	3	6.12
4		4g–i, 4k–n	2CB3b, 2Bt4b, 2CB4b, 2Bt5b, 2CB5b, 2Bt6b, 2Cb6b	1.95–2.45	0.50	2	4.00	—	—	—	—
Unit 3											
1	1 × 2	2a	C1	0–0.30	0.34	2	5.88	—	—	6	17.65
2		2a–c	C1, C2, C3	0.30–0.40	0.20	6	30.00	8	40.00	10	50.00
3		2b, 2c	C2, C3	0.40–0.50	0.20	5	25.00	1	5.00	—	—
4		2b, 2c, 3a	C2, C3, 2A1b	0.50–0.60	0.20	23	115.00	9	45.00	2	10.00

Level, by Unit	Size (m)	Strata	Soil Horizon	Depth (m)	Volume (m^3)	Lithic Artifacts		Vertebrate Fauna		Invertebrate Fauna	
						Count	Density (/m^3)	Weight (g)	Density (g/m^3)	Weight (g)	Density (g/m^3)
5		2c, 3a	C3, 2A1b	0.60–0.70	0.20	25	125.00	30	150.00	7	35.00
6		2c, 3a	C3, 2A1b	0.70–0.80	0.21	49	233.33	28	133.33	—	—
7		2c, 3a	C3, 2A1b	0.80–0.90	0.19	59	310.53	50	263.16	3	15.79
8		3a	2A1b	0.90–1.00	0.20	74	370.00	30	150.00	3	15.00
9		3a	2A1b	1.00–1.10	0.20	39	195.00	21	105.00	6	30.00
10		3a	2A1b	1.10–1.20	0.20	45	225.00	38	190.00	4	20.00
11		3a	2A1b	1.20–1.30	0.19	29	152.63	8	42.11	—	—
12		3a	2A1b	1.30–1.40	0.20	19	95.00	10	50.00	1	5.00
13		3a	2A1b	1.40–1.50	0.22	6	27.27	8	36.36	—	—
14		3a	2A1b	1.50–1.60	0.18	9	50.00	5	27.78	—	—
15		3a	2A1b	1.60–1.70	0.22	11	50.00	11	50.00	—	—
16		3a	2A1b	1.70–1.80	0.18	9	50.00	3	16.37	2	11.11
17		4a	2A2b	1.80–1.90	0.16	8	50.00	1	6.25	4	25.00
Unit 4											
8	1 × 2	3a, 4a	2A1b, 2A2b	1.95–2.00	.09	7	77.00	4	44.44	—	—
9		4a	2A2b	2.00–2.10	.20	7	35.00	2	10.00	1	5.00
10		4a	2A2b	2.10–2.20	.23	9	39.13	7	30.43	1	4.34
Unit 6											
1	1 × 1	2c	C1	0–0.30	0.10	6	60.00	3	30.00	—	—
2		2c, 2d, 3b	C1, C2, 2A1b	0.30–0.60	0.30	16	53.33	13	43.33	—	—
3		3b, 2c	2A1b, C1	0.60–0.70	0.10	21	210.00	43	430.00	—	—
4		3b, 2c	2A1b, C1	0.70–0.80	0.11	6	54.55	16	145.45	2	18.18
5		3b	2A1b	0.80–0.90	0.10	15	150.00	30	300.00	—	—
6		3b	2A1b	0.90–1.00	0.11	20	181.82	44.6	405.45	14	127.27
7		3b	2A1b	1.00–1.10	0.11	5	45.45	25	227.27	3	27.27
8		3b	2A1b	1.10–1.20	0.10	17	170.00	19	190.00	7	70.00
9		3b	2A1b	1.20–1.30	0.09	13	144.44	13	144.44	5	55.56

continued on next page

Level, by Unit	Size (m)	Strata	Soil Horizon	Depth (m)	Volume (m^3)	Lithic Artifacts		Vertebrate Fauna		Invertebrate Fauna	
						Count	Density ($/m^3$)	Weight (g)	Density (g/m^3)	Weight (g)	Density (g/m^3)
Unit 10											
1	1 × 1	3b	2A1b	1.30–1.40	0.10	19	190.00	26	260.00	—	—
2		3b	2A1b	1.40–1.50	0.10	17	170.00	16	160.00	—	—
3		3b, 4o	2A1b, 2A2b	1.50–1.60	0.10	12	120.00	16	160.00	2	20.00
4		3b, 4o	2A1b, 2A2b	1.60–1.70	0.09	4	44.44	12	133.33	1	11.11
5		3b, 4o	2A1b, 2A2b	1.70–1.80	0.10	26	260.00	52	520.00	1	10.00
6		4o, 4p	2A2b, 2A3b	1.80–1.90	0.13	15	115.38	18	138.46	—	—
7		4p	2A3b	1.90–2.00	0.08	6	75.00	3	37.50	1	12.50
Unit 9 SE, SW, NE, NW											
1	2 × 2	3c	2A1b	0.86–0.96	0.40	807	2,017.50	3,522.8	8,807.00	270	675.00
2		3c	2A1b	0.96–1.08	0.45	372	826.67	3,035.8	6,746.22	338	751.11
Unit 9 SE, SW											
3	1 × 2	3c	2A1b	1.08–1.16	0.09	8	88.89	27	300.00	29	322.22
Unit 11 S											
1	1 × 1	3d	A1	0–0.25	0.12	3	25.00	5	41.67	94	783.33
Unit 11 N, S											
2	1 × 2	3d	A1	0.25–0.30	0.11	2	18.18	—	—	58	527.27
3		3d	A1	0.30–0.40	0.13	3	23.08	5	38.46	77	592.30
4		3d	A1	0.40–0.50	0.19	9	47.37	17	89.47	42	221.05
5		3d	A1	0.50–0.60	0.20	7	35.00	5	25.00	38	190.00
6		3d	A1	0.60–0.70	0.19	15	78.94	20	105.26	18	94.74
7		3d	A1	0.70–0.80	0.20	15	75.00	22	110.00	19	95.00
8		3d	A1	0.80–0.90	0.20	5	25.00	14	70.00	54	270.00
9		3d	A1	0.90–1.00	0.20	10	50.00	8	40.00	44	220.00
10		3d, 4e	A1, A2	1.00–1.10	0.20	8	40.00	17	85.00	7	35.00
11		3d, 4e	A1, A2	1.10–1.20	0.22	7	31.81	2	9.09	8	36.36

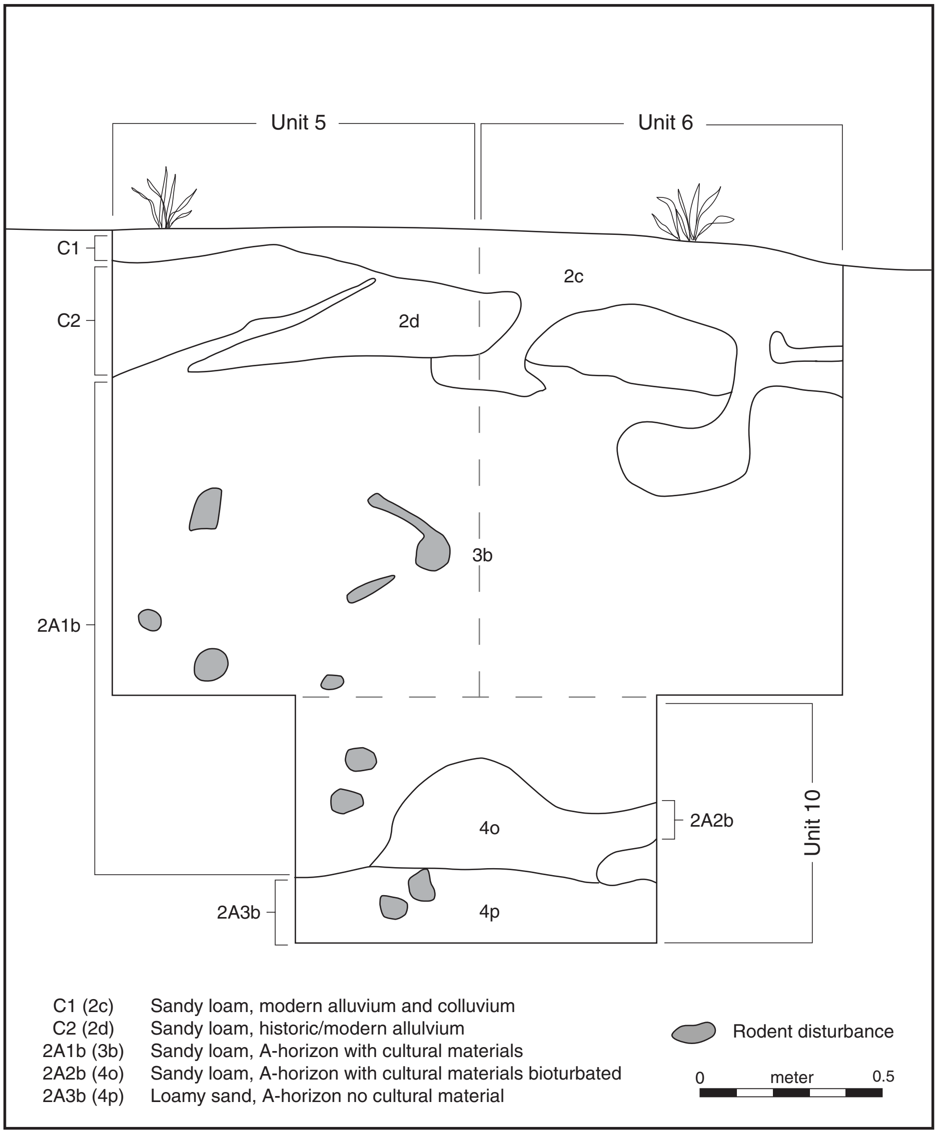

Figure 59. Stratigraphic soil profile of the south wall of Units 5, 6, and 10.

Units 5–8 and 10

This set of units was excavated as a 2-by-2-m block of four 1-by-1-m units (Units 5–8). Each unit was excavated to a depth of 130 cm, whereupon a 1-by-1-m unit (Unit 10) was placed in the center of the block and excavation continued for another 70 cm, to a total depth of 2 m. This excavation block was placed on the same bench as Units 1–4, but slightly further up the slope. For analytical purposes, Unit 10 was seen as a continuation of the 2-by-2-m unit block containing Units 5–8. In Table 9, we included only Units 6 and 10 and consider them a continuous data set, labeled elsewhere Unit 6/10.

Stratigraphically, this block of units looked very similar to Units 1–4 (Figure 59). Modern and historical-period alluvium and colluvium (Strata 2c and 2d) capped a heavily bioturbated A horizon (Strata 3b and 4o) that contained a thick, vertically diffused cultural deposit. Distribution of cultural material in this block of units differed from that seen in Units 3 and 4. No pattern in the vertical distribution or concentration of cultural materials was discovered in Unit 6/10. Apparent from an examination of Strata 3b, 4o, and 4p was a homogenous layer of cultural material; minor fluctuations between levels and artifact classes appears random. Heavy rodent disturbance occurred throughout and is likely responsible for the lack of structure in the deposit.

Again comparing Units 3–4 and Units 5–8 and 10, we note that instead of tapering off with depth, the highest density of vertebrate fauna was in Level 5 of Unit 10, at 1.7–1.8 m below the surface. This difference in site structure seems puzzling given that the stratigraphic profiles look similar and the unit blocks were separated by less than 20 m. The block containing Units 5–8 and Unit 10 was placed close to a large drainage to the east, which could have reworked the soils in this area.

Marine shell samples were collected from Unit 6, Level 6, and Unit 10, Level 7, and sent in for radiocarbon assay (Table 10). Both samples date to the beginning of the Late period but appear to be a reversal of what would be expected if there was good stratigraphic integrity at this location. The sample of *Chione* sp. collected from Level 7 of Unit 10 returned an intercept date of A.D. 1000, nearly 400 years later (i.e., more recent) than the date (A.D. 610) from the sample from Unit 6, Level 6, which was 90 cm higher and within a different stratum. Several possibilities could account for such results. Excavators noted heavy bioturbation throughout this set of units. Burrowing rodents and other natural forces have moved cultural materials vertically and horizontally throughout this area of the site. Fragments of shell could have been transported 1 m or more by such disturbance. This cultural deposit may also be secondary in nature, having washed down the slope from a location above on the bluff tops. In this case, the later components of sites on the bluff might erode and build up below in the reverse order of their original depositional sequence.

A third possibility is that these deposits were created by modern disturbance associated with the construction of the sewer line and adjacent service road or the development of Loyola Marymount University on the bluff above. Cultural materials from the bluff tops or from elsewhere on the property may have been imported as fill to stabilize the bluff edge below the sewer line. Archival photographs show that during construction of Loyola Marymount University, the large drainage above LAN-211/H was mechanically filled. Grading on the university campus undoubtedly disturbed archaeological materials that may have been transported to the drainage for fill. Subsequent flooding and erosion of the hill slope could have washed cultural materials down onto the bench on which LAN-211/H sits. The reversal of these two radiocarbon dates attests to the amount of disturbance within Strata 3b, 4o, and 4p.

Unit 9

Unit 9 (Figure 60; see Figure 52) at LAN-211/H was by far the most productive as measured by the amount of cultural material recovered per cubic meter of soil (see Table 9). Placed on the eastern side of Trench 11 in the paved parking area of the salvage yard, Unit 9 was a 2-by-2-m block divided into four 1-by-1-m quads and excavated in arbitrary 10-cm increments. Upper sterile soils that were described in Trench 11 as historical-period flood deposits were mechanically removed prior to excavation.

The stratigraphic sequence observed in Unit 9 (Figure 61) was essentially identical to that recorded for Trench 11 (see Figure 51). Alternating layers of sand and silt capped a naturally sloping A horizon that contained a dense 30-cm-thick deposit of cultural material. Unit 9 was placed at the toe slope of the alluvial fan at the mouth of the large drainage that cuts the bluff above the site. In the northern portion of Unit 9, the fan slope flattens out, perhaps as a result of flood episodes subsequent to or during occupation of this part of the site. The density of cultural material in even the lowest level of Unit 9 was far higher than anywhere else at LAN-211/H. Despite the fact that the cultural deposit was relatively thin, a variation in the distribution of artifacts was noted; artifact density decreased with depth. Whether this was a result of cultural material being washed down the fan and settling below or the product of human behavior could not be determined.

Table 10. Radiocarbon Data from LAN-211/H

Provenience	Depth m AMSL (feet AMSL)	Sample Number [a]	Species Sampled	Measured ^{14}C Age (B.P.)	$^{13/12}C$‰	Corrected ^{14}C Age (cal B.P.) [b]	Intercept	Calibrated Age (95% probability)
Unit 6, Level 6	8.6–8.5 (28.3–27.9)	Beta-145027	*Chione* sp.	2030 ± 60	+1.3	1810 ± 70	cal A.D. 610	cal A.D. 440–715
Unit 10, Level 7	7.6–7.5 (24.9–24.6)	Beta-145028	*Chione* sp.	1640 ± 40	+3.6	1420 ± 50	cal A.D. 1000	cal A.D. 890–1065
Unit 9, Level 1	3.2–3.1 (10.5–10.2)	Beta-145029	*Haliotis* sp.	910 ± 70	+1	690 ± 80 [c]	cal A.D. 1640	cal A.D. 1465–1810
Unit 9, Level 2	3.1–3.0 (10.2–9.8)	Beta-145030	*Chione* sp.	1030 ± 70	0	810 ± 80	cal A.D. 1490	cal A.D. 1405–1665

[a] Beta = Beta Analytic, Inc., Miami, Florida
[b] INTCAL98 Radiocarbon Age Calibration (Stuiver et al. 1998)
[c] MARINE98 database

Figure 60. View of the south and east walls of Unit 9, LAN-211/H.

Unit 9 was different from the other units at LAN-211/H in a number of important aspects. Despite a significant amount of bioturbation, the thin, dense deposit in Unit 9 was intact. Shell collected for radiocarbon assay from Levels 1 and 2 of the southeastern quadrant returned promising results (see Table 10). The sample collected from Level 1 returned a date of A.D. 1640, whereas the sample from Level 2 returned a date of A.D. 1490. Separated by only 10 cm, these levels appear to be internally consistent, placing this portion of the site well into the protohistoric time period. Calibrated to 1 sigma, the two dates overlap and can essentially be considered the same date. These dates correspond well with bead data collected from this block of units (see Chapter 9), suggesting that this portion of the site represents a single temporal component dating to a transition period between the Late and protohistoric periods.

Unit 11

Unit 11 was a 1-by-2-m unit placed on the eastern side of the large drainage at the eastern end of LAN-211/H. Unit 11 was excavated to a depth of 120 cm below ground surface in arbitrary 10-cm increments with provenience maintained to the 1-by-1-m unit. Excavated on a steep slope (Figure 62), the first four levels dug in northern and southern 1-by-1-m units recovered differing amounts of matrix. Unit 11 had a different stratigraphic and cultural composition from other units at LAN-211/H. In contrast to the other unit blocks, the stratigraphic sequence in Unit 11 was very simple. The entire unit was excavated through an A horizon 1.2 m thick with cultural materials recovered in varying densities throughout all levels. Two strata were identified: Stratum 3d, seen in most of the unit, was defined as a fine sandy loam, and Stratum 4e appeared as a lighter colored sandy loam with a lower artifact density. Extensive bioturbation was noted throughout all levels of excavation; in some cases, cultural materials were only found within the krotovinas.

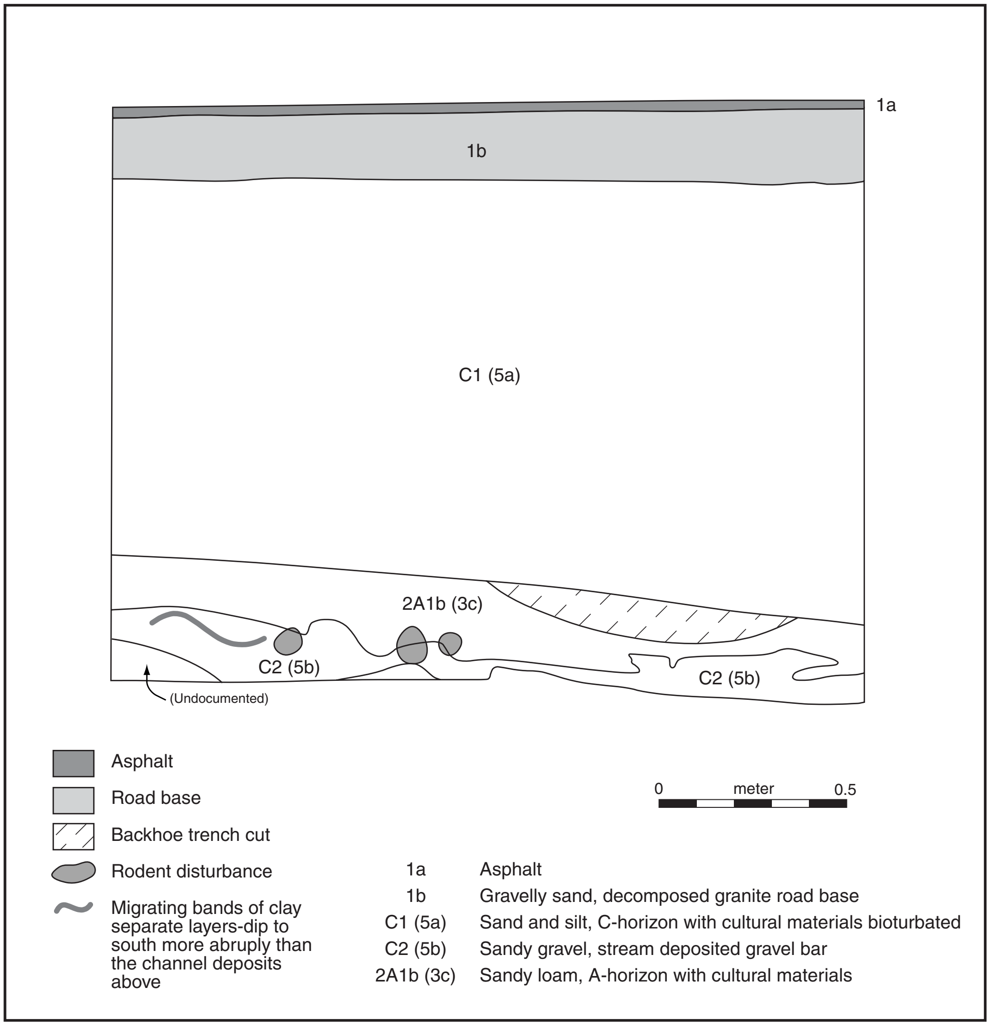

Figure 61. Stratigraphic soil profile of the west wall of Unit 9, LAN-211/H.

Comparison of artifact densities between levels in Unit 11 presents a curious picture (see Table 9). Interestingly, the highest density of invertebrates is in the top level, which we assume has been severely disturbed in the recent past. The weights and overall densities of invertebrates are higher than all other units at LAN-211/H, with the exception of Unit 9. Below Level 1, the density of invertebrates drops steadily until Levels 8 and 9, where large numbers were again recovered. Densities of vertebrate fauna are more consistent; there is a peak in the density at Levels 6 and 7, which corresponds with a peak in lithic density and a drop in invertebrate density. This phenomenon also occurs in the bottom levels of Units 10, where shell densities drop significantly and densities of lithic and vertebrate fauna rise slightly.

Although the cultural deposit in Unit 11 was in places quite dense, it was difficult to interpret. There were large numbers of invertebrates recovered from this unit in almost every level, whereas the counts of lithics and weights of vertebrate fauna were relatively low. The stratigraphic integrity of the cultural deposit found in Unit 11 appeared intact, although the lack of modern colluvial and alluvial materials in the upper levels of the unit was puzzling. As this unit was placed just east of a concrete channel that was constructed to control runoff from the bluff above, we expected to find signs of historical-period or modern disturbance, but there was little evidence found during excavation. Unit 11 may have penetrated

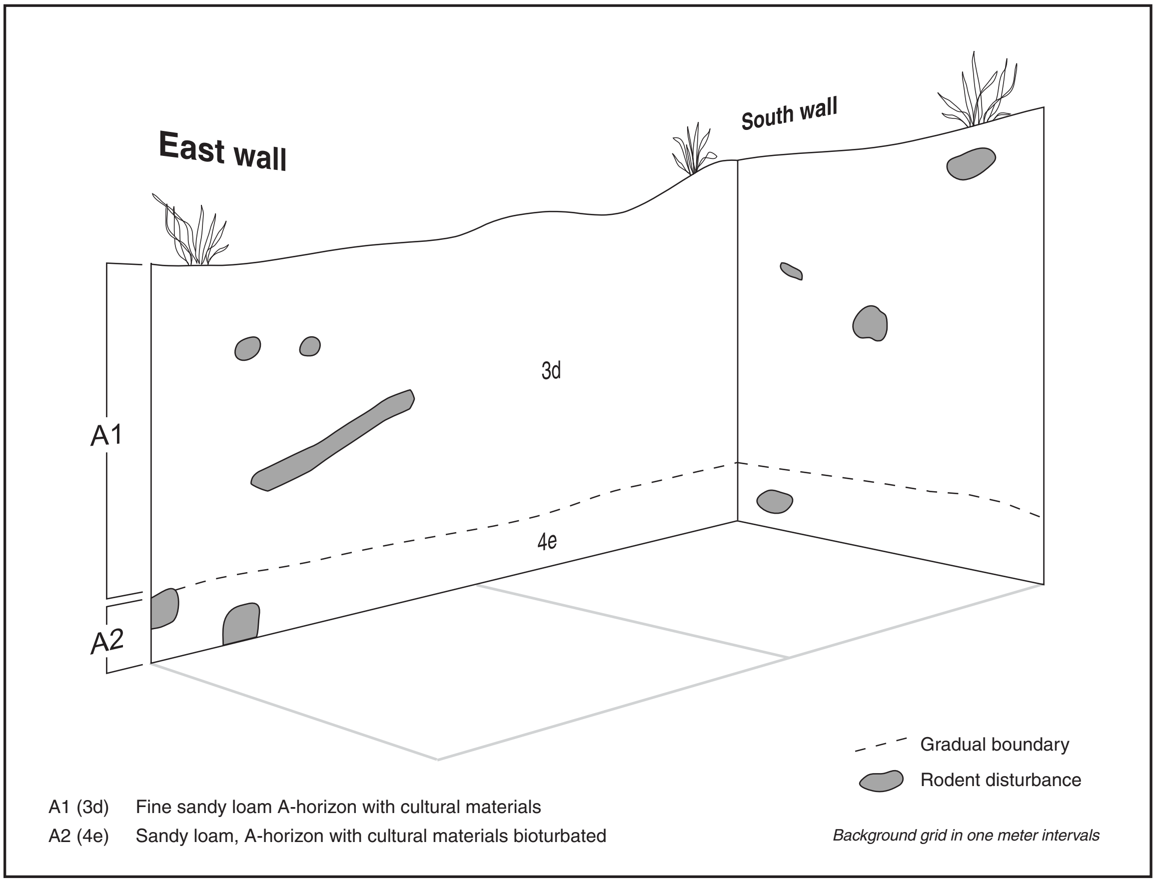

Figure 62. Stratigraphic soil profile of Unit 11, LAN-211/H.

a deposit of cultural material that had washed down from the bluff top or was disturbed during the construction of the runoff control channel; however, the patterning seen in the artifact density data argues against this interpretation. Further excavation at LAN-211/H may resolve the question.

LAN-2769

The cultural deposit at LAN-2769 was described in 1990 as "two narrow bands of dark, organic soil nestled along the edge of the bluff. Both bands are composed of dark organic silty sand with shell intermixed" (Altschul et al. 1991:153). At that time, neither the extent nor the integrity of the deposit could be determined. Its location—behind and to the west of the asphalt-covered parking lot known as "Trailer City" at the time of this investigation—suggested that the lower portion of the site had been removed during construction of the parking lot (Figure 63). To determine the extent and integrity of cultural deposits at LAN-2769, we implemented a multiphased strategy similar to that described for LAN-211/H.

Figure 63. Excavation at LAN-2769, showing proximity of "Trailer City."

Mechanical Excavation

At LAN-2769, we excavated three bucket augers and seven trenches (see Figure 31). Of the three augers, only BA 251 encountered artifacts (five pieces of lithic debitage) and these were found in a highly disturbed stratum of Category 4 soil that also contained modern construction debris (concrete and asphalt). Augering was stopped after three holes were excavated because the truck-mounted rig could not negotiate between the trailers. Consequently, the core area of the site could not be tested using this method.

On August 19, 1999, three trenches (Trenches 1-1, 1-2, and 1-3) were dug in the parking lot, in the area of LAN-2769 just north of the base of the bluff, and four trenches were excavated to the west, in and south of an equipment yard (Trenches 1-4, 1-5, 1-13, and 1-14). Using a backhoe, we placed the trenches as close to the surmised site boundaries as possible. The soils at LAN-2769 appeared in six distinct soil horizons, although not all trenches exposed these soil types, nor were they uniformly encountered across the site. These strata are described in detail in Chapter 5, and are shown in tabular form in Table A.2. In general, the trenches penetrated the toe-slope portion of the hill-slope facies, and in several cases, floodplain deposits of the alluvial plain facies were reached. None of the seven trenches located intact prehistoric cultural deposits. The excavation of Trench 1-5 did reveal that the channeling identified in one stratum in Trench 1-4 appeared to run parallel to the base of the bluff. This channeling is interpreted as representing a historical-period flood deposit.

A graphic presentation of the results of bucket augering and five of the trenches at LAN-2769 shows that soils in the LAN-2769 area are highly mixed, probably the result of disturbance from historical-period and Hughes Aircraft Company–era activities (Figure 64). Trenches 1-2 and 1-3, for example, were placed only 10 m north and 5 m south of BA 251, but look very different from each other. Trench 1-2 follows a similar pattern as observed in BA 251, with only slight variation between the depths of

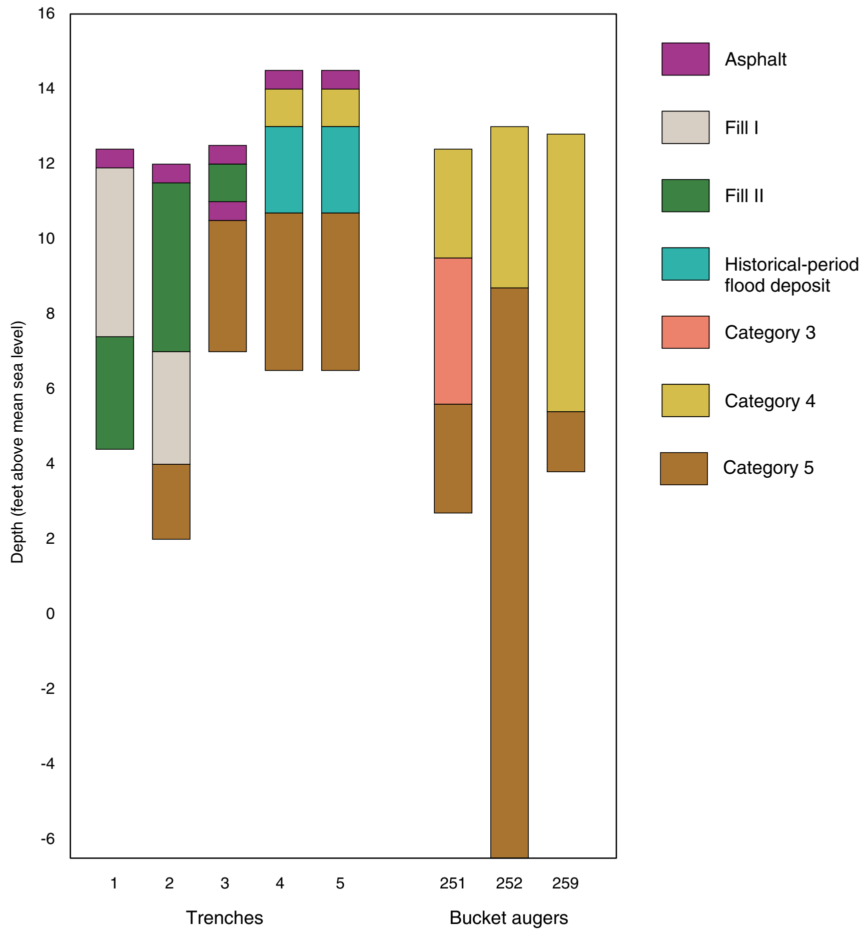

Figure 64. Schematic soil profile of LAN-2769.

native soil. In Trench 1-2, we found native soil at about 1.22 m AMSL, whereas in Trench 1-3, native soils were encountered at a much shallower depth, at 3.2 m AMSL, suggesting that the prehistoric alluvial fan may be partially intact near the base of the slope. Trenches 1-1 and 1-2 illustrate the severity of modern and historical-period disturbances in the area. In Trench 1-1, fill type I (fill that appears intentionally placed during construction, see Table A.2) overlies fill type II (sediment that was redeposited as part of either modern construction or earth-moving activities), whereas the opposite sequence is seen in Trench 1-2, located approximately 35 m to the west.

Manual Excavation

Trenching was partially successful in establishing the site boundaries at LAN-2769. We discovered no intact cultural deposits in the north end of the parking lot, suggesting that we had correctly mapped the site's northern limit. However, on the southern perimeter at the base of the slope, standing structures prevented mechanical trenching. SRI hand-excavated units in this area to provide controlled information on the horizontal and vertical distribution of prehistoric cultural materials (if present), to obtain fine-grained geomorphic data to establish the integrity of the deposit, and to tie the cultural materials to the site stratigraphy.

We excavated a total of nine 1-by-1-m units in this site (see Figure 31). The units were placed judgmentally in the toe slope in areas where cultural materials had been observed during the 1990 SRI survey of the property. Two 2-by-2-m blocks (Units 1 and 2) were excavated in 1-by-1-m quadrants. In Unit 2, at 1.2 m below ground surface, safety concerns dictated that we continue excavation in a single 1-by-1-m unit. Unit 3 was placed in the center of Unit 2 and was excavated 70 cm deeper. For purposes of analysis, Unit 3 was viewed as a continuation of Unit 2. We dry-screened all material in the field through ⅛-inch mesh screens, then sent the residue to the SRI water-screening facility to be water screened through ⅛-inch mesh screens for further removal of sediments. Sidewalls of the units were faced, and stratigraphic soil profiles were drawn. Results of stratigraphic analysis are presented below and are followed by a discussion of artifact density from the excavation units (Table 11).

Unit 1

Unit 1 was placed at the base of the slope on the south edge of the paved parking lot, close to the center of the site boundary as identified by the SRI survey in 1990 (Altschul et al. 1991). At the base of the bluff, where the toe slope meets the back slope, a weakly developed soil horizon is present that indicates at least a brief period of stability in the past.

Unit 1, a 2-by-2-m block, was excavated on the slope, with the high corner at 4.91 m AMSL and the low corner at 4.33 m AMSL. Excavation methods were previously described in Chapter 4. We excavated 1-by-1-m quadrants in arbitrary 20-cm levels to 90 cm below the surface. Individual provenience designations were assigned to each level by quadrant. Because Unit 1 was placed on a slope, the northern half of the unit was not excavated for the first two levels. Figure 65 details the soil profile of the south wall of this unit, and Table A.3 contains stratigraphic descriptions. The southeastern quadrant of Unit 1, excavated from the ground surface to a depth of 90 cm, was chosen for analysis.

Five layers (Strata 1a–1e) of redeposited fill or colluvial material overlay a sparse cultural deposit in Unit 1. All colluvial or fill strata contained modern debris, such as glass, cow bone, and fragments of rubber, as well as a very small number of prehistoric cultural artifacts. The upper strata likely represent a combination of fill and modern "slope wash" created during the construction of the sewer line in the 1920 on the slope of the hill above. The modern and historical-period materials seen in Stratum 1 are recent litter.

Level 2, which crosscut three strata, had the highest density of lithic artifacts and vertebrate fauna in Unit 1, though these densities were still very low considering the 20-cm thickness of levels excavated. Vertebrate fauna counts may be inflated by intrusive taxa, such as rodents or reptiles (see Table 9). Several possible explanations could account for the cultural deposit in Unit 1: first, cultural materials may have been imported with fill for Hughes Aircraft Company–related activities from some unknown location; second, they may have originated at one of the sites on the bluff top or on the slope above LAN-2769, and subsequently been redeposited below by erosion or the construction of the sewer and its associated service road; third, the cultural deposit is in situ, albeit highly disturbed.

If the source of the cultural deposit in Unit 1 is imported fill, we would expect an even distribution and an abrupt contact with the lower strata. In fact, the contacts between Strata 1a, 1b, 1e, and 2a are abrupt, indicating that these strata have been recently introduced. The fact that Strata 2a and 3a appear to be A horizon materials but without an underlying B horizon adds credence to this argument. The contact with underlying Stratum 4a, however, is diffuse and appears to represent an intact soil.

Cultural materials in Unit 1 may also represent an aggraded deposit which has eroded from the bluff tops or been redeposited during construction of the sewer line. A small prehistoric site (LAN-2379) , about which very little is known, was recorded by Chester King in 1995 on the bluff above and slightly east of LAN-2769 (see Figure 5). During housing construction in this area, cultural materials from this site might have been graded and pushed to the edge of the bluff for slope stabilization, after which, erosion brought them down the bluff face. Unfortunately, we cannot investigate this possibility further, as no data are available from LAN-2379 for comparison with the LAN-2769 collection. If culture-

Table 11. LAN-2769 Artifact and Ecofact Densities

Level, by Unit	Strata	Soil Horizon	Depth (m)	Sample Volume (m^3)	Lithic Artifacts		Vertebrate Fauna		Invertebrate Fauna	
					Count	Density (/m^3)	Weight (g)	Density (g/m^3)	Weight (g)	Density (g/m^3)
Unit 1 SE										
1	1a–e, 2a	colluvium or fill	0–0.3	0.10	2	20.00	0.10	1.00	—	—
2	1b, 2a, 3a	colluvium or fill, A1b, A2b	0.3–0.5	0.12	3	25.00	12.0	102.92	—	—
3	3a, 4a	A2b, C1b	0.5–0.7	0.20	1	5.00	11.10	54.57	—	—
4	3a, 4a, 4b	A2b, C1b, C2b	0.7–0.9	0.20	1	5.00	5.50	27.50	—	—
Unit 2 SE										
1	1f, 1g, 3b	C1, C2, 2Ab	0–0.4	0.21	—	—	—	—	—	—
2	1g, 3b	C2, 2Ab	0.4–0.6	0.20	—	—	—	—	1.00	5.00
3	3b	2Ab	0.6–0.8	0.20	2	10.00	—	—	—	—
4	3b	2Ab	0.8–0.9	0.10	1	10.00	—	—	—	—
5	3b	2Ab	0.9–1.0	0.10	1	10.00	—	—	—	—
6	3b	2Ab	1.0–1.1	0.10	—	—	—	—	—	—
7	3b	2Ab	1.1–1.2	0.10	—	—	2.0	20.00	—	—
Unit 3										
1	3b	2Ab	1.2–1.3	0.10	2	20.00	—	—	—	—
2	3b	2Ab	1.3–1.4	0.10	—	—	—	—	—	—
3	3b, 4c	2Ab, 2ACb	1.4–1.5	0.10	3	30.00	—	—	—	—
4	4c	2ACb	1.5–1.6	0.10	2	20.00	—	—	—	—
5	4c	2ACb	1.6–1.7	0.10	3	30.00	0.3	3.00	2.59	25.90
6	4c	2ACb	1.7–1.8	0.10	5	50.00	2.0	20.00	—	—
7	4c	2ACb	1.8–1.9	0.10	6	60.00	—	—	—	0.00

Note: All units are 1 by 1 m.

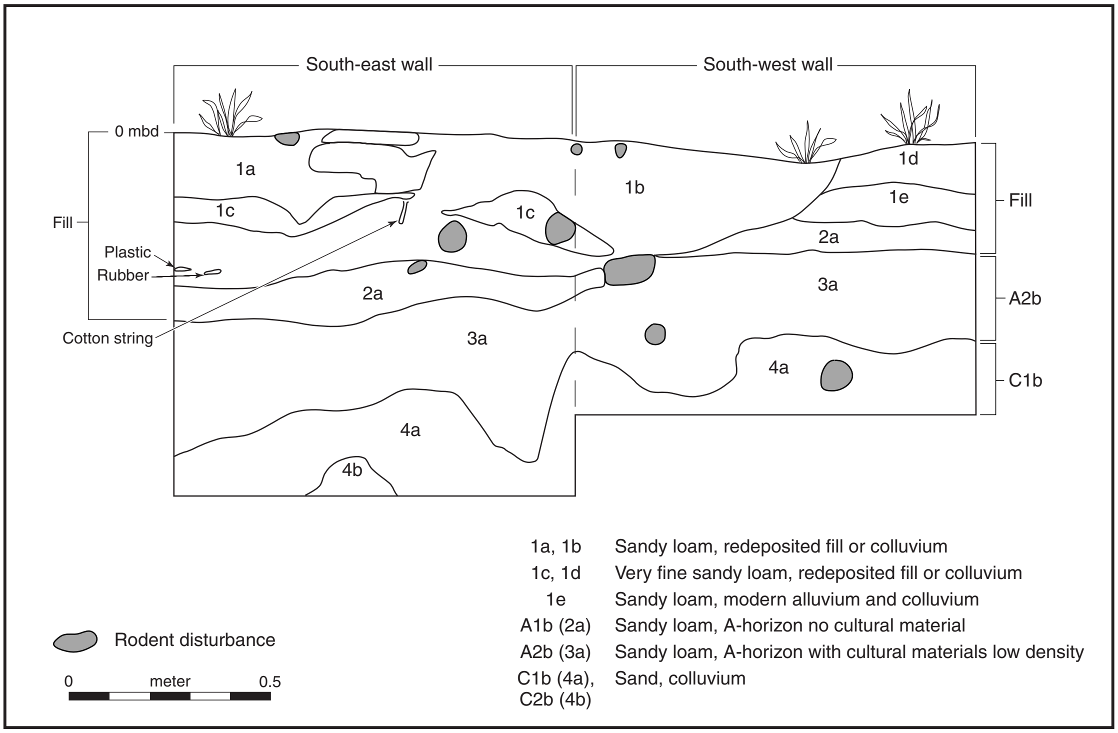

Figure 65. Stratigraphic soil profile of Unit 1, LAN-2769.

bearing soils had been brought down by erosion, the result would likely look very similar stratigraphically to that outlined above and is probably the case for at least the upper portion of the potentially intact Stratum 4 deposit.

Lastly, Stratum 4 of Unit 1 may represent an intact, very sparse, in situ deposit. The lower contacts between the A horizon Strata 2a and 3a are gradual and appear natural, as does the contact between Stratum 3a and the underlying Stratum 4a. However, both the soil profile and the excavation notes describe a large amount of natural disturbance in these strata. Any analysis of prehistoric cultural materials found at Playa Vista must factor in a high degree of disturbance from bioturbation. Numerous recent rodent holes were visible in the soil profile, and we assume that there were many more which are no longer visible. The sparse prehistoric deposit found in this location may have been diffused throughout the strata by the many agents of bioturbation.

A number of factors complicate the analysis of the integrity of the Unit 1 cultural deposit, but it is clearly highly disturbed. We conclude that Unit 1 is a secondary deposit.

Units 2 and 3

Units 2 and 3 were excavated farther up the slope and south of Unit 1. Unit 2 was a 2-by-2-m block, which terminated at a depth of 1.2 m below ground surface. We placed Unit 3, a 1-by-1-m unit, into the center of the floor of Unit 2, and continued excavating another 70 cm to a depth of 1.9 m below the highest corner of Unit 2. Unit 2, like Unit 1, was excavated on a significant slope; the sloping portion of the unit was taken down in three partial 10-cm levels. At the end of level 3, excavation proceeded in arbitrary 10-cm levels.

The first two levels of Unit 2, excavated almost entirely through modern trash-filled alluvium and olluvium, yielded almost no prehistoric cultural material (Figure 66). Stratum 1g soils, which dominated

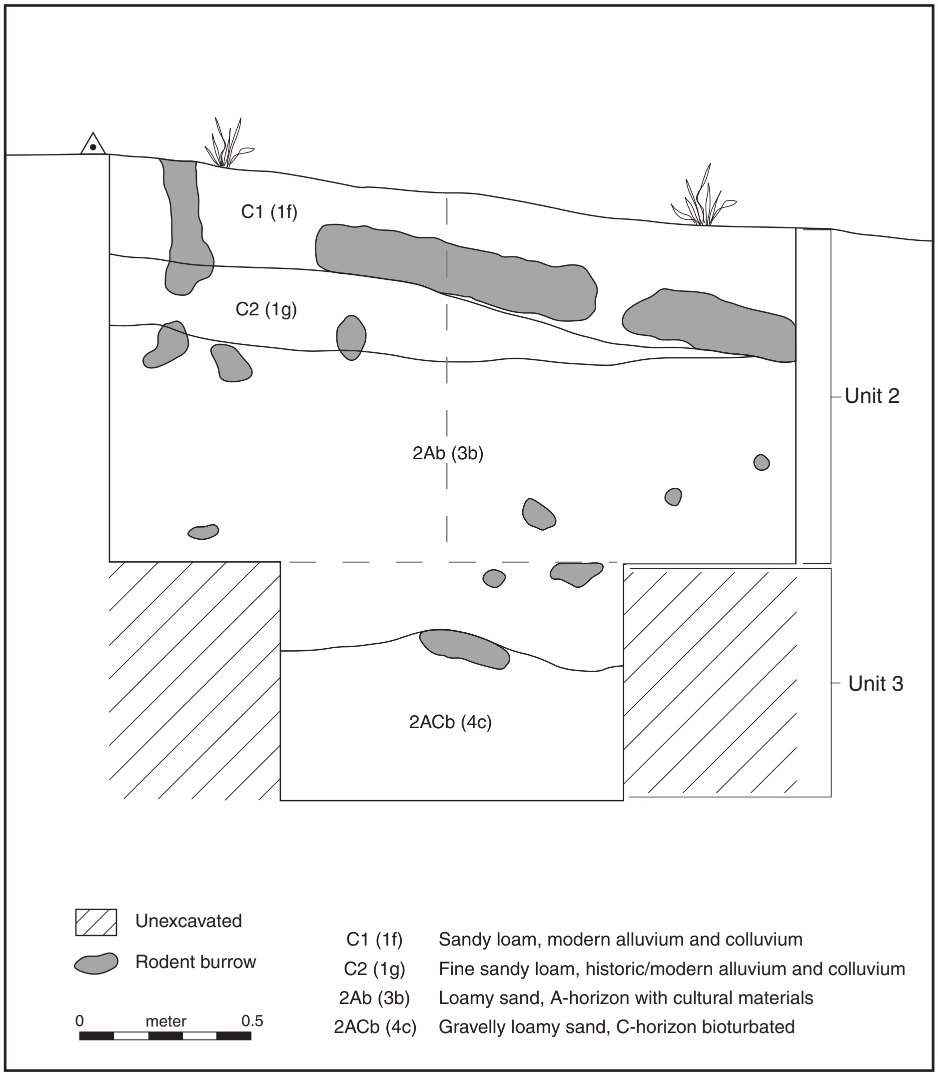

Figure 66. Stratigraphic soil profile of Units 2 and 3, LAN-2769.

Level 2, included sandstone chunks representing the bedrock underlying the bluff that was likely cut into when the trench for the sewer line was excavated and transported downslope. A small portion of the bottom of Level 2 reached Stratum 3b, a heavily bioturbated A horizon that contained lithics, marine shell, and a small amount of vertebrate faunal material. Stratum 3b was approximately 80–90 cm thick, and the contact between it and Stratum 1g was abrupt, whereas the contact with the underlying Stratum 4c was gradual, suggesting that at least a portion of this stratum was intact. Stratum 3b graded into Stratum 4c within Level 3 of Unit 3.

Curiously, Stratum 4c, a bioturbated C horizon, contained higher densities of shell, vertebrate fauna, and lithics than Stratum 3, and the amounts increased with depth. One possible explanation for the increase may be that artifacts were transported down into this stratigraphic layer by bioturbation. The actual numbers of artifacts recovered are quite low and reflect the small sample size; nevertheless, it appears that a sparse, intact prehistoric cultural deposit was found in Units 2 and 3 at LAN-2769.

Summary and Conclusions

A three-phase strategy was employed to locate and evaluate known and previously unknown cultural resources within Area D. The three phases were (1) bucket augering to find sites, (2) trenching to define site boundaries, and (3) manual excavation to assess site integrity and obtain controlled samples. This strategy resulted in redefining the boundaries of three sites. The boundary of LAN-62 was substantially expanded; the site now covers the area previously recorded as LAN-211 (Thiel 1953). The designation of LAN-211/H was moved east to encompass a cultural deposit identified in 1990 as SR-13. The trinomial was also changed from LAN-211 to LAN-211/H, to reflect the fact that it is a multicomponent site covering a total of 23,270 m^2 (5.75 acres).

LAN-2769 is the trinomial given to the cultural deposit previously known as SR-12. LAN-2769 contained a very sparse cultural deposit that may be highly disturbed, if not secondarily placed. At the base of the bluff, intact sediments were identified, although investigations did not find intact cultural materials. We infer from these observations that the slope that currently exists above LAN-2769 is probably a by-product of the construction of sewer line and Cabora Drive along the bluff face. Bucket augers and trenches in the lower parking lot clearly indicate extensive disturbance. Culture-bearing deposits found in that area likely have no stratigraphic integrity. At final mapping, LAN-2769 covered 3,240 m^2 (0.07 acres).

Current conditions at the site present a false impression of its appearance in prehistory. Most likely, the inhabitants of LAN-2769 resided on the toe slope of a gradual alluvial fan that extended out into the wetlands. Much of the site has been truncated, and the remaining sparse deposit—probably peripheral to the original site core—has been covered by a significant amount of recent and historical-period alluvial and colluvial materials and possibly imported fill.

By contrast, intact cultural deposits were located in several areas at LAN-211/H. Excavations on the large bench at the base of the bluff revealed a thick, intact deposit covering a relatively large area. Surprisingly, a very dense, intact deposit was found buried below the paved parking area. Numerous artifacts and high densities of vertebrate and invertebrate fauna were collected from a unit placed into this deposit. Differences in relative densities of various artifact classes between units may be an indication of internal site structure.

Radiocarbon dates were derived from four samples of marine shell collected from two unit blocks at LAN-211/H. The results indicate that at least two components are represented, one dated to the Late period and the other to the protohistoric period. The date range may reflect temporally distinct loci at the site or it may be a function of sample size. The stratigraphic context for dates collected from Units 6 and 10 was questionable, whereas that for Unit 9 appeared intact.

Bucket augering throughout Area D revealed cultural remains scattered throughout the project area. Many of the cultural materials recovered were found in highly disturbed contexts used as fill for Hughes Aircraft Company–era activities. As with most areas at Playa Vista, the nature of historical-period disturbance is highly variable. Through the various testing phases, we have learned that the placement of individual bucket auger units, trenches, or excavation units of even moderate size can provide information only on a specific unit of space. A “swiss cheese” effect has been noted, meaning that, because of significant landscape modifications, the archaeological signature can change abruptly, both horizontally and vertically, across the project area. Small trenches placed only 20 m away from each other may reveal very different subsurface stratigraphic profiles. Experience in data recovery at LAN-2768 and LAN-193/H has shown us that locating intact cultural deposits requires extensive subsurface exposures. The three-phased strategy of bucket augering, trenching, and manual excavation achieved this exposure and was successful in accomplishing the goals of identifying and evaluating buried cultural deposits at the base of the bluff.

CHAPTER 7

Vertebrate Faunal Remains

David Maxwell

This chapter is organized in two parts: the first part consists of the analyses of the vertebrate faunal remains from LAN-211/H and LAN-2769; the second part compares the results from those sites to other sites in the Ballona. I begin with a discussion of the descriptive and analytical methods employed to study the vertebrate remains. The remains from each site are then described, with most of the attention being focused on those from LAN-211/H, by far the larger collection.

The second part of the chapter presents a series of synopses to highlight the patterning noted at other sites in the area. With this baseline established, LAN-211/H is discussed in the context of the Ballona in general and in relation to nearby LAN-1932/H in particular. The chapter concludes with a brief discussion of the evidence for both continuity and change during the protohistoric period.

Methods

All faunal materials recovered from the ¼-inch mesh screen and larger were analyzed. From the ⅛-inch mesh screen, a nonrandom sample of faunal remains, excepting the fish bones, was selected as described in Chapter 4. This strategy produced faunal material for analysis from four units at LAN-211/H (Units 4, 6/10, 9, and 11). Additional faunal remains from Units 1, 2, 3, 5, 7, 8 and 10 were also submitted for analysis. The relatively small faunal collection from LAN-2769 was analyzed in its entirety. Staff analyst Robert Mariani examined and identified all fish remains recovered larger than ⅛ inch. Results from all analyses are combined here.

As part of the ongoing PVAHP in the Ballona, faunal analysis has been previously conducted for several sites (Maxwell 1998a, 1999a, 1999b, 1999c, 2000). To maintain comparability and consistency, all have used the same methods of identification, description, and analysis. These are discussed in detail below.

Identification

Each recovered specimen was identified to as specific a taxonomic level as possible, beginning with class and skeletal element. Highly fragmentary specimens, lacking recognizable features such as muscle attachments or articular surfaces, were described simply as "unidentifiable." When possible, specimens were identified to the family, and frequently the generic, level. Identifications were made using the Zooarchaeology Comparative Collection, housed in Simon Fraser University (SFU) in Burnaby, British Columbia; fish were identified by Robert Mariani using his personal comparative collection, augmented with materials from the Natural History Museum of Los Angeles County. Additional osteology references included Yee Cannon (1987) for fish, Castro (1983) for shark teeth, Gilbert et al. (1996) for birds, Gilbert (1990) for mammals, Olsen (1968) for reptiles, and Hillson (1986) for teeth.

The majority of the genera and species reported are very common in the Los Angeles Basin, and their identification needs no discussion. However, several exceptions should be mentioned. A single shark tooth fragment was identified as great white (cf. *Carcarodon carcharias*) on the basis of morphology, using Castro (1983) as a guide. Several large bird bones were identified as swan (cf. *Cygnus* sp.) based on morphological similarities to specimens in the SFU faunal collection. Ten specimens of domestic cow *(Bos taurus)* were recovered from LAN-211/H; all were compared with other large ungulates (deer, moose, horse, caribou, and elk) to ensure a correct identification, and all matched positively with domestic cow. Also present were two fragments of pronghorn *(Antilocapra americana).* One of these was a fragmentary specimen of frontal (skull) bone, including the horn core, which allowed for positive identification following lengthy comparison with other horned and antlered species.

Size Classes

Each bone or fragment was attributed to one of four body-size classes. Sizes employed in this study are (1) large, indicating body size similar to a deer or larger; (2) medium, ranging from jackrabbit to coyote; (3) small, encompassing larger rodents through cottontails and skunks; and (4) very small, including most microfauna. Body-size classification of unidentifiable materials are gross estimates based entirely on “eyeballing” the specimen, rather than on metric criteria. Unidentifiable materials allow for overlap, and thus specimens are described as “medium to large” and so forth.

Taphonomy and Formation Processes

Because the study of taphonomy and other formation processes can potentially illuminate the factors leading to assemblage formation and deformation, it is important to record as many types of taphonomic data as possible for each bone. These are discussed below.

Weathering

Bone weathering has been of great interest for the past 20 years (see Behrensmeyer 1978; Lyman 1994; Lyman and Fox 1989) and is frequently used to infer differences and similarities in the depositional histories of different specimens and assemblages, particularly with regard to periods of surface exposure prior to burial. For the LAN-211/H and LAN-2769 collections, analysis of weathering follow the stages outlined by Behrensmeyer (1978), as these are well known and provide a comparative standard. It is, however, acknowledged that those stages were developed to describe patterns of diagenesis noted for large-bodied African animals, rather than the patterns of weathering present on small animals from coastal southern California. Therefore, these stages are employed on a descriptive basis only, and we do not assume they can be used to estimate the duration of exposure prior to burial (see especially Lyman and Fox 1989; Potts 1988). Further, there are no published descriptions of weathering stages for any non-mammalian species; thus, whereas obvious weathering is frequently noted on the bones of birds, reptiles, and fish, there are no criteria for describing these patterns. In this study, birds and reptiles are classified in the same descriptive stages as mammals; fish are classified simply as weathered or unweathered, rather than in stages. This allows for assessment of weathering damage to the entire collection, rather than just the mammalian portion.

Burning

Like weathering, the burning of bone has received considerable attention (Lyman 1994; McCutcheon 1992; Nicholson 1993; Stiner et al. 1995). Burning, however, is perhaps less understood than bone weathering, and its interpretation is problematic. Szuter (1991) argued that patterns of burned bone at Hohokam sites are a reflection of the roasting of whole rodents, and burning results from deliberate human behavior. Bone burning also can occur incidentally to human behaviors, such as during wildfires or when refuse-bearing deposits burn (Maxwell 2003a).

For the present study, bone is classified as either unburned or burned; the latter state is further classified into the following categories:

Blackened: The entire specimen has been exposed to heat sufficient to turn it black, similar to charcoal. This is suggestive of exposure to low heat (240–440°C).

Calcined: The specimen has been exposed to heat sufficient to turn at least part of it white or gray, and the bone frequently takes on a chalky consistency. Calcination is suggestive of exposure to high heat (> 440°C).

Partial: Part of the bone is blackened, whereas other parts remain unburned. Partial blackening may be suggestive of exposure of only part of the specimen, possibly during roasting or similar activities.

Bone Completeness and the Fragmentation Index

In mainland southern California, rodent burrowing and historical-period agricultural practices frequently disturb the upper levels of archaeological sites, and bone collections are typically highly fragmentary. The fragmentation index (FI) has been developed as a means of assessing the degree of bone breakage present in a collection (Maxwell 1998b, 1999c). Fragmentary bone is described as a simple percentage of the original whole specimen; a complete specimen is given the value of 1.0, whereas a minute fragment is classified as 0.1; all other specimens fall within this continuum. FI is calculated as follows:

$$FI = \left(\frac{\Sigma c}{f}\right)100$$

where *c* is the numeric degree of completeness (e.g., 0.3, or 30 percent) and varies between 0.1 and 1.0, and *f* is the number of fragments.

The degree of completeness *(c)* of each specimen is estimated during initial examination, the *c* values are totaled, and the sum is divided by the number of specimens. For example, hypothetical Unit A contained eight bone fragments whose *c* values are 0.2 (n = 1), 0.3 (n = 3), 0.4 (n = 2), and 0.5 (n = 2). The sum of these *c* values is 2.9. This sum is then divided by 8 and multiplied by 100, producing an FI of 36. The higher the FI value, the lower the degree of fragmentation in the assemblage. A value of 100 indicates that none of the bone is broken, whereas a value of 10 demonstrates that the entire assemblage is highly fragmentary. Hypothetical Unit A has a low FI value, indicating that most of the bones have been broken and are relatively fragmented.

Low FI values are useful as indicators of postdepositional disturbance, such as plowing, at a site. Beyond this simple use, the FI is more valuable as a tool for recognizing intrusive specimens. Recently intruded bones should be less fragmentary than bones of long-buried specimens. Food bones are likely to show a high degree of fragmentation as a result of common food preparation practices; for example, the Gabrielino reportedly crushed small animals, bones and all, before adding them to soup or mush

(McCawley 1996:117). Rodent activity can also be responsible for fragmentation of bones buried in archaeological deposits, through scavenging, tunneling, and nest-building. Thus, taxa with a high FI value (meaning the bones are relatively whole) are more likely to be intrusive than taxa with a low FI value. This assumption has been supported in several previous studies (Maxwell 1998b, 1998c, 1999c).

Data from ORA-116, Newport Bay, demonstrated the utility of the FI (Grenda et al. 1998). At ORA-116, rodent disturbance was widespread, and faunal remains were abundant; further, the presence of house pits indicated considerable reworking of the deposits by the prehistoric inhabitants of the site. Thus, I hypothesized that bone completeness could be used as a proxy measure of which bones had been present at the time of house-pit construction, and which had entered the archaeological context later. When degree of completeness was calculated by taxon, it became apparent that only two taxa tended to be complete: rodents (particularly gophers) and reptiles (specifically, snakes). As noted, rodent burrows were found throughout the site, strongly suggesting that the bones of these animals were intrusive. The generally complete nature of the rodent bones further intimated that these remains had not undergone the same types of formation processes as the other bones at the site. Snake remains were more concentrated, but were found in an area with particularly large and notable rodent burrows. Snakes are known rodent hunters, and at this site, their bones were generally complete as well. Thus, the evidence from spatial analysis, combined with the FI values, strongly suggested that the snake and rodent component of the ORA-116 faunal collection was intrusive.

Being able to separate intrusive faunal elements from those reflecting cultural behavior represents an important increase in the accuracy and usefulness of faunal data. The "noise" level in the data is decreased, and we can be more confident that the bones we examine represent prehistoric food and resource residue, rather than postdepositional, intrusive species.

Mineral Staining

Bones stained by minerals in groundwater are commonly found in both archaeological and paleontological assemblages. Examination of the formation process involved has received very little attention, however (see Shahack-Gross et al. 1997), and its interpretation is unclear. In this study, mineral staining was recorded as a simple presence or absence variable; staining is distinguished from burning on the basis of color, with stained specimens appearing dark brown and burned specimens being blackened or calcined. The goal of recording such data was to recognize the presence of very recent intrusive specimens, based on the assumption that recent bone would be less likely to be stained than bone that has been in the assemblage for a longer period of time.

Other Formation Processes

A number of other taphonomic indicators have been recorded for this collection; most of these tend to be rare finds. *Cut marks* have only been identified macroscopically, and are very rare. They are seen as sharp, usually short, straight incisions into the bone, frequently running perpendicular to the long axis of the bone. *Gnawing* on bones by both rodents and carnivores is widely reported; however, evidence of this type of damage is extremely rare in the LAN-211/H collection and, thus, offers little insight into bone-scavenging activities. The scarcity of gnawing is a surprising observation, given the high frequencies of rodent bones within the collection. *Root etching* is recognized as a series of very small indentations into a bone. These are jagged and angular, rather than straight like a cut mark, and typically mineral stained, whereas the surrounding matrix is not. Root etching should occur primarily within the root zone; high frequencies of root-etched bone in deeper subsurface contexts may show areas of heavy rodent disturbance or a prolonged buildup of soil deposits. *Caliche* (calcium carbonate) coating on bone is assumed to indicate the presence of groundwater with a high degree of calcium in it, quite likely due to dissolved shell. *Water rolling* of specimens is recognized by the presence of gently rounded and lightly polished edges on bone, where edges might be expected to be sharp. This type of damage suggests that parts of the collection were transported by water action, even if only over a very short distance. Water-rolled bone is distinguished from worked bone by the lack of an obvious form, and by the presence of rounding and polishing over the entire specimen, rather than only in certain places.

Vertebrate Faunal Remains from LAN-211/H

Of the nearly 3,800 bones analyzed and described from LAN-211/H, roughly 80 percent were identifiable to at least the class level (Table 12). Bony fish, reptiles, and birds were found in unusually high frequencies in comparison with other lowland Ballona sites; mammal bones were much less common than in other sites. Taphonomic damage, including burning and weathering, were surprisingly uncommon in this collection. Bone fragmentation patterns strongly suggest the presence of a large number of intrusive reptiles (especially snakes) and rodents. Also present were several specimens of domestic cow, including three exhibiting cut marks. LAN-211/H yielded several exotic faunas, including great white shark, pronghorn, and swan. Whereas these species suggest long-distance interaction, a local origin cannot be ruled out. Finally, the LAN-211/H vertebrate data helped determine that the site was occupied at or near the historical period. Ten specimens of domestic cow *(Bos taurus)* are present in the collection, clearly indicating that at least some portions of the site were occupied after contact.

Several research questions were posed during the study of these remains:

Spatial comparison. How similar is the vertebrate collection from LAN-211/H to that of other sites from the Ballona? In particular, is this “lowland” collection (Maxwell 1999a) similar to other “lowland” collections? Is it more similar to collections from bluff-top sites? Is it unique?

Chronological comparison. How similar is the LAN-211/H collection to other protohistoric-period collections in the Ballona? How similar is it to collections from Late period sites? Intermediate period sites?

Wetlands adaptations. Can we learn anything from this collection about patterns of human adaptation to the wetlands through time?

As will be discussed later in this chapter, the comparison of the LAN-211/H vertebrate collection with those from other sites in the Ballona raised a fourth set of questions:

Taphonomic processes. Is weathering always more severe in older sites than younger sites? Did sites along upper Centinela Creek undergo different formation processes than other sites in the Ballona wetlands?

Table 12. Vertebrate Faunal Remains from LAN-211/H

Order, by Class	Family	Genus and Species	Common Name	Count
Chondrichthyes				
Carcharhiniformes	unidentifiable	unidentifiable	shark	6
	Lamnidae	*Carcharodon carcharias*	great white shark	1
	Triakidae	*Triakis semifasciata*	leopard shark	11
	Carcharhinidae	unidentifiable	requiem sharks	20
	Squatinidae	*Squatina californica*	Pacific angel shark	2
Rhinobatiformes	Rhinobatidae	*Rhinobatos productus*	shovelnose guitarfish	70
Myliobatidiformes	Myliobatidae	*Myliobatis californica*	bat ray	4
Unidentifiable			cartilaginous fish	4
Osteichthyes				
Clupeiformes	Clupeidae	*Sardinops sagax*	Pacific sardine	5
Batrachoidiformes	Batrachoididae	*Porichthys myriaster*	speckled midshipman	1
Atheriniformes	Atherinidae	*Atherinopsis californiensis*	jacksmelt	2
		Leurestes tenuis	grunion	4
Scorpaeniformes	Scorpaenidae	Sebastes sp.	rockfish	2
Perciformes	Cottidae	*Scorpaenichthys marmoratus*	cabezon	1
	Carangidae	*Seriola lalandi*	yellowtail	1
	Sciaenidae	*Genyonemus lineatus*	white croaker	2
		Menticirrhus undulatus	California corbina	13
		Roncador stearnsii	spotfin croaker	5
		Seriphus politus	queenfish	1
		Umbrina roncador	yellowfin croaker	1
		unidentifiable	unidentified croaker/drum	24
	Embiotocidae	*Amphistichus argenteus*	barred surfperch	352
		Damalichthyes vacca	pile surfperch	8
		Embiotoca jacksoni	black perch	1
		Hyperprosopon argenteum	walleye surfperch	93
		Rhacochilus toxotes	rubberlip surfperch	5
		unidentifiable	unidentified surfperch	53
	Labridae	*Oxyjulis californica*	senorita	2
		Semicossyphus pulcher	California sheephead	1
	Sphyraenidae	*Sphyraena argentea*	Pacific barracuda	1
	Scombridae	*Scomber japonicus*	Pacific mackerel	8
Unidentifiable			unidentifiable bony fish	356
Reptilia				
Squamata	unidentifiable		reptile	30
Squamata (Sauria)	Iguanidae	*Phrynosoma* cf. *coronatum*	coast horned lizard	1
Squamata (Serpentes)	Colubridae	unidentifiable	nonpoisonous snake	270
	Crotalidae	unidentifiable	poisonous snake	60
	unidentifiable		snake	38

Order, by Class	Family	Genus and Species	Common Name	Count
Chelonia	Testudinae	unidentifiable	tortoise/turtle	5
Unidentifiable			reptile	3
Aves				
Anseriformes	Anatidae	cf. *Cygnus* sp.	swan	7
		cf. *Anser* sp.	goose	1
		Anas sp.	duck	47
		unidentifiable	swan/goose/duck	5
	unidentifiable		swan/goose/duck	1
Falconiformes	Accipitrdiae	cf. *Aquila chrysaetos*	golden eagle	1
Charadriiformes	Laridae	*Larus californicus*	California gull	1
		Larus sp.	gull	1
cf. Passeriformes			passerines	2
Unidentifiable			bird	198
Mammalia				
Lagomorpha	Leporidae	*Lepus californicus*	black-tailed jackrabbit	2
		Sylvilagus sp.	cottontail	10
		unidentifiable	hares/rabbits	7
Rodentia	Sciuridae	*Sciuris* sp.	gray squirrel	18
	Cricetidae	*Peromyscus* sp.	mouse	1
		Neotoma sp.	wood rat	1
		Microtus sp.	vole	50
		unidentifiable	native mice/rats	1
	Geomyidae	*Thomomys* sp.	pocket gopher	70
	unidentifiable		rodent	277
Carnivora	Procyonidae	*Procyon lotor*	raccoon	4
	Mustelidae	*Martes pennanti*	fisher	1
		Lutra canadensis	river otter	1
		cf. *Mephitis mephistis*	skunk	2
		Taxidea taxus	badger	1
	Canidae	*Canis* sp.	coyote/dog	15
		unidentifiable	canid	6
	Felidae		cats	3
	unidentifiable		carnivore	15
Pinnepedia	Otariidae	*Zalophus californicus*	California sea lion	1
Artiodactyla	Bovidae	*Bos taurus*	domestic cow	10
		Antilocapra americana	pronghorn	2
	Cervidae	*Odocoileus* sp.	deer	74
	unidentifiable		hooved mammal	5
Unidentifiable			mammal	750
Unidentifiable				734
Total				3,792

Taxonomic Analysis

Cartilaginous Fish

Cartilaginous fish constitute only 4 percent of the vertebrate collection, consistent with other lowland Ballona sites (Maxwell 2000). These remains consist primarily of shovelnose guitarfish *(Rhinobatos productus),* bat ray *(Myliobatis californica),* and several species of shark. The majority of shark remains are lagoon species, such as Pacific angel shark *(Squatina californica)* and leopard shark *(Triakis semifasciata).* One specimen is worthy of note: a single tooth fragment, likely from a great white shark *(Carcharodon carcharias),* was recovered. Great whites are present in the area (Love 1996); whether this specimen was obtained through local fishing or by trade is unknown.

Bony Fish

Bony fish are a major component of the identifiable bone from LAN-211/H, making up nearly one-third of the vertebrate fauna. Identifiable specimens are predominantly barred surfperch *(Amphistichus argenteus),* accounting for more than one-third of the fish collection. Surfperch in general (family Embiotocidae) make up more than half of all bony fish remains recovered from LAN-211/H; slightly more than one-third of the material could not be identified to order, meaning that surfperch constitutes 86 percent of the identified bony fish. This extremely limited distribution of resources indicates that the inhabitants of LAN-211/H concentrated their fishing primarily on the nearshore coastal environment. This represents a switch towards open, coastal, fish resources and away from lagoon resources and probably results from increasing sedimentation of the lagoon itself, a change that will be discussed in more detail towards the end of the chapter.

Reptile Remains

Reptiles were found in surprising abundance among the LAN-211/H material (13 percent of identifiable bone); this represents nearly twice the frequency of any other site studied in the Ballona region. Most of the reptile remains were from snakes, and the vast majority (88 percent) of the snake remains come from the southwestern quadrant of Unit 9. This is highly suggestive of a nesting area or place of high food availability, such as a pit feature or other area used for refuse disposal.

Four varieties of reptilian remains are present: nonpoisonous snakes (family Colubridae) are the most common, and probably consist of king snake and gopher snake. Rattlesnake (family Crotalidae) is a distant second, including several burned specimens. Also present are a handful of turtle or tortoise (family Testudinae) carapace fragments, and a single specimen of coastal horned lizard *(Platyrhinos californicus).*

Bird Remains

Bird bone makes up 9 percent of the materials identified from LAN-211/H. Although three-quarters of the bird remains could not be identified beyond class, those that were show a remarkable consistency. Ninety-five percent of the identifiable bird remains are ducks, geese, and swans (family Anatidae). The most common form was identifiable only as duck (*Anas* sp.). Also present were several very large specimens tentatively identified as swan (cf. *Cygnus* sp.), with trumpeter swan the most likely variety. This is a surprising find, as trumpeter swan is considered a rare bird in this area today. Also present were specimens of gull, goose, and a single eagle talon.

Mammal Remains

The LAN-211/H material contains a wide variety of mammalian remains. Ten specimens of domestic cow *(Bos taurus)* demonstrate that some components of LAN-211/H date to the historical period. The cow remains consist of three vertebral fragments, small portions of a distal humerus and proximal metapodial, two complete phalanges, and three complete sesamoids. None shows any signs of mechanical butchery, despite half of the bones being potential meat cuts. The lack of mechanical butchery suggests that these bones are probably not intrusive modern refuse. They were concentrated in the upper levels of Unit 9; seven specimens were discovered in Level 1 of Unit 9, and a single specimen was found in Level 2. Of the two remaining fragments of cow bone, one was recovered from Trench 11, adjacent to Unit 9, and the second was located during nonintrusive monitoring prior to the excavation of Unit 9. With this clustering, we cannot rule out the possibility that these bones are the remains of an isolated bovine individual.

Three of the cow bones exhibit cut marks. Both phalanges have cut marks in a pattern ringing the diaphysis (shaft), whereas one of the vertebral fragments has two roughly parallel marks on the spinous process. According to Binford (1981:110–111), marks on the spinous process of a thoracic vertebra are consistent with removal of the tenderloin. Binford (1981:126) notes that cut marks on phalanges are rare in North America; he suggests that these occur during skinning if "great pains are being taken to skin out the foot in great detail." There are no signs of mechanical butchery, and the types of cut marks present seem consistent with butchery being conducted by someone very familiar with skinning and obtaining choice cuts of meat. Cut marks were also noted on a duck or goose element and a deer antler tine. It seems very likely that these marked bones indicate a protohistoric or historical-period component at LAN-211/H.

Of other large mammals recovered from LAN-211/H, deer (*Odocoileus* sp.) was the most common. Also present was a single specimen each of California sea lion *(Zalophus californicus)* and pronghorn *(Antilocapra americana).* Two pronghorn bones were recovered, a vertebral fragment and a portion of the frontal bone, including the horn core; whether these are part of the same individual cannot be determined, although both come from the same area of the site. Although rare, pronghorn were known in the greater Los Angeles Basin and were present in Antelope Valley, some 70 miles away, until 1933 (Jameson and Peeters 1988:225). In the Ballona, pronghorn remains were reported from two other sites: LAN-60, a tentative identification (Cairns 1994), and LAN-194, a historical-period site (King 1967).

Lubinski (1999) noted that pronghorn meat is musky in flavor, and ethnographically was not a favored food source if other large game (e.g., deer, bighorn sheep) were available. He suggested that pronghorn might have been hunted for its hide, which was used to make clothing. Techniques for hunting pronghorn were discussed by Lubinski (1999) and Arkush (1999); however, given the paucity of materials recovered at LAN-211/H, it is impossible to suggest how the animal(s) was taken, or whether it was hunted for its meat, its hide, or its antlers; the presence of a cranial element may indicate that the antler was used, possibly for tool manufacture. It is also possible that the skull or entire head had some ritual function. Pronghorn is not listed among the known biota of the Ballona (Friesen et al. 1981), either in historical-period times or at present.

A variety of carnivores also form part of the LAN-211/H faunal collection, including dog or coyote (*Canis* sp.), unidentified cat (family Felidae), river otter *(Lutra canadensis),* fisher *(Martes* cf. *pennati),* badger *(Taxidea taxus),* skunk (cf. *Mephitis mephitis*), and racoon *(Procyon lotor).* Carnivores constitute nearly 4 percent of the mammalian collection, and the diversity suggests that a wide range of prey animals was available for these hunters.

Rabbit and hare remains were not plentiful in the LAN-211/H collection, although specimens of both cottontail (*Sylvilagus* sp.) and jackrabbit *(Lepus californicus)* were present. These species do not appear to have been a major dietary component.

Rodent remains are abundant and make up 31 percent of the mammalian fauna at LAN-211/H. As is typical of southern California sites in general, gopher (*Thomomys* sp.) is the dominant form; however, LAN-211/H is unusual among Ballona sites in that vole (*Microtus* sp.) is also very common, and second in frequency only to gopher. Also recovered were several specimens of ground squirrel (*Sciurus* sp.), and single examples of wood rat (*Neotoma* sp.) and meadow mouse (*Peromyscus* sp.).

Formation Processes

LAN-211/H can be distinguished from other sites in the Ballona region by a marked lack of obvious taphonomic formation processes affecting the vertebrate collection. There are few instances of large-scale burning, concentrations of advanced weathering, or clusters of mineral-stained bones.

Weathering

More than three-quarters of the nearly 3,800 bones analyzed from LAN-211/H fall into Behrensmeyer's (1978) Stage 1; these exhibit little damage beyond the basic degreasing expected of bone buried under typical soil conditions. This pattern indicates that most of the materials recovered from LAN-211/H were buried rapidly. Another 10 percent of the bones fall into a range between Stage 1 and Stage 2 (Stage 1.5 in numerical tables), marked by slight defoliation and cracking, and indicating a short period of surface exposure prior to burial. Fewer than 15 percent of all bones fall into more advanced stages of weathering.

The few accumulations of heavily weathered, Stage 2 bone that were discovered were located away from the main bone concentration in Unit 9, suggesting a different depositional history. The bone collections from Units 4 and 6, though small, were found in concentrations which exhibit heavy weathering. The southern portion of Unit 4 at a depth of 170 cm contained a high frequency (60 percent) of bones displaying Stage 2.5 weathering, suggesting noncontinuous deposition, although the sample size—fewer than 50 specimens—is very small. Faunal material recovered from 60 to 70 cm deep in Unit 6 shows a similar pattern (66 percent of bone in weathering Stage 2 or greater), but with a sample of more than 200 pieces. Again, this suggests noncontinuous deposition, with much of the bone exposed on the surface for some time prior to burial.

Such patterning may be the result of refuse-disposal practices. If people occupying the bluffs above LAN-211/H were to dispose of their refuse by tossing it down the hillside (a practice Hayden and Cannon [1983] demonstrated to be quite common in the Maya highlands), then much of this material might be exposed on the surface prior to its eventual burial, and thus would exhibit a greater degree of weathering than would rapidly buried bone. Another possible explanation for the discontinuous areas of weathered bone would be localized erosion, leading to the exposure of buried bone. Future research should concentrate on the comparison of weathering patterns in bluff sites and lowland sites, as this may help to clarify these issues.

Burning

There is surprisingly little burned bone at LAN-211/H, with more than 85 percent of the collection showing no signs of such treatment. Further, what bone was burned was not found in any concentration; such materials were well distributed throughout the analyzed sample. Only a handful of exceptions exist:

the 1-by-1-m unit in the southern part of 2-by-2-m Unit 9 yielded nearly 250 specimens, of which 20 percent are burned; Level 3 and Level 6 of Unit 6 both yielded more than 200 specimens each, and have burn frequencies of 14 percent and 17 percent, respectively. None of these examples contains enough burned bone to suggest an area of repeated refuse burning, such as a hearth used for this purpose over a prolonged period of time; rather, these appear more likely to be isolated burning events. Minimally, these data suggest that refuse was not routinely disposed of by fire, at least in those parts of the site tested to date. Those specimens that were burned are blackened or partially burned, rather than calcined, indicating that very hot fires (greater than 440°C [McCutcheon 1992]) were rarely present.

Other Formation Processes

A variety of other formation-process indicators were recorded for the vertebrate faunal remains from LAN-211/H, including the presence or absence of mineral staining, water rolling, and caliche accumulation; however, analysis was not particularly enlightening. Only a handful of specimens showed signs of either water rolling or caliche; mineral staining divided the collection almost in half, with 47 percent of the specimens stained. There were few areas with high frequencies of mineral staining—which may be indicative of prolonged exposure to groundwater—or of low frequencies of staining, possibly indicative of intrusive specimens. Only one provenience, with a substantial bone collection of more than 800 bones, shows a high frequency of mineral staining (67 percent). This collection was recovered from the second level of the southwest quadrant of Unit 9, an area with a high concentration of bone, that possibly functioned as a catch basin; it is possible that water was retained with the bone in this area, and this resulted in the mineral staining observed.

Fragmentation

An FI value (Maxwell 1998b) was calculated for each order of vertebrate fauna recovered at LAN-211/H (Table 13), using the method described above. This index is designed to create a relative measure of bone fragmentation, leading to insights into likely intrusive specimens and food-processing behaviors. The LAN-211/H data conform to the pattern observed elsewhere in southern California, where those orders most likely to be intrusive (rodents, snakes) also show the least amount of fragmentation. Snakes from LAN-211/H, for example, have an FI of 0.92, indicating a very low incidence of fragmentation, and suggesting many in situ deaths. Rodents have an FI of 0.70, also demonstrating a low incidence of breakage and, therefore, a higher likelihood of burrow death. The high frequency of snake remains in a single locale (the southern quadrants of Unit 9), combined with the high FI argues for a burrow of some sort, with many of the remains probably intrusive. A similar pattern was observed at ORA-116 (Maxwell 1998b), where high frequencies of largely complete rodent and snake bones in the same context were hypothesized to be the result of a predator-prey relationship in a localized environment. Based on the preliminary data from LAN-211/H, a similar situation likely existed in the Ballona.

The other orders of vertebrate fauna from LAN-211/H have much lower FI values, making it unlikely that any are intrusive.

Table 13. LAN-211/H Fragmentation Index (FI) Values

Class	Order	FI
Chondrichthyes	All	0.61
Osteichthyes	All	0.56
Reptilia	Squamata	0.36
	Squamata (Sauria)	0.10
	Squamata (Serpentes)	0.92
	Chelonia	0.10
Aves	Anseriformes	0.52
	Falconiformes	1.00
	Charadriiformes	0.15
	Passeriformes	0.65
Mammalia	Lagomorpha	0.56
	Rodentia	0.71
	Carnivora	0.54
	Pinnipedia	0.90
	Artiodactyla	0.48

Vertebrate Faunal Remains from LAN-2769

A small bone collection (n = 1,235) was recovered from testing at LAN-2769; it consists almost entirely of mammal bones, with rodent remains the most common (Table 14). The analysis of these remains was approached with the three following research questions in mind: does LAN-2769 represent an intact archaeological site? Can we distinguish between site materials and intrusive remains? How does LAN-2769 compare with other sites in the Ballona in terms of faunal class representation and taphonomic processes? Analytical methods employed in this study are identical to those described for LAN-211/H.

Taxonomic Analysis

Fish Remains

LAN-2769 yielded only seven fish bones (four bony fish and three cartilaginous fish); all remains are vertebrae. This distribution suggests minimal use of both lagoon and open coastal resources. Burning is rare in the fish collection, with only a single cartilaginous specimen showing signs of exposure to heat.

Table 14. Vertebrate Remains from LAN-2769

Order, by Class	Family	Genus and Species	Common Name	Count
Chondrichthyes				
Unidentifiable	unidentifiable	unidentifiable	cartilaginous fish	3
Osteichthyes				
Unidentifiable	unidentifiable	unidentifiable	bony fish	4
Reptilia				
Squamata (Serpentes)	Crotalidae	unidentifiable	rattlesnake	5
	Colubridae		nonpoisonous snake	43
Squamata	unidentifiable	unidentifiable	snake or lizard	7
Aves				
unidentifiable	unidentifiable	unidentifiable	bird	15
Mammalia				
Rodentia	Geomyidae	*Thomomys* sp.	pocket gopher	120
	Cricetidae	*Microtus* sp.	meadow vole	8
	Sciuridae	*Sciurus* sp.	squirrel	5
	unidentifiable	unidentifiable	rodent	230
Carnivora	unidentifiable	unidentifiable	carnivore	1
Artiodactyla	unidentifiable	unidentifiable	artiodactyl	1
unidentifiable	unidentifiable	unidentifiable	mammal	631
Unidentifiable			bone	162
Total				1,235

Reptile Remains

Fifty-five reptile bones are present in the LAN-2769 collection; the majority (n = 48) were identifiable as snake remains. Nonpoisonous snakes (family Colubridae) are prevalent, with 43 specimens present. Rattlesnakes (family Crotalidae), recognizable by the presence of a haemal spine on the vertebra, are also present (n = 5), but turtle or tortoise remains are absent. None of the reptile specimens is burned.

Avian Remains

Fifteen bird bones were recovered from LAN-2769; none could be identified beyond the class level. Comparison with other sites in the Ballona suggests that ducks and their allies are the most likely specimens at LAN-2769. None of the bird bones appeared burned in any way.

Mammal Remains

Mammals are by far the predominant taxon at LAN-2769, constituting an astonishing 92.8 percent of all bone identified to the class level. Nearly two-thirds (63.4 percent) of the mammal bone could not be identified beyond class. Rodents are the dominant order (n = 363); no other order is represented by more than a single specimen. Gopher (*Thomomys* sp.), squirrel (*Sciurus* sp.), and meadow vole (*Microtus* sp.) are all present, with gopher by far the most common. Both artiodactyls and carnivores are very rare in the collection: only 18 bones from LAN-2769 come from animals larger than the small to medium (roughly jackrabbit- to coyote-sized) body-size class. This is a very unusual pattern and strongly suggests a high number of intrusive specimens.

Taphonomic Processes

Weathering

Weathering beyond Stage 1 is common in the LAN-2769 material, with 35.2 percent of the bones showing some signs of this type of damage. Most of the weathering is minimal (Stage 1.5), however, suggesting that surface exposure was not prolonged in most areas of the site. Bone from Provenience 1 is especially heavily weathered, with 29 of 30 bones recovered falling into weathering Stage 2.5 or higher. Heavy weathering may indicate that surface materials were collected or that this area was damaged prior to excavation. Other heavily weathered specimens tend to be widely dispersed throughout the site.

Burning

LAN-2769 has the lowest frequency of burned bone of any site this author has studied, with only 1.5 percent showing signs of exposure to heat. Typically, any archaeological site has about 10–15 percent burned bone, and all other sites in the Ballona analyzed by SRI have burn frequencies of at least 25 percent. The very low frequency seen at LAN-2769 is probably indicative of a very high number of intrusive specimens.

Other Formation Processes

A variety of other types of taphonomic data were recorded for the LAN-2769 collection; examples are exceedingly rare (cut marks, water rolling, root etching) and affect no more than five bones each, or are absent entirely (gnawing, caliche). The one common type of damage is mineral staining, which affects nearly three-quarters of the bone present.

Fragmentation Index

An FI value was calculated for each identifiable taxon from LAN-2769 (Table 15), and these calculations demonstrate that, in general, the bone recovered is not highly fragmentary. This finding is particularly notable in the case of rodents and snakes—taxonomic groups likely to be intrusive—which are very complete. All specimens identifiable to the family level tend to have high FI values, indicating a low degree of fragmentation; further, all taxa identifiable to the ordinal level have relatively high FI values also. The pattern of largely complete rodents and reptiles is typical of the Ballona sites studied to date and very suggestive of an intrusive origin.

Table 15. LAN-2769 Fragmentation Index (FI) Values

Class	Order	Family	FI Value
Chondrichthyes	unidentifiable	unidentifiable	1.00
Osteichthyes	unidentifiable	unidentifiable	0.38
Reptilia	Squamata (Serpentes)	Colubridae	0.96
		Crotalidae	1.00
		unidentifiable	0.43
Aves	unidentifiable	unidentifiable	0.20
Mammalia	Rodentia	Geomyidae	0.71
		Cricetidae	0.94
		Sciuridae	0.86
		unidentifiable	0.41
	Carnivora	unidentifiable	1.00
	Artiodactyla	unidentifiable	0.30

Regional Comparison

Sufficient faunal analysis has been conducted on sites in the Ballona for distinctive local patterns to emerge. Previous studies demonstrate that significant variation exists between sites located along the bluff tops and those located in the lowland areas along the creeks and around the lagoon edge. Such differences are generally unsurprising, given the microenvironments of these regions; what is surprising is that the patterns found are in almost direct opposition to what was expected, with lagoon fish dominant in the bluff-top sites and terrestrial mammals most common in lowland sites. This section provides a summary of the vertebrate fauna recovered from different sites in the Ballona and serves as a background for the comparative studies that follow. Figure 67 provides proportional representation by faunal class for each site. Sites are classified by topographic setting and the dominant temporal component. The discussion begins with the bluff-top sites and continues with those in the lowlands.

Bluff-Top Sites

The faunal material from the bluff-top sites shows a high degree of consistency (see Figure 67). The collections from most sites are dominated by lagoon fish species, particularly bat rays, guitarfish, and other cartilaginous fish. Bony fish and terrestrial fauna were also found, although generally in very small numbers, suggesting that the acquisition of both of these types of resources was secondary to catching rays. Physical proximity of these sites to the local lagoon makes the high frequency of lagoon fish species unsurprising. It is intriguing that these animals were transported so far from their place of capture prior to their entering the archaeological record. Transport of fauna indicates the bluff-top sites were probably used for fish-processing activities such as drying or smoking. To date, none of the bluff-top sites has been studied with respect to taphonomic processes, making comparison with the lowland sites impossible.

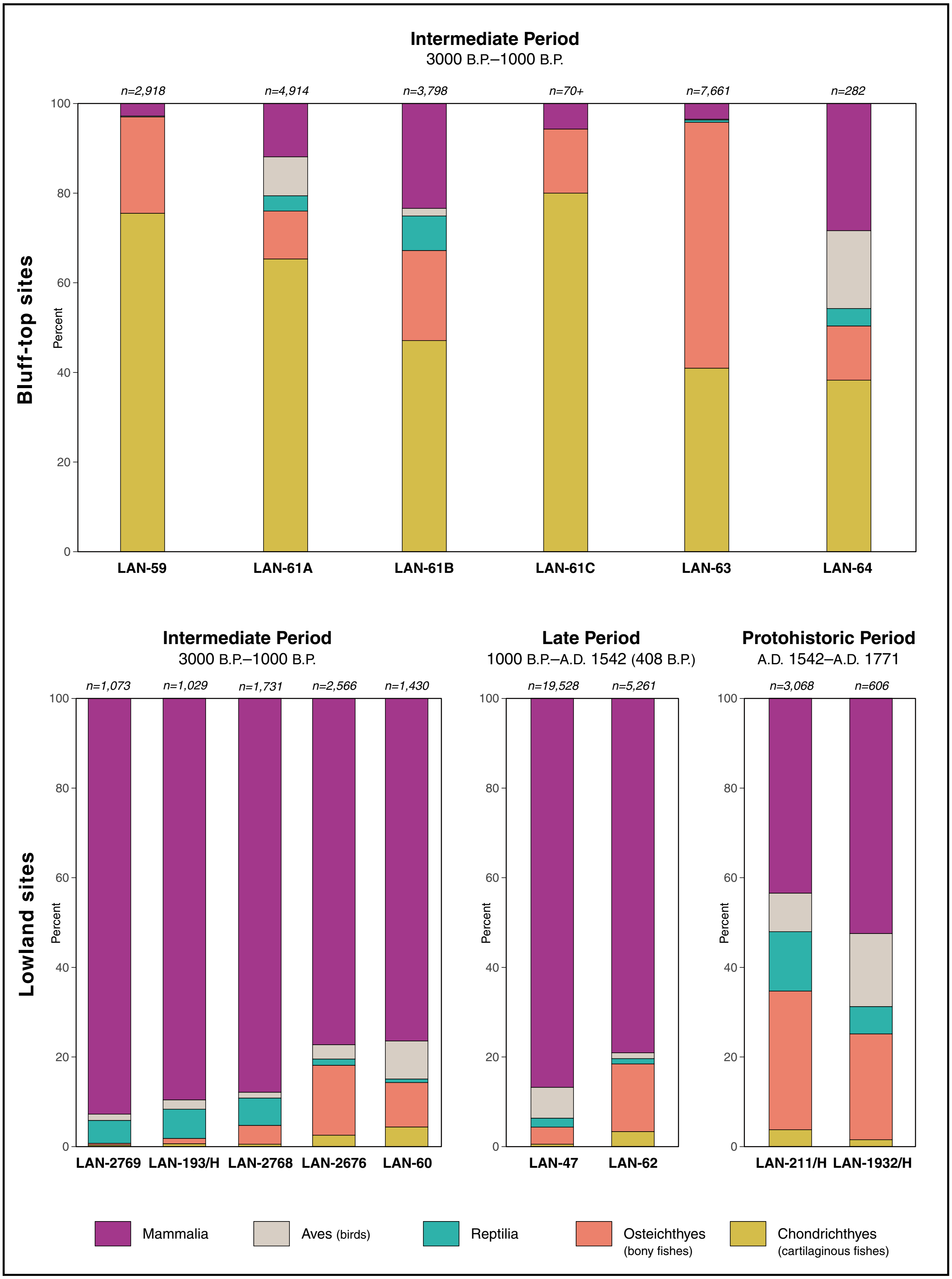

Figure 67. Faunal classes from bluff-top and lowland sites by temporal period.

The Hughes Site (LAN-59)

From the Hughes site, a terminal Intermediate period bluff-top site, Colby (1984) reported nearly 1,000 specimens of nonfish bone, although fewer than 100 of these bones were identifiable. The materials were dominated by pocket gopher, which accounted for nearly half of the identifiable remains. Unusual animals were rare, with only bobcat, weasel, grasshopper mouse, and horse (all tentative identifications) being out of the ordinary. The faunal report for this site was brief and preliminary, and birds were mentioned only in passing, with several specimens attributed to ducks. Taphonomic processes were not mentioned.

The Hughes site was dominated by fish remains (Salls 1988), particularly cartilaginous specimens; thus, LAN-59 is an archetype of the bluff-top pattern in the Ballona: high frequencies of cartilaginous lagoon species and low frequencies of terrestrial fauna. More than three-quarters of the 2,830 fish bones identified were cartilaginous, indicating an intense utilization of the bay estuary habitat. Guitarfish (23 percent) and angel shark (21 percent) dominated the Chondrichthyes collection, followed by thornbacks and bat rays (11 percent each), and smoothhound sharks (10 percent). Surfperch (22 percent), croakers and drums (13 percent), and flatfishes (11 percent) were the dominant forms among the 627 bony fish recovered. This distribution suggested that open coastal habitats were fished but were secondary to the local lagoon. Bony fish indicated seasonal use of the area, with the surfperch captured locally during winter and spring, the croakers and drums nearshore during the summer, and the mackerels offshore during the summer. The other common taxa were probably taken locally throughout the year.

The pattern at LAN-59 is one of heavy predation on cartilaginous fish, suggesting an economic emphasis on the lagoon itself. All other types of fauna were secondary and probably of little specific importance. It is also apparent that the site has undergone some degree of rodent disturbance, as is typical for mainland southern California.

The Marymount Site (LAN-61A)

LAN-61A, on the east side of the Lincoln Gap, dates primarily to the Intermediate period; nearly 1,100 nonfish specimens were collected at the site (Colby 1985), which showed a rather different pattern than other sites in the area. A high proportion of rabbit remains (19 percent) and a relatively low number of rodents (17 percent) suggested that although intrusive specimens were present, they were not the dominant fauna. Pinnipeds (seals and sea lions) were also important, accounting for almost 7 percent of the collection and indicating that marine hunting was practiced in the area (Brown and Smith 1985a). Reptile remains were common (14 percent), and, surprisingly, were dominated by turtle or tortoise fragments (75 percent) rather than the typical situation of intrusive snake vertebrae. Bird remains (Brown and Smith 1985b) were also found with surprising frequency (36 percent of all nonfish remains); however, the method of data presentation made it very difficult to determine which species were present. Minimally, it appeared that ducks and geese dominate the collection—a situation typical for the area.

Fish remains were primarily cartilaginous, with bat rays the most common (nearly one-quarter of the fish collection). Also found in high frequencies were guitarfish (13 percent), thornback (6 percent), and leopard sharks (5 percent). These species indicated fishing within the local lagoon environment, with a concentration on bottom-dwelling species. Rays account for more than 85 percent of the identifiable cartilaginous collection. Although uncommon, large oceanic sharks (makos, great whites) were also present, pointing to open-ocean fishing.

Bony fish accounted for only slightly more than 10 percent of the bone at the Marymount site; surfperch was the most common (16 percent), followed by croakers and drums (11 percent); other species were found only in low numbers. These species suggested that the site was used during more than one season, with surfperch probably taken during the winter and spring, and the croakers and drums during the summer. These species indicated that not all fishing was done in the lagoon environment. LAN-61A was also unusual in the high number of unidentifiable fish specimens (46 percent), suggesting a high degree of fragmentation-causing processes.

The pattern at the Marymount site is one of heavy predation on cartilaginous fish, suggesting an economic emphasis on the lagoon. All other types of fauna were secondary and probably of little economic importance. It was also apparent that the site has undergone some degree of rodent disturbance.

The Loyola Site (LAN-61B)

Nearly 3,800 bones were analyzed from the Loyola site (Brown and Smith 1985a, 1985b; Colby 1985), another mostly Intermediate period site on the east side of the Lincoln Gap. Nonfish remains accounted for almost one-third of the material. Gophers were the most plentiful taxon (33 percent), and rodents in general accounted for 35 percent of the collection. The high numbers of rodent remains suggested that postdepositional disturbance processes were important at this site, and the high frequency of snake remains (18 percent) was also indicative of the same type of disturbance. Thus, the probably intrusive fauna accounted for more than half of the terrestrial bones.

Two mammalian species are of interest in this collection: rabbits were plentiful at LAN-61B, representing one-quarter of all mammals. Rabbits were probably taken when available as a dietary supplement. Pinnipeds were also found in some quantity (6 percent), suggesting maritime hunting.

Cartilaginous fish were the dominant fauna at LAN-61B, constituting nearly half of the collection. Bat rays were the most common (30 percent), followed by guitarfish (19 percent), thornbacks (6 percent) and leopard sharks (10 percent). These species indicated fishing within the local lagoon environment, with a concentration on bottom-dwelling species. Rays made up over 80 percent of the identifiable cartilaginous collection. Bony fish accounted for 20 percent of the collection, and surfperch was the most common bony fish at LAN-61B (23 percent), followed by mackerels and tunas (15 percent); other species were found in low numbers only. The presence of these fish demonstrated that this area was used during multiple seasons: the surfperch suggest a winter-spring occupation, whereas the mackerels are a warm-water taxon and were probably caught during the summer. Fragmentation also appears to be high at this site, with 40 percent of the fish remains unidentifiable beyond class.

The pattern observed at LAN-61B is consistent with a generalized resource-gathering strategy. The adaptation concentrated on the collection of cartilaginous fish in the lagoon and was supplemented with bony fish and terrestrial resources.

LAN-61C

LAN-61C, the third of the Loyola-Marymount site loci, had a sparse terrestrial fauna collection. Only four specimens were reported (Colby 1985), although, interestingly, three of these were pinnipeds. The cartilaginous fish collection from LAN-61C was also very small, with only 56 specimens present. Bat ray was most common (36 percent), followed by guitarfish (23 percent); rays made up over 80 percent of the identifiable cartilaginous fish, suggesting an emphasis on fishing within the local lagoon environment, with a concentration on bottom-dwelling species.

The Del Rey Site (LAN-63)

The Del Rey site is an Intermediate period occupation on the bluffs; faunal remains recovered from the site are difficult to interpret due to contrasting analytical styles (Colby 1987a; Salls 1988). Colby displayed nonfish data by weights and minimum number of individuals (MNI) values, whereas Salls presented fish remains by count. Based on these data, nonfish remains account for slightly more than 4 percent of the bone recovered. Of the minimum of 315 terrestrial animals present at this site, more than 80 percent of the collection was mammalian. Forty-eight taxa were reported, although only gopher (*Thomomys* sp.), cottontail (*Sylvilagus* sp.), and deer (*Odocoileus* sp.) were represented by more than 10 individuals; this undoubtedly reflected the method of quantification (MNI) more than any other factor. Several unusual species were present in the Del Rey materials, including bobcat *(Lynx rufus),* opossum *(Didelphis marsupialis),* killer whale *(Orcinus orca),* two species of dolphin, Pacific loon *(Gavia pacifica),* albatross (*Diomedea albatrus*), great blue heron (*Ardea herodias*), and three species of snake. Most of the mammal specimens are common and likely intrusive, however; nearly 60 percent of the mammalian collection were rodents of some sort, and more than 40 percent of those fully identified were gophers. Rabbits were roughly 17 percent of the small terrestrial collection, suggesting that they functioned as a dietary supplement. Also present were carnivores (canids, eared seals) in small numbers (11 percent combined); these might have been hunted by humans, or might have been a natural component of the site. Colby noted a very high degree of fragmentation in most faunal remains and commented that medium to large mammalian bones were frequently burned (25–75 percent, depending on location). She argued that burning was indicative of food preparation and suggested that dogs were consumed on site. Other taphonomic factors were not described.

Salls (1988) reported on more than 7,300 fish remains; bony fish were the dominant form, an unusual circumstance for a bluff-top site in the Ballona, where cartilaginous fish are usually more numerous. The dominant taxa at LAN-63 were sardine (14 percent), guitarfish (13 percent), bat ray (11 percent), and surfperch (10 percent), indicating a strong mixture of bay estuary and open-water fishing. The presence of sardines and surfperch, two common families, suggested that the site was used throughout much of the year (though not necessarily continuously), as sardines are a warm-water species, implying summer capture, whereas surfperch are a cold-water species, and their presence indicated winter-spring fishing.

Unlike many sites in the Ballona area, the inhabitants of LAN-63 did not concentrate solely on local resources. The variety within the large collection of fish bone at this site demonstrated the habitual exploitation of various environments. Croakers, drums, and flatfish, for example, indicated the routine procurement of bottom dwellers, whereas sardines, tunas, and mackerels were taken in the open ocean. Nearshore species were also very common. Thus, a generalized fishing strategy can be posited for LAN-63. It is worth mentioning that LAN-63 has 11 specimens of freshwater sucker and is one of two sites in this area where freshwater fish remains were present.

The overall pattern at LAN-63 is indicative of its repeated use as a short-term fishing camp, probably recurring throughout much of the year. Burning was the only formation process recorded at this site, and evidence of it was not found in a high frequency. Just under 20 percent of the fragments from this site were burned, falling within the common background frequency of 15–20 percent.

The Bluff Site (LAN-64)

The Bluff site is an Intermediate period deposit located on the west side of the Lincoln Gap. Faunal remains suffered from the same problems as those reported from the nearby Del Rey site, in that two analysts took very different analytical approaches to the nonfish (Colby 1987b) and fish (Salls 1988) remains; the disparities make comparisons with each other and with other sites problematic. The nonfish collection was very small (140 specimens) with only 16 taxa reported; only eared seal, dolphin, and badger were at all unusual. Gopher and cottontail were the dominant fauna. At LAN-64, burning appeared to have particularly affected cottontail and bird remains (41 and 53 percent burned, respectively). Other taphonomic factors were not reported, although the collection was described as fragmentary. The low numbers suggest that terrestrial fauna contributed little to the total economy.

Fish remains from the Bluff site were scanty, with fewer than 150 reported. These were dominated by cartilaginous fish (76 percent), with bat ray the most common (33 percent), and only stingray, angel shark, and guitarfish found in frequencies greater than 10 percent. This distribution is consistent with estuary fishing. Bony fish were very rare at LAN-64, with only 34 specimens present. Sheephead and flounder were the most common (18 percent), suggesting that some bottom and kelp-bed fishing occurred in this area, although plainly lagoon fishing was more important.

LAN-64 seems to have been used only rarely for human habitation. The fauna collected from this site were probably captured locally. Burning was surprisingly common among the few terrestrial remains, with more than one-third of the terrestrial specimens affected in this fashion (burning was not recorded for the fish remains). Burning may reflect the disposal of animal remains into fires during the limited periods of site occupation.

The Berger Street Site (LAN-206)

Nonfish remains from the Early or Intermediate period components at LAN-206 (Colby 1997) were described by weight rather than count, making comparison with other sites in the area difficult (hence, LAN-206 is not on Figure 67). MNI values were also calculated, although none of the species identified was represented by more than two individuals. Colby noted that nearly half of the remains were burned, and suggested that this burning was indicative of food preparation. Based on this argument, she reconstructed the prehistoric diet as including raccoon, canid, rabbit, jackrabbit, turtle, bird, snake, squirrel, and possibly badger and sea otter. Colby stated that a high percentage of the large unidentifiable mammal bones were burned, and that these were probably deer. Fish remains consisted of 185 specimens (Salls 1997); two-thirds of these were cartilaginous. Bat ray and guitarfish were the dominant forms, constituting nearly half of the remains. Bony fish were less common, and few were identified in any quantity; croakers/drums and surfperch were the most common.

Lowland Ballona Sites

The lowland sites show a consistent—if perplexing—pattern (see Figure 67). Compared to the bluff-top sites, all contained relatively low frequencies of fish bone and relatively high percentages of terrestrial fauna, particularly mammals (Maxwell 1999a). Logically, one would expect sites near the lagoon or in riparian areas to have fauna indicative of localized fishing and that the faunal collection would be composed primarily of lagoon fish. Those fish that are present typically reflect a wide range of habitats, ranging from lagoon to open ocean. It appears that these sites were used for a variety of hunting and fishing activities but that fish processing was never a dominant practice in the lowland areas. This may indicate that the edge of the lagoon was not favorable for such behavior; if fish were preserved through drying or smoking, the lagoon edge might not have had a climate conducive to such activities—particularly if it was too damp to keep fires going. The trend at all lowland sites is toward short-term occupation at various times throughout the year, similar to the pattern identified by Van Horn (1987) for the bluff-top sites. Intrusion into these sites by burrowing animals, particularly rodents, seems to have resulted in heavy fragmentation of the bone in all the lowland sites.

The Admiralty Site (LAN-47)

LAN-47, a Late period site located on the edge of the historical Ballona Lagoon, yielded a large faunal collection that was overwhelmingly terrestrial, with mammals the dominant form (Sandefur and Colby

1992). LAN-47 was the only site in the area that yielded amphibian bones, although these composed only a small portion of the herpefaunal collection. The vast majority of the reptilian bone was snake, suggesting a high proportion of intrusive materials. The bird collection was indicative of the nearby marsh environment, with a very high proportion of ducks and geese (n = 410, 30.4 percent). Other birds expected for such an environment—rails, loons, grebes—were also present. There were few shorebirds in the collection, which suggests that nearby beaches were not exploited or that birds from this environment were not brought to LAN-47.

Of the nearly 2,300 mammalian bones identifiable to at least the family level, the dominant form was gopher (62 percent), indicating that there was considerable disturbance at LAN-47 and that rodent burrowing was an important site-formation process. Rodents accounted for 85 percent of the fully identifiable mammal bone from this site, and although some of these specimens might have been food remains, it is likely that the majority were intrusive.

Cartilaginous fish were rare at LAN-47: only 102 specimens were present. These were dominated by bat ray and guitarfish; combined, these composed nearly three-quarters of the Chondrichthyes collection, suggesting that sharks were not a targeted species at this site and that fishing was centered on the local environment. Bony fish were slightly more abundant, accounting for nearly 4 percent of the collection. Surfperch was the most common (21.5 percent), followed by silversides (18 percent), and flatfish (11 percent). From this, we conclude that fishing took place during the winter months along the local coast, away from the lagoon. The presence of silversides and the small quantity of sardines also provided evidence for nearshore and even pelagic fishing. LAN-47 is also the only site in the area with sea chubs (family Kyphosidae), probably taken from local kelp beds.

The overall pattern at LAN-47 was unclear, due to the high number of intrusive specimens and the high degree of fragmentation. Fish processing, however, did not appear to have been practiced to any great extent, as fish remains accounted for less than 5 percent of the bone present. Twenty-two percent of the specimens were burned, and, as Sandefur and Colby (1992) pointed out, this was a high percentage given the frequency of intrusive specimens. Although these authors suggested that roasting was a frequent means of food preparation, the burning was more likely the result of fires built in existing midden areas and of bone occasionally disposed into fires.

The Centinela Site (LAN-60)

LAN-60 is an Intermediate period site located on the bank of Centinela Creek (Grenda et al. 1994); vertebrate remains were analyzed by Cairns (1994) and Salls and Cairns (1994). Cairns (1994) studied more than 2,200 nonfish remains, identifying 13 species of mammals, 12 bird species, and 2 varieties of reptiles. Cairns noted that nearly 90 percent of the bones recovered were unidentifiable, indicating considerable breakage; she suggested (following Altschul and Shelley 1987) that at least some of the bone damage related to food-preparation techniques was to access bone marrow and grease. Cairns also reported that 12 percent of the collection exhibited signs of burning, with small rodents being the most frequently burned taxon; unfortunately, weathering and other taphonomic processes were not reported.

The Centinela site yielded cottontail, jackrabbit, tree and ground squirrels, pocket gophers and mice, kangaroo rat, wood rat, canids, racoon, skunk, deer, and pronghorn; avifauna consisted of Canada goose, scrub jay, falcons, northern harrier, and a variety of ducks. Reptile remains were undifferentiated lizards and snakes. Rabbits were also of some importance at LAN-60, constituting roughly 8 percent of all terrestrial fauna; these were probably taken for food, and, given the paucity of fish remains at this site, rabbit hunting might have been a primary focus of activity in this area. Birds were also common in the collection (10 percent of all terrestrial resources), suggesting that these might also have been hunted locally. The majority of the bird remains are unidentifiable, making it difficult to suggest whether they were hunted for food or feathers or were simply intrusive.

Salls and Cairns (1994) analyzed 205 fish bones and identified 27 species. The most common were shovelnose guitarfish, Pacific bonito, Pacific sardine, and shiner surfperch; no species clearly dominated the collection. Bony fish account for almost 70 percent of the recovered remains. Burning was less common in the fish collection (7 percent) than in the nonfish remains. Salls and Cairns suggested that fishing occurred year-round based on the species distribution present at LAN-60. They also posited that a variety of fishing strategies, such as beach seines, dip nets, hooks and lines, and lights, might have been employed to catch bay and estuary fish.

The Chondrichthyes collection at LAN-60 was very small, with only 63 specimens present. The most commonly identified species were guitarfish, thornback, and leopard shark. Rays made up nearly 90 percent of the identifiable cartilaginous collection. The presence of these species indicate that fishing took place within the local lagoon environment, with a concentration on bottom-dwelling species. The bony fish collection at LAN-60 was also very small, with only 142 specimens present. Surfperch was the most common, followed by mackerels and tunas, flatfish, and sardine. Worth noting was the presence of a single specimen of Santa Ana sucker, a freshwater species. The pattern at LAN-60 suggested fishing throughout the year, with surfperch taken during the winter and spring, and mackerels and sardines caught offshore during the summer; flatfish were probably taken throughout the year.

The faunal exploitation pattern at LAN-60 suggested short-term occupations repeated throughout the year for different resource-acquisition activities, including both nearshore and offshore fishing and the hunting of rabbits and probably birds. However, the extremely high frequency of intrusive rodent remains makes any other human-fauna interactions impossible to recognize.

The Peck Site (LAN-62)

Located at the confluence of Centinela Creek and the Ballona Lagoon, LAN-62 is considered crucial for understanding prehistoric cultural evolution in the Ballona. Unfortunately, previous excavations by Peck (1947) and Van Horn (Van Horn et al. 1983) did not systematically collect faunal remains. Thus, only SRI's limited testing program will be discussed here (Maxwell 1998a). Inferences from this analysis are considered tentative.

Testing at LAN-62 yielded a collection dominated by terrestrial mammal remains, with relatively few bony or cartilaginous fish present (despite a sample bias towards these remains). Unusual species were rare, with only intrusive fauna falling outside the standard Ballona range of snakes, ducks, rodents, coyotes, and deer. Fish remains from LAN-62 showed a high frequency of bony fish (15 percent of the site materials); surfperch was the dominant fish (41 percent of all bony fish), indicating that coastal fishing was more common than lagoon fishing and that this probably occurred during the winter-spring seasons. Cartilaginous fish were uncommon (3 percent of collection).

Formation processes indicated that the bone assemblage was transformed considerably after deposition. This was obvious from the high degree of fragmentation, which affected all nonrodent and nonreptile remains. Both burning and weathering also had dramatic effects on the assemblage. A high frequency of burned bone (approximately 30 percent) was noted, possibly due to the repeated use of this site. Repeated hearth construction in existing midden deposits can result in the burning of old bone in addition to anything disposed of into an active fire. Weathering is suggestive of prolonged breaks in the depositional sequence, such as would occur in the repeated cycle of site use and abandonment. If bones were left on the surface of the site and then the site was abandoned for some time, the bones will display a considerable amount of weathering. It appears that this process occurred on several occasions, resulting in concentrations of bones exhibiting heavy weathering.

The Hammack Street Site (LAN-194)

LAN-194, located north and east of the Playa Vista project, was tested by Chester King in 1967 (King 1967). His preliminary report gave only cursory attention to vertebrate fauna but mentioned the presence of three species of domestic animal: cow (*Bos* sp.), horse (*Equus caballus*), and goat (*Capra* sp.); horse was the most common find with six specimens present. None of the domestic fauna are described as butchered or otherwise modified, with the exception of a single horse metatarsal (cannon bone) used as an awl. A variety of other fauna were found, including ground squirrel, gopher, wood rat, kit fox, ring-tailed cat, pronghorn, turtle or tortoise, and unidentified birds and fish.

LAN-1932/H

This site contains a disturbed protohistoric component that was either mechanically mixed in place or redeposited from somewhere in the immediate vicinity. This component contained an unusual distribution of vertebrate remains (see Figure 67). Though superficially similar to the other lowland sites in having a relatively high frequency of mammalian fauna, LAN-1932/H was distinctive in its high proportions of bony fish and bird remains. With the exception of LAN-211/H, all other lowland sites had class distributions in which mammal remains accounted for at least three-quarters of the collection; at LAN-1932/H, mammals made up only slightly more than half. Further, at other lowland sites, the combined bony fish and bird remains yielded just 20 percent of the bones, whereas these accounted for nearly 40 percent at LAN-1932/H. These discrepancies may result from sampling error; to date, our analysis consists of only some 600 bones. However, this pattern is sufficiently distinctive to suggest a different resource exploitation pattern, possibly related to the late date of LAN-1932/H. The similarities of LAN-1932/H and LAN-211/H are discussed later in this chapter.

The unusual frequencies of vertebrate fauna may be attributed to cultural change brought on by European contact. Contact resulted in population movements, decimation by disease, and probably a breakdown in the traditional hunting and gathering lifeway. If the subsistence economy had shifted away from strict hunting and gathering towards the use of domestic crops, and trade for various resources, it may explain why this site looks so different from the others in the area. Of particular interest are the bird remains, as these are dominated by wing and shoulder elements. This may be evidence that aboriginal people were targeting specific species for their feathers, possibly to manufacture items for trade. Further analysis is needed to identify as many of these bird bones as possible, to determine which feathers might have been in demand (see Brown 1989 for discussion).

LAN-2676

LAN-2676 is a difficult site to interpret. Located on the lagoon edge, the site was heavily disturbed and there are no remaining intact deposits. Most evidence suggest the site was “flipped” in place when the runway was expanded by Hughes Aircraft Company in the 1950s. Thus, although internal site structure is gone, the faunal collection does provide information on lagoon edge adaptations through the Intermediate and Late periods and possibly extending into the protohistoric and historical periods.

More than 2,500 bones have been analyzed from LAN-2676 (Maxwell 1998a). These were dominated by mammalian remains, which accounted for three-quarters of the collection. This material was highly fragmentary and much was unidentifiable beyond class. Rabbits were found in some frequency but were not a dietary staple. Rodents were the most numerous identifiable specimens, and most of these might have been intrusive. Much of the reptilian bone was also probably intrusive, although a number of turtle or tortoise remains were present; these are unsurprising in a marsh environment, and might have been exploited as an occasional food source. Bird remains likewise reflected the marsh environment, with ducks and geese the most common forms; gull and kingfisher were also present. All the bird specimens might have been exploited for either food or feathers, although the element distribution did not support the idea of targeting specific birds for their feathers (see Brown 1989 for discussion).

Preservation of cartilaginous fish was poor, and less than 10 percent could be identified beyond the class level. Bony fish were dominated by sardines (40 percent); surfperch was the only other fish found in significant numbers (roughly 11 percent). The high frequency of sardines, an open-ocean species, indicated that considerable attention was focused on offshore fishing, probably during the summer when the water is warmer. Love (1996) noted that sardine populations go through cycles of abundance and scarcity and that these cycles last from 20 to 150 years. Thus, their abundance may be indicative of an El Niño event. Surfperch prefer cold water and were probably caught during the winter or spring. As both species are present, LAN-2676 might have been occupied throughout the year.

Taphonomic damage to the collection was both common and severe. Burning affected one-third of the bone, probably reflecting the practice of using fires for refuse disposal. Weathering affected more than 20 percent of the collection, suggesting that bone was routinely left exposed during periods of temporary site abandonment. This same situation would also occur if older midden materials were reworked by later site activities, including human occupation and rodent burrowing.

LAN-2676 appears to have been used repeatedly at different times of the year for the exploitation of different resources, such as sardines during the summer and surfperch during the winter and spring months. During these occupations, other vertebrate resources were likely exploited when available, and the processing of these materials (particularly mammals) resulted in heavy fragmentation of the bone. Further bone destruction occurred as a result of burrowing activity by rodents and reptiles.

LAN-2768 and LAN-193/H

LAN-2768 and LAN-193/H represent similar occupations of Centinela Creek just upstream from LAN-211/H; both are Intermediate period sites. The faunal collection from these two sites fits well within the pattern established for lowland sites in the Ballona region: they contained a wealth of terrestrial mammal remains and few marine resources, including lagoon species (Maxwell 1999a). The taxa recovered indicated that much of the faunal exploitation was focused on locally available animals. The people using this area were targeting species that either inhabited the narrow riparian zone on a regular basis or were drawn there by the availability of fresh water. The bones of animals such as rabbits, squirrels, turtles, and deer were found in the collection, with few examples of fauna that could be considered exotic. A single tiger-shark tooth is of some interest, as the Los Angeles area is at the northern extreme of their typical habitat; this specimen might have been traded in from the south, where waters are warmer. Also of some interest, although certainly not exotic, is the presence of a single bobcat phalanx. Traditionally, Gabrielino lineages belonged to one of two moieties, either "wildcat" (bobcat) or coyote (McCawley 1996:89). The remains of these common animals might have had some ritual significance.

Most of the bones from these sites were weathered—nearly 55 percent at LAN-2768 and just over half at LAN-193/H. The high percentages suggested that large quantities of bone were exposed on the surface prior to final burial. This exposure might have occurred prior to their initial interment, or these bones might have undergone a cycle of burial, reexposure, and reburial, perhaps as a result of bioturbation, human activity (ancient or modern), geological or fluvial action, or some combination of these processes. The effects of burning were not commonly observed on these remains, affecting less than 20 percent of the collection at either site.

Comparative Taphonomy of Sites in the Ballona Region

Taphonomic processes have played a considerable role in altering the bone collections of all the sites in the Ballona region, and the effects of weathering and burning in particular have been noted by various researchers. Unfortunately, different analysts have been involved in projects in the Ballona, and each has had different methods of recording and reporting taphonomic faunal attributes. Comparisons are therefore difficult. For purposes of this study, we will only examine sites analyzed by SRI.

Weathering

Weathering appears to be the taphonomic indicator with the greatest degree of intersite variation. The seven sites studied to date can be broken into three classes based on the percent of bone exhibiting signs of weathering (Figure 68).

Low

This class includes LAN-2676, LAN-211/H, and LAN-1932/H. Sites in this class are characterized by 75 percent or more of the bone collection being typed as weathering Stage 1, indicating little damage beyond basic degreasing. Little evidence of weathering suggests the bones were not exposed to the elements for long periods of time. For LAN-2676, the faunal collection may have been buried relatively rapidly after disposition given this site's location in the wetlands. For the collections from LAN-211/H and LAN-1932/H, a different postdepositional mechanism may have been responsible for their unweathered condition. These bones may have been deposited during the late eighteenth century and buried by sewer line construction about 150 years later.

Medium

This class, which includes LAN-62 and LAN-2769, is defined by 50–75 percent of the bone collection falling into weathering Stage 1. A greater degree of variation in depositional rates is observed at medium-class sites than in the low-weathering group, and may indicate postdepositional damage leading to bone exposure. LAN-2769 is deleted from further discussion due to its small and problematic sample. LAN-62 lies on saddles above the wetlands. Flooding would reach this site less frequently than LAN-2767, its neighbor immediately north in the wetlands. Faunal remains deposited on an elevated surface might have been exposed to the elements for longer periods of time than at sites located in the wetlands.

High

LAN-193/H and LAN-2768 constitute this class, which is defined as less than 50 percent of the bone falls into weathering Stage 1. Intriguingly, both sites fitting this pattern are from the upper reaches of Centinela Creek. Elsewhere, Maxwell (1999a, 1999b) suggested that these sites might have experienced burial and reexposure as Centinela Creek covered the area with sediments during floods and cut open new exposures during periods of down-cutting.

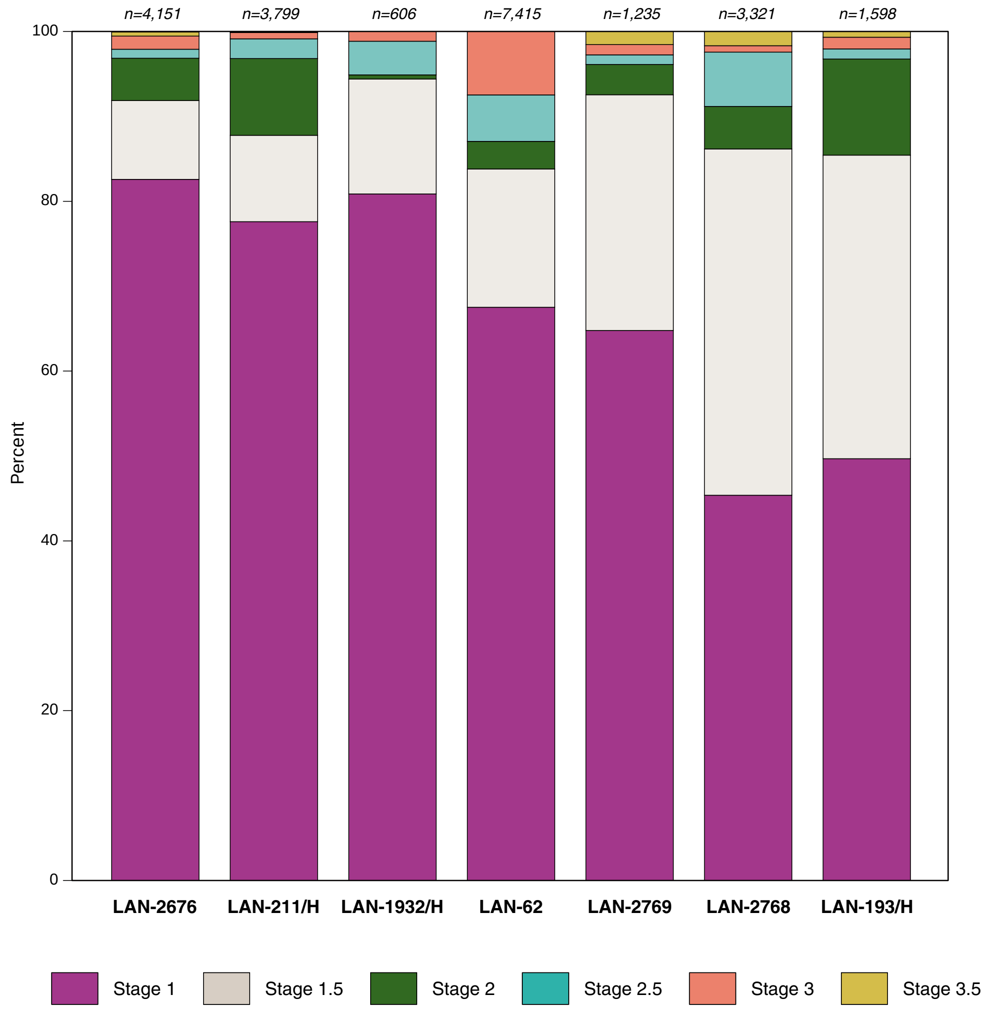

Figure 68. Weathered faunal remains by percentage at selected Ballona sites.

The pattern observed is certainly preliminary, based on only a handful of sites and excluding any from the bluff-top area (where weathering was not described in detail). However, they do show a remarkable pattern, where those sites that are the oldest (LAN-193/H and LAN-2768) have the highest frequency of weathered bone, and those that are the youngest (LAN-211/H and LAN-1932/H) have the lowest frequency of weathered bone. As noted in the methods section, weathering has traditionally been used as a proxy measure for duration of exposure *prior* to burial, with the assumption that bone ceases to weather once it is in the ground. The data at hand, however, may reflect that weathering continues to affect bone after burial. It is certainly possible that the upper Centinela Creek sites underwent very different depositional histories than those in other areas; a larger sample of sites studied with specific attention to taphonomy is needed prior to a judgment being made about the meaning and causality of the pattern observed.

Weathering may be a very telling measure in future studies, suggesting that age is the primary factor being measured by recording weathering patterns, rather than postdepositional actions, whether human or nonhuman. Further studies need to assess whether age is the primary factor being measured by recording weathering patterns, rather than postdepositional actions, whether human or nonhuman. Our work

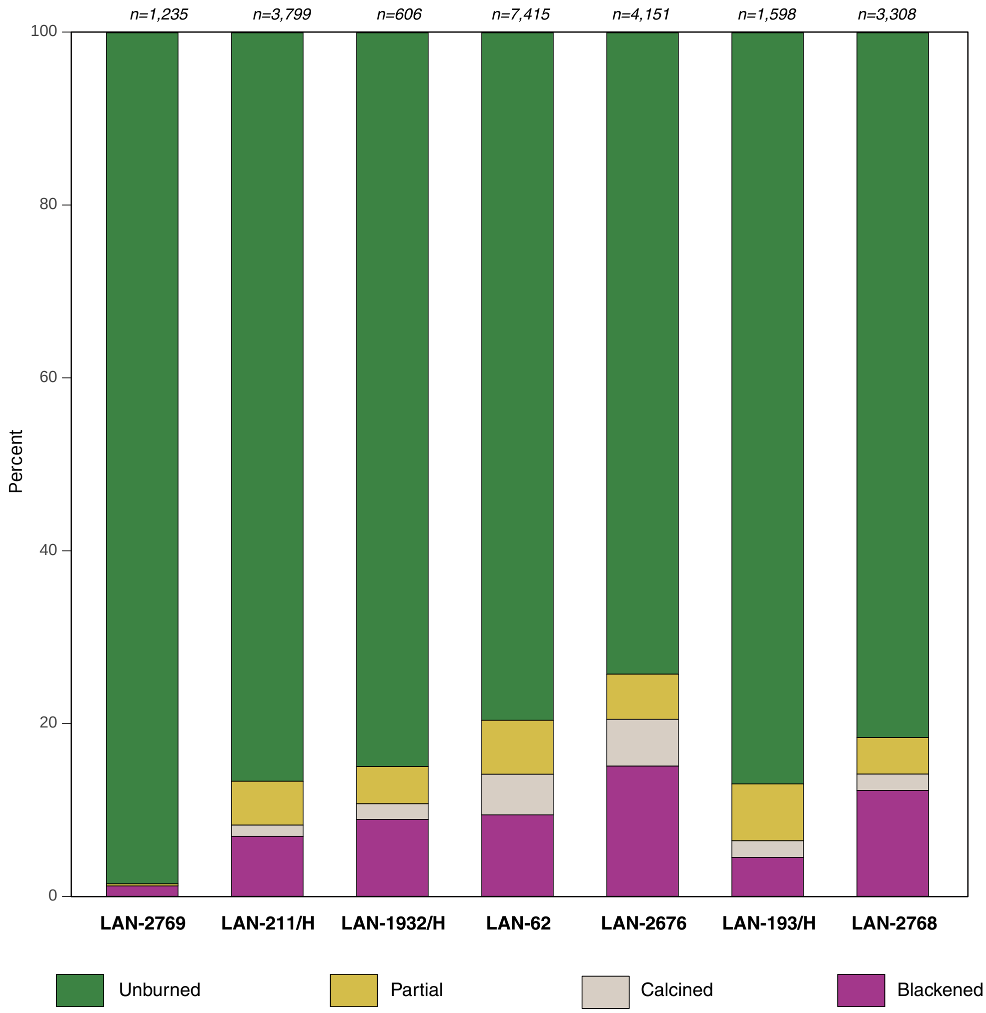

Figure 69. Burned faunal remains by percentage at selected Ballona sites.

emphasizes the tremendous need for a series of well-documented experiments designed to study patterns of weathering for southern California in general, and in particular, on the types of fauna typically encountered in the region, particularly small mammals and nonmammalian fauna.

Burning

In contrast to the patterns observed for weathering data, burn patterns are remarkably consistent for the Ballona region, although, again, only a handful of sites have sufficient data recorded to address this issue. Seven sites are currently available for comparison (Figure 69), and most show remarkably little variation in burn frequencies, with all but one site falling into the range of 75–87 percent unburned. At the one exception, LAN-2769, less than 2 percent of the bone collection showed signs of exposure to heat. Although the sample from this site was relatively small (n = 1,235), it is sufficient to suggest that sampling error alone is not entirely to blame. The low occurrence of burning at this site is probably related to the high frequency of intrusive remains in the collection.

Discussion

In the introduction to the LAN-211/H vertebrate analysis, a series of general research questions was presented; these stressed the importance of determining how LAN-211/H fits into the adaptive system employed in the Ballona by comparing these data with materials from other sites excavated in the area, rather than interpreting the site in isolation. This section begins by reviewing the research questions in turn; following this, I discuss some of the distinctive features of the LAN-211/H collection and offer some directions for future research. The discussion concludes with commentary on the possible relationship between LAN-211/H and nearby LAN-1932/H.

Spatial Comparison

A general system of classifying the Ballona sites based on their vertebrate class distributions has been presented previously (Maxwell 1999a). In short, sites tend to break into the "lowland" pattern, with a high frequency of terrestrial mammals, or a "bluff-top" pattern, with a high frequency of cartilaginous fish.

The LAN-211/H collection is quite distinct from most other sites in the Ballona, having high frequencies of bony fish, reptiles and birds, and a relatively low frequency of mammal remains (see Figure 67). The proportions of bony fish and mammal at LAN-211/H are consistent with nearby LAN-1932/H, but very different from other Ballona sites. Only LAN-63, on the bluff tops, has a higher frequency of bony fish remains (55 percent) than LAN-211/H. Indeed, LAN-59 and LAN-61B—both on the bluffs—are the only other sites where bony fish compose more than 20 percent of the total bone sample.

LAN-211/H also has relatively high frequencies of reptile and bird remains. Reptiles account for 13 percent of all identifiable bone, nearly twice the frequency seen at any other site in the Ballona. The other sites in the region with high frequencies of reptile remains primarily date to the Intermediate period: LAN-193/H (6.5 percent), LAN-2768 (6.1 percent), and LAN-61B (7.7 percent), although a protohistoric-period site, LAN-1932/H (6.1 percent) also fits this pattern. Bird bone makes up 9 percent of the identified collection at LAN-211/H; this is one of the highest frequencies seen in Ballona sites with bone collections larger than 1,000 specimens. Similar frequencies are seen at LAN-60 (8.5 percent) and LAN-61A (8.7 percent), both Intermediate period sites situated on the bluff top. LAN-47, located quite some distance from the bluffs, is the only Late period site where birds account for more than 5 percent of the identified fauna. LAN-1932/H, the other protohistoric site, has an even higher frequency of bird remains (16.3 percent) than LAN-211/H, but a bone collection of only 600 pieces. Perhaps high frequencies of bird bone is a behavioral feature of the protohistoric period.

Mammal remains at LAN-211/H account for only 43 percent of the identifiable collection; the typical lowland frequency is 75–80 percent. The LAN-211/H vertebrate collection most closely resembles materials from nearby LAN-1932/H, where mammalian remains constitute only 53 percent of the collection. LAN-211/H lacks a unique mammalian species, although a handful of those present are known from very few sites in the Ballona. LAN-211/H and LAN-60 are the only sites where pronghorn has been identified; LAN-211/H and LAN-2676 are the only sites with domestic cow remains. Domestic fauna in general are rarely reported in the region (sheep is known from LAN-47; horse is reported from LAN-193/H, LAN-194, and LAN-59). The domestic cow remains from LAN-211/H are significant because of the presence of cut marks; these marks are located on phalanges, an area where they would be unexpected if European butchers were responsible, but indicative of careful removal of the hoof. This behavior is likely indicative of Native American or Mexican butchery of this domestic animal. How the cow was obtained by the Native peoples is unknown.

Chronological Comparison

LAN-211/H bears little resemblance to any of the other sites studied in the Ballona, with the exception of LAN-1932/H, which is of a similar age and located nearby. LAN-211/H shows general similarities with Intermediate and Late period sites from the Ballona, having a similar complement of taxa present, and suggesting a primarily hunter-gatherer lifestyle. Specific similarities are superficial, however, and more in-depth examination suggests that significant change had occurred by the time LAN-211/H was abandoned. Most notable among the changes are the presence of domestic fauna and the apparent reliance upon bony fish as a food resource. Hispanic contact is obviously responsible for the presence of domestic cattle in the faunal collection. The high frequency of bony fish at both LAN-211/H and LAN-1932/H may relate to the late ages of these sites, and suggests that subsistence was shifting to the open coast, probably due to increasing siltation of the lagoon areas. Determining whether LAN-211/H is typical of the early historical period will require testing of other sites of the same age.

Wetlands Adaptations

There is evidence for a pattern of adaptation shifts through time in the Ballona. Earlier occupations, particularly those on the bluffs, seem to have a subsistence economy centered on lagoon fishing; later occupations, all from the lowlands, focus more on open coastal resources, and less on lagoon species. The high frequency of surfperch at LAN-211/H may result from amplified coastal fishing due to increased sedimentation of the lagoon in late prehistory. Surfperch are found nearshore (Salls 1988), and were probably taken either from the shore or from small boats just offshore. Surfperch prefer cooler waters (Love 1996), and their presence may indicate periods of winter fishing. The high frequency of surfperch among the bony fish from LAN-211/H is a relatively common feature in the Ballona, being observed both in the lowlands (LAN-60, LAN-62, and LAN-47) and the bluff tops (LAN-59, LAN-61A, LAN-61B). In most other sites where surfperch dominates the bony fish collection, however, there are relatively few bony fish remains; LAN-47 is the exception to this rule.

LAN-47 predates LAN-211/H by about 500–700 years, but even so, both have piscine assemblages suggesting nearshore fishing during times of cooler water temperatures. This fact may indicate a switch from the lagoonal resources, utilized in earlier occupations on the bluff tops and along the river's edge, toward coastal resources. Our reconstructions of the Ballona suggest that sedimentation increased considerably through time, to the point where there was far more marsh than lagoon by the late 1800s. The shrinking lagoon would result in fewer and fewer local marine resources—such as guitarfish and bat ray—and a need to exploit other environments. If the late prehistoric population was moving away from the lagoon as a result of decreasing productivity, the nearshore environment would be the next closest resource area. Intensifying exploitation in this habitat would result in a marked increase in the numbers of bony fish in general, and during winter months, surfperch in particular.

Taphonomic Processes

Taphonomic and other formation processes can only be compared with other sites studied by SRI; there are currently no data on these types of damage from bluff-top sites. Burning at LAN-211/H appears to be consistent with the distribution seen at most sites in the Ballona, with unburned bone accounting for roughly 85 percent of the collection. Weathering is considerably more common in older sites than in younger ones. LAN-193/H and LAN-2768, Intermediate period sites, have 50 percent or more of their bone collections fall into weathering Stage 1.5 (that is, between Stages 1 and 2) or higher. In contrast, weathering affects less than one-quarter of the collections from primarily younger sites like LAN-211/H, LAN-1932/H, and LAN-2676.

Exotic Faunas

Of considerable interest at LAN-211/H are several exotic faunas, species that are either not normally found in the Ballona region or are unusual as components of archaeological sites. It may also be significant that all exotic elements were recovered from Unit 9. Great white shark is present at LAN-211/H in the form of a single tooth fragment. Although great whites are not uncommon in the waters off southern California (Love 1996), given the size of these animals and the dangers inherent in their capture, their remains qualify as exotic. Great white remains also were reported at the Admiralty site (LAN-47) (Sandefur and Colby 1992), the Marymount site (LAN-61A, three specimens) (Salls 1988), and at the Del Rey site (LAN-63, eight specimens) (Salls 1988). Any of these specimens could have been taken locally; it is unclear whether great whites played any role in the prehistoric economy. It is also possible that a single tooth could have been collected out of context (on the beach, for example) and that it represents a curiosity or ritual item, rather than having economic significance.

Also recovered at LAN-211/H are unusual bird species, including swan (*Cygnus* sp.) and goose (*Anser* sp.). Although both frequent wetlands environments such as the Ballona, neither is common in the area today (Dunn and Dickinson 1999). In a recent survey of Ballona avifauna, Dock and Schreiber (1981) reported only two species of goose (*Branta bernicla,* the brant, and *Anser anser*, the domestic goose) and no examples of swan. Dunn and Dickinson (1999:66) noted that the trumpeter swan *(Cygnus buccinator)* normally ranges south only to the central coast of Oregon, but is considered "rare in winter south to California." Trumpeter swans (or closely related species) could have visited the Ballona. If such a rare bird were present in the area, its feathers might have been quite attractive to humans as status symbols or trade items. The swan remains all come from the same general area, and the nonoverlapping element distribution suggests a single individual. Goose remains are less surprising; several species of geese have winter ranges well into southern California (Dunn and Dickinson 1999). These include: the greater white-fronted goose *(Anser albifrons),* the snow goose *(Chen caerulescens),* and Ross's goose *(C. rossii),* all with a winter range into the San Fernando valley; the Canada goose *(Branta canadensis),* whose winter range encompasses all of southern California and into Baja; and the Brant *(B. bernicla),* mentioned previously. Brown (1989) noted the presence of snow goose, Canada goose, and cackling Canada goose in the faunal collection from LAN-59 on the bluffs. Any of these species could have contributed the goose bones recovered at LAN-211/H; some of the species (white-fronted, snow, and Ross's) might have been brought into the Ballona from the San Fernando Valley, suggesting long-distance movement or trade. However, birds are well known for straying outside their normal ranges and could well have been taken locally.

The presence of at least two bones (horn core and vertebra) of pronghorn *(Antilocapra americana)* is intriguing at LAN-211/H. Pronghorn has been recovered from two other sites in the Ballona (LAN-60 and LAN-194), although the animal is not known today from the area or coastal California in general (Freisen et al. 1981). This species is most common in the Great Basin and eastern Sierra Nevada (Jameson and Peeters 1988; Lubinski 1999), although Jameson and Peeters (1988) stated that pronghorn was known from Antelope Valley until the 1930s, meaning it might have been available in prehistory. Lubinski (1999) noted that pronghorn flesh is musky in flavor, suggesting that these remains may not be related to subsistence. Antler is a common raw material for tool manufacture and for use in soft-hammer percussion; pronghorn hides were also favored materials for the manufacture of clothing in the Great Basin (Lubinski 1999). The remains recovered from LAN-211/H could be consistent with either type of material function.

In comparison with other Ballona sites, LAN-2769 is intriguing for both its similarities and its differences. The contents of the vertebrate collection, dominated by mammal remains, is not very different from other lowland sites in the region; the 92.8 percent mammal distribution is only a few percentage points higher than what is seen at LAN-193/H (mammals = 89.6 percent). LAN-2769 is also very similar to LAN-193/H in its very low frequency of fish remains. From the perspective of weathering, LAN-2769 is also typical; 64.8 percent of the bone from LAN-2769 is in weathering Stage 1 making the site very similar to LAN-62; the high frequency of bone in Stage 1.5 is reminiscent of LAN-193/H and LAN-2768, both Intermediate period sites. Indeed, based on the class distribution and weathering patterns, LAN-2769 appears to be a typical Intermediate to Late period site from the Ballona. The differences lie in the remarkable lack of burning seen at LAN-2769—by far the lowest in the Ballona—and in the very limited range of species present in the material. Only five taxa (rattlesnake, nonpoisonous snake, gopher, squirrel, and meadow vole) were identified (although there were a handful of unidentifiable bird remains), and all of these species—while potential food sources in prehistory—are extremely likely to intrude into archaeological sites.

The vertebrate component of LAN-2769 leads to two possible conclusions: either this is a nonsite, or it is a portion of a site that has been heavily impacted and is full of intrusive specimens. I tend to favor the latter interpretation, given the presence of weathered specimens, and of highly fragmentary remains. LAN-2769 definitely has a very high proportion of intrusive materials, especially rodents and snakes, which constitute the bulk of the identifiable fauna. The general lack of burned bone also supports the idea that very little of this material is of archaeological origin. However, the presence of fish remains (including a burned specimen), and a few cut marked bones indicates human presence. I suspect we are dealing with a site that has been heavily impacted or perhaps largely destroyed, leaving only a handful of highly mixed remains for us to examine. Whether this occurred in prehistory or in the twentieth century is unclear at this time. The limited range of species present, combined with the generally high FI values for identifiable materials suggests a large intrusive component.

LAN-211/H and LAN-1932/H: Evidence for a Connection?

As noted above, the vertebrate collections from LAN-211/H and LAN-1932/H are remarkably similar in class distribution, and in terms of taphonomic factors such as burning, weathering, and bone fragmentation. There are currently two working hypotheses for the origins of the LAN-1932/H material: (1) the site is flipped and the original midden was located near its present location, or (2) the material derives from a site near the base of the bluffs. The remarkable similarities in the vertebrate collections from these two sites suggests the latter, that LAN-211/H is the source of the materials in LAN-1932/H. The class distributions at these sites are very similar to one another and demonstrably different from any other site in the Ballona. These two sites also have very similar patterns of taphonomic damage (burning and weathering), although their distributions conform to general Late period patterns for the Ballona and cannot be distinguished confidently from those at other sites.

Directions for Future Research

The collection from LAN-211/H provides many new insights into protohistoric adaptations to life on the Ballona. But, like any research, it creates many questions as well. Four specific research questions are constructed from this analysis; two relate to taphonomy, one to butchery, and the last focuses on comparative analysis within the Southern California Bight.

Preservation of Bird Bone

LAN-211/H is notable for a relatively high frequency of bird bone in comparison with other sites in the area; this is also noted at LAN-1932/H. The question is whether this pattern is related to human activity, or if there is some sort of taphonomic issue to be considered. Bird bone has a much thinner cortex than mammalian bone, and thus may be more susceptible to weathering and mechanical damage than mammal bone. If this is indeed the case, it may explain why bird bone is found in greater frequencies in more recent sites than in older ones. Experimental work is needed to determine whether, given exposure to the same types of elements, bird bone breaks down more quickly than mammal bone. If there is no appreciable difference, then the pattern seen at LAN-211/H may be attributable to human behavior.

Differences in Weathering Frequencies

This study demonstrates that frequencies of bone weathering in the Ballona seem to correlate with the age of the site in question, with older sites having a much higher frequency of weathered bone than recent sites. As noted above, weathering studies tend to make the implicit assumption that weathering essentially ceases to affect bone following burial. Materials from the Ballona may be demonstrating that this assumption is incorrect. We need to determine whether the differences in weathering frequencies observed reflect differences in site age or differences in formation histories. Future research should emphasize comparison with other studies of sites of different ages in the same location and, ideally, should include replicative experiments.

Native American Butchery Practices

At LAN-211/H, we have examples of domestic cattle bones butchered by Native American peoples. Future research should address whether the cut marks on the cow phalanges reflect a native tradition or if the marks might have been produced by people influenced by Hispanic butchery practice. Conclusive examples of native butchering of large mammals, both wild and domestic, should be compared to the LAN-211/H collection to determine whether the same patterns of cut marks are present.

Protohistoric and Historical-Period Adaptations in the Bight

Research at LAN-211/H has shown a need for comparative analysis of protohistoric and historical-period adaptions within the Southern California Bight. How similar is the LAN-211/H collection to other protohistoric and historical-period collections outside the Ballona? What does faunal variability in the protohistoric period tell us about the nature of diet and adaptation during this period? Results from LAN-211/H need to be compared with a wider range of protohistoric and historical-period sites outside the Ballona to establish trends in subsistence practices during this period of dramatic cultural change in southern California.

Conclusions

LAN-211/H provides a glimpse into the final chapter of a prolonged system of indigenous adaptation employed in the Ballona region. The early occupations in this region show a reliance on extremely localized fishing concentrated on the lagoon. Although this preference did not preclude coastal fishing—

coastal species are recovered from all sites—the lagoon seems to have been the primary focus, and the bluff tops were probably used for processing rays and guitarfish for storage. The increased reliance on surfperch seen at LAN-211/H indicates a shift in resource exploitation, probably as a result of increasing siltation of the lagoon that made it a less productive environment. With local access to large numbers of lagoon species cut off, the focus shifted to the open coast. The shift from the lagoon to coast was probably far less dramatic than it appears archaeologically; it probably occurred gradually over time. Further, surfperch is reported from most sites in the Ballona and is the dominant bony fish at four lowland sites (LAN-47, LAN-60, LAN-62, and LAN-2676) and three bluff-top sites (LAN-59, LAN-61A, LAN-61B), indicating that this was hardly a change to a new and unfamiliar resource. These other sites range from the Intermediate to the Late periods, suggesting that the exploitation of the open coast in general and surfperch in particular was a long-standing adaptation in southern California.

The LAN-211/H vertebrate collection shows an intriguing blend of continuity with and change from earlier occupations of the Ballona. Change is most evident in the presence of domesticated animals, the increased importance of surfperch, and in the distribution of fauna by class, with mammals being much less dominant. One of the most intriguing aspects of the LAN-211/H collection is the presence of domestic cow bones with what appear to be aboriginal butchery marks. Although there are a few cow bones present, and only a few of these are cutmarked, the location of the marks are strongly suggestive of a non-European butchery practice of skinning out the hoof. Thus, we see a demonstrative change from the prehistoric period in terms of food resources, yet strong continuity based on the method of preparation. Continuity stems from the general similarities in common species of mammal and fish, and in the taphonomic similarities with other sites in the region. The weathering pattern at LAN-211/H is very similar to that seen at other late sites, with more than three-quarters of the bone falling into weathering Stage 1.

LAN-211/H has the potential to provide a wealth of faunal information about a poorly known period of late prehistory, one in which profound social changes were occurring. Additional research is needed in order to determine the extent to which social changes influenced diet, patterns of trade and travel, butchery patterns, and methods of refuse disposal.

CHAPTER 8

Invertebrate Faunal Remains

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Analysis of invertebrate faunal remains recovered during testing at LAN-211/H and LAN-2769 has the potential to increase our understanding of the prehistory of the Ballona region. The shell remains contained in these sites reflect the complex interaction of human behavior, paleoenvironment, and site-formation processes. Potential research domains involving analysis of shell data have been outlined in previous studies (see Altschul and Ciolek-Torrello 1997; Altschul et al. 1991; Altschul, Homburg, and Ciolek-Torrello 1992; Grenda et al. 1994), and include questions of chronology, settlement patterning, subsistence strategies, habitat use, paleoenvironmental reconstruction, social organization, and site-formation processes. The limited amount of shell recovered during test excavation at LAN-211/H and LAN-2769 restricts the issues that can be profitably explored with these data. Consequently, this chapter focuses on habitat use, site structure, and formation processes. Variability in shell abundance among sites in the Ballona area is explored from both a geographical and a temporal perspective, and the site is compared to other protohistoric and historical-period sites outside the Ballona.

Methods

The initial sampling strategies and laboratory procedures used for this analysis were previously described in Chapter 4. All shell pieces larger than ⅛ inch were identified and analyzed completely. Previous work at LAN-62 (Keller and Ford 1998:101) showed virtually no significant difference in taxa representativeness between the ⅛-inch fraction and larger sizes. Given the considerable effort required to analyze ⅛-inch shell and the tendency for the relative number of identifiable specimens to decrease with smaller screen sizes, SRI decided to cull for analysis from the ⅛-inch fraction only those pieces with diagnostic elements that could be used for calculating the number of identified specimens (NISP).

The shell material from each provenience was analyzed separately. Each specimen was identified to the most specific taxonomic level possible with reference to standard identification guides (e.g., Keen and Coan 1974; McLean 1978; Morris et al. 1980; Rehder 1996; Ricketts et al. 1985) and to the SRI shell type collection. Where the guides differ, we rely on Rehder's (1996) more recent classification. Nearly all of the specimens recovered were identifiable to the family level, and the majority were identified to the genus level. In addition to taxonomic identification, all shell pieces were weighed, and their NISP value recorded. Analysts assigned NISP values by counting all pieces containing a nonrepetitive element. For bivalves (class Pelecypoda), NISP reflects the number of whole hinges and hinge fragments that are more than 50 percent complete, whereas for gastropods (class Gastropoda), each whole shell, columella, and apex was counted. The NISP count is useful for comparison of shell density with other sites in the Ballona, which generally have shell amounts expressed in this form. MNI is another useful unit of measure for expressing taxon frequency. For bivalves, MNI was calculated by dividing NISP by 2 because in life, each animal has two valves. The MNI count for gastropods is the same as NISP.

Shell analysts have long debated the merits of quantification by weight versus by count (see Mason et al. 1998). Both methods have their strengths and weaknesses. Using weight will generally overemphasize the relative abundance of more robust species like Venus clam (*Chione* spp.) or Pismo clam (*Tivela stultorum*) and underestimate the occurrence of more fragile species like scallop (*Argopecten* spp.). Weight, however, is useful for developing measures of relative dietary importance of shellfish taxa because it tends to compensate for size variability within species. Conversely, MNI, which more accurately reflects the actual proportions of individual animals represented, is better suited for determining habitat use and paleoenvironmental reconstruction (Claassen 1998:106–107; Glassow 1998:412). The overall low frequency of shell from LAN-2769 and low frequency of shell recovered from several areas within LAN-211/H resulted in extremely low NISP, and correspondingly, even lower MNI values, calling into question the representativeness of these counting measures for characterizing these sites. Consequently, our analysis relies more heavily on shell weight than count, although counts are presented here for comparative purposes.

Results

LAN-211/H

Of the four units from LAN-211/H selected for analysis, all contained invertebrate remains (Units 6 and 10 are considered a single unit, as explained in Chapter 4.) The majority of the shell was recovered from Units 9 and 11, whereas Unit 6/10 contained far fewer shells, and only trace amounts were recovered from Unit 4. Together, these four units produced a total of 437.4 g of shell (Table 16) and 60 identifiable specimens that exhibit distinct invertebrate attributes (Table 17). The invertebrate remains from the three units on the alluvial fan (Units 4, 6/10, and 11) are discussed first, followed by a discussion of the invertebrates from Unit 9, which was on the floodplain.

Unit 4

Unit 4, located in the southwestern portion of the site, contained only trace amounts of shell. Identifiable species noted here are limited to scallop (*Argopecten circularis*) and littleneck clam (*Protothaca staminea*), which were confined to Levels 5 and 6 (Figure 70). All shell from this unit consists of small fragments smaller than ¼ inch (Figure 71). The few species recovered from this unit commonly inhabit the intertidal zone of bays and estuaries.

Unit 6/10

Unit 6/10, placed approximately 15 m east of Unit 4, represents a continuous column of site sediments from this area. Shellfish remains are more abundant here than at Unit 4 and include abalone (*Haliotis* spp.), scallop, and littleneck clam, as well as Venus clam and fragments of unidentifiable shell (Table 18). The frequency distribution of fragment size shows that just over 20 percent of all shell is from the ¼-inch size class, whereas well over half measure 1 inch or larger. The vertical distribution of shell density (standardized as shell weight/m^3 of sediment) shows a trimodal distribution, with obvious peaks at Levels 6, 8, and 16, separated by levels with little or no shell (see Figure 71). Radiocarbon assays from shell recovered from Level 6 of Unit 6 and Level 7 of Unit 10 returned dates of A.D. 610 and 1000,

Table 16. Invertebrates Identified at LAN-211/H

Class and Family	Genus and Species (Common Name)	Habitat	Comments	Weight (g)
Marine invertebrates				
Gastropoda (snails and slugs)				
Unidentified			broken or eroded fragments lacking identifiable features	0.1
Haliotidae	*Haliotis* spp. (abalone)	most live along rocky shores in intertidal or moderately deep water	feeds on algae, especially giant kelp	130.0
Pelecypoda (bivalves)				
Unidentified			broken or degraded fragments lacking identifiable features	8.9
Donacidae	*Donax gouldii* (bean clam)	intertidal, buried in sand on surf-washed beaches	very small clam, unlikely food source	0.6
Mactridae	*Tresus* spp. (horse or gaper clam)	low-tide line to 30 m, buried in sand or sandy mud offshore	locally collected and reportedly delicious	0.7
Mytilidae	*Mytilus* spp. (mussels)	intertidal to 40 m, on rocks, gravel, and wooden structures along the coast and in bays and estuaries		5.8
Ostreidae	*Ostrea lurida* (native Pacific oyster)	intertidal to 35 m, attached to hard substrates and in beds on mud flats and gravel bars, in quiet bays and estuaries	prehistorically a primary food source, today replaced commercially by imported species	0.7
Pectinidae	*Argopecten circularis* (speckled scallop)	intertidal to 50 m, on sand and mud in bays and estuaries, also free-swimming		35.6
Solenidae	*Tagelus* spp. (jackknife clam)	intertidal, in sandy mud flats of bays and estuaries	used as fish bait today	1.3
Veneridae	unidentified (Venus clam family)	most are found intertidally and in moderately deep water buried in sand or mud offshore and in bays		11.6
	Chione spp. (Venus clam)	intertidal to 45 m, in mud or sand flats in bays and estuaries and also offshore	includes *C. californiensis*, *C. undatella*, and *C. fluctafraga*.	119.2
	Protothaca staminea (native littleneck clam)	intertidal, on sandy mud with gravel in protected bays and estuaries, also offshore near rocks and rubble	very popular commercial clam today	78.9
	Saxidomus nuttalli (common Washington clam)	low-tide line to 40 m, deeply buried in sand in bays and estuaries, also in sand near rocks along the open coast	also known as the butter clam, fished commercially along the California coast	15.3

continued on next page

Class and Family	Genus and Species (Common Name)	Habitat	Comments	Weight (g)
Polyplacophora (chitons)				
Unidentified	(chitons)	intertidal, under rocks or in crevices, also under algae		0.9
Unidentified	(marine invertebrates)		broken or degraded fragments lacking identifiable features	16.7
Subtotal				426.3
Freshwater invertebrates				
Pelecypoda				
Margaritiferidae	*Margaritifera falcata*	prefers clear swift streams partly in gravel and sandy substrates	larva transported upstream by attaching them-selves to gills of certain fish species; some adult specimens are hermaphroditic, allowing small populations to reproduce	11.1
Total				437.4

Table 17. Invertebrate Taxa from LAN-211/H in Order of Abundance

Taxon	NISP [a]	MNI [b]	Percentage of Total MNI
Veneridae			
Chione spp.	24	12	40.0
Pectinidae			
Argopecten circularis	12	6	20.0
Veneridae			
Unidentified	12	6	20.0
Veneridae			
Protothaca staminea	7	4	13.3
Haliotidae			
Haliotis spp.	1	1	3.3
Unionidae			
Margaritifera falcata	2	1	3.3
Total	58	30	99.9

Note: Only specimens identifiable to family or more specific are included (site total NISP = 60; site total MNI = 32).
[a] NISP = number of identified specimens
[b] MNI = minimum number of individuals

respectively (see Table 11), demonstrating disturbance of the deposit and throwing into question the meaning of this vertical patterning. This reversal of dates coincides with small quantities of modern materials found dispersed throughout the site sediments here. The invertebrate remains from Unit 6/10 are equally split between those species commonly inhabiting the intertidal zone in bays and estuaries (e.g., scallop, Venus clam, littleneck clam) and those typically found living along rocky shores in intertidal or moderately deep water (e.g., abalone).

Unit 11

Unit 11 was located in the eastern portion of the project area on an alluvial fan at the mouth of a small drainage emanating from the bluff top to the south. This unit produced over three times as much shell as was found at Unit 6/10 and accounts for roughly one-third of the shell recovered from the site. The range of taxa recovered is similar to that found at Unit 6/10 but in substantially different amounts. Unlike Unit 6/10, which was dominated by abalone, the most frequently identified taxon at Unit 11 are Venus and littleneck clams, which, occurring in virtually identical amounts, together account for nearly all the shell recovered from this area (see Table 18). The vertical distribution of shell density (see Figure 71) exhibits a unimodal tendency, although small peaks are present in Level 5 and again in Levels 8 and 9. Analysis of the shell collection from Unit 11 shows that the vast majority of shell here measures ½ inch

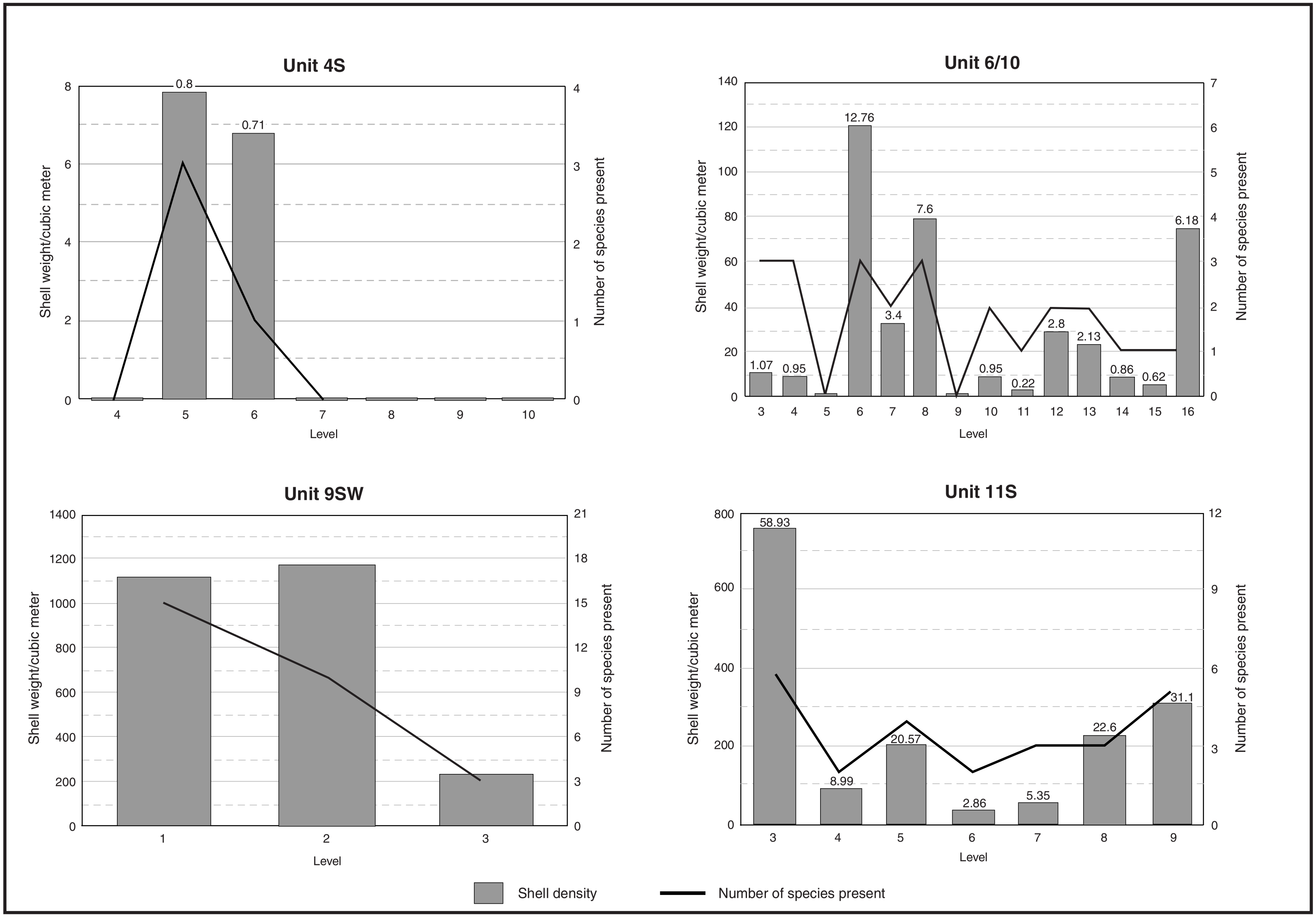
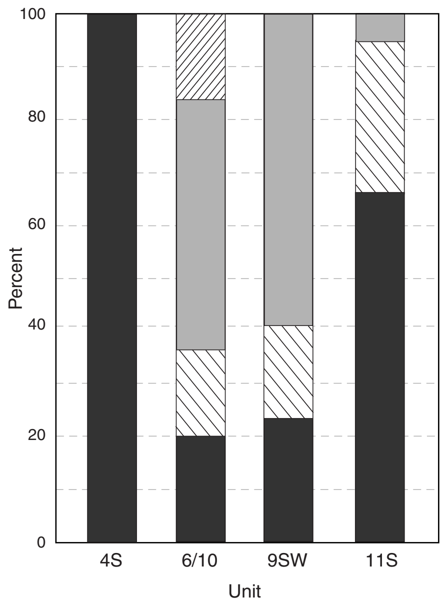


Figure 70. Shell density by unit and level at LAN-211/H.



Size in inches	Unit 4S		Unit 6/10		Unit 9SW		Unit 11S		Site total	
	Weight	Percent	Weight	Percent	Weight	Percent	Weight	Percent	Weight	Percent
0.25	1.5	100.0	8.3	21.0	58.0	23.6	99.6	66.2	167.4	38.3
0.5	0.0	0.0	6.5	16.4	45.7	18.9	43.6	29.0	95.7	21.9
1.0	0.0	0.0	18.6	47.0	142.2	57.8	7.2	4.8	168.0	38.4
2.0	0.0	0.0	6.2	15.6	0.0	0.0	0.0	0.0	6.2	1.4
Total	1.5	100.0	39.5	100.0	245.9	100.0	150.4	100.0	437.3	100.0

Note: Percentage of total weight (g) by size class per unit

Figure 71. Shell fragmentation at LAN-211/H.

or smaller and that roughly two-thirds of the collection is from the 1/4-inch size class (Table 19). The invertebrate remains recovered from this unit are overwhelmingly dominated by bay or estuarine species, with only trace amounts of abalone found.

Unit 9

A markedly diverse collection of invertebrate remains was recovered from Unit 9. Located on the flat floodplain below Units 4, 6/10, and 11, this unit produced more shell by weight than the three other units combined and accounts for over half of taxa documented at the site. The size distribution of shell fragments has a very similar pattern to that observed in Unit 6/10, with just a little less than 25 percent of the shell fragments coming from the 1/4-inch size class and over half the collection larger than 1 inch (see Table 19). The shell collection from this unit contains abundant abalone, which accounts for nearly half of the invertebrates by weight. The remainder of the shell is the typical mix of bay or estuarine species already documented at other areas of the site, as well as small amounts of California mussel *(Mytilus californianus),* and bean clam (*Donax* spp.) (see Table 18). Abalone are typically found attached to rocks along rocky shores from the intertidal zone to moderately deep water. Mussels inhabit the intertidal zone, attached to rocks and gravel along the open coast and in bays and estuaries, whereas bean clams live buried in sand on surf-washed beaches. The vertical distribution of shell density shows a thin cultural deposit mostly confined to the upper two levels (see Figure 71). Two radiocarbon assays from Unit 9, one from Level 1 in the southwest quadrant and one from Level 2 in the southeast quadrant, were run on shell from this unit; they returned dates of A.D. 1640 and 1490, respectively. At one sigma (see Table 11), these dates overlap and statistically are interpreted as the same age.

Table 18. Invertebrate Weight (in Grams) by Unit at LAN-211/H

Class and Family	Genus and Species	Unit 4 S	6/10	9 SW	11 S	Total	%
Gastropoda							
Haliotidae	*Haliotis* spp.	0.7	19.4	109.8	0.1	130.0	29.7
Unidentified		—	—	0.1	—	0.1	< 0.1
Pelecypoda							
Donacidae	*Donax* spp.	—	—	0.6	—	0.6	0.1
Mactridae	*Tresus* spp.	—	—	0.7	—	0.7	0.2
Mytilidae	*Mytilus californianus*	—	—	5.8	—	5.8	1.3
Ostreidae	*Ostrea lurida*	—	—	0.7	—	0.7	0.2
Pectinidae	*Argopecten circularis*	0.1	3.3	32.1	0.1	35.6	8.1
Solenidae	*Tagelus* spp.	—	—	0.8	0.5	1.3	0.3
Veneridae							
	unidentified	—	—	9.2	2.4	11.6	2.7
	Chione spp.	—	8.1	38.4	72.7	119.2	27.3
	Protothaca staminea	0.7	0.9	5.3	72.0	78.9	18.0
	Saxidomus nuttalli	—	—	15.3	—	15.3	3.5
Unionidae	*Margaritifera falcata*	—	—	11.1	—	11.1	2.5
Unidentified		—	3.0	4.6	1.3	8.9	2.0
Polyplacophora							
Unidentified		—	—	0.9	—	0.9	0.2
Unidentifiable shell		0.1	4.8	10.5	1.3	16.7	3.8
Total		1.6	39.5	245.9	150.4	437.4	100.0

Table 19. Fragmentation Indexes (FI) at LAN-211/H, LAN-1932H, and LAN-2676

Shell Size	LAN-211/H					LAN-1932/H	LAN-2676
	Unit 4S	Unit 6/10	Unit 9SW	Unit 11S	Site Total	Site Total	Site Total
1/2 inch and larger	—	31.3	187.9	50.8	270.0	2888.0	6334.4
1/4 inch	1.5	8.3	58.0	99.6	167.4	3013.4	6937.6
Fragmentation Index	0.0	3.8	3.2	0.5	1.6	1.0	0.9

Perhaps the most interesting invertebrate recovery from Unit 9 is two specimens of freshwater mussel, *Margaritifera falcata* (western pearlshell mussel). The documented range of this mussel is from southern Alaska to central California, and eastward to western Montana, western Wyoming, and northern Utah. The most southerly distribution of this species in California is the southern Santa Cruz Mountains and upper Kern River in Tulare County (Burch 1947:6; Taylor 1981:143). Inhabiting the same areas preferred by trout, these mussels live in cool, clear, swift-moving streams with sand or gravel substrates.

LAN-2769

Only a very small amount of invertebrate remains were recovered from LAN-2769 (Table 20); the vast majority by weight was Venus clam, with trace amounts of scallop, mussel (*Mytilus* spp.), and unidentifiable shell present. Venus clam is also the most prevalent by count, accounting for half of the MNI recorded at the site (Table 21). Shell was recovered from both excavation blocks, but Unit 3 at Block 2 accounts for nearly half of the shell remains (Table 22).

Habitats indicated by this collection mostly reflect bay and estuary settings (Venus clam and scallop). Open, rocky coast may be indicated by the presence of mussel, although the specimens recovered from LAN-2769 are not identifiable to the species level and might be bay mussel *(Mytilus edulus),* which prefer quieter water.

Discussion

In this section, the results of the analysis of shellfish remains are discussed from four perspectives of increasing scope. First, results are examined within the site boundaries with particular focus on shell fragmentation ratios, followed by a discussion of shellfish within Ballona Lagoon generally. The results are then considered from a wider geographical and temporal perspective; comparisons are drawn with sites beyond the Ballona and from earlier periods. Lastly the invertebrate collection from LAN-211/H is examined for its usefulness in addressing questions of subsistence procurement during the protohistoric period.

Intrasite Comparison

Comparison of the four areas tested by SRI during excavation at LAN-211/H shows considerable difference in the distribution of shell abundance and variability across the site. Relatively little shell was recovered from Units 4 and 6/10. Unit 4, in particular, was nearly devoid of invertebrate remains and may mark the western site boundary. Unit 11, located in the southeastern portion of site, produced considerably more shell. Although this area produced a greater range of species, the collection here is overwhelmingly dominated by Venus clam and littleneck clam. Unit 9 produced the majority of shell recovered during excavation and provided more than half of the species diversity. Aside from abalone, which accounts for nearly half the shell collection by weight, this unit is almost equally dominated by Venus clam and scallop. Unit 9 also differs from the other units by the presence of mussel and bean clam, which inhabit areas outside the bay or estuarine habitat.

The degree of shell fragmentation also varies considerably across the site. Assuming that shells were relatively undamaged when they were discarded in prehistory, the degree of fragmentation of a collection is assumed to be the result of postdepositional processes such as weathering, trampling, modern

Table 20. Invertebrates Identified at LAN-2769

Class and Family	Genus and Species (Common Name)	Habitat	Comments	Weight (g)
Pelecypoda (bivalves)				
Mytilidae	*Mytilus* spp. (mussels)	intertidal to 40 m, on rocks, gravel, and wooden structures along the coast and in bays and estuaries		< 0.1
Pectinidae	*Argopecten* spp. (scallop)	intertidal to 50 m, on sand and mud in bays and estuaries, also free-swimming		< 0.1
Veneridae	*Chione* spp. (Venus clam)	intertidal to 46 m, in mud or sand flats in bays and estuaries and also offshore	may include *C. californiensis*, *C. undatella*, and *C. fluctafraga*	5.4
Unidentified			broken or degraded fragments lacking identifiable features	< 0.1
Total				5.4 + trace

Table 21. Identified Invertebrate Taxa from LAN-2769, in Order of Abundance

Taxon	NISP	MNI	Percentage of Total MNI [a]
Chione spp.	4	2	50.0
Argopecten spp.	2	1	25.0
Mytilus spp.	1	1	25.0
Total	7	4	100.0

Note: Only identifiable specimens are included (site total NISP = 8; site total MNI = 4).

Table 22. Invertebrate Weight (in Grams) by Unit at LAN-2769

Taxon	Block 1		Block 2				Total
	Unit 1 NW	Unit 1 SE	Unit 2 NW	Unit 2 SE	Unit 2 SW	Unit 3	
Argopecten spp.	—	< 0.1	< 0.1	—	—	—	< 0.1
Chione spp.	1.8	—	—	1.0	—	2.6	5.4
Mytilus spp.	< 0.1	—	—	—	—	—	< 0.1
Unidentifiable shell	—	—	—	—	< 0.1	—	< 0.1
Total	> 1.8	< 0.1	< 0.1	1.0	< 0.1	2.6	> 5.4

mechanical disturbances, and even archaeological excavation. Shell refuse discarded away from site activity areas is expected to contain less-fragmented shell, whereas shell discarded in activity areas subject to heavy foot traffic would be more highly fragmented.

In order to compare the degree of fragmentation between areas, we follow the method outlined by Claassen (1998:114–115), in which the fragmentation ratio is calculated by dividing the total weight from the ½-inch and larger size classes by the total weight of shell from the ¼-inch size class. This ratio reflects the amount of fragmentation; the smaller the value, the higher the fragmentation, and conversely, the larger the number, the less fragmented the shell collection. As displayed in Table 19, there are considerable differences in the fragmentation ratios across the site. The least fragmented and potentially least-disturbed areas are found at Units 6/10 and 9, with fragmentation ratios of 3.8 and 3.2, respectively. Unit 4 contained too little shell to interpret, but Unit 11, which contained one-third of the recovered shell, has a fragmentation ratio of 0.5., the lowest of all the analyzed units. The reason for the highly fragmented condition of the shell from Unit 11 is unknown and could be attributable to any number of postdepositional processes.

To help interpret the meaning of these numbers, it is useful to compare them to fragmentation ratios from other Ballona sites with better-known depositional histories. LAN-1932/H and LAN-2676, two sites highly disturbed by agricultural plowing and later runway construction, have fragmentation ratios of 1.0 and 0.9, respectively. Considering that the shell from Unit 11 is even more fragmented than the shell from these two mechanically disturbed sites suggests that the deposit here may likewise be disturbed. Unit 11 is on an alluvial fan at the mouth of a small drainage near a concrete-lined channel and below the sewer access road, making it particularly vulnerable to disturbance. Alternatively, site sediments here could derive from LAN-212 on the bluff top above LAN-211/H, and could have been transported downslope during construction of Loyola Marymount University or washed downslope during heavy rains. The shell from Units 6/10 and 9 have comparatively high fragmentation ratios and appear intact.

The Economics of Shellfish Use

Most invertebrate analyses at archaeological sites in the Ballona area view human predation on shellfish populations as opportunistic, with the frequency and variability of shellfish found reflecting environmental conditions in the immediate site vicinity at the time of occupation. Human agency or preference is seldom seen as explaining the patterns of shellfish remains. This position leads archaeologists to use archaeological shell collections to develop paleoenvironmental reconstructions, which they then use to explain the patterns seen in invertebrate remains. This perspective apparently prompted Van Horn (Van

Horn and Murray 1985:200) to interpret a decrease in the amount of oyster *(Ostrea lurida)* from earlier to later components at the Loyola Marymount site, LAN-61, as an indication of the gradual siltation of the Ballona estuary. Similarly, Van Horn (1984:44) suggested that the abundance of Pismo clam at LAN-59 indicated the possible presence of a sandy shoreline much farther inland than exists at present.

However, these ecological models of human behavior are better envisioned as hypotheses requiring validation rather than as assumptions with which to interpret data. Using archaeological data to develop paleoenvironmental reconstructions and then using those reconstructions to infer human behavior from those same data creates a circular argument. In a given collection, the dominance of particular taxa that are restricted to specific habitats allows us to state that the site inhabitants had access to those habitats, but it does not necessarily follow that those habitats had to be close to those sites. It may very well be that the temporal variability in dominance of one taxon over another in a region is the result of changing environmental conditions, but it may also be the result of other causes. Keeping paleoenvironmental reconstructions independent of archaeological data allows us to test our models of human behavior against independent environmental data.

Current paleoenvironmental models of the Ballona (Homburg et al. 2001; see Chapter 5) are based on sediment cores collected from across the eastern Ballona. A suite of paleoenvironmental studies including ostracode, pollen, and mineralogical analyses of these cores is helping us refine our understanding of the Ballona environment. The picture emerging from these studies is one of relative stability punctuated by periods of significant environmental perturbations.

Sea-level rise between 15,000 and 7000 B.P. flooded what was essentially a terrestrial valley. After this time, the rate of sea-level rise slowed, keeping pace with tectonic uplift and resulting in a sort of quasistatic equilibrium. Also at this time, sedimentation rates increased compared to sea level rise, and a sandy barrier began to form across the bay, creating a lagoon. The earliest known invertebrates from geologic contexts in the Ballona are Venus clams radiocarbon dated to 7520 ± 90 B.P. (Shelley 2001), although oysters first appear in sediments immediately beneath the clam and would seem, therefore, to be older. These two species, and others represented in the cores, are common in mudflat habitats in the intertidal zone.

Sedimentation of the Ballona continued between about 7500 and 4000 B.P. During this time, the lagoon supported extensive beds of oyster and jackknife clam *(Tagelus californianus),* but by about 4000 B.P., the oyster and jackknife clam beds along the eastern edge of the lagoon were abruptly silted over. Invertebrates recovered from above these beds are restricted to horn snails (*Cerithidea* sp.) and freshwater snails. Horn snails can tolerate more fresh water than oysters or jackknife clams, and their presence coinciding with the absence of oyster and jackknife clam indicates a hydrologic shift from marine to fresh water. This shift may be attributable to the sand barrier closing off the mouth of the lagoon, drastically reducing the effect of tidal influence and the incursion of salt water into the lagoon. Increased sedimentation after 3000 B.P. continued to fill the lagoon, forming extensive marshes and wetland areas. As the inlet to the lagoon became more restricted and the volume of the lagoon decreased from increased sedimentation, the lagoon would have been transformed from a marine-influenced lagoon to an estuary as the relative amount of fresh water in the lagoon increased. Depending on the fluctuating dominance of marine versus freshwater regimes, the nature of the estuary changed along with the composition of its invertebrate populations. Through time, increasing sedimentation transformed the wetlands into coastal plain. The nature of the lagoon west of present Lincoln Boulevard is still poorly understood, but a historical map from 1861 shows the lagoon confined to an area northwest of the present intersection of Lincoln and Jefferson Boulevards. Between 4000 and 7000 B.P., extensive marshes and mudflats flanked the open-water lagoon. By 200 B.P., these mudflat habitats appear to have diminished faster than the lagoon.

A recent inventory of marine mollusks inhabiting the Ballona (Ramirez 1981) showed that despite its small size, the Ballona salt marsh still supports a varied invertebrate population similar in composition to Mugu Lagoon in Ventura County and Mission Bay in San Diego County (Ramirez 1981:Mo3). Although the Ballona marsh has been severely altered from its configuration between the Late and historical periods, the mix of species present during modern invertebrate studies provides an indication of the types of invertebrates that would have previously inhabited the marsh and lagoon during the recent past. The results of Ramirez's study show that the three most common species are littleneck clam, bent-nosed clam (*Macoma nasuta*), and jackknife clam. During that study, Venus clams were observed as dead specimens only.

Radiocarbon assays from LAN-211/H indicate the site contains two temporal components, one component sampled in Unit 6/10 and dating between A.D. 610 and 1000, and the other in Unit 9 dating between A.D. 1490 and 1640. Glass beads recovered from both Units 9 and 6/10 date to the early historical period, confirming occupation during that time. Paleoenvironmental reconstructions of the Ballona for the late prehistoric and protohistoric periods depict a small lagoon blocked from the sea by a sand barrier and ringed with extensive salt marshes and wetlands. Shellfish populations would have been dominated by bay- and mudflat-loving species like Venus clam, littleneck clam, oyster, and scallop, with small populations of bay mussel, Washington clam, and gaper clam. A few more open coast species like abalone, slipper shell, and chiton might have inhabited the mouth of the inlet (Keller 1999:88) although abalone generally prefer more open coast. Neither rocky-shore species (California mussel) nor sandy-shore species (Pismo clam, bean clam) would be expected to live in the Ballona estuary.

Analysis by weight of shellfish recovered from LAN-211/H shows that the collection is dominated by three species: abalone (30 percent), Venus clam (27 percent), and littleneck clam (18 percent). MNI values show a different pattern, with Venus clam being the most prevalent species, followed in order of abundance by scallop, Veneridae (Venus clam family), and littleneck clam. Abalone, which is the most frequent by weight, constitutes only a little more than 3 percent of the invertebrate MNI. Other species represented by weight but absent from MNI calculations due to a lack of diagnostic elements include bean clam and California mussel. The MNI and weight data show a mixed collection of species that typically inhabit different habitats. Although some abalone species are reportedly found in estuary mouths, more suitable abalone habitat is located some distance to the north and south of the Ballona. Bean clams are found in the sand along surf-swept beaches, and California mussels are found in open-coast, rocky-shore habitats. The remainder of the species prefer bay and mudflat habitats and are still found in the Ballona today.

LAN-211/H is positioned relatively near the western edge of the estuary, and the prehistoric inhabitants of the site would have had easy access to the Ballona's mudflats, tidal marsh, and lagoon. Aside from abalone, the shell from the site shows an overwhelming dominance of mudflat or bay taxa and only a small amount of shell from sandy- and rocky-shore habitats. Shellfish procurement is quite simple, and cross-cultural studies have shown that all members of a community including women, children, and the elderly can participate (Meehan 1982). Most invertebrate species live in sandy, gravely, or muddy substrates and are easily collected by digging at low tide using a simple fire-hardened digging stick (Greengo 1952). Venus clams would have been particularly easy to collect as they are frequently found on the surface of mudflats (Ricketts et al. 1985:372). Two clam species (gaper clam [*Tresus* sp.] and Washington clam [*Saxidomus nuttalli*]) recovered from LAN-211/H are more difficult to collect because they tend to burrow deeper into the mud than the other species. Gaper clams are particularly difficult to collect, as they live in burrows up to 1 m deep (Ricketts et al. 1985:376–378).

Regional Comparisons

The placement of LAN-211/H in a regional context is critical to evaluating SRI's models of human settlement and subsistence in the Ballona. Previous shellfish research has looked at the distribution of archaeological sites in the Ballona based on geographical position (e.g., bluff top, lagoon edge, and riparian zone) (Table 23) (Keller 1999; Keller and Ford 1998). Unfortunately, comparison with other

Table 23. Comparison of Invertebrate Remains at Selected Ballona Sites

Site	NISP	NISP per m^3	Number of Genera	Dominant Taxa	Dominant Taxa (%)
Bluff sites					
LAN-59 (Hughes)	2,480	28.5	8	*Tivela stultorum*	86
				Chione spp.	8
				Argopecten circularis	6
LAN-61 (Loyola Marymount)	789	1.9	10	Veneridae	67
				Ostrea lurida	29
				Haliotis spp.	2
LAN-63 (Del Rey)	23,792	117.4	23	*Chione* spp.	84
				Ostrea lurida	7
				Argopecten circularis	5
				Protothaca staminea	4
LAN-64 (Bluff)	187	19.9	4	*Chione* spp.	94
				Ostrea lurida	4
				Protothaca staminea	1
				Haliotis spp.	1
LAN-206 (Berger)	776	161.7	15	*Chione* spp.	56
				Argopecten circularis	28
				Ostrea lurida	16
Lowland sites					
LAN-60 (Centinela)	976	116.2	12	*Chione* spp. [a]	72
				Protothaca staminea [a]	21
				Ostrea lurida [a]	3
				Tivela stultorum [a]	2
LAN-194	no data	no data	no data	*Tivela stultorum* [a]	38
				Chione spp. [a]	28
				Ostrea lurida [a]	19
				Argopecten circularis [a]	7
LAN-211/H	59	19.8	10	*Haliotis* spp. [a]	33
				Chione spp. [a]	27
				Protothaca staminea [a]	18
				Argopecten circularis [a]	8
				Saxidomus nuttalli	3
LAN-2768	319	35.1	13	*Argopecten circularis*	34
				Protothaca staminea	23
				Chione spp.	15
				Ostrea lurida	13

Site	NISP	NISP per m^3	Number of Genera	Dominant Taxa	Dominant Taxa (%)
Lagoon-edge sites					
LAN-47 (Admiralty)	14,290	595.4	24	*Chione* spp.	43
				Ostrea lurida	32
				Protothaca staminea	13
				Argopecten circularis	5
LAN-62 (Peck)	1,273	252.5	15	Veneridae [a]	73
				Pectinidae [a]	8
				Haliotis sp. [a]	4
				Ostrea lurida [a]	3
LAN-1932/H	230	511.1	10	*Chione* spp.	26
				Protothaca staminea	25
				Ostrea lurida	21
				Pectinidae	15
LAN-2676	2,412	193.0	38	Veneridae [a]	49
				Ostrea lurida [a]	15
				Pectindae [a]	7
				Haliotis sp. [a]	2

Note: Adapted from Keller (1999).
[a] Percentage calculated from weights, not counts.

Ballona sites is difficult because various researchers quantified shell using different methods. Bluff-top sites were quantified by NISP (Van Horn 1984, 1987; Van Horn and Murray 1985; Van Horn and White 1997c), whereas several of the riparian and lagoon-edge sites were quantified by weight (Altschul et al. 1998; Altschul, Homburg and Ciolek-Torrello 1992; Grenda et al. 1994). Because of differences in shell density, there is no direct correlation between NISP and shell weight (Mason et al. 1998). The effect of this on our ability to compare sites in the Ballona is that the percentage of thick-walled shell, such as Venus clam, in a collection will show elevated amounts when calculated as weight as opposed to NISP. Sites where Venus clam dominates the collection by NISP will show even greater quantities of this species when amounts are calculated by weight.

Keller (1999) and others (Keller and Ford 1998; Shelley 2001) pointed out that most Ballona sites, regardless of location, are dominated by estuarine species, most notably Venus clam. The two sites that deviate from this pattern, LAN-59 and LAN-2768, are dominated by Pismo clam and scallop, respectively. The prevalence of Pismo clam at LAN-59 was explained by Van Horn (Van Horn 1984:44) as resulting from a sandy bayshore northwest of the site, whereas the prevalence of scallop at LAN-2768 was similarly argued as possibly reflecting a changing estuarine environment (Keller 1999:98). (As summarized above, paleoenvironmental data do not support the notion of a Pismo clam habitat having been close to LAN-59 when the site was occupied.) The prevalence of Venus clam at most Ballona area sites is hardly unexpected considering the estuarine nature of the Ballona during most of prehistory. To elicit behaviorally relevant inferences from these data requires looking at these distributions in a new way.

I concur with previous observations that the range of shellfish species remains relatively constant from site to site. Apparent differences in species diversity can result from several factors, including availability, shell taphonomy, excavation sample size, and of course, human behavior. Most sites in the Ballona exhibit the same general mix of shellfish, but the ratios of dominant shell species differ among sites. As stated earlier, the distribution of the most prevalent species found in the Ballona clearly show that many sites are dominated by Venus clam. Previous explanations for this pattern apparently assume that shellfish species were collected in proportion to their abundance in the estuary. This, however, might not necessarily have been the case. Each shellfish species occupies an optimal microhabitat within the estuarine zone, so that Venus clam and littleneck clam, both of which inhabit the estuarine intertidal zone, are most prevalent in mudflat and bay-mouth zones, respectively. As noted above, the burrowing behavior of invertebrates also varies considerably; Venus clam, which live in the intertidal zone of mudflats and bays, are frequently found on the ground surface at low tide (Ricketts et al. 1985:372), whereas gaper clam, which are found in the same habitat as Venus clam, can burrow to depths of up to 1 m (Ricketts et al. 1985:376–378). Both of these factors—portion of the estuarine system and burrowing behavior—can affect the ease with which specific species can be collected: within the mudflat zone, it is much easier to collect Venus clam from the surface and near-surface than it is to extract gaper clam from their burrows. It may be that shifting dominance of one species over another, as demonstrated in Ballona archaeological sites, is not solely a reflection of the natural abundance of these taxa as determined by environmental factors but might result from human decisions to target specific resources.

Hunter-gatherer foraging and subsistence strategies can be classified as generalized or specialized (Winterhalder 1981). Generalized subsistence strategies are those that rely on a broader range or diversity of food types, whereas specialized strategies are focused on fewer but more abundant resources. All things being equal, a decrease in resource abundance should foster a broadening of the resource base (Winterhalder 1981); that is, a decrease in the abundance of a particular shellfish species should result in an increasing reliance on alternative taxa. The causes of decreasing abundance can be natural or cultural factors. Using this simple notion, we categorize the sites in the Ballona based on relative abundance of shellfish species recovered. Sites where the majority (greater than 50 percent) of the shellfish collection is attributable to one taxon are classified as focused, whereas sites where no taxon dominates by majority are classified as general. Classifying the Ballona sites in this manner and plotting their presence by both geographical location and temporal period produces an interesting pattern (Table 24).

This pattern shows that the bluff tops were occupied during the Early and Intermediate periods by people primarily focusing their shellfish-collection strategy on Venus clams. During the Intermediate period, people were also occupying the riparian and lagoon-edge zones. Along the riparian zone, shellfish collection was split between focused and general, with the LAN-60 collection dominated by Venus clam, whereas the collection from LAN-2768 represented a generalized collection strategy based on scallop and littleneck clam. Lagoon-edge occupations during this time were mostly focused on Venus clam, and although the invertebrate collection from LAN-2676 (a lagoon-edge site) does not have a majority of any one species, Venus clam accounts for 43 percent of the collection. It is important to note that LAN-2676 was occupied throughout the Intermediate period and on into the Late period, and that construction activities have mixed the deposit.

Only one site in the Ballona, LAN-47, is firmly dated to the Late prehistoric period. Located along the northern edge of the lagoon, this site contains a shellfish collection reflecting a generalized collection strategy emphasizing Venus clam. The tentatively dated Late period component at LAN-211/H, located along the riparian zone, also shows a generalized pattern based on Venus clam and littleneck clam. Occupations in the Ballona dating to the protohistoric and early historical periods are found in both the riparian and lagoon-edge zones. Shellfish-collection strategies during this time, regardless of location, have a generalized pattern. However, the protohistoric component at LAN-211/H, represented by Unit 9, exhibits a focused collection strategy dominated by abalone. The meaning of this pattern is not exactly clear because, although abalone meat can be an important food source, abalone shell was highly prized

Table 24. Distribution of Ballona Area Sites by Environment and Temporal Period

Environment	Millingstone Period	Intermediate Period	Late Period	Protohistoric or Historical Period
Bluff top	***F*** LAN-206 (*Chione*)	***F*** LAN-59 (*Tivela*) ***F*** LAN-61 (*Veneridae*) ***F*** LAN-63 (*Chione*) ***F*** LAN-64 (*Chione*)		
Riparian		***F*** LAN-60 (*Chione*) ***G*** LAN-2768 (*Argopecten*, *Protothaca*)		***G*** LAN-194 (*Tivela*, *Chione*) ***G*** LAN-211 (*Haliotis*, *Chione*)
Lagoon		***F*** LAN-62 (*Chione*) ***G*** LAN-2676 (*Chione*)	G LAN-47 (*Chione*, *Ostrea*)	***G*** LAN-1932H (*Chione*, *Protothaca*)

Note: Dominant taxon/a at each site in parenthesis.
Key: ***F*** = focused: majority (> 50%) of assemblage attributable to one taxon; ***G*** = general: no taxon dominates by majority (> 50%)

for fish hooks, beads, and ornaments. The abundance of abalone shell at this unit may represent a specialized abalone tool- or ornament-manufacturing location. Taken as a whole, however, the collection from LAN-211/H reflects a generalized collection strategy focused on abalone and Venus clam.

In summary, the Early and Intermediate period collections on the bluff top represent a focused collection strategy based on Venus clam. Intermediate period occupations along the riparian and lagoon-edge zones also indicate focused collection strategies mostly based on Venus clams. LAN-2676 appears to have a more generalized strategy, but the mixed nature of the deposits and long time-span represented calls into question the validity of the data. LAN-2768 also contains a collection reflecting a generalized collection strategy, although the abundance of scallop and littleneck clam and conspicuously low amounts of Venus clam are puzzling. During the Late and protohistoric periods, shellfish collection appears to be based on a generalized strategy.

At present, the causes of this apparent shift in collection strategy are unknown and may very well reflect changing environmental conditions. Regardless of the causes, the effect of these changes is interesting in its own right. Erlandson (1994:Table 4-1) and Meighan (1959:Table 6) provided conversion factors for estimating the amount of meat represented by a given weight of shell (Table 25). Although these conversions are subject to a host of problems (Claassen 1998:187–191; Erlandson 1994:57; Mason et al. 1998), they can be used to estimate relative amounts of meat provided by shellfish. From these conversion factors, it is clear that Venus clam provides the least amount of meat relative to shell weight. Pismo clam, oyster, and surprisingly, abalone supply only slightly more meat per shell weight than Venus clam, whereas scallop yields more than twice as much meat as Venus clam, littleneck clam more than three and one-half times the amount, and gaper clam 10 times the meat as Venus clam for the same weight of shell. When viewing archaeological shellfish remains in light of the amount of meat provided by a given taxon, the relative dominance of species in a collection shifts. At LAN-211/H for instance, Venus clam is 1.5 times more prevalent than littleneck clam by shell weight, but littleneck clam provided double the amount of meat. In fact, when viewed by meat weight, littleneck clam is more abundant at this site than any other taxon, including abalone. From this it is apparent that all things being equal, a replacement of Venus clam with any other species results in increased amount of meat procured in relation to shell weight. We recognize that this is an overly simplistic model and does not account for

Table 25. Meat Yield Conversion Factors for Some Common Marine Shellfish

Taxon (Common Name)	Meat Yield Conversion Factor	Meat Yield Compared to *Chione californiensis*
Chione californiensis (common Californian Venus clam)	0.171	1.00
Tivela stultorum (Pismo clam)	0.254	1.49
Haliotis spp. (abalone)	0.263	1.54
Ostrea lurida (native Pacific oyster)	0.292	1.71
Mytilus californianus (California mussel)	0.298	1.74
Septifer bifurcatus (bifurcate mussel)	0.364	2.13
Tegula funebralis (black tegula)	0.365	2.13
Argopecten circularis (Pacific calico scallop)	0.400	2.34
Mytilus edulis (bay mussel)	0.438	2.56
Saxidomus nuttalli (common Washington clam)	0.463	2.71
Protothaca staminea (common Pacific littleneck clam)	0.61	3.57
Polinices lewisii (Lewis' moon snail)	0.722	4.22
Tagelus californianus (California jackknife clam)	1.24	7.25
Tresus nuttallii (Pacific gaper clam)	1.70	9.94

Note: Adapted from Erlandson 1994:Table 4-1 and Meighan 1959:Table 6.

several variables—most notably, the total amount of shell present—but it does provide an indication of an apparent increase in meat yield.

Preliminary analysis indicates that the shift from the Early and Intermediate period focused collection strategy that targeted Venus clams to the Late and protohistoric period generalized strategy that emphasized a greater proportion of other species, particularly scallop and littleneck clam, could have resulted in an increased meat yield. The question that must be answered is why people living in the Ballona would shift from collecting Venus clams, which are easy to procure, to collecting species like littleneck clams, scallops, and gaper clams that are harder to collect. The most expedient explanation is that the diminishing proportion of mudflats relative to open-water lagoon precipitated a decline in the abundance of mudflat species, and the local inhabitants began to rely more heavily on open-water species. Although this explains the apparent shift from a Venus-clam–based, focused collection strategy to a generalized one, it begs the question of why, in the first place, the people of the Early and Intermediate periods focused on Venus clams to the near exclusion of other species, especially considering that paleoenvironmental data suggest the presence of an open-water lagoon environment that would have been a prime habitat for other species. Our analysis seems to show that these earlier inhabitants were focusing their attention on the species that were the easiest to collect, supporting the contention that the ratio of shellfish remains is not necessarily a reflection of their relative abundance in the estuary. If the shellfish patterns in the Intermediate period reflect deliberate decisions on which species or what part of the estuary to target, then it is possible that the distribution of shellfish found at later sites might also reflect behavioral rather than exclusively environmental factors. In this light, the apparent intensification noted at the Ballona sites might reflect prevailing settlement patterns, in addition to environmental reasons. Increasing pressure on the existing shellfish populations, as inferred from the shift from a focused to a generalized collection strategy, could have resulted from decreasing mobility, with people visiting the Ballona either for longer periods of time or more often. Perhaps the cause was larger groups visiting on the same approximate schedule as before. In either case, as existing stocks of easy-to-collect Venus clams were depleted, the people of the Ballona began to rely on other species to a greater extent than before.

The invertebrate collection from LAN-211/H is unique among Ballona sites in two respects; first is the abundance of abalone present. Although Keller (1999:88) suggested that abalone might have previously inhabited the outer portion of the Ballona estuary system, at present there is no evidence for this except for the recovery of abalone at local archaeological sites. Even if abalone did previously inhabit the estuary, it would have most likely been during the early formation of the lagoon, when the presence of submerged rocks to which these animals typically attach themselves was more likely. By the time that LAN-211/H was occupied during the protohistoric period, sedimentation would have reduced the number of rocky exposures, thus decreasing the natural abundance of these species in the bay, and we would not expect an increase in abalone use at this late time. A more likely explanation is that the abalone present at LAN-211/H were specifically targeted by the site inhabitants, who either had to travel outside the Ballona area to collect them from more suitable habitats north or south of the estuary, or who acquired the shell through trade.

The second unique aspect of the LAN-211/H shellfish remains is the presence of the freshwater western pearlshell mussel. Western pearlshell mussel is characterized by a highly nacreous interior surface, a trait it shares with abalone, with which it can be easily confused when identifying small fragments lacking diagnostic elements. Western pearlshell mussel was widely used in the manufacture of buttons around the turn of the nineteenth century (Melton 1996:252), providing an indication of the potential suitability of this shell for making beads and ornaments. At present, the southernmost identification of western pearlshell mussel in California is from the southern Santa Cruz Mountains (where it is now probably extinct) and the upper Kern River (Burch 1947:6; Taylor 1981:143). The preferred habitat of these mussels—clear, cool, swift-moving freshwater streams with sand or gravel substrates—is not present in the Ballona, and these shells had to be imported from outside the area. Although it is possible that these mussels could have previously inhabited streams of the upper watershed of the Los Angeles River, or other southern California mountain streams, it is more likely that they were imported from central or northern California. No other examples of western pearlshell mussel are reported from the Ballona.

The low frequency of this mussel in the collection (three specimens are known from the collection, two from Unit 9 and one from a provenience not included in this analysis) and the great distance over which it was imported make it highly unlikely that this mussel was used for food at LAN-211/H; it seems more likely that the shell itself might have been traded to use in ornaments. Taken together, abalone and western pearlshell mussel indicate a sharp rise in the amount of highly nacreous shell at LAN-211/H as compared to other sites in the area and may indicate an increase in shell-ornament manufacture here. If the western pearlshell mussel was traded for use in ornament manufacture, its presence is puzzling, considering abundant nearby abalone supplies. Additional data may help resolve this issue.

LAN-211/H and the Protohistoric Period

A fair number of protohistoric and early-historical-period sites occupied by Native Americans are known from coastal California. Only a few have been systematically excavated, however, and of those, most do not contain discreet deposits attributable to these time periods. Of those sites reviewed for the current project (see Chapter 2), only three sites contain data relevant to our invertebrate analysis, and two of these are located far to the north of the Ballona area. These three sites are the Hammack Street site, Helo' on Mescalitan Island in Goleta Slough of the Santa Barbara Channel area, and Mission Santa Cruz on the north shore of Monterey Bay.

The Hammack Street site (LAN-194) is a stratified deposit with two distinct temporal components. The youngest component dates to the historical period between A.D. 1825 and 1850, whereas the older component could not be firmly dated but apparently lacked contact-period artifacts and probably dated to the Late period (King 1967). Although King excavated the site stratigraphically, it is difficult to distinguish one component from the other in his report, so we must look at the shellfish collection from the site in its entirety. Furthermore, King reported the presence of both marine and freshwater mollusks but omitted data on the freshwater specimens. In all, 12 taxa of marine invertebrates were recovered from the site. Pismo clam was the most common species by weight and constituted 38 percent of the collection. Next in abundance were Venus clam (28 percent), oyster (19 percent), scallop (7 percent), and abalone (4 percent). No other species is present in amounts greater than 1 percent. A range of habitats was reflected in the collection, including rocky coast, sandy beach, and bay or estuary. The presence of two species, Pismo clam and California mussel, that inhabit environments outside the Ballona is noteworthy because they indicate that the Native Americans living at the site retained access to the coastal zone.

The Chumash village of Helo' (SBA-46) was a multicomponent site occupied mostly during late prehistory to the early historical period, but earlier components were also identified (Rockwell and Gamble 1992). The shellfish collection contained over 43 identifiable species. Although the greatest species diversity was found among snails, the vast majority of shellfish by weight are bivalves. The total shell collection was dominated by Venus clam (50 percent by weight), followed in order of abundance by littleneck clam (26 percent), oyster (13 percent), Washington clam (3 percent), and bent-nosed clam (2 percent). The remaining species, including abalone, each made up less than 1 percent of the collection (Denardo 1990:18-5). The majority of these shellfish inhabit the estuarine habitats found in nearby Goleta Slough, with only small amounts from sandy-beach and rocky-shore environments (Denardo 1990:18-3–18-4). Analysis of the temporal distribution of shellfish from Helo' shows very little change over time, except for a slight increase of Venus clam from earlier to later deposits. The frequency of littleneck clam remains stable over time (Denardo 1990).

Mission Santa Cruz was established in 1791 and continued to house a neophyte population until secularization in 1834. Excavations at the mission resulted in a surprisingly large quantity and variety of marine invertebrates (Allen 1998:58–59). In all, 7257.7 g of shell representing 29 species were recovered from the site. More than 50 percent of the shell, both by MNI and by weight, is California mussel. The next most frequently identified species are abalone (17 percent) and Washington clam (11 percent) (Allen 1998:Table 6.2). Analysis of the shellfish remains by size showed the presence of varying sizes of shellfish, suggesting that all sizes were indiscriminately gathered, and habitats represented by the collection reflect the nearby shoreline and estuaries of Monterey Bay. Excavation of the site focused on two temporally discreet areas, one dating to what Allen referred to as the Early Mission period (A.D. 1800–1824) and the other to the Late Mission period (A.D. 1824–1834). Comparing the invertebrate remains between the Early and Late Mission periods, Allen (1998:57) saw no significant differences between the two collections and viewed shellfish gathering and consumption as indicating continuity of use of this traditional food resource (Allen 1998:63).

Both abalone and *Olivella* shell beads were recovered from the Mission Santa Cruz. Interestingly, so was a large amount of bead-making detritus, suggesting the presence of a shell-bead making workshop at the mission. Shell ornaments made at the mission are believed to have been traded to other mission and nonmission Native Americans (Allen 1998:95).

Direct comparison of sites situated along different bays and estuaries is generally meaningless because the shellfish assemblages are dependant to a great extent on the unique environmental conditions and history of each area. What makes these mission-era sites important to our understanding of LAN-211/H is what they can tell us about the protohistoric and historical periods in general. The most compelling commonality between these sites is the demonstrated continuity of shellfish in the subsistence practices of these people. During the early historical period, neophytes living at Mission Santa Cruz retained access to Monterey Bay. They routinely gathered a range of shellfish there and brought them back to the mission where they prepared and ate the meat and manufactured beads and ornaments from the shells.

The continued manufacture and use of shell ornaments is also interesting. Shell ornaments, mostly *Olivella* beads, abalone beads, and pendants, continued to be manufactured during the early historical period and were traded at inland sites far from the coast (Chambers Group 1990; McCown 1995). The importance of shell ornaments is not completely understood, but Curtis (1959:129) suggested that the extensive use of shell ornamentation was a diagnostic trait of the protohistoric and early historical periods at Arroyo Sequit (LAN-52), a coastal Chumash village in northern Los Angeles County. This observation is very interesting in light of the abundant abalone and the presence of western pearlshell mussel at LAN-211/H, which might indicate shell-ornament manufacture. It is possible that shell ornamentation served as a means of displaying ethnic identity during times of social change in the protohistoric and early historical periods, and that the intensity of shell manufacture increased in response to accelerated social change and acculturation. This is a question that deserves further exploration.

Summary

Archaeological testing at LAN-2769 and LAN-211/H revealed that both sites contain varying quantities of invertebrate remains. The extremely small amount of shell recovered from LAN-2769 during test excavation consists of mostly bay- and estuary-loving species. This habitat is located relatively close to the site and would have been easily exploited by the site inhabitants.

The collection from LAN-211/H is much more substantial, with a wider range of species reflecting a generalized collection strategy from multiple marine environments, including open or rocky coast, sandy shore, and bay or estuary. Spatial analysis at LAN-211/H indicates relatively robust patterns of the majority of shellfish by weight and greatest species diversity at Unit 9. The collection at this unit is dominated by abalone, which might indicate shell-tool or -ornament manufacturing, a hypothesis further supported by the presence of the exotic, freshwater western pearlshell mussel.

When placed in context with surrounding Ballona area archaeological sites, the LAN-211/H shell indicates a generalized collection strategy typical of Late and protohistoric-period sites in the area. This collection strategy, which used a broad range of marine shellfish, including harder to collect species, is different from the earlier Intermediate period and Early period focus on the easy-to-collect Venus clam. This subsistence shift takes fuller advantage of the marine environment by targeting animals with larger meat weight to shell weight ratios. The reason for adopting this strategy is unclear, but most certainly is based to a large extent on changing environmental conditions (decreasing mudflat habitat relative to open-water lagoon); it might also be partly based on shifting settlement patterns influenced by social dynamics reaching outside the Ballona.

One of the noteworthy aspects of LAN-211/H is its age. Preliminary analysis of radiocarbon dates indicates the presence of two temporal components: the earlier from a Late period occupation, followed by a later protohistoric-period use. The protohistoric deposit from Unit 9 contains a very rich and diverse invertebrate collection. Most striking about the Unit 9 collection is the abundance of abalone, a characteristic absent at all other Ballona sites. Also unique to this unit is the presence of western pearlshell mussel, an exotic species that was probably traded into the area from the mountains of central California. Both the abalone and western pearlshell mussel are highly nacreous, a quality prized for shell ornaments. Some evidence suggests that extensive use of shell ornamentation is a diagnostic trait of the protohistoric period (Curtis 1959:129). The discovery of a neophyte shell-ornament workshop at Mission Santa Cruz showed that this trait extended into the early historical period as well (Allen 1998).

The results of test excavation at LAN-211/H indicate that the invertebrate remains found here have the potential to add to our understanding of how people lived in the Ballona. Future research should explore changing patterns of shellfish exploitation in the area and show how they relate to environmental conditions. Understanding the ways in which the shell collection deviates from predications based on environmental models may allow us to infer social organization. The abundant abalone and presence of the exotic western pearlshell mussel are also important because they may provide data that may help to better understand the social significance of shell ornamentation and elucidate the nature of trade relationships during the protohistoric period, a particularly volatile period of social change.

CHAPTER 9

Beads, Ornaments, and Other Artifacts

Robert O. Gibson, David Maxwell, Anne Q. Stoll, and Donn R. Grenda

In this chapter, we present the results of the analysis of beads, ornaments, and other artifacts, including worked bone and shell tools, excavated from test units at LAN-211/H and LAN-1932/H (which is included for comparative purposes). Excavations at LAN-2769 produced no artifacts of these types. Excavations yielded a total of 128 items; of these, 70 consisted of artifacts recovered from LAN-211/H. These include 37 shell beads, 20 glass beads, 4 stone beads, 1 bone bead, 1 stone disk, 1 shell fishhook, 1 shell with asphaltum, 1 burnt shell fragment, 2 bone awls, 1 bone tube, and 1 drilled tooth. Fifty-three artifacts were found at LAN-1932/H consisting of 38 shell beads, 4 unidentified shell disks, 1 glass bead, 5 bone beads, 1 serpentine bead, 1 bone awl, 1 bone gorge or awl fragment, and 2 unidentified worked bone fragments. Five items initially included in the analysis and listed in the bead catalog in Appendix B, were subsequently discarded as nonartifactual. David Maxwell analyzed the 14 worked bone artifacts, and the other 109 artifacts were analyzed by Robert Gibson.

This chapter begins with background information concerning the usefulness of beads as chronological and social indicators. This section is followed by a discussion of the methods and results of bead analysis and local site comparisons. This chapter ends with the results of the worked bone analysis. For a complete presentation of bead data, including traits and measurements, see Appendix B.

Beads

Generally speaking, this class of artifacts is thought to have both an economic and social function. For the Chumash, shell bead ornaments denoted wealth and status and were conspicuously displayed during ritual and social gatherings. Beads were used as offerings and adorned the dancers during festivals and special rituals, such as the harvest ceremony (Librado 1981:48, 85–86). Beads also served as a medium of exchange and as a validation of social and political authority (King 1974:91). Archaeologically, beads are highly prized for their usefulness in dating cultural deposits, as many bead types are temporally sensitive. As the most commonly used material for bead manufacture, *Olivella* shell beads have been recovered in large numbers from archaeological deposits throughout the state. *Olivella biplicata* beads have proven especially useful for dating, as a chronological sequence for their manufacture has been devised using burial lot seriation (King 1990a).

Recent research on the trade network of shell beads across California suggests that the Gabrielino may have acted as go-betweens in shell bead trade between the Chumash and inland groups such as the Cahuilla and Kumeyaay (Gamble and Zepeda 2002). Cremations at the historic Kumeyaay site of Amat Inuk in eastern San Diego County were found to contain 7,831 *Olivella* rough disk beads, a discovery made especially significant by the fact that shell beads of any type were not generally manufactured in San Diego County (Gamble and Zepeda 2002:80). Bead characteristics, such as diameters and hole perforations, indicated manufacture after 1800, leading the authors to deduce that long distance exchange networks among California Indian societies continued well into the period of Spanish contact (Gamble and Zepeda 2002:87). Following this lead, shell beads from Ballona area sites may reflect patterns of exchange that operated into the historical era.

Beads discussed in this chapter include those manufactured from glass, shell, stone, and bone. A discussion of the temporal placement of these artifacts is presented below, followed by a brief description of their social and technological implications. The methods used for the bead analysis are then described, followed by results, which show that the majority of the beads were found in Unit 9 at LAN-211/H and date to the protohistoric and early historical periods.

The project area is located within the territory historically occupied by the Gabrielino (Bean and Smith 1978). Manufacturing techniques and use of shell beads among the Gabrielino are poorly understood; however, a well-documented body of research exists for similar types of beads found in adjacent Chumash territory. Our analysis assumes that Chumash data apply to shell beads from the Ballona. The interested reader is referred to work by Gibson (1976, 1992), Gibson and King (1991), and King (1974, 1976, 1978, 1988, 1990a, 1990b, 1991).

Chronology

As discussed in Chapter 2, the protohistoric period (A.D. 1542–1771) and early historical period (A.D. 1771–1834) have been separated to facilitate differentiation between pre- and post-contact native contexts. Glass beads, by definition, are post-contact and must date to A.D. 1542 or later. Bead data from LAN-211/H and LAN-1932/H indicate that occupation of these sites, ranging between A.D. 1550 and 1850, overlaps both the protohistoric and historical periods.

Whole *Olivella* Beads

These shell beads, which are made from a nearly complete *Olivella* shell with the spire removed perpendicular to the body axis, have been produced and distributed throughout most of California and the Great Basin over a span of at least 7,000 years (Bennyhoff and Hughes 1987; King 1981). In central California and the Great Basin, *Olivella* beads with the spire ground diagonally (Type A2a) are known in quantity only after the end of the Early period (ca. 3000 B.P.). In the Santa Barbara Channel Islands, *Olivella* beads with diagonally ground spires are commonly found in contexts dating to the Intermediate period from around 2450 to 1900 B.P. The beads become scarce after 1800 B.P. but have been found as late as 1500 B.P. (Gibson 1975:116; King 1981:56, 192).

Bead size can be temporally significant. Beads made from small shells (less than 6.5 mm in diameter) were most popular during the Intermediate period (ca. 2000 B.P.), then gained favor again beginning around A.D. 1850 (800 B.P.). However, little significance can be attached to size alone unless a large sample from intact strata is available for analysis.

At ORA-64, a large site overlooking Upper Newport Bay, more than 350 shell beads were recovered, most of which were of the whole *O. biplicata* bead type. Fourteen of these beads were sent to Lawrence Livermore National Laboratory for AMS radiocarbon dating. Two returned dates circa 7600 B.P., and the remaining 12 dated to between 8300 and 8950 B.P. (Macko 1998:93–96). These beads provided the oldest dates for the site and confirm that this bead type represents the early Holocene bead styles.

Olivella Lipped Beads

The date range for the types of *Olivella* lipped beads found at LAN-1932/H and LAN-211/H spans the period between A.D. 1550 (400 B.P.) and A.D. 1780 (170 B.P.). Within that span, the different varieties grade from thin-lipped round, diagnostic of the early protohistoric period; through thin-lipped oval (transitional between thin-lipped and full-lipped forms); to full-lipped beads, generally diagnostic of the later protohistoric period. Deep large-lipped beads first occur ca. A.D. 1650 and become increasingly common in the historical period (Bennyhoff and Hughes 1987:129).

Lipped beads were used as a medium of exchange between individuals and households. Although not common in Santa Barbara Channel Island grave lots, they were widely used throughout central and southern California (King 1978:60).

Olivella Cup Beads

Olivella cup beads are chronological indicators of the Late period in the Chumash cultural area; they are absent from sites before A.D. 1100. Two subgroups have been distinguished. From ca. A.D. 1100 to 1500, larger cups (around 3.8 mm to larger than 4.3 mm) were prominent, whereas from ca. A.D. 1500 to 1782, smaller cups (2.1–3.8 mm) were more popular (King 1990b:157). The specimens from LAN-211/H and LAN-1932/H are within the size range of examples that have been dated to the later end of the spectrum, between A.D. 1650 and A.D. 1782 (King 1990b:8–23). Incised cups are most common during the protohistoric period. At the Medea Creek Cemetery (LAN-243C), a Late period site in Agoura Hills, cup beads were found in all areas of the cemetery; however, the highest concentrations were in the western area, where persons of wealth and status were interred (King 1974).

Cup beads were used as a medium of exchange between individuals or households. King (1990a:160) found that coiled strings of *Olivella* cup beads sometimes were found in graves but usually in small numbers. Occasionally, very large numbers are found with high-status burials. Cup beads were sometimes attached to other implements (e.g., bone or wooden objects) with asphaltum and might also have been sewn onto perishable items such as baskets.

Olivella Cut-Wall Beads

The classification “cut-wall beads” is an overarching category that includes saucers (Gibson Type G), disks (Gibson Type H), and wall disks (Gibson Type J). All three of these bead types were found at LAN-211/H and LAN-1932/H. *Olivella* wall disks and tiny saucer beads were first manufactured during the Intermediate period, ca. 2450–1940 B.P. By around 1900 B.P., both large and small wall disk beads had become the most common form of shell bead in the Santa Barbara Channel region, and both types continued in use into the Late period in southern California. Hole diameter is critical to distinguishing the tiny saucers (G1 type) made during the Intermediate from those in use during later periods. Tiny saucer beads from the project area have relatively large hole diameters, thus placing them at the later end of their temporal spectrum, after A.D. 1550.

Shortly after A.D. 1780, wall disk beads grade into rough and chipped disks (Gibson 1976:157). The earliest evidence of the complete manufacturing sequence of *Olivella* disk beads (chipped, rough, semi-ground, to ground) dates to about A.D. 1780. Eventually, during the historical period, they became the most common type of shell bead made in southern California, based on sequences defined at Medea Creek (LAN-243), Malibu (LAN-264), and San Buenaventura Mission (VEN-87) (Gibson 1976; King 1990a, 1990b, 1991). Dynamic interaction between native populations and European culture resulted in many changes in the size and shape of this bead. Between A.D. 1780 and 1840, these beads generally increased in overall diameter, while the degree of grinding on their peripheries decreased, thus blurring some of their diagnostic distinctions. The overall diameter, periphery treatment, hole size, and form are time-sensitive variables, as past researchers have shown (Gibson 1976; King 1990b, 1991).

Data on rough disk beads from LAN-211/H and LAN-1932/H were compared to those data obtained from the Chumash sites Helo' (SBA-46), SBA-60, and at Malibu (LAN-264) (Gibson 1975, 1995, 2000; King 1990b). Comparing rough disk beads from these sites with those from LAN-211/H and LAN-1932/H, it is clear that the average diameter of the LAN-211/H and LAN-1932/H beads is relatively small compared to those from SBA-46 and the later portions of LAN-264. Further, the perforations of the five mostly ground (Type H1b) specimens from both of SRI's sites average 1.0 mm, representing the small end of the size range for these disk beads. Based on this size comparison, the *Olivella* Type H beads from LAN-211/H and LAN-1932/H are most similar to the beads found the Malibu site (early phase) and SBA-60 and thus probably date between about A.D. 1780 and 1800, at the latest.

Chumash ethnographic data indicate that *Olivella* wall disk beads were strung and used as bracelets. Long strings were wound around the wrist several times or worn as belts by chiefs on fiesta days. Strands were also used as necklaces and functioned in ritual intervillage or interregional exchanges between village chiefs and other individuals of high status. *Olivella* saucers and wall disks were not used as a medium of exchange between individuals or households; rather, such items were used to validate social and political authority (King 1974:91).

Mytilus and *Haliotis* Disk Beads

In the Santa Barbara Channel region, *Mytilus* disk beads most frequently date between A.D. 900 and 1150. After A.D. 1400, these beads were used less frequently, but they continued to be used into the historical period (King 1990a:187). Two *Mytilus* disk beads were recovered from LAN-1932/H, likely dating to the post–A.D. 1400 period.

No beads made from *Mytilus* shell were found at LAN-211/H; three *Haliotis rufescens* epidermis disk beads were recovered from this site, however. These disk beads are first seen at sites dating from A.D. 1550 and become more common by A.D. 1780. The smaller sizes (about 2.6 mm in diameter, 1.0 mm thick, and having a 1.2-mm hole) date from about A.D. 1650. After A.D. 1780, these beads increase in size, ranging from 3.5 to 6.5 mm in diameter. The three specimens from LAN-211/H average 4.4 mm in diameter, suggesting the later period for their manufacture date. No beads made from *Haliotis* shell were recovered from LAN-1932/H.

Glass Beads

Cane beads are not diagnostic of the historical period only; they are known from protohistoric contexts also. These beads' wide temporal span makes them less useful in dating than shell beads. Wire-wound beads are a relatively rare type in historical-period contexts. They were not recorded at Malibu (LAN-264) and were assigned to a post–A.D. 1816 period or later at VEN-87 (Gibson 1976:122; King 1990b; King and Gibson 1972).

Stone Beads

The dating sequence for stone beads has not been well established, and some local variation may exist. According to King (1981), beads of hard stone were mostly made during the Early period and the first phase of the Intermediate. Hard stone beads were probably the most commonly used shaped beads during most of the Early Period; they become relatively rare after about 1950 B.P. (King 1981:172). In the Chumash culture area, hard stone disk-cylinder beads made from serpentine, serpentine-jadeite, and jadeite are usually associated with large, thick disk-cylinder beads made from clam shell. Both types increased in frequency at the end of the Early period (King 1981:177). Thin chlorite-schist disk beads found at LAN-264 were dated to the Early and Intermediate periods (Gibson 1975:113). The sequence of change in stone beads during the Intermediate period is poorly understood. Steatite beads are known from both Intermediate and Late period sites and are generally not culturally or chronologically diagnostic.

Bone Beads

Although bone beads have been found throughout the Ballona, they are relatively rare in lowland sites. Generally bone beads are not considered culturally or temporally diagnostic. More than 2,000 bone beads were found at ORA-64, a site occupied between 9000 B.P. to about 4300 B.P. (Macko 1998:93). King noted that in Chumash territory, small-mammal tube beads were frequently used ca. 3000 B.P. and persisted as a rare bead type through to the historical period (King 1990a:123). A bone bead was found in association with Rose Springs projectile points, a bone awl, and an *Olivella* spire-removed bead in a cairn burial in Death Valley. The burial dated to Death Valley III period, ca. A.D. 1–1000 (1950–950 B.P.) (Wilke 1978:446). No solid chronological sequence has yet been devised for bone beads, as they are known from the full temporal range of sites in southern California.

Methods

Gibson examined 109 artifacts (102 beads and 7 miscellaneous shell artifacts) using a 15-power binocular microscope, then placed each of the beads into one of 24 distinct categories of glass, shell, and stone. Typological bead analysis uses the classification system and temporal framework established for the Santa Barbara Channel region by C. King (1981, 1990a) which has been correlated with the California bead typology of Bennyhoff and Hughes (1987). The shell bead classification system of King (1981) and Bennyhoff and Hughes (1987) is based on bead shape, material, overall dimension, perforation characteristics, periphery and surface appearance (focusing on attributes such as incising and grinding), and other minor modifications. Glass beads introduced after A.D. 1769 were typed using the Buenaventura Mission typology (Gibson 1976).

All measurements, made in millimeters, were taken as if the bead were on a string held between the hands horizontal to the surface of the earth. Bead diameter is measured as the greatest distance across the face of the bead, perpendicular to the string. If a bead is irregular in shape, the maximum and minimum diameters are generally given (i.e., 9.0 by 7.5 mm). If only one measurement is given, it is assumed the bead is approximately circular in outline (Gibson 1992).

In the proper orientation, the thickness of a bead is the same as its length, which is measured as the greatest distance between the ventral and dorsal surfaces. The thickness of *Olivella* disks, cups, and lipped beads is dependent on the natural thickness of the *Olivella* shell. The thickness of other types of beads (including clam, *Mytilus,* and *Haliotis* disks) is related to the amount of energy expended in grinding one or both faces of the bead, as well as its circumference or perimeter.

The hole diameter is measured as the minimum distance across the perforation. If a hole is labeled as "biconical" (meaning drilled from both the ventral and dorsal sides of the bead), the minimum diameter will be somewhere near the midpoint of a bead. A "conical" perforation refers to a hole drilled from one side of a bead only. It is important to note whether a hole is drilled from ventral or the dorsal side. In some cases after drilling a conical hole, the bead maker would turn a bead over and slightly ream out the other side in order to make the hole smooth and even. This type of perforation is generally not considered to be biconically drilled. For this analysis, the biconical perforations were examined to determine if they had been equally drilled from each side or more from the ventral or dorsal side. This information is noted in Appendix B as "b80v" (biconical hole drilled 80 percent from the ventral side of the bead), or "cv" (conical hole drilled from the ventral side of the bead). The bore of a hole is considered straight if the sides of the hole are parallel. Holes were carefully examined and measured using a 10× reticle with a metric scale in 0.2-mm divisions. The format used to express all bead measurements presents the diameter (or length and width) first, followed by bead thickness, then minimum hole diameter, for example, 5.0/2.4/1.2 mm. All bead data were cataloged in a Panorama database using a Macintosh G4 computer. Appendix B contains the detailed artifact catalog.

Olivella Beads

Thirty-four *Olivella* shell beads were found at LAN-211/H and 36 at LAN-1932/H. A selection of these beads are presented by type in Table 26. Each of these types is discussed below.

Whole Spire-Removed Beads

Beads of this type were made by grinding the spire ends of *O. biplicata* shells to produce a circular hole perpendicular to the long axis of the shell. The one example of this type from LAN-211/H (Figure 72a) was ground at a slight diagonal (about 30 degrees or less) but not enough to classify it as an oblique (A2) type. *Olivella* spire-removed beads, including diagonally removed spire types, were probably strung together. Sometimes flat wear facets occur on the sides of shells, suggesting they were strung or sewn as appliqué (King 1981:193). One small *O. biplicata* shell from LAN-1932/H (Figure 73a) was modified at about a 45 degree angle and showed traces of a red stain around the top of the spire.

Callus Beads

Callus beads are normally round to oval beads made from the upper callus (inner lip) and adjacent body whorl of the *Olivella* shell. Nine varieties of *Olivella* callus beads were analyzed in this collection, all types of either lipped beads (E type) or cup beads (K type). Lipped bead varieties consist of thick, thin round (Figure 73b), full (Figure 73c), deep large, thin round (Figure 72b), and thin oval. Lipped beads manufactured from the *O. biplicata* shell display a cross section with a thicker side (the callus area) and a thinner side (the wall area). The outline of this type of bead can range from circular through oval to rectangular. Peripheries are ground, and the perforation is typically drilled midway between the wall and callus areas.

Cup bead types consist of plain (Figures 72c–d and 73d), diagonal incised (Figures 72e–f) and "X" incised. Cup beads, also manufactured from the callus portion of the *Olivella* shell, are relatively small and circular in outline when viewed in cross section. The ventral side is more convex than the dorsal side, thereby giving this form a cup-like appearance. Usually cup beads are thicker than 1.3 mm; thin cups grade into wall disk beads. Perforations may be conically or biconically drilled. Four of the 16 cup beads were decorated with either diagonal or "X" incising.

Table 26. *Olivella* Beads from LAN-211/H and LAN-1932/H

Bead Type,[a] by Shell Portion	LAN-211/H	LAN-1932/H	Figure	Dates
Whole				
Spire removed, simple, A1c	1	—	72a	
Spire removed, oblique, A2a	—	1	73a	5000–4500 B.P.
Callus				
Lipped, E	—	1		
Lipped, thin, E1	—	1		
Lipped, round thin, E1a	—	3	73b	A.D. 1500–1650
Lipped, oval thin, E1b	1	4	72b	A.D. 1600–1700
Lipped, thick, E2	1	—		A.D. 1650–1785
Lipped, full, E2a	1	10	73c	
Lipped, deep large, E3b	—	1		A.D. 1650–1785
Cups, plain, K1	7	5	72c–d, 73d	A.D. 1150–1785
Cups, incised	2	2	72e–f	post–A.D. 1500
Cut wall				
Saucers, tiny, G1	6	5	72g–i	A.D. 700–1780
Saucers, normal, G2	2	—		A.D. 700–1780
Disc, ground, H1a	2	—	72k	A.D. 1780–1790
Disc, mostly ground, H1b	3	1	72l–n	A.D. 1780–1790
Disc, rough, H2	2	—		A.D. 1780–1790
Disc, rough, ground, H2a	4	—	73e–f	A.D. 1780–1790
Wall disc, abraded, J	—	2		A.D. 700–1780
Wall disc, irregular	2	—		
Total	34	36		

[a] Type keys are equivalents in Bennyhoff and Hughes (1987).

Cut-Wall Beads

Two decades of research have provided a solid seriation for *Olivella* cut-wall beads. Three principal varieties of cut-wall beads were analyzed: saucers (Type G), disk beads (Type H), and wall disks (Type J). Saucer beads, made from the wall of the *Olivella* shell, are circular in outline and usually have a well-ground periphery (Figures 72g–i). In cross section, the curvature of the internal and external surfaces is the same. At LAN-211/H and LAN-1932/H, the overall diameters of these beads are small, varying from 2.9 to 4.3 mm, with a minimum average diameter of 3.4 mm. Hole types range from

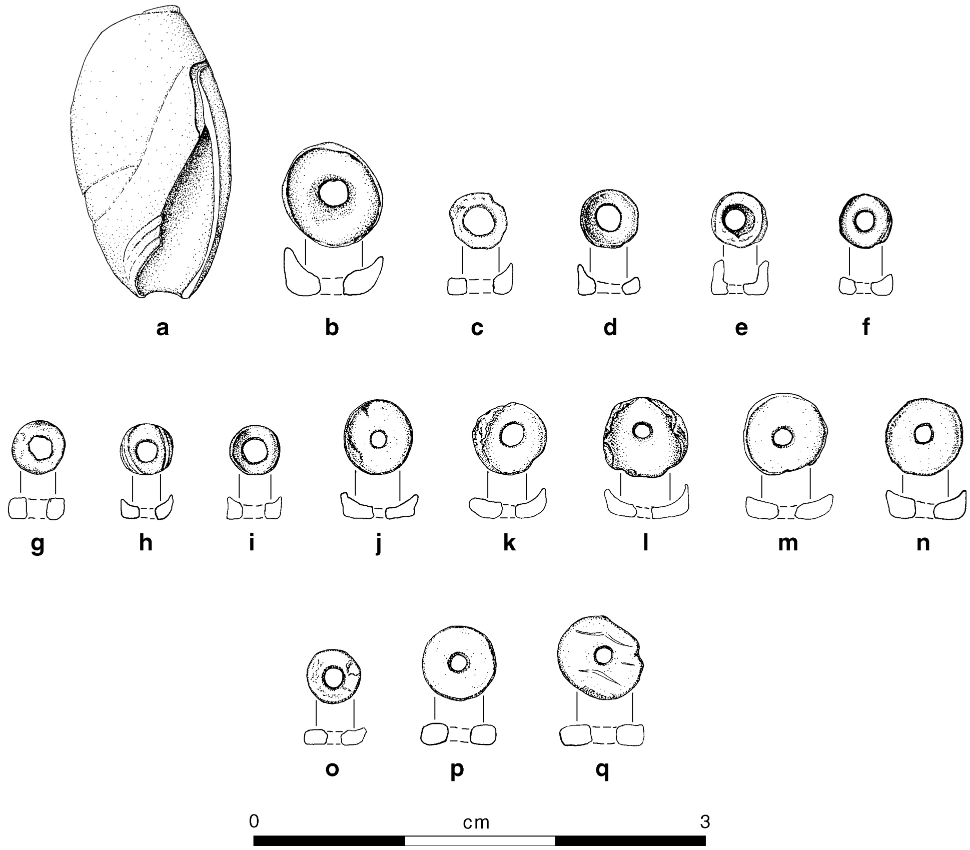


Figure 72. *Olivella biplicata* shell beads from LAN-211/H: (a) large spire removed; (b) thin-lipped oval; (c–d) cup; (e–f) cup with diagonal incising; (g–i) tiny saucer; (j) ground disk; (k) semiground disk; (l–n) rough disk. *Haliotis rufescens* disks: (o–q).

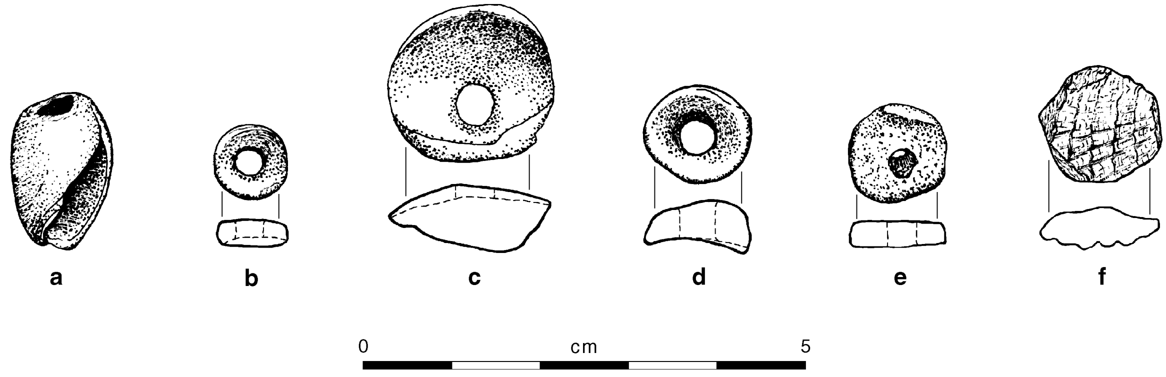


Figure 73. *Olivella biplicata* shell beads from LAN-1932/H: (a) oblique spire removed; (b) thin-lipped round; (c) full lipped; (d) cup. Unidentified shell: (e–f) rough disks.

conical (drilled from the ventral surface) to biconical, and their diameters run from 1.2 to 1.6 mm, with an average of 1.4 mm. Asphaltum stains were observed on one example from LAN-1932/H.

Disk beads (Type H), also manufactured from the walls of *Olivella* shells, are circular to square in outline. In cross section, the curvature of the internal and external surfaces is the same, and the thickness does not vary. The external margin or periphery of this bead varies from chipped to ground, passing through six graduations as defined by King (1991:8-14). Disk beads are divided into subcategories: well-ground, ground mostly ground, partly ground, rough-ground and chipped, based on degree of finishing. Ground disk beads (Type H) belonging to the last two gradation categories (ground and well-ground) can be difficult to distinguish from wall disk beads (Type J) and saucer beads (Type G) that have completely ground peripheries. Hole diameter and shape are the main criteria for separating these varieties of ground disk beads from wall disks and saucers. Ground disk beads have holes smaller than 1.2 mm, usually have a straight bore, and often have a punched dorsal side. Holes such as these are produced by using metal needles to drill them. By contrast, wall disk beads usually have biconical or conical holes larger than 1.2 mm.

Another important variety of *Olivella* cut-wall bead is the wall disk bead (Type J). This type of bead is made from the wall of the shell, is circular to oval in outline, and usually has a well-ground periphery. In cross section, the curvatures of the internal and external surfaces are the same. The single Type J bead, a wall disk bead, from LAN-211/H is a fragment but is larger overall than the two wall disk beads found at LAN-1932/H (Figure 73e–f). From LAN-211/H, SRI recovered 11 Type H disk beads: 2 ground disk beads, one of which is shown in Figure 72j, 3 mostly ground disks, one of which is illustrated in Figure 72k, and 6 rough disk beads; three are shown in Figures 72l–n. A single mostly ground disk bead was recovered from LAN-1932/H.

One of the two abraded wall disk beads from LAN-1932/H was made from the thin wall area of an *O. biplicata* shell. The dorsal side has been abraded almost through the shell and the last bit was punched through from the ventral side to form an irregular, almost triangular hole about 1.4 mm in diameter. This bead was recovered from Unit 13, Level 2, the same unit and level that produced an *Olivella* spire-removed diagonal (Type A2a) bead. This rare type of bead dates to the period from A.D. 1550 to 1780.

Other Shell Beads

The two *Mytilus* disk beads recovered from LAN-1932/H are made from cream-colored mussel shells, most likely those of the California mussel *(M. californianus).* Without seeing an interior cross section of the bead, it is often difficult to distinguish cream-colored *Mytilus* disks from pale pink red abalone *(Haliotis rufescens)* epidermis disks. These specimens are circular to slightly irregular in outline, flat in cross section, and their dorsal and ventral faces are well ground.

Beads made from *Mytilus* shell were usually combined on strings, named *'ikimis,* with white *Olivella* or clam-shell beads (Gibson 1976:90). At the Medea Creek Cemetery site (LAN-243C), *Mytilus* disks and cylinders were found in the western and central areas of the cemetery. They appear to have been used in ritual exchanges between political leaders and chiefs (King 1974:89).

The three *H. rufescens* epidermis disk beads recovered from LAN-211/H are well ground, circular in outline, and pale pink in color. This type of bead is made from the outer epidermis of the shell (Figures 72o–q). At Malibu (LAN-264) and Medea Creek (LAN-243C), these beads were found in the central and west areas of the cemetery. They were sometimes strung with clam and *Mytilus* disks to form necklaces used by chiefs and other high-status people (Gibson 1976:90; King 1974:87). The *H. rufescens* epidermis disks, *Mytilus* disks, clam, and possible stone disks could all have been used as jewelry or ornaments for special occasions.

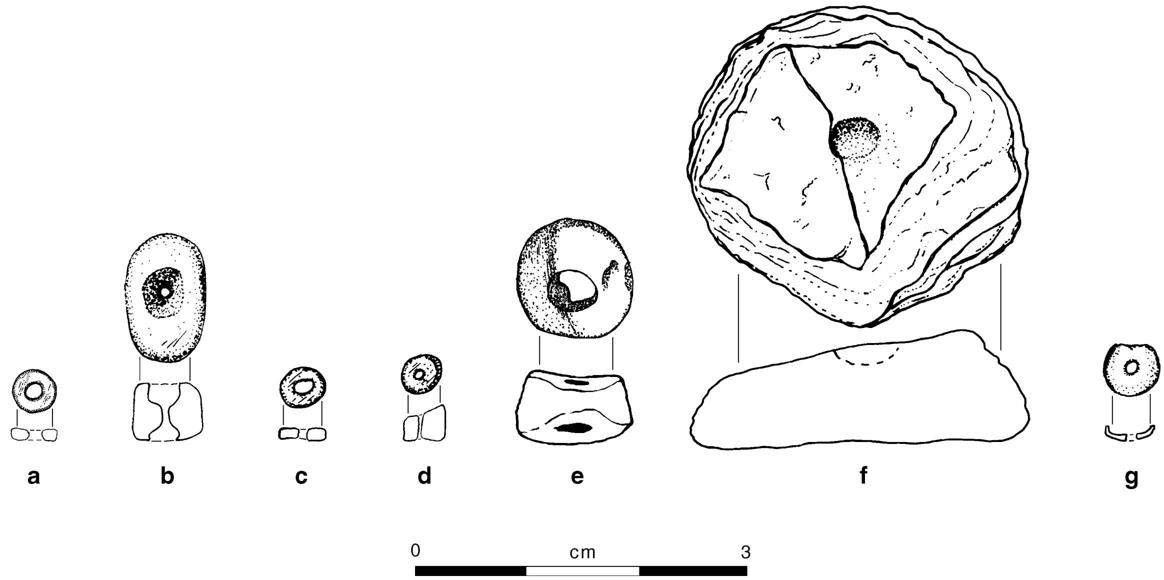


Figure 74. Stone and bone beads from LAN-211/H and LAN-1932/H: (a–d) steatite beads from LAN-211/H; (e) serpentine bead from LAN-1932/H; (f) schist disk from LAN-211/H; (g) bone bead from LAN-211/H.

Stone Beads

Four stone beads (Figure 74a–d) and one stone disk were found at LAN-211/H; a single serpentine bead was recovered from LAN-1932/H (Figure 74e). Stone beads were usually made by cutting or grinding down pieces of stone to shape, which were then perforated. In many cases, hard stone beads were finished by polishing using fine-grained abrasives. The stages of manufacture of barrel-type stone beads were essentially the same as those used to make cylinder and tubular shell beads. Most of the materials used for stone beads such as talc schists, chlorite schists, and reddish brown and yellow burned shale are softer than the shells used to make beads. Some of the harder materials used include serpentine, serpentine-jadeite, and chert (King 1981:168–171). The single dark serpentine bead recovered from LAN-1932/H measures 9.0 mm wide by 5.6 mm thick, and has an interior perforation of 2.3 mm. It is nearly complete, with only a small chip missing from one surface, which may have occurred during manufacture.

The stone beads from LAN-211/H were carved from Santa Catalina Island steatite, are centrally perforated, and represent two separate bead types. One of the four specimens, a dark gray steatite bead in cylindrical barrel-style shape (Figure 74d), has a rating greater than 3 on the Mohs hardness scale.

In addition to these four steatite beads, a rough stone disk made from gray schist was found at LAN-211/H (Figure 74f). Both faces of this disk have been lightly drilled, creating a small cup-like mark on each surface. The two drill marks were offset from each other and would not have joined if drilling had continued. This artifact could be an abandoned attempt to create a schist disk bead; such beads were found in large numbers at LAN-264 (Gibson 1975:113). The identification of this specimen remains uncertain, however; the drilled depressions give this artifact the appearance of a spindle whorl.

Bone Beads

Most bone beads and tubes were made by cutting segments of the shafts of long bones of small mammals (King 1981:168–169). Six bone beads were recovered during this project, five from LAN-1932/H and one from LAN-211/H (Table 27). Considering worked bone as a whole, beads are the dominant artifact form. Three of the beads from LAN-1932/H are very small and very roughly shaped pieces, exhibiting little evidence of grinding. It appears that these were simply cut off from a small mammal long bone, with the marrow cavity minimally worked for stringing. The other two beads are larger in size, thoroughly polished, and exhibit signs of mineral staining. One of the specimens from LAN-1932/H is roughly barrel shaped while the other is more tubular in shape. The single specimen from LAN-211/H was roughly concave in cross section and drilled with a metal needle (Figure 74g).

Glass Beads

SRI recovered 21 glass beads from these two sites: 20 from LAN-211/H and 1 from LAN-1932/H. Of these, 20 were cane beads and 1 from LAN-211/H was wire wound.

Table 27. Stone, Bone, and Glass Beads from LAN-211/H and LAN-1932/H

Manufacture Method, by Material	Description	Gibson Type	LAN-211/H (n)	LAN-1932/H (n)	Figure
Stone					
Abraded	dark steatite		4	—	74a–d
Ground	black serpentine		—	1	74e
Chipped, abraded	grey schist disc		1	—	74f
Bone					
Well shaped	mammal bone shaft	EE1	—	2	
Roughly shaped	rodent bone shaft		1	5	74g
Glass					
Cane	cobalt blue	C1a	5	—	75a–c
Cane	copper blue	C2a	4	—	75d–e
Cane	green	C3a	7	1	75f–g
Cane	clear	C5a	1	—	75h
Cane	translucent red with green core	C6a	2	—	75i–j
Wire wound	red	W6e	1	—	75k
Total			26	9	

Cane Beads

Six types of glass cane beads are commonly found in historical-period sites in southern California; all types were recovered from excavations at the San Buenaventura Mission (Gibson 1976; King 1990a; King and Gibson 1972). Five of these types were recovered from LAN-211/H and LAN-1932/H: cobalt blue (Figure 75a–c), copper blue (Figure 75d–e), green (Figure 75f–g), clear (Figure 75h), and translucent red with green core (Figure 75i–j).

Cane beads are made by snapping long tubes of glass and tumbling the segments in drums of hot sand to produce an oblate spheroid shape with rounded ends. To create red cane beads, for example, an oblate spheroid bead was made by taking a colorless cane and rolling it in brick-red molten glass to give the clear glass core a thin coating of red color. Then the cane was cut and tumbled. The single clear example (from LAN-211/H) represents the same manufacturing technique as other cane beds except that no coloring agent was added to the glass. These beads were manufactured in Venice, Italy, and purchased by the Spanish for their commerce in the New World. The construction of the Santa Barbara Presidio was accomplished in part by paying the Chumash for their labor with glass beads (Geiger 1965:14). All specimens recovered at LAN-211/H and LAN-1932/H exhibit a dark patina from weathering.

Wire-Wound Beads

Wire wound beads are manufactured by drawing a rod of hot glass, heating one end and wrapping it around a copper or iron wire, after which the glass is cut away from the rod. The glass ring on the wire is then heated until it softens to become round or oval in shape. The wire is set aside to cool, after which the glass bead slides off (Gibson 1976:104).

Wire-wound beads are a relatively rare type in archaeological contexts. They were not recorded at Malibu (LAN-264) and were assigned to a post–A.D. 1816 period or later at VEN-87 (Gibson 1976:122; King 1990b; King and Gibson 1972). The single specimen from LAN-211/H was the only example of a wire wound glass bead submitted for analysis. The bead has been broken in half and is translucent red in color; small bubbles in the glass are not distorted (Figure 75k).

Miscellaneous Shell Artifacts

A single curved fragment of nacreous *Haliotis* shell from LAN-211/H may represent the midsection of a body fragment of a circular shell fishhook. The fragment is 16.1 mm long and 3.1 mm thick (Figure 76a). Shell fishhooks generally occur in the Intermediate period by 2150 B.P. in southern California (King 1990b:231; Koerper et al. 1995). Some confusion has occurred about the antiquity of circular shell fishhooks in southern California. This largely stems from the work of Orr (1968:185) on Santa Rosa Island, who depicted two long, grooved, shank shell fishhooks from a highland site found in a radiocarbon-dated context of about 5000 B.P. These data were referenced by Strudwick (1985) in his study of circular fishhooks. However, the large volume of data from many Early period sites in southern California sites does not support this early date for large shell fishhooks. The earliest date for small circular (simple "J" shape, Strudwick types 1b and 2) shell fishhooks is about 2500 B.P., obtained at the Malibu site (LAN-264). The shift to larger fishhooks occurred after 2000 B.P. The hook style with short to long grooves on the proximal end (Strudwick types 1a and 1b) dates from about A.D. 900 to 1650 (King 1990b:232). Unfortunately the specimen from LAN-211/H is too fragmentary to type.

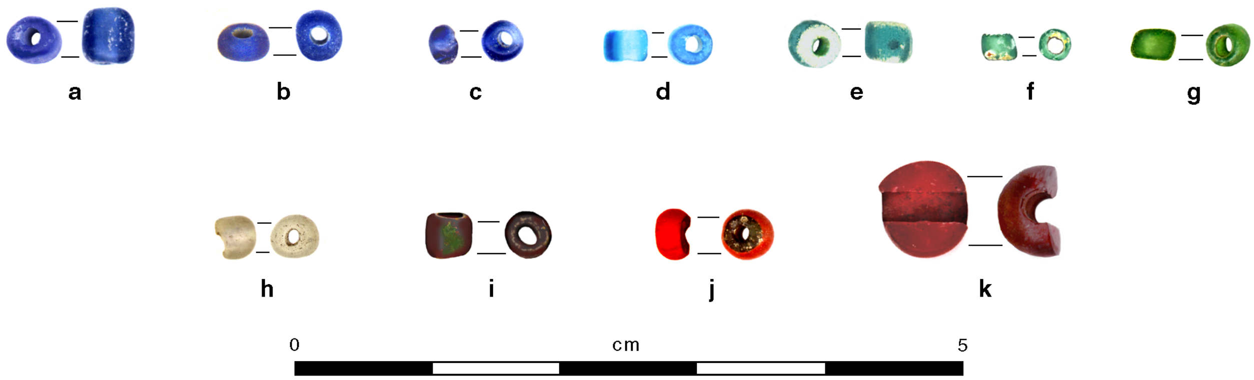


Figure 75. Glass beads from LAN-211/H: (a–c) cane, cobalt blue; (d–e) cane, copper blue; (f–g) cane, green; (h) cane, clear; (i–j) cane, translucent red with green core; (k) wire-wound, red.

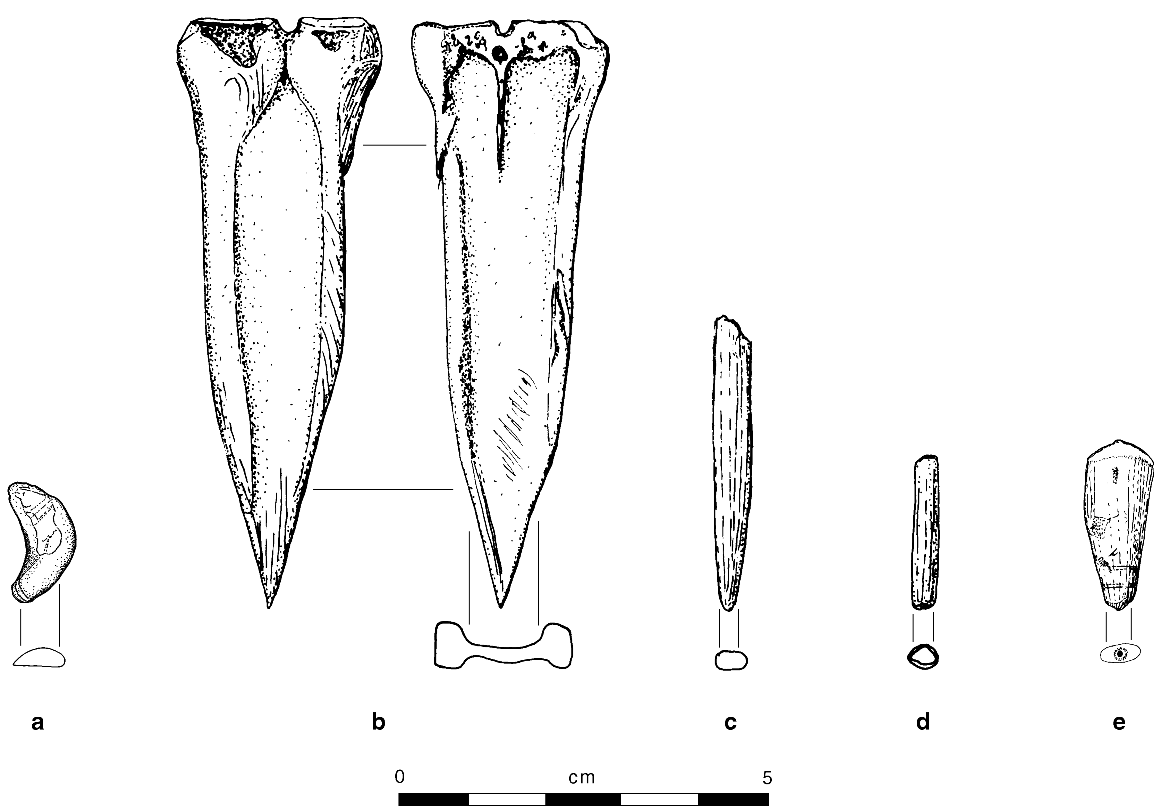


Figure 76. Miscellaneous shell and bone artifacts from LAN-211/H: (a) shell fishhook preform; (b) bone awl; (c) bone awl tip; (d) bone tube bead; (e) canid tooth pendant.

Four miscellaneous shell disks were recovered from LAN-1932/H. Three of these were white to cream colored; their color suggests either *Mytilus* or *Haliotis* shell but they appear harder than either of these two shell varieties. The edges of one specimen are chipped or weathered. The material of the remaining specimen from LAN-1932/H could not be identified. One circular disk of an unidentified species of shell was recovered from LAN-211/H. This disk is burnt gray and slightly weathered, and measures 8.8 mm in diameter and 1.6 mm thick.

A single small fragment of *Haliotis* shell with a lump of asphaltum on its ventral side was found at LAN-211/H and may be a fragment of an asphaltum container. It measures about 10 by 20 mm and does not exhibit any other modification. Whole abalone shells were often used to store asphaltum and other materials.

Worked Bone

The bone artifact inventory from LAN-211/H is very small. Five worked or possibly worked specimens were recovered, including two awls (one complete and one fragmentary), a single bone bead (discussed above), a bone tube, and one drilled canid tooth. Of the two awls, the largest and best preserved is very similar to Gifford's (1940) Type A1b2, and is made from the proximal portion of a deer metapodial (cannon bone) (Figure 76b). The proximal end of this artifact was partially drilled from one side to produce an eye. A second awl fragment, the distal portion of an awl (Figure 76c), is slightly weathered and heavily mineral stained. The material is mammal bone; element and species are unidentifiable.

A bone tube made from the long bone of a mammal, probably a rodent, was recovered from Unit 9 at LAN-211/H (Figure 76d). The tube was ground at both ends and may have been polished. A single canid canine tooth, split longitudinally, was also recovered from Unit 9 (Figure 76e). The split may have occurred after deposition, as teeth frequently split this way in the ground. Some minimal grinding was observed on the enamel surface. The bone awls were probably used in the preparation of basketry and possibly clothing, whereas the bone bead, the tube, and perhaps the tooth may have been used in decoration.

Five bone beads, one bone awl, one bone gorge or awl tip fragment, and two unidentified worked bone fragments were recovered from LAN-1932/H. The bone beads have been discussed above. The bone awl fragment, a medial fragment with the tip missing, was probably manufactured from a deer metapodial (cannon bone). This specimen bears a remarkable resemblance in both size and shape to another bone tool recovered from nearby LAN-60; this would suggest minimally that some of the same sorts of activities occurred at both sites. The gorge or awl tip fragment is a simple bone point with minimal shaping.

The two unidentified bone specimens appear to have been worked. One is clearly polished on the cortical surface but is so fragmentary that neither its form nor its function can be inferred. The second specimen may or may not be worked. It is notable for the presence of approximately 12 striations perpendicular to the axis of the bone shaft. These may be cut marks, although the size of the bone in question makes this questionable; the specimen is small enough to suggest an animal no larger than a cottontail rabbit, and cut marks are virtually absent in the remainder of the analyzed faunal collection. The origin of these marks remains unclear.

Discussion

Bead data from LAN-211/H and LAN-1932/H clearly indicate occupation of the Ballona during the protohistoric period and into the early historical period. Results of a spatial analysis of the distribution of shell and glass beads at LAN-211/H and a careful search for evidence of shell artifact manufacture are presented below. We conclude with a brief comparison of bead data from bluff-top and lowland sites, showing that a distinct pattern prevails within the Ballona.

Distribution of Temporally Sensitive Beads within LAN-211/H

The bead sample from LAN-211/H consisted of 37 shell, 20 glass, 4 stone, and 1 bone bead. The date range for the shell beads, ca. A.D. 1500–1800, clearly places this site within the protohistoric period. One wire-wound glass bead may date to A.D. 1816 or later, indicating a temporal overlap into the early historical period.

The distribution of selected bead types across the site was examined. Test units at LAN-211/H were clustered into three groups: Units 1–8, Unit 9, and Unit 11 (Unit 10 was excluded from the analysis as no beads were found in it). These three groupings are all approximately 20–30 m apart. When a comparison is made of these three groups, a definite concentration of selected beads types is apparent.

Taken collectively, Units 1–8 were found to contain 12 glass cane beads and no shell beads. These beads were distributed from the surface to as deep as 90 cm (Level 9) in an area of the site thought to be disturbed. It is unusual for only glass beads to occur in an area. It suggests a marked difference between this part of the site and the other two areas where shell beads were recovered. Unit 11, at the far eastern end of the site, contained only three *Olivella* semiground wall disks, which probably date to the 1790s. No earlier types of shell beads or later glass beads were recovered from this area.

The four test units in Unit 9 produced the largest number of bead types, including glass cane beads, stone and bone beads, rough disks, tiny saucers, spire-removed beads, cups, semiground disks, wall disks, and full-lipped beads. The temporally diagnostic beads (rough disks, ground needle-drilled wall disks, semiground and full lipped) from this unit suggest use only during the protohistoric and early historical periods from A.D. 1650 to 1780. The nine *Olivella* cup beads (four of which are incised) and *Haliotis* disks also found in Unit 9 could also date to this period. None of the thin-lipped round beads and only one thin-lipped oval *Olivella* beads were recovered from LAN-211/H; these types precede the full-lipped type. These data suggest very little occupation, if any, prior to 1650 at Unit 9 and none in the other two areas.

Temporally sensitive beads from LAN-211/H and LAN-1932/H suggest two different occupations during the Intermediate and protohistoric to early historical periods. The earliest date range, between 3,400 and 2,200 years B.P., is represented by a single *Olivella* bead, a diagonally spire-ground Type A2a bead from Unit 13, LAN-1932/H. No other definite Intermediate period beads were found; the only other possible candidate is an *Olivella* wall disk with an abraded hole also recovered from Unit 13, LAN-1932/H. A unique type, it may also date to the Intermediate period, but this is uncertain. A few very weathered, fragmentary *Olivella* wall disks were found that could be Intermediate period saucers, but they were found in association with Late period beads. Even if complete, these disks are in the size range that could also be Late period types.

As indicated by the date ranges for shell beads from LAN-211/H and LAN-1932/H (see Table 26), both sites were occupied during the protohistoric and historical periods between ca. A.D. 1550 and 1800. At this time, native culture in southern California was experiencing rapid and profound change; the resultant social upheaval was reflected in their beads and ornaments. Manufacturing techniques and choice of raw materials changed abruptly as trade networks were disrupted. The introduction of glass beads significantly altered the traditional bead-making and distribution systems for southern California's indigenous peoples.

Bead and Ornament Manufacture at LAN-211/H and LAN-1932/H

Based on bead data, reliable evidence of *Olivella* bead manufacture was absent from the samples at both LAN-211/H and LAN-1932/H, as was evidence of abalone ornament or fishhook manufacture. LAN-211/H contained a higher frequency of *Haliotis* fragments than was observed at LAN-1932/H; 175 pieces of abalone (*Haliotis* sp.) were collected and examined for evidence of modification to produce shell beads, ornaments, or fishhooks. The following observations were made:

1. Fragments were often from the apex, the thickest portion of the shell, or from the thicker rim of the shell.

2. Fragments were often thin pieces of epidermis, usually a weathered green or dark color.

3. Only about 10 of the 175 fragments were from *H. rufescens*; the others were probably from other *Haliotis* species, such as *H. cracherodii* or *H. fulgens.*

4. Eleven pieces were weathered and chalky with rounded edges, often nacreous.

5. All remaining pieces had been recently broken. A few appeared to have ground surfaces, but under the microscope the surfaces were irregular, not abraded.

Based on these observations, no evidence was noted of *Haliotis* shell being made into beads, ornaments, or fishhooks at LAN-211/H. Most of the epidermis fragments examined were not *H. rufescens,* which is typically used for beads in the Late period.

Three finished *H. rufescens* epidermis disk beads were recovered from LAN-211/H. It is possible that these disks, along with the *Mytilus* disks and white shell and stone disks, were used as jewelry worn by high-status people on special occasions. Although the four incised *Olivella* cups are types typically found in areas of sites occupied by high-status people, most of the rest of the beads from both sites appear to represent all socioeconomic classes.

Site Comparison

A comparison of identified beads from selected sites within the Ballona and Los Angeles Basin highlights an interesting pattern in their distribution by material type (Table 28). Glass beads appear in small numbers on the bluff tops and in the lowlands; however, a distinct pattern emerges when data on shell and stone beads are compared. Van Horn and his associates recovered almost no shell beads during their bluff-top excavations but did find hundreds of stone beads (Van Horn 1987; Van Horn and White 1983). Bone beads also are more numerous on the bluffs than below.

This result is reversed at lowland sites such as LAN-211/H and LAN-1932/H, which have far greater numbers of shell beads than stone or bone. At LAN-47, the Admiralty site in Marina del Rey at the northern edge of the Ballona lowlands, more than 96 percent of beads recovered were made from shell (Troncone and Altschul 1992). Very similar numbers were seen at the contemporaneous Late period site of Yaangna (LAN-1575/H), the Native American community located at the Los Angeles Pueblo

Table 28. Beads from Sites in the Ballona

Bead Type	Bluff-Top Sites			Inland	Lowland Sites			
	LAN-59	LAN-61A, B, C	LAN-63	LAN-1575/H [a]	LAN-47	LAN-211/H	LAN-1932/H	LAN-2676
Olivella	few	—	6	675	322	34	36	143
Other shell	rare	—	—	28	138	3	2	8
Stone	75+	136	416	7	10	4	1	3
Bone	3	94	34	—	7	1	5	—
Glass	—	10	3	—	—	20	1	—

[a] Yaangna

(Denardo 1999:88). Of the beads recovered during excavations there, nearly 95 percent consisted of shell beads.

The most parsimonious explanation is that the numbers of stone and bone versus shell beads simply reflect the difference in the relative dates of occupation of bluff-top sites versus lowland sites. All four bluff-top sites were occupied during the Intermediate period, whereas the lowland sites date to the Late and protohistoric periods.

CHAPTER 10

Stone Artifacts

E. Jane Rosenthal and Marc W. Hintzman

In this chapter, we present results of the analysis of lithic artifacts recovered from SRI's excavations at LAN-211/H and LAN-2769, and some of the data from LAN-1932/H. Our analysis focuses on LAN-211/H, whose 3,026 stone artifacts account for more than 97 percent of the 3,111 artifacts recovered from LAN-211/H and LAN-2769. We begin by providing the research context that guided the analysis of LAN-211/H, followed by a discussion of our analytical methods. We then present the results by material type, after which we conclude with a discussion of artifact distribution, tool production, and an analysis of the site's distinctive toolkit. The discussion of the stone artifacts recovered at LAN-2769 is much more descriptive. The results of the analysis are presented first, followed by general inferences of the kind allowed by small collections. Lithic artifacts from LAN-1932/H are presented in tabular form for comparison purposes only; their analysis will be presented in a future publication. For this chapter, Jane Rosenthal was responsible for artifact identifications and analysis; descriptions of artifacts and material types were contributed by Marc Hintzman.

LAN-211/H

Testing at LAN-211/H recovered 3,026 stone artifacts. All specimens were analyzed. Table 29 presents the artifact classes recovered.

The stone artifact collection from LAN-211/H represents a flaked and ground stone tool kit of which a substantial portion consists of smaller edge-modified flakes and bifacially worked hunting gear. Ground stone food-processing and cooking equipment was used and, as it broke, was discarded at the site. The presence of numerous tarring pebbles suggests that canteens and other baskets were woven and waterproofed locally. Four stone beads and one stone disc (described and discussed in Chapter 9) indicate ornamentation. These artifacts imply that a group resided at LAN-211/H long enough to accumulate specialized tools and ornaments at the site

Radiocarbon and bead dating indicate that the later component of this site dates to the period between circa A.D. 1600 and 1825 (see Chapters 6 and 9). Temporally diagnostic stone projectile points found at the site support this date range. The stone artifact collection from LAN-211/H represents a rare opportunity to examine the use of stone artifacts during this poorly understood period of rapid change for Native American cultures of southern California.

Research Context

In lithic studies, technological organization is used as a theoretical concept to focus on strategies for the procurement, manufacture, use, transport, and discard of lithic materials and tools (Nelson 1991:57). These strategies are applied by people to the problems they encounter in their physical, biological, and

Table 29. Distribution of Stone Artifact Classes from LAN-211/H

Location	Projectile Point	Biface	Core	Other Flaked Stone Tools[a]	Hammer Stone	Ground Stone	Tarring Pebble	Debitage[b]	Total
Unit 1	—	1	—	—	—	—	1	53	55
Unit 2	—	—	—	—	—	—	—	71	71
Unit 3	1	3	—	7	1	—	6	400	418
Unit 4	2	6	1	3	1	5	4	595	617
Unit 5	—	2	1	2	—	1	4	97	107
Unit 6	1	—	—	4	—	—	4	110	119
Unit 7	—	3	—	6	1	1	1	91	103
Unit 8	1	2	—	2	—	1	3	150	159
Unit 9	4	11	6	24	1	8	22	1,100	1,176
Unit 10	1	—	—	2	—	—	1	95	99
Unit 11	1	—	4	1	—	—	2	80	88
Trench 11	—	—	1	2	—	5	1	5	14
Total	11	28	13	53	4	21	49	2,847	3,026

[a] Includes scrapers, burin spalls, and edge-modified flakes
[b] Includes flakes, shatter, and tested cobbles

social environments (Carr 1994a:1). Lithic studies also typically seek information about the method of reduction used to produce stone tools, how such tools were used, and details of their abandonment (Flenniken and Raymond 1986). Toward these goals, technological and morphological attributes of the lithic artifacts were used to identify the behavior behind reduction strategies and tool function.

At LAN-211/H, we are primarily interested in how native people coped with the social, economic, and ecological problems created by Hispanic colonization and missionization and the ways in which their adaptation is reflected by changes in technological organization. Our expectations regarding technological change are guided by work plan developed for LAN-211/H (Grenda et al. 1999), as well as by propositions offered by Deetz (1963:180–182), Bamforth (1990a, 1993), and Allen (1998).

James Deetz was one of the first researchers to highlight the high degree of technological continuity and slow pace of replacement in California mission artifacts. Deetz observed that although activities introduced by the Hispanic missionaries and settlers (e.g., tanning hides, farming, milling) were generally accomplished using metal tools, stone or bone tools were retained for use in other domestic tasks, such as wild-game butchering or seed grinding. New materials, such as iron axes and vesicular basalt metates, were slow to be adopted in domestic contexts. At Mission La Purísima Concepción, Deetz's excavations yielded just four stone flakes in the tanning vat area but numerous mortars, pestles, comals, and basketry impressions, as well as Mexican manos and metates, in the neophyte quarters (Deetz 1963:180–182).

Deetz (1963:186) suggested that the broad trend in the selective retention or abandonment of various aspects of aboriginal technology was related to gender. Allen (1998:68) expanded this hypothesis by proposing that the mission division of labor and assignment of tasks expanded male roles but restricted those of females. Although native women continued some shellfish- and plant-collecting using traditional methods, when neophytes were processing European foods and materials, they employed nontraditional stone or metal tools. Many neophyte quarters have produced metates and manos of Mexican vesicular stone (Allen 1998; Deetz 1963; Greenwood 1976; Hoover and Costello 1985). By contrast, choice of tools for native men engaged in activities such as hunting or fishing was not proscribed. For such discretionary activities, traditional techniques and tools were used.

Bamforth (1993) agreed with Deetz and carried his ideas a step further in the analysis of the early-historical-period stone artifacts from Helo,' a village at Goleta Slough. Noting that metal tools were more effective for certain tasks, Bamforth suggested that the greater efficiency of new tools prompted the replacement of traditional technologies in economically important tasks. In labor-intensive activities such as woodworking, stone tools were almost immediately replaced by metal axes, saws, planes, and the like. In contrast, stone-tool use persisted for less labor-intensive tasks particularly if their economic importance was declining (Bamforth 1993:67–69).

Bamforth (1993) suggested that some technological change resulted from the general disruption of indigenous society at contact. Metal or glass replaced obsidian or fused shale because the exchange system that delivered these desired commodities dissolved as Native Americans were removed to the missions. Knowledge about the sources and use of these commodities disappeared, and often there was insufficient time to obtain or work these special materials.

We feel these authors have perceptively described the effects of missionization on stone tool technology in the early historical period. Our analysis of stone tools from LAN-211/H supports the assertion that foraging and hunting with stone tools remained important enough to persist well past the introduction of metal. To some extent, the persistence occurred with mission support, as traditional food-gathering strategies enabled native people to supplement their diet and buffered them from crop failure. When food reserves were exhausted in the early years of the missions, the missionaries out of necessity encouraged a temporary return to native practices (Coombs and Plog 1977; Englehardt 1927a:36; Hoover 1989).

These discussions are important in framing the study of LAN-211/H. Archaeologists have researched the replacement of traditional technologies at the missions, where neophytes were repeatedly exposed to the new materials. But what about in the settlements just outside the reach of the missions? Were "gentiles," or nonmissionized Native Americans, as quick to adopt the more efficient technology? Was post-contact indigenous technology in rapid decline anyway, for other, more complex social reasons not related to efficiency?

To monitor change in technological organization, we must control for time. We suspect that the pace of technological change was gradual in the prehistoric and protohistoric periods, then extremely rapid with the establishment of the missions. Our ability to separate the Late period component from the protohistoric and early-historical-period component is central to our use of the LAN-211/H stone artifact collection to address this topic. Ideally, absolute dating, along with relative dates provided by beads and other diagnostic artifacts, provides temporal control of these components.

Methods

All carefully formed, deliberately modified, or heavily edge-damaged artifacts from LAN-211/H and LAN-2769 were analyzed. The analysis identified both morphological and functional artifact categories. Morphological categories combined attributes of manufacture and shape, whereas functional categories recognized known or presumed uses. Our methods follow those previously used in the PVAHP (see Altschul et al. 1999). Key points of the analysis are described below.

Formal tools such as points, manos, pestles, scrapers, and bifaces, as well as flaked artifacts with either invasive or margin retouch were included in the tool category. Flakes with no deliberate retouch but with rounded, smoothed, or crushed margins were considered to be probable tools. We recorded striking-platform attributes (natural, single-facet, and multifacet), and the exterior (dorsal) flake surface (completely cortical, greater than 50 percent cortical, less than 50 percent cortical, and noncortical) for all tools. We also noted what portion of the artifact (proximal, distal) was recovered. Flake edge-preparation attributes such as the location and method of retouching or damage were observed. For ground stone, we noted the intensity of use and the number of surfaces used. When possible we measured maximum dimensions oriented from the striking platform, including length (perpendicular to the platform), width (parallel to the platform from margin to margin), and thickness (from the bulbar to exterior face). Core platform and flake-removal direction attributes were described.

For the unmodified flaked stone, including the debitage, we recorded the platform, amount of cortex, terminus attributes, and the reduction system (flake-core, bifacial, or bipolar reduction). A platform-to-terminus dimension was measured for each complete flake to indicate standard size; among fragmentary, nondiagnostic flakes, however, only the maximum size, in 5-mm intervals, was noted.

Results

We summarize tool categories by grouping artifact types of similar manufacture, provide information about quantity, predominant materials, type, and size, and describe where the tools were found. Next, information about core reduction and debitage is presented. We conclude by describing material procurement, manufacture, use, repair, reuse, and discard. Our analysis then addresses questions about observed changes in the tool kit to demonstrate the research potential of the stone collection.

Flaked Stone Tools

Flaked stone artifacts produced by either percussion or pressure method were common (n = 2,956). We identified 111 whole and fragmentary flaked stone tools (Table 30) The flaked stone collection suggests a number of activities, including hunting, butchering, woodworking, and tool manufacture and maintenance.

Points and Bifaces

Just over 23 percent of the stone tools found at LAN-211/H were either projectile points or bifaces (see Tables 29 and 30). Points were made by careful bifacial pressure flaking of small (30–40-mm) flake blanks. Point blanks were first worked on one face, then on the other. The hafting area was then thinned or shaped to form one of three haft elements: a straight, oval, or concave base. For the purposes of this analysis, bifaces are defined as artifacts that are generally lenticular in cross section, with flake scares on both sides, and lacking evidence of hafting or extensive modification from use. This definition includes the large “rough-out” bifacial flake cores, preforms for projectile points and knives, and fragments of the distal ends of weapons. The definition excludes projectile points that retain hafting elements (bases, notches, tangs), and drills.

Complete points (Figure 77a–k) and bifaces (Figure 78a–h) from LAN-211/H were almost identical in size (mean length of 21 mm), suggesting that many bifaces were preforms lacking only the final finishing of their bases. Proximal (base) and distal (tip) sections of bifaces showed bending fractures, which can be produced during production or use or can result from postdepositional damage. Chert dominates the collection, but both chalcedony and fused shale are present in small quantities.

Of the 39 points and biface preforms SRI recovered, nine are Cottonwood Triangular arrow points. This point type, which is found at late-prehistoric and historical-period sites throughout southern California, changes form and decreases in size over time (Koerper, Schroth, Mason, and Peterson 1996). Thomas (1981) indicated Cottonwood Triangular points are always less than 30 mm long. The mean length of the points from LAN-211/H is 19 mm; therefore, these specimens are smaller Cottonwood points and, following Koerper, indicate relatively late manufacture. Unit 9 contained four of these points and 11 bifaces, the largest quantity found in any unit.

Table 30. Flaked Stone Artifacts from LAN-211/H, by Material Type

Material	Projectile Point	Biface	Core	Scraper	Burin Spall	Modified Flake	Hammer Stone	Tested Cobble	Unmodified Flake	Shatter	Total
Andesite	—	—	1	—	—	4	1	—	120	4	130
Basalt	—	—	2	—	—	16	—	—	231	11	260
Chalcedony	—	4	1	—	—	3	—	—	264	10	282
Chert	10	24	9	—	3	21	—	—	1,921	164	2,152
Fused shale	1	—	—	—	—	—	—	—	1	—	2
Glass	—	—	—	—	—	1	—	—	2	—	3
Metasedimentary	—	—	—	—	—	1	—	—	5	—	6
Metavolcanic	—	—	—	—	—	—	—	1	9	—	10
Obsidian	—	—	—	—	—	—	—	—	7	2	9
Quartz	—	—	—	—	—	1	—	—	4	—	5
Quartzite	—	—	—	1	—	—	2	1	60	1	65
Shale	—	—	—	—	—	1	—	—	5	—	6
Other	—	—	—	—	—	1	1	—	19	5	26
Total	11	28	13	1	3	49	4	2	2,648	197	2,956

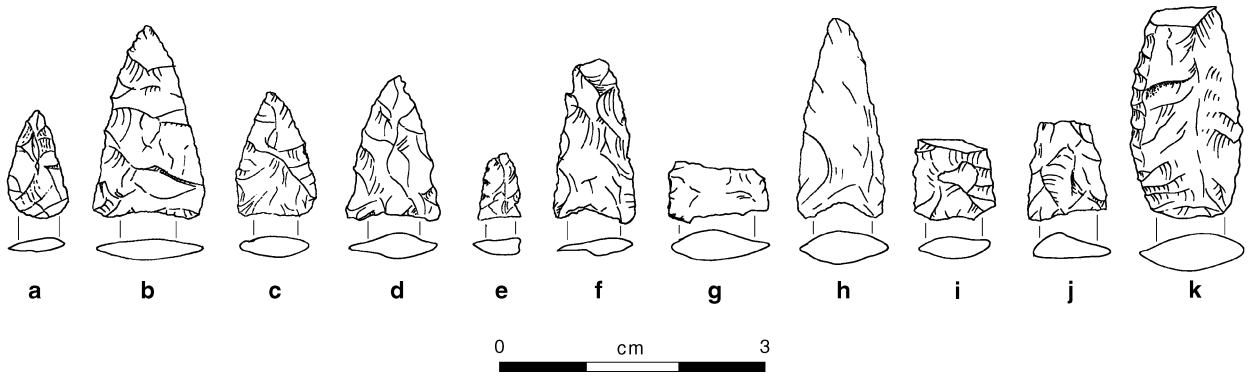


Figure 77. Projectile points from LAN-211/H:
(a–d) whole chert points; (e–g) chert point fragments; (h) whole chert Cottonwood point; (i–j) chert Cottonwood point fragments; (k) fused-shale point fragment.

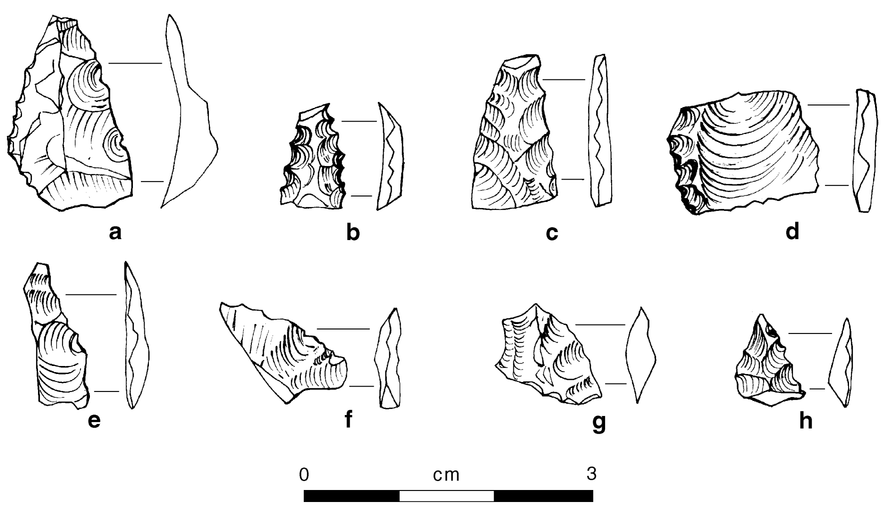


Figure 78. Bifaces from LAN-211/H:
(a–h) chert bifaces and biface fragments.

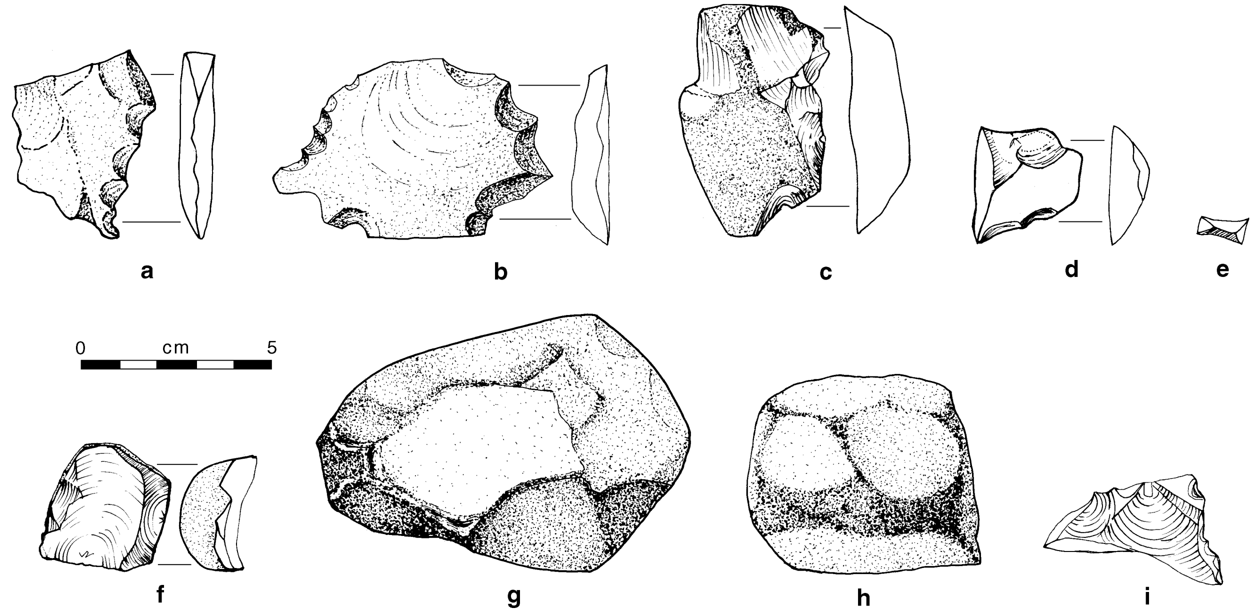


Figure 79. Percussion artifacts from LAN-211/H: (a) quartzite scraper; (b–c) basalt modified flakes; (d) chert modified flake; (e) chert burin spall; (f) chert core; (g–h) quartzite hammer stones; (i) glass percussion-retouched flake.

The single Desert Side-notched point was found in Unit 6 and was made from a small chert flake pressure-flaked into a triangular form. The point is very small, barely 16 mm long, and is identical to Desert Side-notched types commonly found in late prehistoric and early-protohistoric-period sites throughout much of the California desert (Koerper, Schroth, Mason, and Peterson 1996).

The two projectile point types, Cottonwood and Desert Side-notched, are roughly contemporary (Thomas 1981:16–18). Their basal differences probably relate to either functional requirements or cultural tradition (Shott 1996:281–282). Socketing, as seen on Cottonwood points, might have made it easier to repair and shape a point in its foreshaft. Lashing with notches, as is typical for side-notched points, could have accommodated a variety of foreshaft diameters. Both point types are characteristic of the lightweight, penetrating projectiles that are associated with complex bows (Christenson 1986).

Scrapers and Edge-Modified Flakes

Two types of simple flake tools—scrapers and edge-modified flakes—were recovered from LAN-211/H (see Table 30). Scrapers, which are larger tools with steeper edge angles than modified flakes, are usually “all-purpose” tools used for working wood, bone, antler, or hides. These tools were used for more demanding tasks that required more rejuvenation than the tasks performed by modified flakes. At this site, SRI recovered a single scraper that had been made from a noncortical quartzite flake and exhibited deliberate, invasive, sequential retouch on its lateral margin (Figure 79a).

Edge-modified tools are a relatively diverse tool group that lack the diagnostic features of a specific tool type. The most common edge-modified tool category at LAN-211/H consisted of flakes made by retouching an exterior (dorsal) face on a lateral margin (Figure 79b–d). Retouching was apparently used to resharpen or rework the cutting edge. Chert (43 percent) and basalt (33 percent) flakes were preferred. The mean lengths (43 mm) and widths (44 mm) of these tools suggest that rectangular to square flakes were selected as blanks. These flakes were probably simple cutting tools. Three specimens had notches, so these might have functioned as spokeshaves to smooth wooden branches or reeds. Nearly half of all edge-modified tools were found in Unit 9 (see Table 29).

Burin Spalls

A burin spall is produced when a platform is prepared on a flake and then struck to remove a long sliver of the flake's sharp edge or margin. The initial detachment of a burin spall produces an element that is triangular in cross section; the removal of more spalls from the same margin results in spalls that are trapezoidal in cross section. Spalls are sometimes recycled and appear as drills or perforating tools. Burin spalls were commonly used as drill bits in the flaked stone industries of the Caspian, but the spalls were not used as blades because they lack the blades' cutting edge. We presume that the same pattern of use would be found in southern California. Distal portions of three chert burin spalls less than 15 mm long were found in Unit 3 (Figure 79e). One was slightly crushed; we could not establish if the damage occurred during production or use of the spall.

Cores

Cores are cobbles, pebbles, or rock nuclei that show evidence of deliberately detached flakes. Because core reduction produces flakes that can be used as blanks for tools, analysis of cores can discover whether there was a consistent or patterned approach to tool production, and which artifacts can be predicted to be present or missing from the site. Cores are the products of three distinct reduction strategies, which are identified from their platform and flake-removal attributes: bifacial, bipolar, and multidirectional. The bifacial and bipolar cores were specifically prepared to make specialized tools. The more generalized multidirectional cores produced flakes of various sizes that could either have been retouched or used without further modification.

At LAN-211/H, SRI found 13 fully formed cores (Figure 79f). Two tested cobbles, each with a single flake removed, were also found at the site; these are included with the totals for flaked stone implements (see Table 29). Most of the cores were either chert or basalt; one andesite and one chalcedony core were also found. Bifacial and multidirectional cores were most common (four each); there were two bipolar cores. Three fragmentary or "exhausted" cores could not be typed. Below, we describe how the cores were reduced and what tools and debitage resulted. Most of the cores were found in Units 9 and 11.

A bifacial core is a percussion-flaked tabular stone with a beveled platform (Whittaker 1994). The four bifacial cores found at LAN-211/H range in maximum dimension from 22.7 to 33.0 mm and differ from bifaces in that the cores are much thicker (6.6–11.2 mm) and could have produced flakes large enough for tools. Alternatively, these cores could have been knife blanks, or could have been further reduced by pressure flaking to make projectile points, or all of these could have happened in sequence.

A bipolar core is made by placing a small pebble or cobble on an anvil and striking it with a stone hammer; this technique produces flat flakes with cortical margins and leaves distinctive marks on the cores (Hayden 1980:3). These cores characteristically have crushed platforms, flake scars that extend the length of the core, and show pronounced concentric rings of force, although a core face may be flat if shearing occurred. Bipolar reduction also produces split-end pebbles and large quantities of shatter, the result of trying to initiate fractures. One of the two bipolar cores found at LAN-211/H, made from chert, had both a sheared face and crushed platforms. This small core, just 20.0 by 19.7 mm, produced flat tool blanks, deduced from its sheared face. Only two bipolar flakes and three burin spalls were recovered. Much of the chert shatter in the collection might also have resulted from bipolar reduction, as will be discussed in the debitage results.

Multidirectional cores are worked in an expedient manner from several platforms. Flakes are struck from prepared platforms, negative flake scars, or cortical surfaces. The goal is to create large flakes and maximize the size of the finished tool. Blanks could be used immediately or further shaped by pressure flaking. Of the four multidirectional cores found, two were made from basalt.

Hammer Stones

A hammer stone is used for the percussion reduction of cores, percussion production of tools, and whenever else a hard percussor is needed. Hammer stones are identified by battering that results from striking two stones together repeatedly (Rondeau 1995). Hammer stones that were used for making or repairing flaked stone tools are usually round or oval fist-sized cobbles with rounded margins and battering on the ends or edges. Although less frequently identified, hammer stones also were used for the production of ground stone tools (Schneider 1993). Four slightly cylindrical cobbles or pebbles were found that were battered on their ridges and poles (Figure 79g–h). This damage indicates that they were used for pounding, possibly for making or reshaping manos or metates or as flaked stone percussion hammers. Three of the four were heavily battered. Two were andesite and two were quartzite, and the largest dimension was 94 mm while the smallest was 56 mm. They were not concentrated in any one unit.

Debitage

Debitage consists of complete flakes which are diagnostic; included in this category are flake fragments or shatter; and tested material, which results from the core-reduction process (Arnold 1983) or from tool manufacture (Crabtree 1982). Debitage constitutes 94 percent of the stone artifact collection at LAN-211/H, and chert is the material of more than 70 percent of the debitage. Few flakes (less than 10 percent) have any cortex.

Pressure flakes constitute 50 percent of the debitage recovered from LAN-211/H, an unusually large proportion, which indicates that tool-production and -reshaping activities occurred frequently at this site. Most chert, chalcedony, and obsidian flakes are by-products of biface reduction and arrow-point manufacture or repair and are typically elongated, curved, and small (the mean length of complete flakes is 16 mm). The basalt and quartzite debitage represents a more generalized flake-core reduction. This large quantity of pressure debitage, along with the number of points and point fragments (both proximal and distal segments) found, suggest that points were breaking through use and production at this site, implying it was a hunting camp.

The overall small to moderate size of the debitage indicates that later-stage flake production predominated. With so few cores in the collection, this conclusion was expected and was confirmed by reviewing the size of complete and fragmentary flakes. Eighty-two percent of complete flakes were smaller than 20 mm, and 69 percent of fragmentary flakes and 64 percent of shatter specimens were smaller than 10 mm.

A minor amount of chert shatter was found, suggesting that Monterey Formation pebbles were occasionally worked at the site. These pebbles were either bipolar or bifacially reduced as a prelude to flake or bifacial-tool manufacture.

Flaked Glass

Two artifacts made from olive green bottle glass and one from clear glass were recovered from LAN-211/H. One of the olive green specimens (Figure 79i) is a percussion-retouched flake; the second green glass flake is a late-stage pressure flake. The latter has a multifaceted platform with the remnant of a bifacial margin that appears to have been prepared by lightly abrading the platform prior to the flake detachment. The dorsal surface of this flake has a strong central ridge that runs along the long axis of the flake, where the margins of two previous pressure flakes intersected. The evenness of this central axis suggests the flakes were removed sequentially; such a technological trajectory is consistent with the production of projectile points and knives. The flake was broken at some previous time, possibly when it was detached. The third (clear) glass specimen is the distal end of a percussion flake that has scars from previous detachments on its dorsal surface. Additional small amounts of glass were found at the site but were unmodified and appeared to be intrusive.

Ground Stone Tools

LAN-211/H contained a variety of tools finished by pecking, abrading, or that evolved through use (Table 31). Along with diagnostic tools, nine fragmentary, ground stone artifacts were found. The activities indicated by these tools include grinding or pulverizing of seeds, plants, or small animals; net fishing or hunting; shell-fishhook finishing; and arrow shaft manufacture and repair.

Manos

Hand-held grinding implements for processing vegetal materials were classified as manos. Manos were usually seed-processing tools but might also have been used to prepare pigments. When manos were broken, they were sometimes reused as hearth stones and asphalt applicators. They are generally used on a metate in a rubbing, rocking, or crushing motion, and the area of wear is usually on flatter faces, rather than concentrated on or adjacent to ends, as with pestles. Six oval manos that had been created by pecking local sandstone, andesite, rhyolite, or granitic cobbles were found at LAN-211/H. Each had use facets on a single face, creating a plano-convex cross section. Three of the six mano fragments were found in Unit 9. An additional piece was found in Trench 11, adjacent to Unit 9.

Metates

Stones used with manos for crushing seeds and other plant materials and for grinding or mashing other foods or substances, such as pigments or small rodents, are generally called metates. The tool stones used for metates are frequently coarse grained or vesicular and often have been flaked to form and pecked to shape. Small fragments (97 and 78 mm on their largest dimension) of two oval, sandstone basin metates were found. They were fully shaped by pecking both the exterior and interior surfaces. Both specimens were trench collections.

Table 31. Ground and Other Stone Artifacts from LAN-211/H

Material	Mano	Metate	Pestle	Reamer	Shaft Straightener	Net Weight	Tarring Pebble	Unidentified Fragments	Total
Andesite	1	—	—	—	—	—	—	—	1
Granite	1	—	—	—	—	—	—	3	4
Igneous	—	—	—	—	—	—	2	—	2
Quartzite	—	—	—	—	—	1	2	—	3
Sandstone	3	2	1	1	—	—	4	1	12
Steatite	—	—	—	—	1	—	—	1	2
Rhyolite	1	—	—	—	—	—	—	—	1
Unknown	—	—	—	—	—	—	41	—	41
Vesicular basalt	—	—	—	—	—	—	—	4	4
Total	6	2	1	1	1	1	49	9	70

Pestles

Pestles are roughly cylindrical stones used in conjunction with a mortar to grind, pound, or crush everything from acorns to small rodents. It has been suggested that pestles and mortars were used predominantly for acorn processing and that metates were used for small-seed processing (Sutton and Arkush 1998:95). A single carefully shaped sandstone pestle fragment was found, showing slight wear polish on its surface. Pestles were used in combination with mortars for pulverizing. This small midsection (28 mm long by 61 mm in diameter) was found in Unit 5.

Tarring Pebbles

Nearly one-quarter (23 percent) of all tools recovered from this site are medium to small pebbles covered with tar. Heated pebbles were used to apply asphalt to baskets for waterproofing, particularly canteens. Pebbles were also used to melt tar to repair equipment and on occasion to attach a basket to a hopper mortar. The mean length of the LAN-211/H pebbles was 31 mm; the largest pebble was 49 mm. Hudson and Blackburn (1986:174–175) suggested that tarring pebbles seldom exceeded 50 mm (2 inches), as this was the typical diameter of a canteen's orifice. Asphalt covered 41 pebbles from LAN-211/H so completely that their material could not be identified. Tarring pebbles were found in every test excavation except Unit 2, and 22—almost half—were found in Unit 9. A small amount of loose asphaltum was also found dispersed throughout the site sediments.

Weight Stones

Weight-stone artifacts in southern California are commonly divided into three types: fishing weights or sinkers, digging-stick weights, and weighted composite tools. Although weight stones were likely used for a variety of tasks, their main function is to add mass to increase the efficiency of a tool. A single specimen, a net weight made from a subangular quartzite cobble, was recovered from LAN-211/H (Figure 80a). A shallow groove covers about three-quarters of the circumference of this stone, indicating where a cord was tied around the stone to attach it to the net. Net weights were used with fishing gear to keep lines or nets submerged. The presence of such artifacts corroborates the evidence from the faunal materials (Chapter 8) that fish were being exploited by the occupants of this site.

Shaft Straighteners

Shaft straighteners are tools with one or more grooves that were used to straighten arrow shafts and were generally heated prior to their use. Shaft straighteners were analyzed by shape, material type, and presence of incisions. A single straightener, made from steatite, was recovered from LAN-211/H; it has a concave groove on one surface that has been darkened and polished through use (Figure 80b). This artifact is an indication of the production and maintenance of hunting gear, specifically arrow shafts.

Reamers

A reamer is used to smooth or enlarge perforations using a grinding action and is commonly associated with shell-fishhook manufacture (Reinman and Townsend 1960:107; Strudwick 1986:139). After punching or drilling a hole in a shell fishhook blank, a reamer is used to enlarge the interior hole. Thus, reamers are a necessary part of the tool kit for fishhook production. The single specimen from LAN-211/H was complete and made from local sandstone (Figure 80c). Polish can be observed along two-thirds of the length of the tool, and a slight shoulder can be detected where the polish stops. Similar artifacts of the same material have been recovered from Late period sites on San Nicolas Island (Maxwell et al. 2002).

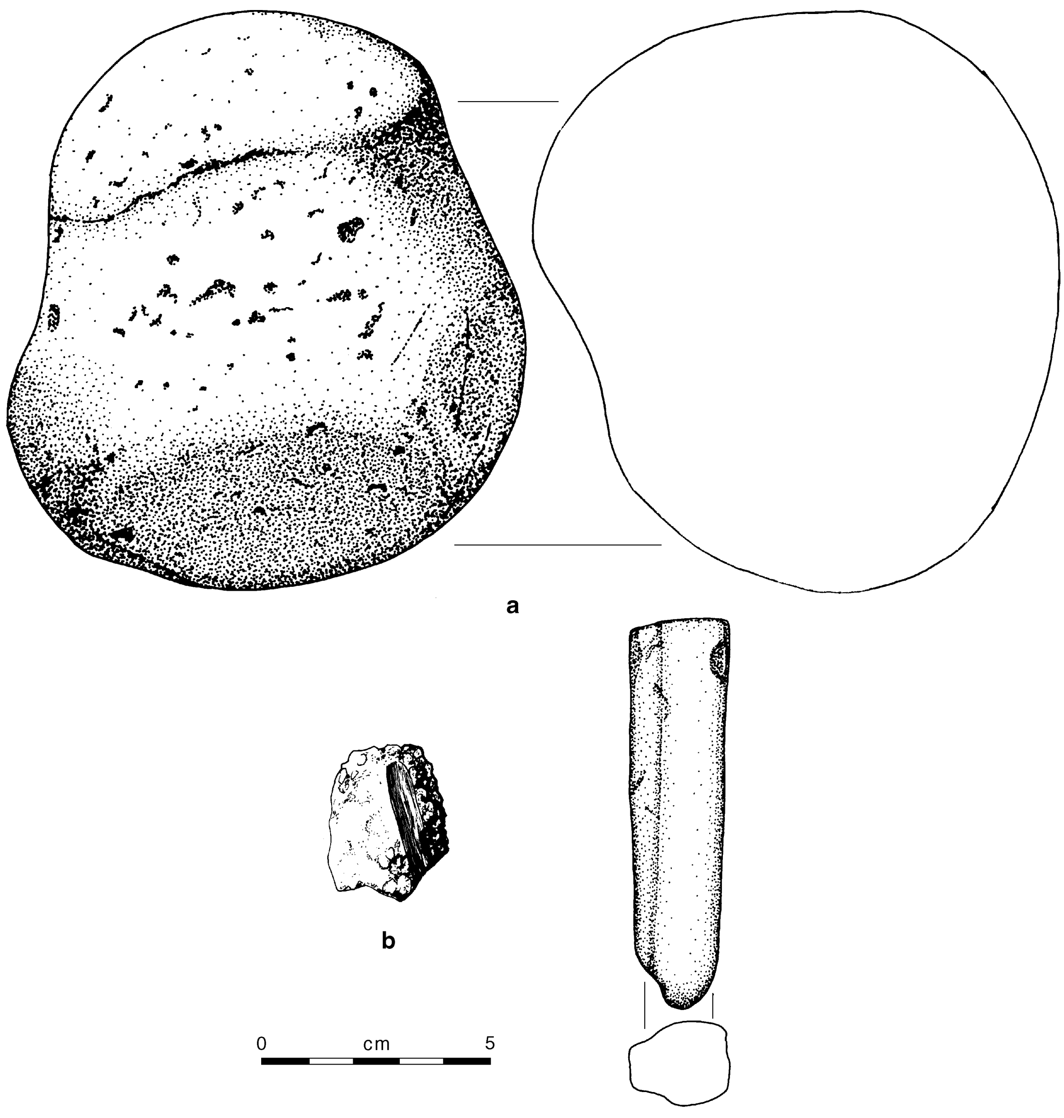


Figure 80. Miscellaneous stone artifacts from LAN-211/H: (a) quartzite weight stone; (b) steatite shaft straightener; (c) sandstone perforator, fishhook reamer.

Discussion

In the following section, we discuss our observations and conclusions concerning the lithic artifacts from LAN-211/H. We begin with a discussion of the spatial distribution of the stone artifacts, focusing on the concentration in Unit 9. We follow this with an examination of the tool stone used, and analysis of stone tool production, usage, repair, and discard. In the closing portion of this section, we compare the stone collection, or "tool kit," from LAN-211/H to other collections throughout southern California. We hypothesize that stone points would persist in the Ballona well into the early historical period because of the Spanish prohibition against providing weapons, such as firearms, to native people.

Artifact Distributions

Stone artifacts were unevenly distributed in the test units at LAN-211/H (see Table 29). To examine the intrasite distribution, we clustered the excavation units into three sets: Units 1–8 and Unit 10, Unit 9, and Unit 11. The three sets were all located about 20–30 m apart. When comparisons are made among these sets, we observed that the bluff terrace units (Units 1–8) contained most of the debitage, and little ground stone. Units 4 and 5 from the terrace set also contained the widest diversity of flaked tools.

The most pronounced concentration of stone artifacts was found in Unit 9. More than a dozen tarring pebbles, half of all obsidian, nearly a quarter of all debitage, all vesicular basalt, and the only scraper were found in 30 cm of deposit within the southwest and southeast quadrants of Unit 9. The deposit in this unit might have been created in prehistory when a work area, possibly adjacent to a residence, was cleaned, so that broken tools, finishing and repairing flakes, and tarring pebbles were collected and then discarded together. Such a concentrated refuse deposit suggests a relatively long-term occupation of the site and a specialized use of space. Although it is premature to infer activities based on these distributions, the spatial variation in stone tool location is consistent with a strongly patterned occupation. We would expect such patterning at sites where behavioral sets were spatially segregated along economic or social lines.

Material Procurement

Monterey Formation chert and chalcedonies dominate the flaked stone in the collection, whereas on the whole, the ground stone tools were made from sandstone or igneous (andesite, granitic) rock. All of the large ground stone tools were produced from the local sandstone. Although local quartzite cobble flakes were present, they provided only a minor, ad hoc, constituent of the tool kit.

The Ballona area and its drainages lack the cherts and chalcedonies that tool makers often preferred for specialized tool manufacture (Rozaire and Belous 1950; Woodford et al. 1954:65–74). Because they had particular material, size, and sturdiness parameters in mind, the tool makers preferred the beaches or outcrops of either the Palos Verdes Hills or the Santa Monica Mountains, to the Westchester Bluffs. Even more distant sources were occasionally tapped. Grimes Canyon fused shale and obsidian (possibly from Obsidian Butte in the Salton Sea area, given its ashy appearance) were recovered in small quantities at LAN-211/H.

Preshaped cores, large flakes, and finished tools of chert, chalcedony, and basalt were brought to the site for use, repair, and reworking. We found evidence that a broken obsidian tool had been recycled into an edge-modified flake. These items might have traveled a circuitous path to reach the Ballona.

We found four fragments of vesicular basalt ground stone at LAN-211/H. There are various sources for this material, ranging from the Channel Islands to the California desert. Vesicular basalt manos have been reported from the neophyte quarters at Missions San Buenaventura (Greenwood 1976:16–17) and

La Purísima (Deetz 1963), as well as among materials at Mission Santa Cruz (Allen 1998:64). The basalt fragments from LAN-211/H are too small to interpret or to identify their original shape.

Tool Production

The LAN-211/H collection exhibits little evidence of initial flaked stone reduction and no ground stone tool production. Only two tested cobbles were found. Cores were principally well-reduced (exhausted), multidirectional types that were being worked with fairly dense quartzite or igneous hammer stones. Cortex, a secondary indicator of initial core shaping, was observed on just 8 percent of all flaked stone. The paucity of completely cortical or partly cortical flakes implies that blanks or preforms were brought to the site and then transformed into points or knives by finishing their surfaces and creating a haft. Flake blanks were occasionally systematically retouched, but mostly they were just used and resharpened.

Tool Use

How were flaked and ground stone tools used at LAN-211/H? Several readily recognizable functional types are present in the collection. We know how manos, metates, and pestles were used, even though the foods were being processed or cooked cannot always be identified. The size and shape of points and bifaces indicate that point blanks (those made in anticipation of use) were being finished and hafted into shafts and used as arrow tips during hunting expeditions.

The modified flakes are more enigmatic. Sharp or resharpened flakes are convenient and appropriate tools for many tasks. Replication and microwear studies (Hayden 1979; Keeley 1980) have suggested that scrapers and utilized flakes were used for butchering; food preparation; and for working wood, bone, plant fiber, and hides. Future investigation in the Ballona could benefit from similar replication and microware studies.

Burin spalls are infrequently reported, probably because they are difficult to identify. In southern California, chert burin spalls are found occasionally among Santa Cruz Island debitage (Arnold 1987a: 80–81). The spalls from LAN-211/H are similar to “bladelets” recovered at LAN-63 and LAN-64, two Intermediate period sites on the bluff tops above the Ballona Lagoon (Van Horn 1987). Quartz bladelets are also known from LAN-47, a Late period site on the north side of the lagoon (Altschul, Homburg, and Ciolek-Torrello 1992:237). Both Van Horn (1987) and Towner (1992) suggested their bladelets were made by the bipolar technique, whereas Arnold described a blade-core manufacturing system (Arnold 1987b).

We maintain that these bladelets were produced by the burin-spall technique and that these small artifacts were probably drills used to make shell beads. Although these rather fragile tools were frequently broken, their triangular shape made them ideal for drilling. Some of the tiny flakes recovered from the site likely reflect pressure retouching to repair broken spalls.

Tarring pebbles represent one element in an important manufacturing activity, basket waterproofing. We can readily envision site residents collecting nearby rushes and reeds (*Juncus* spp., *Phragmites* spp., *Scirpus* spp.) and returning to LAN-211/H to weave and tar new water bottles.

Tool Repair and Discard

Occasionally small chert and obsidian tools were resharpened and repaired; the use-life of most tools, however, ended when they were broken, lost, buried, or swept into the refuse pile. Debitage from secondary reduction, final shaping, and repair activities also might have been removed from work spaces and dumped with other refuse into a marshy area or the nearby creek. The artifact diversity found in Unit 9 may reflect a clean-up and discard pattern rather than abandonment in-place.

The Tool Kit at LAN-211/H

The tool kit, or stone artifact collection, from LAN-211/H includes arrow points, bifaces, and unifaces in some quantity, all attesting to the continued use of stone projectiles into early historical times. Contrary to Allen's (1998:83) hypothesis that points would be cursorily made during this period, the chert Cottonwood Triangular and Desert Side-notched arrowheads at LAN-211/H are carefully fashioned using traditional pressure-flaking techniques. Small stone flakes that could have been used to fillet fish and butcher wild game are present at LAN-211/H, and the sandstone, andesitic, as are the granitic milling equipment that could have processed saltbush seeds, buckwheat, or acorns.

A review of protohistoric and historical-period research suggests that fewer nonlocal materials should be present because aboriginal trade networks were disrupted. Small pressure flakes, an edge-modified flake, and shatter made from imported fused shale and obsidian were observed in small quantities at LAN-211/H, but only one formal tool of imported material was discovered, a fused shale projectile point. These artifacts may represent scavenging or recycling of material, possibly from nearby multicomponent sites such as LAN-62. The absence of obsidian and the manufacture of points from Monterey chert at LAN-211/H could be a reflection of trade limitations; toolmakers substituted the more easily obtainable chert for imported obsidian. Although we saw no porcelain substitution, we did find three glass flakes showing signs of other flake removals and deliberate reduction or creation strategies. This discovery suggests a practice of material replacement.

We hypothesize that native people familiar with the new technology introduced by the missionaries and faced with labor-intensive activities requiring sturdy tools would generally prefer iron knives or axes because of their greater efficiency, if they had access to them. We expect that the transition from traditional technology to the new system would be documented by a paucity of large volcanic and quartzite flaked stone tools such as scrapers, bifacial knives, and choppers (Binford and O'Connell 1984). We also anticipate that fewer hammer stones would be found because metal hammers might have replaced stone precursors during tool manufacture. Only four hammer stones were found during the testing, and this may document their predicted decrease. No metal artifacts, however, have yet been recovered from at LAN-211/H.

Summary

The stone artifact collection from LAN-211/H has three aspects: first, a small, portable tool kit representing a restricted range of activities; second, a larger seed-processing tool collection; and third, tools for producing fishing gear and waterproofing basketry. These tools may reflect a pre-Spanish, aboriginal tool kit, or portions of a mission-period tool kit where metal had not yet replaced stone, either due to Spanish firearm prohibitions or to limited access to smaller iron pieces. We see new materials replacing old: glass is used in place of obsidian. We wonder if the foods being caught, collected, and processed are changing too?

Tools from non-Ballona stone (chert) were finished, repaired, and used at LAN-211/H. Carefully designed tools appear to have been imported in finished form. Cores and flakes from reworking and repairing tools tend to be small, suggesting that imported materials (obsidian, fused shale) might have been scavenged. The characteristics of the curated tool kit, how it was made, why it was retained as well as its prominence in the technological organization of the protohistoric or early historical periods are research issues that future LAN-211/H investigations may help answer.

Table 32. Stone Artifacts from LAN-2769

Material	Projectile Point	Biface	Drill	Core	Hammer Stone	Mano	Unmodified Flake	Total
Andesite	—	—	—	—	—	—	1	1
Basalt	1	—	—	1	1	—	5	8
Chalcedony	—	—	1	—	—	—	10	11
Chert	—	4	—	—	—	—	42	46
Granite	—	—	—	—	—	1	—	1
Quartz	—	—	—	—	—	—	10	10
Quartz crystal	—	—	—	—	—	—	1	1
Quartzite	—	—	—	1	—	—	6	7
Total	1	4	1	2	1	1	75	85

LAN-2769

Test excavations at LAN-2769 recovered 85 stone artifacts: 8 tools, 2 cores, and 75 pieces of debitage (Table 32). All specimens were analyzed. Most of the artifacts were chert pressure flakes representing final finishing, resharpening, or refurbishing of flake tools. We briefly summarize the tool categories and provide information about core reduction and debitage as indicators of the technological organization; we also discuss material procurement, manufacture, use, repair, reuse, and discard patterns. These categories and the methods used in this study were described previously in the results for LAN-211/H.

Results

Stone artifact categories in the LAN-2769 collection are presented in Table 32. Broken bifaces (n = 4), a drill (n = 1), and cores (n = 2) suggest that tool production rather than tool use was the principal activity at the site. This hypothesis is further confirmed by 75 unmodified flakes, 30 complete and the remainder fragmentary, that also were found. Most artifacts were made from chert from the Santa Monica Bay vicinity; no imported material was present.

Bifaces

Four fragmentary chert bifaces were found (Figure 81a–b). One had been discarded because of a bending fracture (a manufacture break); the other three specimens were so fragmentary that the reason for their abandonment is unclear. All were percussion flakes shaped by pressure retouch.

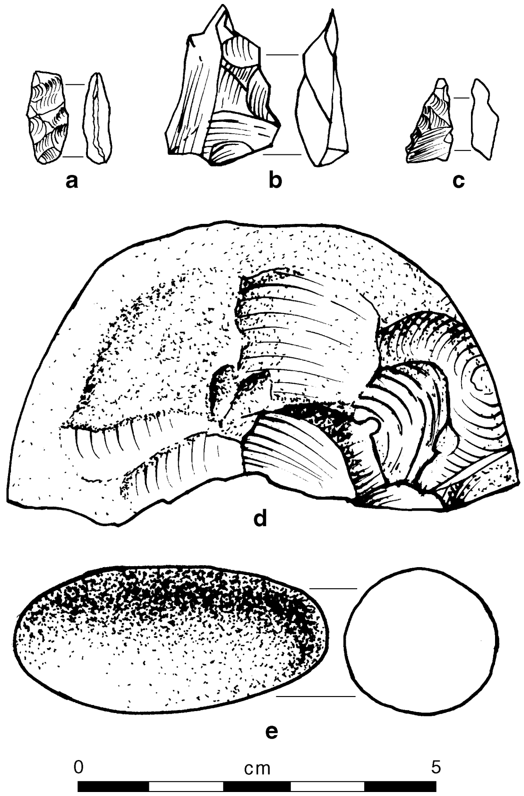


Figure 81. Stone artifacts from LAN-2769: (a–b) chert bifaces; (c) chalcedony drill; (d) basalt core; (e) basalt hammer stone.

Drill

We recovered the distal portion of a drill formed on a chalcedony pressure-retouched burin spall (Figure 81c). The retouch is rounded and ground, and the fragment measures just a little over 11 mm long.

Cores

Cores are cobbles, pebbles, or rock nuclei that show evidence of deliberate, patterned, flake detachment. Two flake cores were recovered from LAN-2769: the first is a basalt multidirectional core with multifacet platforms (Figure 81d). This core is complete and is the larger of the two recovered. The second flake core, made of quartzite, has been fragmented; only the midsection of it was recovered. This core is small, portable, and could readily be used to produce a flake. Although quartzite can be obtained in the immediate vicinity of LAN-2769, the core was not shaped when the material was quarried; instead, it appears to have been selected and brought to the site for finishing.

Hammer Stone

A small, cylindrical basalt pebble, 43 mm long and 24 mm in diameter, with battered poles was recovered (Figure 81e). The damage to the ends suggests it was used as a bipolar percussion hammer. This pattern of damage on this hammer stone is interesting in that bipolar battering is not usually found on the poles, but on a face.

Debitage

Debitage consists of complete flakes and flake fragments (see Table 10); no shatter was found. Of the 75 flakes recovered, only 30 are complete. Conclusions about tool making and debitage characteristics are limited by the absence of key attributes in this small and mostly fragmentary sample. As Table 32 shows, a majority of the debitage is chert. Seventy-five percent of the debitage is Monterey Formation material; quartzite and volcanics account for only a few pieces.

Pressure flakes from biface reduction are the most common debitage type (52 percent). Almost three-quarters of the flakes have no cortex. Over half the debitage are flakes produced during biface and arrow point manufacture or repair (bifacial thinning flakes). The overall small debitage size (91 percent less than 10 mm) indicates most flakes were generated during late stage percussion and pressure reduction.

Mano

The single milling stone recovered, an almost complete granite mano; it is roughly oval and has two worn, flattened faces. The mano measures 95 by 91 by 40 mm.

Discussion

In this section, we present our observations about this small stone collection. The disturbed context of this site limits its information potential. After a brief discussion of the intrasite distribution of artifacts and tool stone used in production, we summarize our findings regarding stone tool production, use, repair, and discard.

Artifact Distributions

Stone artifacts were unevenly distributed among the nine 1-by-1-m test units at LAN-2769. No unit contained large numbers of stone artifacts, and we suspect that variation in density and frequency has more to do with postdepositional processes moving artifacts throughout the site, such as water movement and rodent burrowing, than with human behavior.

Material Procurement

The tool stones used are mostly Monterey Formation cherts and chalcedonies, with small amounts of quartzite. These materials can be procured either on the coast of the Palos Verdes Hills or in the Santa Monica Mountains. Quartzite can be found in the Ballona drainages, with local deposits in the Baldwin and Del Rey Hills. Material from distant sources, such as Coso (eastern Sierra) obsidian, is not represented. No soapstone from Santa Catalina was recovered. In general, materials were collected either as pebbles in the Ballona vicinity or from outcrops or detritus along the coast. The single mano, a granitic stone, could have a distant origin, such as the San Gabriel Mountains, although it likely was manufactured locally from a cobble deposited in the Baldwin Hills gravels.

Tool Production

There are two flaked stone reduction techniques represented in this collection. One reduction trajectory involves smaller, chert tabular cores and quartzite pebbles. The size of the cores restricted production to flakes smaller than 40 mm. Alternatively, some chert flakes were made into bifacial preforms and then probably finished as projectile points.

Tool Use

A single finished tool, a projectile point made from basalt, was found at LAN-2769. All flaked material basically results from tool manufacture. The biface and drill are indirect evidence for the use of arrow points and larger notched tools. The mano indicates that seed or possibly small-mammal processing occurred at the site.

Tool Repair and Discard

Small chert flakes can be attributed to biface manufacture and finishing, which produces such small flakes in considerable quantities. Some of the percussion flakes result from resharpening or repair. This kind of debitage can occur in many contexts. Tools can be repaired at camps or activity areas while waiting for game to arrive, the tide to change, or for materials to be gathered. Debitage also could have been cleared from work areas and discarded.

Summary

We recovered a light scatter of tools and debitage from LAN-2769, the result of finishing, reworking, and repairing tools. The small sample size probably accounts for the lack of diagnostic flaked stone; only a single diagnostic stone artifact was recovered. This suggests that the stone artifact collection primarily reflects a tool kit representing a restricted range of maintenance activities—principally, preparing hunting gear and processing plant food.

Intersite Comparisons

In the Ballona, the preference for small tools made from chert continued from prehistory into the protohistoric period. This assertion is evidenced by the stone tool collection from LAN-1932/H, a protohistoric site located in the Ballona lowlands. Initial analysis of stone artifacts from this site indicate a similar tool type profiles and material preference to LAN-211H (Table 33). A small number of finished tools fashioned mostly from chert (Figure 82a–b) were found, along with debitage primarily made from chert. A projectile point made from jasper was also recovered (Figure 82c). Of the ground stone specimens recovered, one was identified as a sandstone mortar and a second, found in two pieces and stained with asphaltum, is a basalt bowl fragment (Figure 82d). The lithic collection is consistent with the interpretation that LAN-1932/H was once part of LAN-211/H before being mechanically removed and spread as fill in the runway area by Hughes Aircraft Company contractors.

A second Ballona-area archaeological site that provided important, if scant, comparative material is the Hammack Street site (LAN-194). Excavation at this single-component, early-historical-period site was limited. Finds included two Cottonwood-style projectile point bases, one of fused shale and one of Monterey chert; a chert and a quartzite scraper; a basalt mano; a hammer stone; and several tarring pebbles. In general, the tools and materials found at Hammack Street are quite similar in type and material to those found at LAN-211/H. The stone tools found at the Hammock Street site demonstrate the survival of some traditional stone tool use patterns into the rancho environment of the early historical period.

Distribution of artifact types in the Ballona has often been discussed in terms of location because of clear distinctions between bluff-top collections versus those from lowland sites along the lagoon edge. Van Horn (1987) separated stone artifacts from his bluff-top excavations into micro- and macroindustries, then further identified specialized flakes (e.g., microliths, so-called potato flakes) and tools (e.g., microdrills) that are produced from small and large flakes. This classificatory scheme has not proved useful in the analysis of stone artifacts from lowland sites. Further, artifact totals by type or material are not consistently reported for bluff-top sites. As a result, comparisons between bluff-top and lowland collections can only be made in general terms.

Table 33. Stone Artifacts from LAN-1932/H, by Material Type

Material	Projectile Point	Biface	Drill	Uniface	Scraper	Core	Modified Flake	Unmodified Flake	Mortar	Unidentified Ground Stone	Total
Andesite	—	—	—	—	1	—	1	57	—	—	59
Basalt	—	—	—	—	1	—	3	32	—	—	36
Chalcedony	—	—	—	—	—	1	—	34	—	—	35
Chert	4	5	1	1	—	3	1	313	—	—	328
Fused shale	—	—	—	—	—	—	—	1	—	—	1
Jasper	1	—	—	—	—	—	—	—	—	—	1
Metavolcanic	—	—	—	—	—	1	—	—	—	—	1
Obsidian	—	—	—	—	—	—	—	1	—	—	1
Porphyritic andesite	—	—	—	—	—	—	1	—	—	—	1
Quartzite	—	—	—	—	—	—	—	15	—	—	15
Rhyolite	—	—	—	—	—	—	—	1	—	—	1
Sandstone	—	—	—	—	—	—	—	—	—	1	1
Vesicular basalt	—	—	—	—	—	—	—	—	1	—	1
Total	5	5	1	1	2	5	6	454	1	1	481

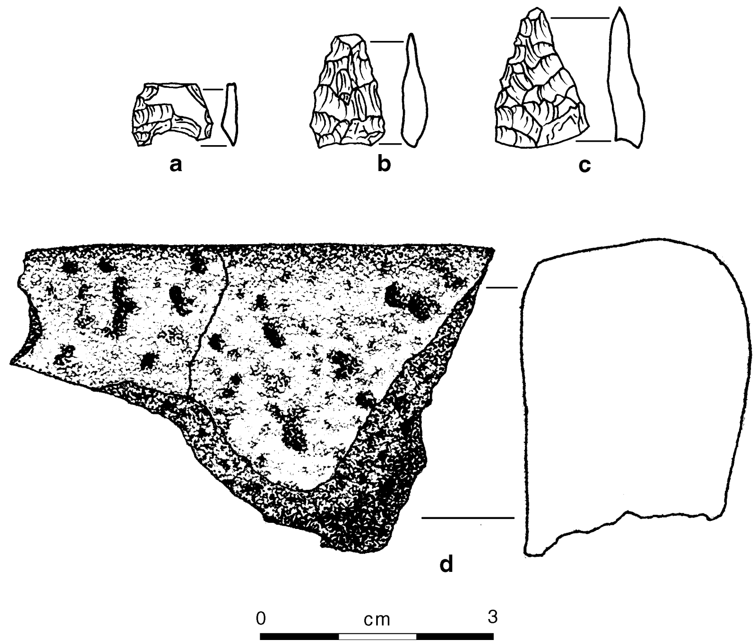


Figure 82. Stone artifacts from LAN-1932/H:
(a–b) chert projectile points; (c) jasper projectile point;
(d) basalt bowl fragment in two pieces.

Discounting the differences in excavation, reporting strategies, and nomenclature for the purpose of highlighting a general trend, Table 34 presents the results of intersite comparison of selected stone artifact types between bluff tops and lowlands. Small tools, such as a variety of unifaces, edge-modified flakes, and bifaces, as well as dart and arrow points, have been found in both bluff-top and lowland sites and are commonly found throughout the region. By contrast, large, carefully made tools of quartzite or igneous materials, and expediently produced flakes that were used for many tasks are uncommon in lowland-site collections. Further, relatively few ground stone or milling implements are found at Late period lowland sites; however, these artifacts are plentiful at Intermediate period bluff-top sites (Van Horn 1987; Van Horn and Murray 1985). There may also be important distinctions within lowlands site along temporal lines. For example, projectile points, which appear scarce in lowland Intermediate sites, become more common in protohistoric and historical-period sites. Additional data to test this observation may become available when lithic collections recovered during data recovery from two additional Intermediate period Ballona-area sites, LAN-193/H and LAN-2768, are analyzed.

Conclusion

We have analyzed two collections from tested sites LAN-211/H and LAN-2769 in the Playa Vista project area and we have summarized the ways in which LAN-211/H compares with earlier and contemporaneous Ballona sites. The small quantity of artifacts from the disturbed context of LAN-2769 provided limited data about the prehistoric people occupying the base of the bluff. In contrast, the stone artifacts

Table 34. Comparison of Stone Artifacts from Ballona-Area Sites

Selected Stone Artifact Types	Bluff-Top Sites			Lowland Sites				
	Intermediate and Late Periods			Intermediate Period	Late Period	Late and Protohistoric Periods		Historical Period
	LAN-61A [a]	LAN-61B [a]	LAN-63 [b]	LAN-60 [c]	LAN-47 [d]	LAN-211/H	LAN-1932/H	LAN-194 [e]
Projectile point	63	90	261	—	36	11	5	2
Scraper, scraper plane	9	15	181	—	—	1	2	—
Burin, burin spall, drill	21	54	13	—	—	3	1	2
Microlith, bladelet, microdrill	130	460	18	—	24	—	—	—
Biface	2	—	11	1	37	28	5	—
Core	96	152	151	9	—	13	5	—
Hammer stone	119	156	276	—	4	4	—	—
Mano	284	299	122	61	13	6	—	1
Metate	55	122	64	3	3	2	—	—
Pestle	1	21	16	—	3	1	—	—
Mortar, bowl	110	138	51	—	—	—	1	—
Tarring pebble	no data	279	659	8	—	49	—	> 1

[a] Van Horn and Murray 1985
[b] Van Horn 1987
[c] Grenda et al. 1994
[d] Towner 1992
[e] King 1967

from LAN-211/H paint an intriguing picture of a hunting and limited-activity camp during a period of transition for the indigenous people of the Ballona. The investigations at LAN-211/H along with data recovery efforts at LAN-2676, -2768, -193/H, -60, and -54 have led to new understandings about the manner in which prehistoric and protohistoric peoples of the Ballona used stone tools. As we prepare for the next phase of the PVAHP, a fresh look at our goals, methods, and procedures was needed. Accordingly, a research design was prepared by Dr. Robert Elston to guide analysis of all lithic collections obtained at Playa Vista sites during data recovery. The research design is presented in Appendix C.

CHAPTER 11

Summary and National Register Evaluation

Richard Ciolek-Torrello

This chapter addresses the third component of SRI's research design (Grenda et al. 1999), summarized in the introductory chapters to this volume: do the archaeological materials designated as LAN-211/H and LAN-2769 represent properties that are eligible for listing in the NRHP? Early in the course of the PVAHP, the decision was made that instead of viewing each archaeological site as a separate property for the purposes of NRHP evaluation, it was more efficient as well as more accurate to view the entire area surrounding the lagoon as a locus of prehistoric settlement. At that time, it was decided that the study of adaptation to a dynamic environment such as the Ballona was a significant research issue. From this perspective, a site's ability to contribute important information to our understanding of such adaptation was the best measure of that site's NRHP eligibility. As a result, the BLAD was proposed to encompass all sites within the Playa Vista project area (Altschul et al. 1991:165–166). Two historic contexts—"human-land relationships" and "culture history and cultural dynamics of prehistoric settlement"—were presented in the research design (Altschul et al. 1991:23–26) as a framework for evaluating prehistoric cultural resources. Since 1991, several sites have been determined to be contributing members to this district, based on previous archaeological investigations.

Among the latter were the sites recorded at the South Central Coastal Information Center as LAN-62 and LAN-211/H. As discussed in Chapter 2, these sites have been combined into the designation LAN-62, which has been determined eligible for the NRHP (see Table 1), and because a treatment plan for data recovery has already been accepted (Altschul et al. 1991), LAN-62 will not be considered further in this chapter.

LAN-211/H, however, will be considered here. Archival research and investigations described in previous chapters reveal that the archaeological deposits that had been designated as LAN-211/H appear to be a continuation and extension of LAN-62, and the designation LAN-211/H had been incorrectly assigned to these deposits during the 1980s. SRI now believes that archaeological materials previously recorded with the temporary designation of SR-13 (Altschul et al. 1991:155) are a better candidate for the site discovered by Deane (Thiel 1953) and originally recorded in the early 1950s (Rozaire and Belous 1950); as a result, SRI transferred the designation LAN-211/H to SR-13. It is this manifestation of LAN-211/H, as well as LAN-2769, that is the subject of the current evaluation. The objective of this chapter is to evaluate whether these two sites represent intact archaeological deposits that are contributing elements to the BLAD.

Although historic contexts for evaluating archaeological properties in the PVAHP were developed in the research design (Altschul et al. 1991) and subsequent treatment plans were prepared for other archaeological properties in the PVAHP (Altschul et al. 1998; Altschul et al. 1999), little was known about the protohistoric and early historical periods in the Ballona, and research themes specific to these periods were not well developed. Considerable information relating to occupation in the Ballona has recently become available as a result of archival research and other investigations. Because of these new data and the nature of the archaeological properties investigated in this report, it became necessary to devote much of this report to developing historic contexts for the protohistoric and early historical periods in the Ballona.

Controlled excavation at LAN-211/H and LAN-2769 achieved most of the goals described in the work plan (Grenda et al. 1999). Cultural deposits located in the 1990 survey (Altschul et al. 1991) were confirmed, site boundaries were estimated, and the integrity and research potential of both sites were evaluated. Evaluation of the two archaeological sites is accomplished by individually summarizing and synthesizing the field results and analytic information presented in the preceding chapters for both sites. First, the age, condition, and integrity of each site are assessed. For the purpose of this discussion, an intact archaeological site is one where the specific cultural resource was deposited by the ancient residents of the Ballona in the location in which it was discovered. The research potential of each site, or its ability to contribute important information to our understanding of adaptation to the lagoon, is then examined. For this purpose, special consideration is given to archaeological materials that provide unique information, especially with respect to the poorly represented protohistoric and early historical periods. Based on this discussion, this chapter concludes with recommendations for NRHP eligibility and additional research.

LAN-211/H

A combination of evidence suggests that there are two, perhaps three, temporal components at LAN-211/H: one possibly dating to the Intermediate period, one dating to the Late period, and one dating to the early historical period. Stratigraphic research revealed a thick, apparently intact midden deposit on a large bench near the base of the bluff. A much denser, intact midden deposit was found below this bench underneath the abandoned parking lot at the foot of the bluff. These deposits occur in Stratum 3, which corresponds with the uppermost A horizon of a moderately developed soil overlying an alluvial fan deposit generated by drainages channeling run-off from the bluff (Chapter 4). Fan sediments located between this A horizon and the underlying C horizon contain clay-rich bands, termed lamellae, that indicate the fan deposit has been stable for the past several thousand years. The fan accumulated very rapidly as sediments were washed down from the slope; however, there is little evidence for human occupation until the fan stabilized and soils began to form on its surface. There is some evidence to suggest that this fan was subjected to intermittent flooding and deposition of fluvial deposits, probably by Centinela Creek, while LAN-211/H was occupied.

Four radiocarbon assays from LAN-211/H suggest two components, one sampled from Unit 6/10 and dating between A.D. 600 and 1000, and the other recovered from Unit 9 and dating between A.D. 1490 and 1640. Unfortunately, the two samples from Unit 6/10, located on the bench west of a large channel that now drains the bluff and divides the deposit at LAN-211/H, appear to be reversed. A radiocarbon sample of *Chione* sp. collected from Level 7 of Unit 10 returned a date of A.D. 1000—some 400 years younger than a *Chione* date of A.D. 610 from Level 6 of Unit 6, 90 cm higher and in a different stratum. Although both samples date to the last millennium of the Intermediate period, such a reversal of dates is not expected if stratigraphic integrity was retained at this locus. Extensive bioturbation of the sediments on the bench could have resulted in the mixing of the deposit and downward transport of shell fragments through the alluvium. Another possibility for this reversal is that the deposit on the bench of the bluff slope is secondary in nature and was redeposited by the erosion of cultural material from the archaeological sites on the bluff top above. Historical-period activities such as the construction of the Los Angeles sewer and the associated Cabora Drive along the middle of the slope above the bench, or Loyola Marymount University on the bluff top above the site could also have resulted in the transport of fill material containing archaeological materials to the bench area (Chapter 5).

By contrast, the deposit sampled in Unit 9 below the parking lot at the foot of the bluff appears to represent a much richer and more intact deposit that dates from the end of the Late period to the early historical period. The two radiocarbon samples from *Chione* specimens in this unit recovered overlapping dates (A.D. 1490 and 1640) that indicate a Late prehistoric to protohistoric age for this deposit. A total of 37 shell beads and 20 glass beads recovered from the entire site confirm a primarily protohistoric age for this deposit. The largest number and greatest variety of beads were recovered from Unit 9. The dates for these beads range from about A.D. 1500 to 1800, although Gibson et al. (Chapter 9) believe that bead evidence indicates very little occupation prior to A.D. 1650. At least one glass bead may date to A.D. 1816 or later, indicating the occupation of the site continued into the early decades of the nineteenth century. Surprisingly, only glass beads were recovered from the bench area around Unit 6/10, which returned the Intermediate period radiocarbon dates. No Intermediate period beads were recovered from the bench area. Unit 11, located on another bench east of the large ravine dividing the site, produced several shell beads, which Gibson et al. date to the 1790s. The presence of a flaked glass tool (Chapter 10) and the butchered remains of domestic animals (Chapter 7) further confirm the protohistoric to historical-period occupation of this site.

Stone tool collections, which are often temporally diagnostic, in this case contribute little to the assessment of the site's age and condition (Chapter 10). The Cottonwood arrow points and the single Desert Side-notched arrow point recovered from the site represent projectile point styles that were most common in the Late and protohistoric periods. The few fragments of carved soapstone bowls and steatite beads are not temporally diagnostic but appear most commonly in the Intermediate and Late periods.

Bone weathering and fragmentation of faunal materials provide support for the relative dating of the different components (Chapter 7). LAN-211/H is quite different from many other sites in the Ballona in terms of taphonomic processes that usually affect bone preservation in archaeological deposits. There are few instances of advanced weathering or patterns of mineral staining that can be expected when bone is exposed to the elements or buried for long periods of time (Chapter 7). In this respect, LAN-211/H is similar to LAN1932/H, another presumed protohistoric-period deposit, and LAN-2676, a disturbed Intermediate to Late period site. Bones from LAN-62, another Intermediate to Late period site, and LAN-2769 are moderately weathered. By contrast, bones from LAN-193/H and LAN-2768—Intermediate period sites located in a similar physiographic context at the foot of the bluff east of LAN-211/H—exhibit the greatest degree of weathering.

Variation in bone weathering across LAN-211/H provides additional evidence suggesting that the midden sampled by Unit 9 is an intact protohistoric-period deposit, whereas the deposit on the bench area may be older or more disturbed. Although the bone collection from excavation units placed on the bench is relatively small, bone from this location exhibits the highest degree of weathering at the site, indicating either longer or periodic disturbance, or older age. By contrast, the least amount of weathered bone was recovered from Unit 9, which produced the greatest accumulation of bone.

As Maxwell points out (Chapter 7), the pattern is preliminary, being based on only a handful of sites and excluding the bluff-top sites. But the pattern is remarkable, with the youngest sites being distinguished by the least degree of bone weathering, whereas the oldest sites have the highest frequency of weathered bone. As Maxwell notes, weathering has traditionally been used as a proxy measure for the duration of exposure prior to burial, the data from the Ballona indicates that weathering may continue to affect the bone after burial. Maxwell presents the intriguing thought that age, rather than postdepositional activities, may be the primary factor being measured by weathering patterns. At this stage in our studies of the Ballona, we cannot place a great deal of confidence in these patterns, but the study of bone weathering as a relative temporal indicator has promise.

The distribution and condition of invertebrate remains adds some credence to the pattern exhibited by bone weathering. For example, the degree of shell fragmentation varies considerably across the site. As Becker (Chapter 8) points out, shell refuse generally exhibits little damage when originally discarded. Fragmentation of shell is generally considered to be the result of postdepositional processes. Thus, highly fragmented shell often indicates redeposition or disturbance. Becker observes that the shell from

Units 6/10 and 9 exhibit the least degree of fragmentation, whereas the shell from Unit 11 is severely fragmented to a degree comparable to sites LAN-2676 and LAN-1932/H, which are severely disturbed.

Taken together, these various lines of information suggest that the alluvial terrace sealed below the parking lot at the base of the bluff represents an intact midden deposit dating to the protohistoric and early historical periods. Even this area, however, appears to have been subject to the "swiss cheese" effect that characterizes much of the area below the bluff. Unit 9 appears to be intact, but trenches placed in nearby areas of the parking lot did not locate intact deposits. The situation is much less clear in areas of the bench near the base of the bluff. None of the excavation units on the bench contain as rich or diverse deposits as Unit 9, and all appear to have been disturbed to some extent. Unit 11 appears to have been the most disturbed. Artifacts dating from the Intermediate period to the early historical period were encountered in several units. It remains unclear, based on current data, if the archaeological materials found on this bench represent a multicomponent occupation that is bioturbated to various degrees. Alternatively, the deposit found on the bench may be mixed with Intermediate period archaeological materials that were either eroded from LAN-61, located on top of the bluff above LAN-211/H, or brought as fill from an unknown location.

LAN-211/H is a rich and diverse site that represents a locus of human activity from at least the seventeenth to the early nineteenth centuries, and perhaps as early as the fifth century. The site, especially the area around Unit 9, is rare, if not unique. Although protohistoric occupations are common along the coast of the Southern California Bight, our search for comparative analogues found few, if any contemporaneous single-component occupations similar to that evident in Unit 9. None is known in the vicinity of the Ballona—LAN-1932/H, which appears to be contemporary, appears to have been severely disturbed and, indeed, may represent a secondary deposit of LAN-211/H. The Hammack Street site, LAN-194, located on the northeast side of the Ballona, may contain a discrete early-historical-period component that overlaps the end of the occupation at LAN-211/H, but little is known about this site from the limited excavations that were undertaken in the 1960s.

SRI's test excavations reveal further that LAN-211/H may contribute important information about human occupation in the Ballona. Analysis of material culture remains suggest that the protohistoric-period occupation of the Ballona was distinct from those of previous periods. Faunal remains indicate a shift in prehistoric subsistence strategies from a long-standing strategy focused on lagoonal shellfish and terrestrial mammals to a generalized shellfish-collection strategy that included a range of coastal habitats. Subsistence at LAN-211/H also evidences an increase in the exploitation of bony fish from near-shore habitats, and the use of birds and exotic animals such as swans, pronghorn, antelope, and domestic animals. Given the unique nature of LAN-211/H, it is difficult to determine if these changes reflect general protohistoric patterns. Cultural materials from LAN-1932/H reflect similar patterns, but because of that site's lack of integrity, they have little research value. The silting in of the lagoon and the reduction in its size during the protohistoric and historical periods, however, is consistent with these changes in subsistence strategies. Becker (Chapter 8) suggests that as the lagoon silted in during the protohistoric period, shellfish beds were reduced in size, forcing the last inhabitants of the Ballona to diversify their collection strategy and target rocky shore and sandy beach habitats. Such diversification might also have involved a shift from lagoon fish to bony fish from the open coastal zone, as well as the increased exploitation of birds. Overall, the vertebrate and invertebrate faunal collections from LAN-211/H contain a wider variety of species than most earlier sites.

The presence of exotic animals in the faunal collection and other aspects of material culture suggest that cultural interaction and exchange patterns also changed during the protohistoric period. Based on the beads recovered from LAN-211/H and other sites in the Ballona, Gibson et al. (Chapter 9) argue that the protohistoric occupants of the Ballona were fully involved in a large-scale economic interaction sphere that operated in southern California during this time. An important part of this interaction sphere was the increased use of shell ornaments. Becker (Chapter 8) points to the abundance of abalone and the presence of an exotic western pearlshell mussel, both highly nacreous shell species that were prized for shell-tool and -ornament manufacture, as indications of a tool or ornament manufacturing area. No direct evidence for shell tool or ornament manufacture, however, was found at LAN-211/H.

Rosenthal and Hintzman (Chapter 10) also tentatively suggest the tool collection reflects technological changes. With the exception of the presence of three flaked glass artifacts (as well as the glass beads), the artifact collection from LAN-211/H lacks evidence of materials, tools, and containers of European derivation such as those found at the early-nineteenth-century Hammack Street site, LAN-194. Rosenthal and Hintzman, however, suggest that the LAN-211/H collection reflects the decline in the use and manufacture of traditional stone tools. They see this pattern in the reduced volume of stone, a decline in the number of stone tool categories, and an increased use of smaller, portable tools. High-quality imported raw materials appear to have become difficult to obtain, and local quartzites were rarely selected for tool production. Instead, most tools were made from basalt and chert, which were obtained locally.

LAN-211/H can contribute unique and important information to our understanding of the two historic contexts that are the basis of our research at Playa Vista. Data from LAN-211/H fill a large void in the culture history of the Ballona area. Previous research at Playa Vista and the Ballona reveals a robust record of Early, Intermediate, and Late period occupation—from the initial settlement atop the bluff in the Early period to resettlement and reorganization along the edge of the lagoon in the Late period. By contrast, the data from LAN-211/H provide insights into the long-speculated, but poorly understood period of time that represents the transition from prehistory to history and from Native American to European lifeways. Preliminary evidence suggests that major changes occurred in human-land relationships in the Ballona during this important time period, as well as in the cultural dynamics of settlement. Our initial analysis of the data collected from the evaluation of this site reveals that these changes involved shifts in subsistence, technology, and social interaction. Much more research, however, will be required at LAN-211/H to explore these patterns fully.

LAN-2769

LAN-2769 presents a marked contrast to LAN-211/H. Although located in an identical setting at the base of the bluff a few hundred meters east of LAN-211/H, LAN-2769 is a sparse site of questionable integrity. LAN-2769 contains a very low-density cultural deposit that may be highly disturbed, if not secondarily deposited (Chapter 6). Only a small portion of the site could be investigated because of restrictions placed upon our excavations. Intact cultural deposits were apparent in an exposure at the base of the bluff when the site was first discovered (Altschul et al. 1991). The investigations reported in this volume, however, were unable to locate any intact deposits below the surface. Instead, severe disturbance was seen in our excavations. We did not attempt any radiocarbon assays from this site because of the paucity of cultural material and the questionable integrity of the deposit. Thus, its age is not known.

No temporally diagnostic artifacts were recovered from LAN-2769. The flaked stone is comparable to Late period collections in the Ballona in the prevalence of small tools made from chert and chalcedony such as unifaces, edge-modified flakes, bifaces, and dart and arrow points (Chapter 10). The small numbers of shellfish remains are mostly the bay- and estuary-loving species that characterize the shellfish collections from most of the prehistoric sites in the Ballona (Chapter 8). These habitats were located relatively close to the site in prehistory, and would have been easily exploited by the site's inhabitants. The equally small collection of vertebrate remains is also similar in its makeup to most other prehistoric sites located along the banks of Centinela Creek. The collection is dominated by terrestrial mammals, whereas the frequencies of fish and birds are very low (Chapter 7). Much of the bone is weathered and highly fragmented. Maxwell (Chapter 7) suggests that weathering patterns point to a typical Intermediate to Late period site from the Ballona. The high proportion of intrusive remains, especially rodents and snakes, which constitute the bulk of the identifiable fauna, together with the general lack of burned bone suggests to Maxwell that little of the recovered material from this site is of cultural origin. The presence of a few fish remains and some butchered bone are the only clear indications of human occupation. On the basis of the vertebrate fauna, Maxwell concludes that the site has been heavily impacted, if not largely destroyed, leaving only a handful of highly mixed remains. Stratigraphic analysis and other cultural materials suggest little else is present.

Recommendations

LAN-211/H is a rich cultural deposit, portions of which appear to be intact. The integrity of other portions of the site remain in doubt, and additional testing will be required to determine the full extent of intact deposits. A variety of mechanical and manual excavations by SRI revealed the presence of a unique and intact cultural deposit below the old parking lot at the base of the bluff that dates from the protohistoric to the early historical period. Cultural materials of this age are not replicated at any other intact site currently known in the Ballona. Our preliminary investigations suggest that this deposit can contribute much significant information to our understanding of man-land relationships, culture history, and the dynamics of settlement in the Ballona. Therefore, SRI recommends that this site is eligible for listing in the NRHP as a contributing member to the BLAD (see Table 1).

By contrast, LAN-2769 is a very sparse and low-diversity deposit of cultural material that appears to have been heavily disturbed by intrusive animals. The small amount of cultural material that is present is very similar to that found at several nearby sites with richer and more substantial intact cultural deposits. What little information is present at this site is redundant and can add little more to our understanding of man-land relationships, culture history, and the dynamics of settlement than what we have already learned from the investigations reported in this document. Therefore, SRI recommends that this site is not eligible for listing in the NRHP as a contributing member to the BLAD (see Table 1).

CHAPTER 12

Treatment Plan

Benjamin R. Vargas, Donn R. Grenda, and Anne Q. Stoll

In Chapter 11, we recommended that LAN-211/H is eligible for listing in the NRHP as a contributing element of the BLAD and that LAN-2769 is not eligible. In this chapter, we assume that the COE, after consultation with the SHPO, ACHP, and other parties to the Playa Vista programmatic agreement, has accepted our recommendations and has determined that LAN-211/H is an NRHP-eligible property. Based on this assumption, we have prepared a treatment plan that, when implemented, will mitigate potential adverse effects to LAN-211/H caused by proposed construction, through data recovery, analysis, and curation. As a noncontributing element of the BLAD, no further work is recommended at LAN-2769.

We begin with a discussion of the planned impacts to LAN-211/H to establish the background for the proposed data recovery. Next, we present our research design, including anticipated outcomes and data requirements. The scope and details of the treatment plan for LAN-211/H are then presented. A plan of work and level of effort for data recovery concludes the chapter.

Impact Analysis

LAN-211/H is situated within the riparian corridor, a strip of land following the base of the bluff destined to be occupied by landscaping and a drainage channel that will conduct run-off to the freshwater marsh west of Lincoln Boulevard. Much of the site will be destroyed by construction of the corridor and bluff stabilization efforts, although direct impacts vary across the site (Figure 83). Three planned construction projects within the corridor will impact LAN-211/H; first, a 30-m-wide (100-foot) drainage channel will be built at the east end of the site, which will open into a 39.6-m-wide (130-foot) drainage at the west end; second, an entry culvert will be constructed for water runoff from the bluff, and third, bank stabilization activities are planned that will involve various combinations of recontouring and revegetation with a variable depth of impact between 0.3 and 1.8 m (1 and 6 feet).

Impact depths of the drainage channel at finished grade are variable and have been estimated at about 1.5 m (5 feet) below the current ground surface at the east end to about 0.6 m (2 feet) at the west end. However, due to compaction requirements and soil conditions, the actual depth of impact will exceed finished grade. The exact amount of overexcavation, soil compaction, and building demolition is unknown, and other construction requirements have not been projected, so SRI has added a buffer of 1.5 m (5 feet) below the finished or existing grade, depending on which is lower. In some cases, finished grade is to be filled above the existing elevation. In this situation, the existing grade will be grubbed and ripped prior to filling. Under these assumptions, nearly all portions of LAN-211/H in the riparian corridor will be severely impacted or completely destroyed. Construction is not proposed for those portions outside the riparian corridor, primarily the northeast section of the site. In fact, deposition in this part of the site, though rare, should be spared from adverse effects of the development. Table 35 presents the type and depth of impact at specific points (i.e., known depths of culture-bearing strata) within the LAN-211/H site boundaries. Construction of the new alignment of Bluff Creek Drive will disturb the

The exact location of archaeological resources and sites are not subject to public disclosure to prevent harm and unauthorized disturbance of the resources and sites, pursuant Section 5097 of the California Public Resources Code and Section 800.11 of the National Historic Preservation Act, as amended. Therefore, this figure has been excluded.

Table 35. Impacts of Construction and Grading at LAN-211/H

Location	Impact	Depth of Impact AMSL		Top of LAN-211 AMSL		Bottom of LAN-211 AMSL	
		m	feet	m	feet	m	feet
Units 3 and 4	bluff stabilization	6.1	20.0	8.5	27.9	6.8	22.3
Unit 9	corridor bank	1.6	5.0	3.1	10.1	3.0	9.8
Unit 11	bluff stabilization	7.6	25.0	9.1	30.0	8.0	26.4
BA 176	corridor bottom	0.9	3.0	2.5	8.2	0.4	1.3
BA 192	grubbing	2.1	7.0	3.7	12.1	2.0	6.7
BA 202	rip and fill	2.9	9.5	4.3	14.1	2.8	9.1
Trench 1-6	corridor bank	4.0	13.0	1.8	5.9	2.9	9.5

area immediately north of the mapped boundaries of LAN-211/H. This area remains uninventoried for cultural resources as a result of restricted access, and there is a moderate probability for buried site deposits. Data recovery, then, will focus in the riparian corridor. This constitutes approximately 14,000 m^2 of the 27,000-m^2 site.

Research Design

In SRI's 1991 PVAHP research design, two historic-context themes were presented as guiding the evaluation of prehistoric cultural resources. These two themes are "human-land relationships" and "culture history and cultural dynamics of prehistoric settlement" (Altschul et al. 1991:23–26). The first theme relates to the ways in which prehistoric inhabitants of the Ballona adapted to variable environmental conditions. To create testable models of adaptive prehistoric response, SRI developed a large-scale, high-resolution paleoenvironmental reconstruction of the Ballona, which was presented in Chapter 5. The second theme encompasses the processual issues of chronology, technology, and cultural affiliation. Within the research scope of the PVAHP, these themes have been organized using either a locational (Altschul et al. 1999:113–123) or temporal orientation (Altschul et al. 1998:123–128; Altschul et al. 2003; Grenda et al. 1999:21–29). Our goal has been to establish the Ballona's interpretive context by examining prehistoric sites within their temporal and spatial contexts. Unfortunately, sites dating to both ends of the temporal spectrum are underrepresented in the Ballona. Because of the lack of archaeological data, research on the most recent phase of prehistory, the protohistoric period (which extends from about A.D. 1542 to 1771), and the early historical period (from A.D. 1771 to 1834) has lagged. The fortuitous discovery of LAN-211/H brought new information to light; we are now poised to pursue research on protohistoric-period occupation of the Ballona.

In this chapter, we present a model of settlement, subsistence, and technology as the main body of this research design. In this model, various scenarios are postulated that incorporate assumptions about the corresponding material record. These scenarios, presented as examples of what an archaeological site might look like given a specific set of conditions, provide hypotheses to be tested against the archaeological data recovered from LAN-211/H. The nature of the relationships between native people and Spanish and Mexican missionaries and settlers determines the form of the material culture to be found at the site.

Regarding the efficacy of model building in archaeology, Foster et al. stated:

> Theoretical models or "pure types"—abstractions of historical reality that can be used in predictive and generalizing ways—are useful tools for advancing comprehension of the data gathered during historical archaeological studies in the project area (Greenwood et al. 1993; Greenwood and Shoup 1983:7). Such models or pure types are logically precise conceptions and thus internally unambiguous. They allow the interpretation of material differences to take place within a holistic framework, without excavating an entire neighborhood or city (Cressey and Stephens 1982:50). They are constructed by isolating the underlying forces and tendencies in a given political economy and social system.
>
> Historical reality—with its multiple actors and complex interplay of human will, ideology, and material forces—does not follow such neat patterns. Yet, such constructs help to interpret a given society, as well as the process of change and development, by comparing and testing the historical and archaeological reality against the model (Foster et al. 1996:8–9).

The model of settlement and subsistence presented in this chapter follows Foster et al.'s (1996) statement in its idealistic intent. We acknowledge that the reality of the archaeological record is more complex and ambiguous. The scenarios are simplified; nevertheless, we feel they accurately reflect the behavioral responses of native people during the "contact" or protohistoric and early historical periods. Our model is useful for exploring the processes of change and development in a given society, in that the model provides a defined structure for comparison and thus a platform for analysis. We present these scenarios and their corresponding archaeological signatures as a heuristic device, to illuminate a part of Native American history not covered by written records.

Protohistoric and Early-Historical-Period Occupation of the Ballona

Following the cultural chronology presented in Chapter 2, the protohistoric period is given a clear definition. The first nonnative to make contact with the Gabrielino was Juan Rodriguez Cabrillo, a Spaniard, who reached Santa Catalina Island in October, 1542 (Beck and Haase 1974:13; McCawley 1996:4). We use the year of Cabrillo's landfall, A.D. 1542, to mark the beginning of the protohistoric period. Using this reasoning, we define a protohistoric period site as one that was created by Native Americans after this initial contact. The founding of the Mission San Gabriel in 1771 has been generally adopted for the end of the protohistoric period (King 1978:58), the date by which "Hispanics" are permanently established among the aboriginal residents of the Los Angeles Basin. As discussed in Chapter 2, the term "Hispanic" is used in this context to refer to the Spanish-born missionaries, to the ethnically mixed soldiers and immigrants who arrived from what is now Mexico to settle in the pueblo, and to the European-influenced culture introduced by these eighteenth-century arrivals to southern California.

At LAN-211/H, radiocarbon assays revealed that Late period components are present; however, they were discovered in a questionable context. The protohistoric and early-historical-period components of the site, dating after A.D. 1640, were identified within an intact, clearly definable stratum. With the integrity of this portion of the site established, LAN-211/H has the potential to illuminate one of the most obscure areas of history in the Ballona and the greater Los Angeles Basin.

Protohistoric and early-historical-period sites in the Los Angeles Basin are extremely rare and have been little studied. As our research has shown (see Chapter 2), the protohistoric and early historical periods in this region are poorly understood. As King observed more than 23 years ago, "The state of knowledge of protohistoric and historic California archeology is limited due to a general lack of intensive archeological investigations and failure of archeologists to distinguish protohistoric and archeological components from earlier components" (King 1978:58). It would seem that little has changed since these words were written. In contrast, elsewhere in the Americas, interaction between Native Americans and Hispanics has received much attention, with several volumes devoted to this issue (Cusick 1998; Farnsworth and Williams 1992; Fitzhugh 1985; Rogers and Wilson 1993; Spicer 1961; Walker 1972).

Although Cabrillo's arrival on Santa Catalina Island in A.D. 1542 marks the moment of initial contact, direct interaction between Hispanics and mainland Native Americans was delayed many years until 1769, when the Portolá expedition crossed the Los Angeles Basin on the way north to Monterey. Portolá found the area populated by people living in numerous small villages dispersed along the major drainages of the basin or in sheltered areas of the coast. These people came to be known as the Gabrielino, the result of their association with the Mission San Gabriel; today, some prefer the name Tongva.

Aside from very brief mentions of coastal people by sixteenth- and seventeenth-century explorers, the journals of the Franciscan missionaries are the primary sources available from which to reconstruct early-historical-period life in the Los Angeles area. Unfortunately, these are biased accounts written long after the fact. Their focus is exclusively on mission activities, with little mention of native people beyond those under the missions' direct sphere of influence. Mission records are essentially silent regarding the aboriginal inhabitants of the Ballona Lagoon, as they are concerning the population of "gentile" or non-missionized natives living in the rural portions of the Los Angeles Basin. Most ethnographic data were collected in the late nineteenth and early twentieth centuries by anthropologists such as J. P. Harrington, C. Hart Merriam, and Alfred Kroeber from informants who generally lived near or were associated in some way with one of the Franciscan missions in the region. These sources provide some indication of protohistoric and early-historical-period occupation of the Ballona, yet supporting evidence is frustratingly fragmentary and incomplete.

According to traditional documentary history, the demise of the indigenous residents of the Los Angeles Basin followed the familiar pattern of subjugation and steep population decline under mission domination. This simplified scenario overlooks the role played in Native American affairs by the pueblo of Los Angeles. Relations between the mission and the pueblo, tense from the beginning, were regularly inflamed by the employment of large numbers of gentile natives who lived at Yaangna, the village adjacent to the pueblo. These gentiles worked as day laborers in the fields and vineyards surrounding the pueblo (Phillips 1980). Through the early 1800s, this relatively self-sufficient group existed outside the spiritual and legal reach of the missionaries and were allowed to remain independent because their labor was in high demand. Contrary to Franciscan chroniclers, not all Native Americans, perhaps not even the majority, came under mission influence during this period. A few *rancherías* or communities of gentile natives might have persisted in the Los Angeles Basin through the 1850s, though their numbers were greatly reduced by such diseases as measles, dysentery, influenza, and, later, smallpox (Mason 1978:8; Phillips 1980:448).

In the Ballona, there was no established mission presence. When the sons of the Machado and Talamantes families sought pasturage for their cattle there in 1819, the Ballona's swampy lands were empty of official claimants, though perhaps not without occupants. With official permission from the Pueblo *alcaldes*, the brothers developed the rancho, herded animals, built adobes, and planted crops, all using native labor. In 1839, the Machados and Talamantes received formal possession of the Rancho La Ballona and created the hub of the historical community of Machado near present-day Culver City. A check of the census records shows that a few native ranch hands and servants still lived in the Machado area in 1900 (see Chapter 2).

From this perspective, our task is to explain what has been found at LAN-211/H and to create a framework within which our discoveries may be interpreted. Unfortunately, comparative material to build such a framework is lacking. Comparable studies of Native American–Hispanic interaction sites are dominated by work at the missions. Generally, these studies focus on the effects of the missionization process on Native American culture, and have been confined to examinations of neophyte dormitory areas (Hoover 1985), or aboriginal settlements located within a mission complex (Lightfoot 1995:204). The results of excavations at these sites are interpreted with the aid of a generalized culture history. Very few scholarly studies have attempted to look beyond the mission quadrangle for quantitative and qualitative comparisons with contemporaneous Native American sites.

The works of Deetz (1963), Bamforth (1993), Larson et al. (1994), Lightfoot (1995), Lightfoot et al. 1991, 1993, 1997, 1998), and Allen (1998) are exceptions. In each of these studies, especially that of Lightfoot and his colleagues (Lightfoot et al. 1991, 1993, 1997, 1998), the effects of aboriginal-Hispanic interaction are considered, and archaeological data are studied from outside of the colonial establishment as a comparative tool. These studies demonstrate a methodological approach which could be successfully employed in the southern California area.

Perhaps the most important characteristic of LAN-211/H is that the protohistoric and early-historical-period component is clearly definable, a unique situation among archaeological sites in the Los Angeles Basin. Because the postcontact component can be segregated and analyzed separately, we escape the problems that have plagued investigations of some other protohistoric and early-historical-period sites in California. So often when early-historical-period sites also contain significant prehistoric components, the two cannot be differentiated because of postdepositional processes such as plowing and rodent disturbance. Because such mixing appears to be absent in parts of LAN-211/H, a complete investigation of the postcontact component at this site during data recovery will provide an opportunity to address acculturation questions pertinent to the Ballona and the larger southern California region.

Research Domains

The research goals of the testing project in the remainder of Area D were basic: to locate and evaluate the integrity of archaeological resources within the project area boundary. As a result of SRI's initial findings, we are able to develop more complex research questions addressing site function and the relation of LAN-211/H to other sites in the Ballona. In this research design, we have divided the broad categories of human-land relationships, culture history, and the cultural dynamics of prehistoric settlement into three domains: paleoenvironment, chronology, and cultural adaptations. Paleoenvironment and chronology are treated as essentially separate research domains, whereas cultural adaptation—issues of subsistence, settlement, exchange and interaction, and technology—is addressed by the creation of several models of protohistoric adaptation in the Ballona. For each research domain, we present a brief context with research questions and our expectations of the archaeological record, followed by the data requirements necessary to address these issues.

Paleoenvironment

In our reconstruction of the paleoenvironment in Chapter 5, we discuss several broad issues that target prehistoric human occupation of the Ballona in relation to the development of the lagoon. Much of our work has focused on the Intermediate and Late periods within the Ballona, and questions specific to the protohistoric and early historical period have generally not been addressed. Two main issues are presented here: what was the depositional environment, and which plant and animal communities were present and exploited during the protohistoric and early historical periods?

Information from paleoenvironmental reconstructions, including pollen data (Davis 2000), indicate major fluctuations between periods of flooding and drought in the Ballona during the Holocene. Using historical data, Altschul, Homburg, and Ciolek-Torrello (1992) described high-magnitude flooding in the

Los Angeles Basin on the average of once every 84 years. Historically, the Los Angeles River was known to change course and sometimes enter the Ballona Creek drainage (see Chapter 5). In our initial work (Altschul et al. 1991), we assumed that Centinela Creek was perennial due to the reliability of its source, freshwater Centinela Springs. Archival research now casts some doubt on this assumption. On several historical maps, including the *diseños* of both the La Ballona and Sausal Redondo Ranchos, Centinela Creek was not shown nor was it mentioned in the 1875 survey notes (see Chapter 2). It seems unlikely that a potable water source such as Centinela Creek would have been omitted from these maps, if it existed. Whether Centinela Creek ran near its present route or entered Ballona Creek farther to the northeast has a bearing on the nature of occupation at the base of the bluff.

Stratigraphic profiles from the northern portion of LAN-211/H (see Chapter 6) and historical photographs of the project area (see Figures 35 and 53) from the twentieth century depict both major and minor flooding events in the Ballona. The timing and magnitude of these events, however, is not well understood. We assume that the prehistoric and historical-period inhabitants of the Ballona, especially those occupying the lowlands, developed strategies for coping with the unpredictable nature of flooding. Understanding the toll that episodes of flooding and drought had on Ballona plant and animal communities during the protohistoric period is an important research domain to be addressed during data recovery; also important is explaining the effect that floods have on archaeological resources.

The introduction of farming to the region would probably have affected water flow as streams and rivers were diverted to irrigate agricultural fields. The construction of *zanjas,* or water diversion channels, was common among the first building projects undertaken at new settlements; the main irrigation ditch, or *Zanja Madre,* from the Los Angeles River to the pueblo was completed at the end of October 1781, less than two months after the original Hispanic settlers arrived (Gumprecht 1999:44). Survey maps of parcels within the Rancho La Ballona indicate that irrigation ditches taking water from Centinela and Ballona Creeks to the fertile agricultural lands east of the Playa Vista project area were well established by 1866 (Huntington Library, San Marino, California, Solano-Reeves Collection, Hansen Field Book 38, Box 2). Although many of these features have been mapped and recorded, little is understood about the effects that such features had on the natural flow of water in the region.

A further significant environmental impact to indigenous populations of the Los Angeles Basin was the decimation of native plant and animal communities as a result of the introduction of agriculture and grazing of domesticated animals (Crosby 1986; Farnsworth 1987:92; Greenwood 1989:455; Hoover 1989:398; Johnston 1962:136). During the historical period, mission and pueblo grazing lands covered thousands of acres over most of the Los Angeles Basin. The result of overgrazing, inadvertent introduction of plant species, and field agriculture was that native plant communities were largely overrun by introduced species of European grasses and weeds. Often carried in the wool of sheep, European grasses and plants were quick to overwhelm native species (Chartkoff and Chartkoff 1984:267–268). The Gabrielinos who worked as ranch hands were occasionally allowed to cultivate their own crops to supplement traditional subsistence plant foods that were quickly disappearing (McCawley 1996:200–201). Depending on the period during which a particular site was occupied, the introduction of new plant species and the destruction of native plant communities may be visible in the archaeological record. This presents a topic of interest to be addressed in data recovery at LAN-211/H.

Research Questions

The following questions are specific to the protohistoric and early historical periods within the Ballona and can be addressed with data collected at LAN-211/H:

1. What was the relative importance of Ballona and Centinela Creeks during the protohistoric and early historical periods? Why does Centinela Creek frequently fail to appear on historical maps? Is upstream irrigation a significant factor effecting the Ballona Creek's flow? Are there major differences between the depositional environments of the Early, Intermediate, Late, protohistoric, and

early historical periods? Can we map the locations of both creeks during the protohistoric and early historical periods? Is there a riparian zone located near the base of the Ballona escarpment during those times?

2. What is the nature of flooding in the Ballona? Are particular events visible in the stratigraphic sequence? Were floods strong enough to affect decisions on the location of settlements, or were these events minor, with no bearing on settlement? Are such floods associated with Centinela or Ballona Creeks?

3. Were native plant populations in the Ballona affected by contact, and establishment of Hispanic settlements in the Los Angeles Basin? Do we see the effects of Hispanic contact in the paleobotanical record?

Data Requirements

Three types of data will be used to address these questions. The primary type of data to be collected will be fine-grained stratigraphic data collected from controlled sampling of midden and feature contexts, as well as from locations peripheral to the site boundaries. Recording of attributes, and physical testing of soils will be used to assess the integrity of cultural deposits and to identify particular geologic data such as flood episodes. Radiometric dating of particular stratigraphic units will aid in tying particular events to human occupation of the Ballona.

Macro- and microbotanical samples constitute the second type of data to be collected. Microfossils that are sensitive to environmental changes will be collected from midden and feature contexts to be compared with nonarchaeological materials of the same age. Macrobotanical samples, such as burnt seeds, will be collected from soils in similar contexts. By collecting these data, environmental and human alterations to the landscape can be reconstructed.

The third line of data to be pursued comes from archival resources. We propose extensive archival research that would include the study of various historical maps and photograph collections. Based on our initial research, it appears that there are some inconsistences in the mapping of environmental features such as Centinela Creek and the extent of marsh areas. Historical records covering boundary disputes and irrigation water rights may provide data on historical flow rates in Centinela and Ballona Creeks. Collecting and georeferencing such data will aid in interpretations of field data and the nature of postdepositional processes.

Chronology

Key to understanding the nature of LAN-211/H is the placement of the site within the temporal context and cultural evolution of the Ballona. Radiocarbon assays returned dates from the Late and protohistoric periods (see Table 11); shell bead data place the site squarely within the protohistoric period (see Chapter 9). Whereas Late period dates were obtained from a possibly disturbed context, the protohistoric period dates are from a clearly definable, intact deposit at the base of the slope. The Late period dates from Unit 6/10 were obtained from shells that were separated by approximately 1 m. The resulting dates, A.D. 610 and A.D. 1000, are suspect because the more recent date was obtained from the lower sample, whereas the older date was derived from shell in the upper level of the unit.

The two remaining radiocarbon assays run from LAN-211/H were both obtained from shell found in Unit 9. Two different shell species were used for the testing, *Haliotis* spp. and *Chione* spp., which, when adjusted for the reservoir effect, produced two-sigma calibrated dates that statistically represent the same time span, between A.D. 1405 and 1810, solidly within the protohistoric and early historical periods.

Although producing credible results from Unit 9, the site's disturbed soils and relatively recent age suggest that we may be working at the limit of the effectiveness of the radiocarbon assay technique.

Corroboration of this date range is indicated by the presence of butchered cow bone in the deposit (see Chapter 7). Cattle were first introduced into Baja California by Jesuit priest Eusebio Kino in 1679; they arrived in numbers in Alta California with the expedition of Juan Bautista de Anza, who brought 1,000 head from Mexico to supply the settlers among his group (Santos 1994:2). Thus, unless they are intrusive, the cow bones found in and near Unit 9 place the date of the upper levels of the site to the early historical period.

The lack of an Intermediate period component to the site is intriguing. Clearly, there is a significant Intermediate period occupation along the base of the bluff at adjacent sites such as LAN-193/H and LAN-2768. It is possible that an Intermediate period component also exists at LAN-211/H, but the limited sample drawn for radiocarbon testing failed to include the earlier material. Additional data are needed to resolve these chronological issues at this site.

Documentary information about Native American lifeways in the Los Angeles Basin during the early historical period has only been partially explored and synthesized; probably the best effort to date is the work of McCawley (1996), which, though scholarly, leaves many questions unanswered. An extensive body of research exists for the Chumash cultural group who lived north of the Ballona area (e.g., McLendon and Johnson 1999) and the later phases of the protohistoric San Luis Rey culture to the south in San Diego County have been well studied (e.g., True et al. 1991). However, most of what is conjectured about Gabrielino cultural patterns prior to the establishment of Franciscan missions is based on a cloudy ethnohistoric record. For example, ethnographer John P. Harrington's principal informant on the Gabrielino, José de los Santos Juncos, was actually of Juaneño descent, while his second-most useful source, José Maria Zalvidea, was unable to speak the Gabrielino language (McCawley1996:14–16).

Recent research with aerial photos and various map collections has revealed intriguing new data about occupation of the Ballona during the latter part of the historical period (see Chapter 2); information about the Ballona during the earlier "mission" period, however, is entirely lacking. Study of San Gabriel Mission registers has the potential to yield information regarding early-historical-period occupation of the Ballona as well as illuminating issues of social organization for the Gabrielino in general. Data from primary sources such mission registers and journals, along with other archival sources such as newspaper articles, maps, government documents, and photo archives, has the potential to yield information on the little known inhabitants of the Ballona during the early historical period.

Regional models of protohistoric and early-historical-period occupation of southern California are lacking. Most often, at other archaeological sites, a protohistoric or early-historical-period component may be known by the presence of glass trade beads or temporally sensitive shell beads but cannot be discerned from the rest of the archaeological record. Unfortunately, mainland sites in southern California are usually subject to years of destruction and mixing from bioturbation. In a portion of LAN-211/H, we have uncovered an intact deposit dating solely to the protohistoric and early historical period, providing a unique opportunity to study this period in isolation. The ethnohistoric record for the Los Angeles Basin is based largely on data collected years after the end of Native American occupation of the area. Rather than using the historical record as a tool for explanation of the archaeological data, our focus will be to develop a comparative approach that moves back and forth between the archaeological and ethnohistoric records.

Research Questions

Two sets of questions are addressed under the category of chronometric issues:

1. Can we distinguish temporal components within the site? Can temporally discrete strata be identified within the deposit? Is the LAN-211/H location unoccupied during the Intermediate period?

2. Is the ethnohistoric record for the Ballona reliable? Is there information regarding Ballona inhabitants available from the registers of Missions San Gabriel or San Fernando? Can we develop regional models useful for answering questions about protohistoric and early-historical-period sites based on the ethnohistoric record in addition to the archaeological record?

Data Requirements

To address the first question, we must further evaluate the integrity of the cultural deposit from which the Late period dates were obtained. Data recovery efforts will need to include large-scale excavations with large subsurface exposures to document the content and integrity of the stratigraphic units. Radiocarbon samples will be collected from identified strata to confirm the occupational history of the site. If features are located through excavation activities, then radiocarbon samples on items such as shell and, if possible, matched pairs of shell and carbon will be collected.

Results from radiocarbon assays will be compared to dates produced by temporally sensitive artifacts such as cow bones and shell beads that can be correlated to particular strata. Absolute dates obtained from marine and freshwater shell species are subject to several problems associated with the natural environment in which they form. Problems such as the reservoir effect, isotopic fractionation, and the presence of radioactive carbon have all been discussed previously (Altschul et al. 1999). As part of the data recovery process at LAN-211/H, SRI intends to develop a calibration curve for the Ballona to compensate for the variation created by these problems. The collection of numerous radiocarbon samples will aid in this process.

As part of the data recovery process, we suggest extensive archival research be undertaken, comparable to that done in the Chumash region (Gamble 1991; Johnson 1982, 1988; King 1992, 1994). The study of mission registers, as well as historical photographs, maps, and government-document collections may provide new primary source data for the Ballona,. The resultant synthesis of the archival data will be used to develop a model for postcontact archaeology in the region, to be tested at other protohistoric and early-historical-period sites.

Cultural Adaptation Model

In this section, we have combined the broad issues of subsistence, settlement, and technology under the heading of cultural adaptation. Blending the archaeological, ethnographic and historic data, the model presents potential scenarios for early-historical-period occupation of the Ballona area, and the accompanying patterns that might be seen in the resulting archaeological record. The scenarios differ largely on the inferred degree of interaction with the Missions San Gabriel or San Fernando, the fledgling pueblo of Los Angeles, or one of the Hispanic ranchos in the area. Figure 84 presents a graphic representation of the model, and Table 36 presents the basic assumptions underpinning the model, with corresponding data categories.

Occupation Scenario 1: Gentile or Renegade

There is a strong possibility that the archaeological signature at LAN-211/H was produced by non-Christianized “gentile” or ex-neophyte “renegade or fugitive” Gabrielinos. A gentile site is one that was inhabited by independent natives who never entered the mission system. A letter written in 1820 by Fathers José Maria Zalvidea and Joaquin Pasqual Nuez from Mission San Gabriel mentioned native settlements and *rancherías* existing outside of the missions in that year:

> With regard to the personal affairs of the missionary Fathers of Mission San Gabriel, we have to say to Your Honor with all due respect that we are in a Mission of 1,600

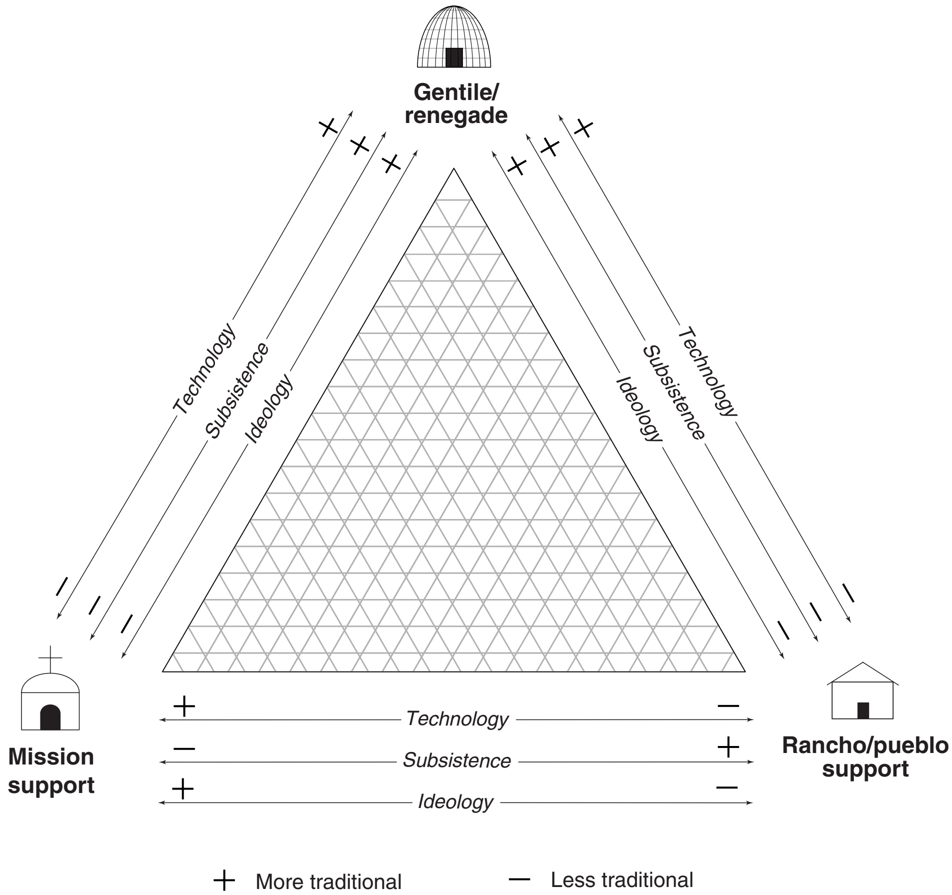


Figure 84. Cultural adaptation model for early-historical-period archaeological sites.

> Christian Indian souls, distributed through necessity in fifteen ranches at various distances, whose care in spiritual and temporal matters is entrusted to us. . . . Furthermore, there are in our charge a reduction of hundreds of pagan Indians who live in their villages (Santa Barbara Archives, letter from Zalvidea and Nuez to Antonio Yorba, April 6, 1820; quoted by Engelhardt 1927a:118).

This statement, made nearly 50 years after the founding of the mission and 40 years after the establishment of the pueblo, clearly shows that hundreds of native peoples still lived outside the direct sphere of the mission system. Similar statements were made regarding the existence of "pagan" or nonmissionized Native Americans at almost all of the other missions in California (Geiger and Meighan 1976). The purported village locations of Sa'angna or Guaspita (Chapter 2), if they existed, may represent this type of settlement.

Another possibility is that LAN-211/H may represent a renegade or fugitive site; that is, one created by estranged neophytes or runaways from the mission, living in the Ballona to escape retribution. Once natives entered the mission, were baptized, and became neophytes, it was understood that they were to maintain residence at the mission or mission establishment, other than brief trips to collect resources or visit relatives (Engelhardt 1927a; Johnston 1962; McCawley 1996:196). In describing the conversion process, Father Pedro Font stated:

Table 36. Cultural Adaptation Model

Factor	Mission-Support Scenario	Gentile or Renegade Scenario	Rancho- or Pueblo-Support Scenario
SETTLEMENT	TEMPORARY	PERMANENT	SEMIPERMANENT TO PERMANENT
Use of space	little site structure; houses absent or temporary	Structured use of space on site; permanent houses in traditional style	Structured use of space on site; permanent houses in Hispanic style
Middens	poorly developed	Well developed	Well to moderately developed
Features	few or small; little variability, mostly hearths or related to food processing	Numerous; wide variety of types: houses, hearths, roasting pits, storage pits, refuse dumps, dance floors	Moderate number; mostly traditional houses, hearths, roasting pits, storage pits; nontraditional feature structure associated with nontraditional activities
Mortuary practices	few or no burials; if present, unstructured use of space, Christian style	Cemetery present; structured, traditional mortuary patterns	Few or no burials; if present, structured use of space, Christian style
Ceremonial features	None	Present	Few or none
DIET BREADTH	FOCUSED OR HOMOGENOUS	GENERALIZED OR DIVERSE; MOST TRADITIONAL	DIVERSE; LEAST TRADITIONAL
Faunal remains	Focused strategy: low variability, or high numbers of few taxa	Diversified; wide variety of taxa; possible emphasis on juvenile or small taxa due to constricted procurement range	Diversified; wide variety of taxa
Domesticated species	Few or none	Few or none	Numerous; possibly majority of faunal collection
Plant remains	Focused strategy; high numbers of some traditional species, some or no introduced species	Diversified; few or no introduced species, some traditional species	Diversified; higher numbers of introduced species; lesser quantities of traditional species, but focused on a few taxa
TECHNOLOGY	MIXED	MIXED; RENEGADE: SOME HISPANIC GENTILE: MOSTLY TRADITIONAL	MIXED: MOSTLY HISPANIC
Lithics	Expedient; possibly crude technique, mostly traditional materials, some flaked glass; traditional ground stone forms	Formal tools. Renegade: some Hispanic ground stone types. Gentile: mostly traditional forms; mostly traditional materials, little or no flaked glass; traditional ground stone forms	Mixed formal and expedient; new forms, crude work; some traditional materials, flaked glass or ceramics; both traditional and Hispanic ground stone forms
Butchering	Traditional methods of butchery with both traditional and Hispanic processing	Renegade: traditional butchery and processing, few Hispanic tools and methods. Gentile: traditional butchery and processing, traditional tools	Hispanic methods of butchery, traditional and Hispanic processing
Clothing	Mostly Hispanic styles	Traditional; some Hispanic	Mostly Hispanic styles
Ceramics	Few or none; mission ware	Few or none; mission ware	Numerous; mission ware, and Hispanic and Chinese styles
Trade goods	Restricted: both traditional and Hispanic materials	Restricted: some traditional materials	Restricted: mostly Hispanic materials

> As those Indians are accustomed to live in the plains and hills like beasts, they are informed in advance that, if they wish to be Christians, they can no longer go to the mountains, but have to live at the Mission; that, if then they leave the rancheria (thus they call the huts and dwelling-place of the convert Indians), they will be followed and sought and then will be punished [Font diary, January 5, 1776, quoted by Engelhardt 1927a:34].

There are few written descriptions of military forays to gather runaways or renegade individuals. Nonetheless, it is clear from the writings of the missionary fathers that desertion was a common problem (Cook 1976; Engelhardt 1927a, 1927b; Geiger and Meighan 1976; Johnston 1962; McCawley 1996:196). At Mission San Gabriel, until the year 1817, almost 10 percent of all converts had deserted (Cook 1976: 61). Several small military incursions into the gentile settlements were described, but usually in response to attacks on missions or other neophyte groups.

If Gabrielino renegades were only briefly associated with the mission, it might be nearly impossible to differentiate the signature of such a site from one that had been occupied by Gabrielino gentiles. The difference between these occupations is a matter of degree. An ex-neophyte renegade site might contain slightly more evidence of familiarity with mission commodities and practices, but there would be very little, if any, evidence of direct contact with Hispanic culture. Indeed, it is likely that renegades ran to familiar gentile villages for safety, further blurring the distinction between these two site types. Archaeologically, a few purported renegade or fugitive settlements have been found in the Central Valley (Jackson and Castillo 1995:36; McCawley 1996:196). The material culture of these sites is of great interest but has proved difficult to interpret. In the absence of better-reported examples, we are obliged to consider gentile and renegade sites to be archaeologically indistinguishable.

Very few gentile settlements dating to the early historical period are known in the Los Angeles Basin and those identified are poorly represented in the literature. Those at which archaeological work has been done generally lack conclusions regarding such important considerations as site structure (Ciolek-Torrello 1998:209) and integrity. Limited excavations have been conducted at the historical Gabrielino villages of Siutcanga (the Encino Village site) (Mason 1986; Whitney-Desautels 1986b), Povuu'nga (Dixon 1972), Kengaa or Genga (Koerper and Drover 1983; Koerper, Earle, Mason, and Apodaca 1996a), Engva or Ongoovanga (Wallace 1984), Malaga Cove (Walker 1937, 1952; Wallace 1986), Suanga or Swaanga (D. Bonner 2000; W. Bonner 2000a, 2000b; Christy 2000; Frazier 2000; Luhnow 2000), yet all have produced only brief descriptive reports.

These sites have been linked to ethnohistoric data from mission registers, and all contained artifacts reflecting their occupation during the early historical period. Excavations at these sites, however, produced little in the way of structural or regional interpretations. For comparisons, we resort to work done in the Chumash area to the north, where sites have been described and interpreted in more detail. Gamble's (1990, 1991) discussions of the historic village of Helo' are an example of an interpretive work at a mission-era gentile site in which site structure was compared to ethnographic and archaeological descriptions. Although admittedly outside of the Gabrielino area, Gamble's work serves as the basis for much of the discussion of site structure in this section.

Archaeological Signature of a Gentile or Renegade Site. In this scenario, settlements should reflect permanent occupations with houses, extramural features, and well-developed middens. A description of a Gabrielino house made by Father Antonio de la Ascensión, a chronicler of the 1602 Vizcaino expedition, while visiting Santa Catalina Island, indicated that these structures could be substantial: ". . . houses made like cabins . . . [were covered with] . . . a mat of rushes very closely woven . . . which they set up on some great upright forked poles. They are so spacious that each will hold fifty people" (Wagner 1966:237; quoted by McCawley 1996:29).

At Helo’, excavated house pits with well-defined features and multiple floors were found that proved consistent with similar ethnohistoric descriptions of Chumash houses (Gamble 1991). From this example, we hypothesize that a gentile or renegade archaeological site should show signs of traditional placement of houses and use of space. In a survey of archaeological and ethnohistoric data, Gamble (1991) discussed several mapped historic Chumash villages in which alignments of houses in rows or lines were described, clearly showing structural organization, and other researchers have also examined the size and formal layout of Chumash villages, defining a village by the number of occupants (Brown 1967; King 1969). On the other hand, using data generated during excavations on Santa Cruz Island, Ciolek-Torrello (1998:212) described houses arranged in a compact group, rather than in lines; a renegade settlement might be clumped this way for protective purposes. Regardless of their organization, we hypothesize that village settlements will exhibit signs of formal or strategic arrangement of structures. Further, the settlement will include a complex suite of extramural features, as these are typical components of villages built by people at this level of cultural complexity (Binford 1983:190; Ciolek-Torrello 1998:191–222; McCawley 1996:23–33; Raab 1993:149).

At a sedentary village, the normal range of activities should produce a variety of features such as house pits, hearths, roasting pits, storage features, activity areas, discrete refuse dumps, processing features, and ritual features. Interpreting site structure based on ethnoarchaeological research, Binford (1983:190) stated:

> I think it is fairly obvious that the care with which an area is maintained is related to the intensity of its use, other things being equal. Areas used intensively are maintained the most thoroughly and will therefore be associated with specialized disposal areas. The degree to which this is true, however, is also a direct function of the length of time that such intensive use lasts—maintenance of areas used intensively only for short periods is minimal. . . . Moreover, the longer the occupation, the more diverse are the activities which are likely to be conducted, so there should be a correlation between length of occupation and the numbers of special purpose activity areas and/or the quantity of carefully maintained, large-scale areas on the periphery of the major activity area.

At Helo’, extramural features such as refuse dumps, rock and FAR clusters, storage pits, ash lenses, and post holes were all found in association with house floors (Gamble 1990:7-1–7-23, 1991:231–273). House floors were well defined and consisted of compacted layers of clayey soil, with a small amount of artifactual material. Several layers were often noted, indicating multiple episodes of preparation and use. Refuse dump features, such as ash lenses, shell lenses, and pits containing concentrations of shell, ash, bone, and other refuse, were typically found outside of house floors, a trait seen at other sites with house pits. Hearths and other rock cluster features were found within and external to the house floors. Many of these features had artifacts and ecofacts associated with them, suggesting they were used in processing activities as well as for providing warmth. Rock-cluster features and hearths are common in the archaeology of southern California, and often these are the only types of identifiable features found at sites.

Based on comparable examples, evidence of traditional ceremonial or ritual activities should also be present at a gentile or renegade site. The likely forms of such features are sweat lodges, dance floors, or other ritual structures (Ciolek-Torrello 1998; Gamble 1990, 1991). In Gamble’s survey of ethnohistoric and archaeological data for the Chumash area, most village sites had some indication of ritual space commonly identified as a sweat lodge, menstrual hut, or sometimes a dance floor. Ciolek-Torrello (1998) discussed these features at length, presenting common traits and describing several variations in the styles. Sweat lodges were typically semisubterranean, with mud roofs and walls, medial support posts, and large central hearths. Ciolek-Torrello also noted that these buildings were usually located near a water source and sometimes appear to have been intentionally burned.

The remains of ritual features such as dance floors and ceremonial enclosures are likely to be more subtle in the archaeological record than other occupational features such as house pits. Gamble (1991) identified possible dance floors as large areas of cleared and compacted earth, sometimes surrounded by cobbles. Ethnohistoric literature details the presence of windbreaks around ritual features in the Gabrielino territory (Kroeber 1925:628; McCawley 1996:148). In one of the earliest encounters between the Gabrielino and the Spanish at Santa Catalina Island, Father Antonio de la Ascensión described the *yovaar,* or ceremonial enclosure, as a

> place of worship or temple where the native perform their sacrifices and adorations. . . . [It] was a large flat patio and in one part of it, where they had what we could call an altar, there was a great circle all surrounded with feathers of various colors and shapes, which must come from the birds they sacrifice. Inside the circle there was a figure like a devil painted in various colors, in the way the Indians of New Spain are accustomed to paint them. At the sides of this were the sun and the moon [Wagner 1966:237; quoted by McCawley 1996:5].

The mortuary practices of gentiles are also expected to be essentially traditional, although the presence of Hispanic items is expected. In later ethnohistoric accounts of the funerary practices of the Gabrielino, both interment and cremation methods were used for the disposal of the dead (Blackburn 1963:33–36). Generally, grave goods were interred with the dead, or, in the case of cremation, the belongings of the deceased were burned. That both methods were used seems to signal a change in practices during the protohistoric and early historical periods:

> Nowadays they do not burn the dead as they did at the beginning of the conquest; but they do still put seeds with them at burial. When an unconverted Indian dies, they make a deep hole for him. Into this they put a pot, a basket, an otter skin, and some two or three pesos worth of beads, above these the dead body, and this they cover with earth [Blackburn 1963:34].

Comparing several Chumash gentile cemetery sites, Martz (1992) noted that practices diverged significantly during the early historical period. In her study of status differentiation in burial populations, Martz was able to identify an increased emphasis on wealth in later populations, which she attributed to the greater availability of high-status goods as a result of interaction with the Spanish (Martz 1992:150). Status differentiation in household activities was well documented at mission sites, but was not an expected trait at early-historical-period gentile settlements; Martz's results represent a significant step forward in archaeologists' understanding of gentile burial practices. Martz also observed low numbers of females in the subject population, a pattern that differed from earlier sites.

The discovery of numerous protohistoric and early-historical-period burials at LAN-2682, the ARCO site, promised a wealth of comparable data about Gabrielino mortuary practices. Located in the city of Carson, this site is probably associated with the ethnohistoric Gabrielino village of *Su'anga* or *Swaanga* (W. Bonner 2000a; Luhnow 2000). Incomplete documentation has made interpretation of this site problematic; nevertheless, the burial assemblages are noteworthy. Two burial populations were uncovered; more traditional methods of burial were noted in the earlier population, whereas burial practices for the later, mission-era population exhibited no patterning of any kind. Inhumations in varying positions, cremations, and partial cremations were all recorded within the small area excavated into the later component, where a limited number of Hispanic items such as leather discs and glass beads were found in association with the human remains (Luhnow 2000). The lack of consistency in the method of the disposal of the dead fits with the ethnohistoric data (Blackburn 1963). The irregularity in mortuary styles in the later population is associated with cultural upheaval during the early historical period (Luhnow

2000). If human remains are found during data recovery at LAN-211/H, an analysis of burial methods used by the occupants will probably prove useful in distinguishing gentiles from missionized occupants.

Considering the predicted subsistence practices in the gentile or renegade scenario, a generalized procurement strategy, with a variety of taxa evident in the faunal collection, is expected. Because of constricted collection range and the associated subsistence stress (overpredation), certain taxa may be represented in what is considered normally small size classes by increasingly smaller individuals or juvenile stages (Salls 1988). Diet breadth expands predictably in response to constricted environmental circumstances also (Halstead and O'Shea 1989:4; Raab 1996; Raab et al. 1995; Winterhalder 1981). For example, the shellfish collection may include different, "less desirable" taxa that would have been passed over during normal collecting conditions (Glassow 1992:127). Gentile sites may include the remains of small species such as rodents or reptiles, sometimes in large numbers, also indicating expanding diet breadth. Sites later in the historical period may also show evidence of overgrazing and agriculture. These practices strongly affected the botanical and mammalian resources that were available to indigenous people attempting to retain a traditional lifestyle (Lightfoot 1995). Macrobotanical samples should indicate the presence of introduced plant species.

Domesticated animal species that might be found in the faunal collection at a gentile site should be few, and those present should show mostly traditional butchery and processing methods. In the case of a renegade community, a slightly greater number of domesticates might appear, as ex-neophytes would be more familiar with the introduced species. If significant numbers were present, it might indicate that the former neophytes were raiding cattle or other animals, a practice known to have occurred (Engelhardt 1927a:352; Lightfoot 1995:201). However, even if remains of cattle or other domesticates were found in large numbers, the method of butchery would still be traditional, using a mostly native tool kit. Bones exhibiting Hispanic-style cut marks, indicating that butchered meat had been given to the natives by the mission fathers or rancheros, would not be anticipated.

Stone tools found in a gentile site would probably appear similar to those used in prehistory, as this type of occupation is essentially a slightly modified continuation of prehistoric and protohistoric lifeways. Most of the lithic collection should use traditional materials, with very little or no substitution of such Hispanic materials, as glass or ceramics. Traditional ground stone forms should persist also, unless decimation of native plant species has lowered the relative amount of ground stone found in the collection overall.

Formal or curated tool technologies, as opposed to more expedient methods, are expected because of restricted access to tool stone. Trade for tool stone was greatly effected by the mission system as marriage and economic ties to other kin groups were disrupted and traditional trading partners were slowly eliminated by incorporation into the mission system (Bamforth 1990a, 1993; McCawley 1996). Lithic collections will reflect the alteration of traditional trade relationships by containing smaller amounts of imported materials such as obsidian or fused shale. As Hispanic technology became increasingly available in the early historical period, obsidian and fused shale were replaced by metal and glass. This trend was observed at the historic village site of Helo', where Bamforth (1990a) noted the influx of metal tools; for example, shell beads were drilled with metal needles, rather than the earlier chert microdrills. At later sites, the technological transition should be clearly visible in the archaeological record: gentile sites would include the smallest quantity of these introduced materials.

Little or no prehistoric ceramics are expected, as pottery-making generally was not practiced in this area; there might be a small amount of what is commonly called "Mission ware," a low-fired brown ware made at the missions and widely traded. At the coastal Chumash village of Muwu, small amounts of plain brown ware of this type were identified as forms produced at Mission San Buenaventura (Love and Resnick 1983). A few other ceramic types such as Mexican majolica and Chinese porcelain were also found at Muwu, but in very small numbers. Gentile clothing is expected to follow traditional lines—that is, almost nonexistent and leaving little or no trace in the archaeological record.

Engelhardt (1927a:83) asserts that San Gabriel Mission territory extended to Santa Monica Bay. Mission records indicate gentiles were occasionally recruited for the mission from the Santa Monica area as late as 1819 (see Chapter 2), so some gentile population continued in the area. The distance from the mission and the marshy nature of the Ballona wetlands, however, might have permitted gentile residents to live at the base of the bluff in relative isolation during the early historical period.

In summary, the archaeological signature for a gentile site may be difficult to distinguish from the renegade type; essentially the difference between the two is one of degree. We expect some indication of contact with Hispanic lifeways, though possibly indirect, and we anticipate that the renegade site will show the greater influence. Renegades, we assume, had some type of early relationship with the mission, however brief and, through this, were exposed to Hispanic technology and goods. In general, we expect a slightly higher degree of Hispanic influence in the renegade site than in the purely gentile settlement. In both, the faunal collection should reflect a generalized subsistence strategy with permanent rather than seasonal occupation of the site and many, if not most, of the lifeways expressed in the material culture found at the site should reflect the persistence of traditional practices.

Occupation Scenario 2: Mission Support

In our mission-support scenario, we hypothesize that neophytes in good standing and associated with Mission San Gabriel (or, possibly, Mission San Fernando) might have established a camp in the Ballona for temporary subsistence procurement or in support of mission activities, such as basket making.

The mission-support scenario is framed by two opposing scholarly perspectives regarding the relationship between the natives and missionaries during the early historical period. The traditional view sees the Franciscan missions as the harbingers of the immediate demise and destruction of Native American lifeways (Castillo 1978, 1989; Chartkoff and Chartkoff 1984; Cook 1976; Costo and Costo 1987; Jackson and Castillo 1995; Moratto 1984). This perspective holds that native people were forcibly brought to missions, detained against their will, and stripped of their native identity by being compelled to adopt Hispanic lifeways (Castillo 1978:101; Costo and Costo 1987:3). The opposing view, which relies on ethnohistoric and archaeological data for support, sees Native Americans as more autonomous and points to the continuation of many traditional practices outside and inside Hispanic institutions during the early historical period (Allen 1998; Deetz 1963; Farnsworth 1987, 1992). Our mission-support scenario follows the arguments of these later scholars, in a departure from the traditional view of Native American–Hispanic interaction during this period.

Archaeological models promoting the concept of forced acculturation have long been attacked for their failure to recognize that Native Americans often entered the mission system of their own volition. The popularized view of the past invariably depicts native people as passive recipients of Hispanic culture, until pushed to overt revolt or resistance. More current research has shown that native peoples were active participants in the cultural exchange, able to make conscious decisions about their degree of interaction with Hispanics (Bamforth 1990a, 1993; Dias 1996; Larson et al. 1994; Lightfoot 1994, 1995; Lightfoot et al. 1998; Phillips 1974; Schortman and Urban 1998; Wilson and Rogers 1993). Although there is no doubt that the effects of disease and abuse had disastrous consequences on Native Americans in the region, there is little solid evidence to substantiate forced conversion.

Mission records (an admittedly biased source) from the early years of the mission system state that native people were not forced into the Christian fold. Engelhardt (1927a), who wrote extensively on practices at Mission San Gabriel, maintained that the Gabrielino were free to choose whether they desired to become Christians. Father Pedro Font, a chronicler of the Anza expedition, explained that "The method which the Fathers observe in the Mission is this: They do not oblige any one to become a Christian, since they admit only those who voluntarily offer themselves" (Font diary, January 5, 1776; quoted by Engelhardt 1927a:34). Although once pagans chose to be converted, they were obliged to remain at the mission, the image of impoverished natives incarcerated within the mission walls is clearly inaccurate. Recent studies indicate that some native cultural practices were tolerated, if not encouraged, inside the mission system. On occasion, generally when prompted by necessity, neophytes were encouraged to temporarily leave the missions to return to traditional subsistence practices to supplement meager diets (Bamforth 1993; Coombs and Plog 1977; Engelhardt 1927a:36; Hoover 1989; Johnston 1962). On the subject of native conversion, Father Font continued:

> If an Indian wishes to go to the mountains to see his relatives or to gather acorns, he is given permission for a certain number of days, and generally they do not fail to return. At times they come with a pagan relative who stays for the catechetical instruction, either drawn by the example of the others or attracted by the *pozole* ["a thick soup of grain, vegetables, besides flesh meat"] which suits them better than the herbs and the food they gather in the hills. So these Indians are wont to be collected through the stomach [Font diary, January 5, 1776; quoted by Engelhardt 1927a:36; explanatory footnote by Engelhardt inserted].

Mission-support sites, we expect, would be short-term camps located within easy traveling distance from the host mission and were established for the acquisition of traditional resources in areas where resources had been exploited prehistorically; there, neophytes might have pursued such activities as fishing, hunting, plant harvesting, shellfish collecting, and basket making. We now explore the anticipated components of such a site.

Archaeological Signature of a Mission-Support Site. The archaeological signature of a mission-support site should reflect only temporary, possibly seasonal, occupation and should contain evidence of highly focused subsistence activity and moderate or sustained contact with the missions. Such a camp site would lack permanent structures, and middens would be poorly developed, relatively homogeneous in composition, and contain the detritus of processing a limited number of species of animals or plants. There would be little evidence of ritual activity or the structured use of space; few areas indicating a discrete activity, such as dumping, would be found in relation to structures or features (Raab 1993:149). In this focused, temporary setting, a mission-support camp would contain few formal features; those present would be of limited variability, such as hearths or lithic concentrations related to processing of particular materials. Cultural materials should be distributed throughout the deposit, with little evidence of structured use of space (Binford 1989b:256).

At such sites, variability of species within the faunal collection, also referred to as "taxonomic richness," is expected to be low, reflecting a focused strategy of food procurement (Chatters 1987:341). Collections from a site of this type are expected to contain proportionally high numbers of taxa characteristic of traditionally favored food sources such as selected species of fish, shellfish, wild game, or native plants. If a camp were established to supplement the mission diet, the faunal assemblage might indicate targeting of specific animals or plants. During excavations at Mission La Purísima, a storeroom was found containing the remains of a "basket full of paired mussel shells," indicating targeted foraging (Deetz 1963:184). At Mission Santa Cruz, Allen (1998), clearly saw a supplemented mission diet in the large numbers of fish and shellfish remains found in midden deposits. A large number of fish bones was also noted at Mission San Buenaventura, leading researchers to conclude that the diet of neophytes was augmented by native fauna (Greenwood 1976). Hoover (1985:100) found wild game and seeds from native plant species at the Mission San Antonio de Padua, suggesting the continuation of native gathering practices there.

Although neophytes were likely to have had greater access to domesticated plants and animals than gentiles, scant evidence of domesticates should be found in a temporary camp site, especially if the function of the site was to supplement the mission diet during times of food shortage. If the camp functioned only for material procurement, the amount of domesticated animal bone present at the site might be related to distance from mission settlements. For example, at the historic Chumash village of

Helo,' located approximately 16 km (10 miles) from the Mission Santa Bárbara, only a small amount of cattle bone was found (Gamble 1990, 1991), whereas faunal collections from features associated with neophytes at Mission San Buenaventura were dominated by domesticates (Greenwood 1976). Interestingly, although cattle bone was most numerous in these neophyte features, a higher proportion of wild species was found in the collection from the site as a whole. Neophytes at San Buenaventura clearly were permitted regular access to traditional foods, which they transported back to the mission.

Native American basketry was highly esteemed by the mission fathers (Farnsworth 1987:483). Basket impressions were commonly found at Mission La Purísima (Deetz 1963) and were observed at Mission San Buenaventura (Greenwood 1976) as well. Specialized basket production seems a likely focus for a mission-support site, as raw materials for baskets had to be gathered outside the mission, sometimes from a considerable distance. Whereas the baskets themselves would probably have deteriorated, the tools for their production may be found in the archaeological record. Basket production is reflected in the archaeological collection by a high of number of tarring pebbles, bone awls, lithic tools used for processing reeds, and concentrations of asphaltum.

A small number of Hispanic goods might be found at a mission-support site; the range of Hispanic artifacts expected include glass beads, ceramics, glass, and metal items. Because of a general scarcity of metal (Chartkoff and Chartkoff:1984:268; Frierman 1982), and a prohibition on trading firearms with Native groups early during the early historical period (Bamforth 1993:50), the discovery of Hispanic tools or weapons is unlikely. We anticipate that neophytes in the early years of the missions would use a traditional tool kit, particularly in pursuit of traditional foods and raw materials. Lithic technology should reflect expedient manufacture and use of stone, as these locations were temporary settlements. Debitage from the maintenance of curated tools should dominate the lithic assemblage, and those whole tools that were produced on site should be informal such as edge-modified bifacial thinning flakes (Binford 1979).

Later in the mission era, stone tools became relatively crude as traditional knowledge declined as a result of native assimilation into the mission system. Allen described the stone artifact collection from Mission Santa Cruz as "degenerative forms of lithic tools" (Allen 1998:83). The argument follows that, as successive generations were born within the mission system, traditional knowledge about stone tool manufacture atrophied as the utility of traditional tool types dwindled. This pattern is noted especially at mission locations as traditional male-related activities such as hunting became obsolete.

Ground stone artifacts recovered from a mission-support site should reflect traditional forms, and, if the site was occupied only temporarily, ground stone tools may show little use. Metcalfe and Barlow (1992) proposed that the condition of ground stone when it is discarded reflects group mobility. These authors suggested that highly mobile groups produced ground stone forms that were lightly used and poorly formed. Conversely, if the mission-support site was visited repeatedly on a seasonal basis, ground stone artifacts might have been cached and have heavy use wear.

Hispanic styles of dress may be represented in a mission-support site by the presence of metal, bone, or shell buttons, or leather goods. Neophytes were reported as adopting the Hispanic style of dress to distinguish themselves from gentile populations (Engelhardt 1927a:36), and the presence of apparel items at the site might further distinguish neophyte sites of this type.

Religious paraphernalia such as crucifixes or rosary beads might also be found, reflecting association with the mission. Burials should be few or absent at a mission-support site, however, as Catholic practices necessitate burial at the mission cemetery. If an interment did take place at such a site, we hypothesize that mortuary practices could mimic Christian styles, with little or no native artifacts interred with individuals. We would not expect to find evidence of traditional ritual activity at this site, following the people's conversion to Christianity.

Overall, a mission-support site might appear very similar to a prehistoric seasonal or temporary resource extraction camp, except for the presence of Hispanic items and Christian burial practices, if observed. Radiocarbon or shell-bead dating might be used to differentiate the two occupation periods. A close relationship with the mission might be visible in the faunal collection if evidence of a focused procurement strategy could be discovered; this would be in contrast to the much more generalized strategy practiced in Late period sites.

Occupation Scenario 3: Rancho- or Pueblo-Support

In a rancho- or pueblo-support scenario, we hypothesize that the site was created by a group of gentiles, or possibly ex-neophytes, who were employed by Hispanic landowners. This scenario departs from the previous two in that the defining factor is not the type of cultural interaction between natives and the missions, but on a relationship between native and employer.

Native labor was economically important throughout California, but it was especially so in the Los Angeles Basin. Most of the labor involved in the founding of the pueblo of Los Angeles was performed by non-Christian Gabrielinos (Engelhardt 1927a). The pueblo was founded at the location of the Gabrielino village known as Yaangna in 1781 (Johnston 1962; McCawley 1996), and not long thereafter, gentiles were regularly employed in the pastures, fields, and vineyards surrounding the little town. Communications between mission fathers, as well as journals and the recollections of visitors to the area describe the economic relationship of the budding pueblo to its native laborers (Engelhardt 1927a; Greenwood 1989; Phillips 1980). The settlement of Yaangna remained on the outskirts of the pueblo for many years, inhabited by native laborers and domestic servants.

Native laborers living in villages outside the pueblo also sometimes came in to the pueblo to work. Native workers were vital to cattle-grazers and grape-growers throughout the basin, particularly at harvest time. Hispanic rancheros were said to intentionally incorporate gentile settlements, or *rancherías,* into their rancho boundaries when making their land claims, so that resident populations could be used as a labor force (Engelhardt 1927a:94; Greenwood 1989; McCawley 1996:200). Often, wealthy Hispanic landowners lived in the pueblo and controlled rancho activities from a distance, while the native workers tended the herds and lived on the land. During the later mission era, the use of gentiles, or "pagans," as workers was so prevalent that it became a source of conflict between mission priests and pueblo-dwellers. In 1812, a questionnaire called *Preguntas y Repuestas* (Questions and Replies) was sent to each mission to be answered by the mission fathers. The fathers at Mission San Gabriel responded to Question 32, a query about classes, including pagans, as follows:

> In the pueblo and ranchos of the other classes, pagans, men as well as women, serve as farm laborers, cooks, water carriers, and in other domestic work. This is one of the most potent causes why the people, calling themselves *Gente de Razón,* are so addicted to idleness. As the pagans labor for one-half or one-third of the product, they are constantly in the service of their masters during the time of planting and harvesting, while the masters, some excepted, never put their hand to the plow or to the sickle. Hence there is the other drawback, that the adult Indians delay having themselves baptized, since in the service of their masters they may follow their notions and pagan habits. This liberty by which they forfeit Christianity, inspires them with a great disaffection for Christianity [quoted by Geiger and Meighan 1976:128–129, italics in original].

Based on recent archival research (see Chapter 2) and Robinson's (1939a) anecdotal account of Native American workers at Rancho La Ballona living at the base of the bluff, we anticipated finding evidence of a rancho-support site within the Playa Vista project area. LAN-211/H possibly includes a component of this site type. The remains of such sites have doubtless been uncovered during excavations at rancho sites in the past, but were not recognized as such. At several early-historical-period excavations (e.g., Frierman 1982; Wilke 1974), the material culture of native laborers and Hispanic rancheros had been blended to the point that it was impossible to separate them in the archaeological record. For example, excavations between 1979 and 1981 at the Ontiveros Adobe, located within Gabrielino territory in the city of Santa Fe Springs in Los Angeles County, uncovered numerous Native American artifacts in addition to an extensive early-historical-period artifact collection. Finds included flaked stone tools, flaked glass debitage, ground stone artifacts, shell and glass beads, and steatite bowl fragments (Frierman 1982:75–90). The discovery context of these artifacts was not mentioned in the report and no analysis was presented. The material culture of native people encountered archaeologically in historical-period Hispanic sites has not been consistently reported.

From ethnohistoric accounts, we know that non-Christianized natives were employed in large numbers by Hispanic landowners in the early historical period. The division of labor on the rancho followed the traditional Hispanic cultural regime: native women worked at domestic chores within Hispanic households, while native men generally labored out-of-doors, either tending stock or in the fields. The presence of the *rancherías* or communities in which many of these ranch-workers lived has been recorded in the Los Angeles Basin (in census documents, for example), but none has been studied in depth.

Archaeological Signature of a Rancho- or Pueblo-Support Site. There are two possible site types for this scenario, permanent and temporary; in the first case, native laborers essentially "belonged" to a rancho, working and living there permanently. In the second case, native laborers were employed temporarily, perhaps seasonally and when released, returned to their native village or *ranchería.* We suggest that the length of employment will have a significant bearing on site structure; if the site we have found was a temporary workers' camp, it will not exhibit the depth of deposit or diversity of features that would be expected at permanent workers' settlement.

The subsistence remains of a rancho- or pueblo-support site should be distinct from the archaeological signature of other scenarios. Although some traditional subsistence practices might continue, one of the defining characteristics of this site type will be the relatively large quantity and treatment of domesticated animal remains in the faunal collection. Native ranch and field workers were often paid in goods for their services (Engelhardt 1927a; Greenwood 1989; Johnston 1962; Kealhofer 1991; McCawley 1996; Phillips 1980); thus, domesticates are expected to make up a much larger relative percentage of this collection than those from other scenarios.

We anticipate that beef would comprise a significant portion of the rancho workers' diet. That the rancho diet typically included great quantities of beef can be seen in the archaeological record uncovered at the Ontiveros Adobe (Frierman 1982). Excavations at this site revealed a faunal collection with the predicted rancho signature: almost the entire collection—96 percent—consisted of the remains of domesticated animals, and approximately 80 percent of that total consisted of cattle bone. The remains of only a few wild birds, rodents, or fish were noted (Gust 1982:143). Although the context of the faunal collection cannot be exclusively tied to native workers at the site, traditional materials such as stone tools were found in association with the faunal remains.

At the Hammack Street site, LAN-194, a component dating to the rancho era between A.D. 1825 and 1850 was identified (King 1967). Very limited salvage excavations were conducted at this site, but what was found provided a glimpse into what is interpreted as a rancho-associated site occupied by Native Americans, likely Gabrielino. At this site, the remains of domesticated animals such as cattle and horses dominated the vertebrate faunal collection. Other large mammals, such as domesticated goat and pronghorn, and smaller mammals, such as rodents, were also found but in much smaller proportions. A small number of fish bones were also recovered. The large mesh size—¼ inch—used for screening the deposit, and the small sample size—only four 1-by-1-m units—probably affected the diversity of the faunal collection; nevertheless, the results are consistent with the model, in that the faunal collection was dominated by domesticated-animal remains.

To account for the bones of domesticated animals in a deposit, we hypothesize that native workers might have accepted lower-quality cuts of meat as payment for labor, or they might have scavenged those that were unwanted by rancho owners. In either case, domesticated animal remains in a rancho-support site should show evidence of Hispanic butchering techniques using Hispanic metal tools, whereas to process the meat, native workers might have favored traditional stone tools. Evidence of crushing bones to extract marrow might also be noted. Cattle and horse bones recovered from LAN-194 showed signs of splitting (possibly for marrow extraction) and bore "hacking" marks from processing. The fact that horse meat was being consumed and that marrow was possibly being extracted from the bones suggest that the native occupants of this site might have been using traditional techniques for processing meat.

Locally made brown ware appears to be a new and important addition to Gabrielino material culture in the early historical period. Found at the Ontiveros and Bandini-Cota Adobes and in excavations near the original Pueblo de los Angeles, this pottery was apparently made by natives for domestic use in Spanish households (Frierman 1982; Kealhofer 1991). The name "Southern California Brown ware" has been given to this ceramic type (Frierman 1982, 1983), likely the same pottery labeled "mission-ware" at the Hammack Street site (King 1967). Given that ceramic industries were generally absent in Gabrielino territory during prehistory (McCawley 1996:138), this manufacturing technique might have been a trait learned at the missions. Brown ware of this type is an anticipated find at a rancho-support site.

Hispanic goods are expected to be present in greater quantities at a pueblo- or rancho-support site than at sites fitting either of the two previous scenarios. Mason noted that native laborers were paid for farming and ranching activities "in old clothing, grain, cotton yardage, tools such as knives and hatchets, strings of beads and a variety of other goods" (Mason 1975:94). Hispanic ceramics and glass are expected to be found in much higher numbers from rancho support than in other scenarios, as these items might also have been given as payment for work, or scavenged from the refuse of Hispanic settlers or rancho owners. At the Hammack Street site, the early-historical-period component was dominated by Hispanic items such as ceramics, glass, and unidentifiable pieces of metal. Units containing these materials also produced small quantities of traditional artifacts such as stone tools. Showing the adaptation of traditional technology to new materials, a bone awl was recovered from this site that had been made from the metatarsal spur of a horse. Artifacts such as these clearly demonstrate the transitional state of native culture during the early historical period.

At the peak of the rancho era, ca. 1850, the style of native residential structures changed drastically. The domed structures seen during the protohistoric and early historical periods were gone; dwelling styles appear to mimic Hispanic structures. Descriptions and historical photographs indicate that later native houses were rectangular buildings constructed of traditional materials such as tules and wood posts, or from adobe in the Hispanic style (McCawley 1996:206). When rancho employment was seasonal, native peoples lived in temporary structures built in a more traditional style, such as those occupied in prehistory. The "brush-and-mud huts" described by Robinson (1939a:104) below the base of the bluff at Rancho La Ballona (see Chapter 2) fit this description.

Traditional stone tool technology was greatly affected by the introduction of metal tools. With prolonged exposure to Hispanic lifeways, native people became increasingly reliant on introduced technology at the expense of traditional knowledge. Stone tools found in early-historical-period sites should reflect a transition towards lower quality, more expedient tool types. Lithic collections should be dominated by debitage and utilized flakes, with little in the way of formal tools. As metal knives would have been present at ranchos and might have been given in payment to native laborers, stone tool collections are likely to be dominated by expedient cutting and processing artifacts such as utilized flakes used for processing meat, rather than butchering. Locally available materials will probably dominate the collection, with the nontraditional materials such as ceramics and glass also introduced. Exotic lithic materials that would have been obtained through trade prehistorically are not expected to be recovered in high numbers, as we assume that the traditional trade alliances and networks would have all but disappeared by the time of ranchos. At the Ontiveros Adobe, debitage dominated the flaked stone tool collection and few formal tools, made mostly from locally available materials, were found (Frierman 1982:80–83). Similarly, at excavations near the Pueblo de los Angeles (Kealhofer 1991), only a small number (n = 22) of flaked stone artifacts were recovered, of which 15 represented unmodified debitage.

Excavations at the Hammock Street site produced a few formal tools such as projectile points; overall, stone tools made up a very small proportion of the artifact collection from the site (King 1967).

We hypothesize that the processing of plant materials utilizing traditional methods with ground stone implements would have continued into the early historical period. Traditional ground stone artifacts such as metates and manos, as well as imported steatite vessels, are found in small numbers in most rancho period settlements (Frierman 1982; Greenwood et al. 1983; Kealhofer 1991). New tool types might also have been introduced, such as the Mexican grinding stone, the *molcajete,* to process the new domesticates. These are also found in mission and rancho contexts.

Data Requirements

To test the hypotheses presented in the model, data from a temporal and regional range of sites must be compiled for comparison. For comparative analysis within the Ballona, artifact collections from LAN-47, LAN-62, LAN-1932/H, and LAN-2676 will be used. Specific targets for analysis are the identification of introduced taxa and evidence of new methods of procurement or processing.

The discovery of burials and ritual structures would provide the clearest means of perceiving ritual practice at the site, activity that might otherwise be difficult to detect in the archaeological record. Such features would contain important data relative to the impact of Hispanic goods, technology, and ideology on the local population. Materials recovered from a site on the periphery of the Hispanic sphere of influence can be compared to prehistoric sites and to those at the missions and ranchos to test the degree of acculturation and resistance to change. Large samples must be collected from midden deposits and features to provide data for detailed analysis.

Dating issues are central to the investigation of protohistoric and early-historical-period sites. Working at nearly the limit of refinement for radiocarbon dating means relying on all available means for temporal control. Time-sensitive materials and specific strata and features that can be securely radiocarbon dated will be sought to place the site in the Ballona chronology, and to distinguish protohistoric from early-historical-period components. Locating house floors or extramural features such as hearths, refuse pits, or burials will allow us to understand site structure and interpret settlement patterns. We may be able to determine the length of occupation of the site from large-scale excavations.

Addressing the various hypotheses suggested by our model requires a break from the traditional southern California model of midden excavation and analysis. Traditionally, southern California archaeological investigations have used a strategy of spacing test units either systematically or randomly across a site to locate features and to acquire a sample of midden. Although this approach is an important tool in any archaeological study, it can only address a limited scope of research questions. Analysis of small, spatially dispersed test units is useful for inferring the nature of faunal and artifactual assemblages; however, it cannot provide information regarding the overall site structure. The discovery of features using the traditional site sampling technique is left to chance, and the result generally does not shed light on the nature of settlement at the site.

To answer questions about site structure and the nature of site settlement, excavations covering a large aerial extent of the site are necessary. This can be accomplished, at least in the discovery stage, by controlled mechanical scraping. With the identification of features such as house pits, ritual structures, artifact concentrations, cemeteries, and refuse dumps, important temporal and behavioral questions of context can be addressed. After excavation and identification of such features, comparative analysis that considers data from prehistory and later historical periods can begin.

Conclusions

Our testing at LAN-211/H revealed a substantial archaeological deposit which exhibited interesting patterns. In addition to the predictable array of large and small mammal species, the faunal collection included a small amount of butchered domesticated cattle bone, and the remains of exotic animal species such as pronghorn, swan, and a species of freshwater mussel, none of which was indigenous to the Ballona Lagoon. We also found that bony fish species constituted a very high proportion of the vertebrate fauna, a result seen in only one other local archaeological site, LAN-63, located on the bluffs. In terms of tools, none of Hispanic manufacture were found at LAN-211/H; tools were essentially traditional in form and material. The collection included numerous stone projectile points, bifaces, utilized flakes, ground stone, and a large number of tarring pebbles. The small amount of imported materials such as obsidian and fused shale found indicated that trade was apparently limited. Hispanic influence is reflected only through the presence of glass trade beads, a few bones of domesticated cattle, and three pieces of flaked glass; no brown ware was recovered.

We present these three scenarios (summarized in Table 36) in the hope that they may be useful in addressing what we perceive as a significant gap in the study of the so-called "contact" period in the Los Angeles Basin. Although the prehistory of the area has been widely studied and general trends are recognized, the brief but critical period of drastic change following Hispanic contact has scarcely been examined archaeologically.

Based on our analysis of the artifacts from LAN-211/H, we assume the site's occupants had minimal contact with Hispanic establishments. Our initial interpretation is that this site fits best into the gentile or renegade scenario due to the limited signs of Hispanic influence, and the presence of a wide array of activities suggesting a permanent habitation. Alternatively, the high proportion of bony fish and large numbers of tarring pebbles suggest specialized activity at the site, an attribute we describe in the mission-support scenario. With the limited excavation undertaken so far at LAN-211/H, our interpretation is preliminary.

Treatment Plan

In the previous section, we have developed scenarios to lead data recovery efforts at LAN-211/H. Because the site contains a discrete protohistoric and early-historical-period component in a clearly non-Hispanic context, we believe that LAN-211/H presents a unique opportunity to answer questions about the poorly known transition from Native American lifeways to the historic period. Our plan for data recovery is the subject of this section.

Excavation Procedures

Data recovery at LAN-211/H will entail four, possibly five, phases, and will include both mechanical and manual excavation (Figure 85). The procedures are comparable to those used on other archaeological sites within the PVAHP. The five phases of work are: (1) mechanical stripping of fill and overburden material; (2) mechanical excavation of trenches; (3) manual excavation of control units into the cultural deposit; (4) mechanical striping and screening of soils to locate features; and if they are discovered, (5) manual excavation of features.

The exact location of archaeological resources and sites are not subject to public disclosure to prevent harm and unauthorized disturbance of the resources and sites, pursuant Section 5097 of the California Public Resources Code and Section 800.11 of the National Historic Preservation Act, as amended. Therefore, this figure has been excluded.

Mechanical Stripping, Phase I

Mechanical stripping at LAN-211/H will be done in two phases for two different purposes. The goal of the first phase is to remove late-historical-period and modern fill materials that have been placed over cultural deposits. This stripping will be conducted within the boundaries of the proposed riparian corridor. From our initial testing, it appears that the depth of fill material is approximately 0.3–1.5 m (1–5 feet). Fill will be removed to a depth just above cultural deposits as determined by a monitoring archaeologist. This depth may vary according to location, and it will be necessary to track changes in soil structure and color to determine the presence of cultural material. The excavation of fill materials may encounter buried utilities; these will be avoided when encountered. Most likely, an excavator or backhoe fitted with a flat blade on its bucket will be used to remove fill materials.

Trenching

Trenches will be used to document soil stratigraphy and the depth and composition of the cultural deposit, to collect samples, and to delineate site boundaries. Trenching will be conducted following the removal of fill materials, using a backhoe fitted with a flat blade. We anticipate excavating three to four trenches to allow adequate profiling of the site stratigraphy. Additionally, five to 10 trenches will be excavated to delineate site boundaries.

We do not anticipate digging deeper than 2 m (6.5 feet) in most areas. It will be necessary for archaeologists to conduct sampling and recording from within the trenches. If trenches have to be excavated to a depth of more than 1.5 m (5 feet), trenches will be shored, sloped, or stepped following California Occupational Safety and Health Administration guidelines. Stepping excavations more than 1.5 m (5 feet) in depth will be the desired course of action because shoring obscures the view of soil stratigraphy. Depending upon the stability of soils and depth of trenching, multiple benches of no more than 0.9 m (3 feet) high at a slope of 1–1.5 percent will be excavated. Ladders will be used for entry and exit of trenches, and, if trench length is extensive, ladders will be placed at 7.6-m (25-foot) intervals. As it may be necessary to leave trenches open for an extended period, trenches will be properly marked and covered, and areas of excavation will be fenced.

To document soil stratigraphy, all walls of each trench will be "cleaned" with a trowel to expose artifacts, stratigraphic boundaries, and possible features. After a trench sidewall has been prepared, documentation will include photography and a measured drawing that delineates identifiable characteristics. Samples for pollen, phytolith, soil testing, and flotation will also be collected from the trenches, and all sample-extraction locations will be identified on the stratigraphic profiles. When collecting such samples, care will be taken to minimize contamination. Unless obvious microstratigraphy can be identified in the field, samples will be generally collected at 10-cm intervals to match the excavation levels within the units. If a stratigraphic or soil-horizon boundary will intersect a 10-cm level, subsamples of each zone will be taken. Pollen samples will be collected and stored in sterile polyethylene bags to avoid contamination from pollen rain, whereas flotation samples will be placed in plastic bags. All samples will be assigned a unique provenience designation number that will allow for tracking through laboratory procedures.

Manual Excavation

Manual excavation of control units will allow us to collect comparable samples of midden constituents so that faunal, lithic, and other analyses may be conducted. Manual excavation of control units will involve four tasks: excavation, dry screening, documentation of stratigraphic profiles, and collection of samples. Excavation will be conducted using shovels, hand picks, and trowels. The size of excavation units may vary according to the factors identified in the field. Generally, 2-by-2-m units will be excavated in arbitrary 10-cm levels from a known datum point. Unique provenience designation numbers will be assigned to each 1-by-1-m, 10-cm-deep level within each 2-by-2-m unit. Arbitrary excavation levels will be used assuming that microstratigraphy has been severely distorted by bioturbation.

If prehistoric cultural features such as hearths, pits, or clusters of rock, are encountered, they will be recorded, and each will be treated as a unique entity. Generally, a small excavation unit will be placed to encompass the feature. The feature will then be sectioned, meaning that half the feature will be removed in 10-cm arbitrary levels. A profile of the feature will be drawn and photographs taken. The remaining half of the feature will then be removed. If large numbers of such features are encountered during excavation, determinations will be made in the field as to which features will be excavated. If features are found that may indicate living surfaces, large block excavations will be required to recover them in their entirety.

If soil conditions allow, excavated materials will be dry screened through $^{1}/_{8}$-inch-mesh screen in the field to reduce the quantity of matrix. After such reduction, or if soils are too moist for field screening, excavated materials will be transferred to SRI's water-screening facility. Water screening of excavated materials will use $^{1}/_{8}$-inch-mesh hardware cloth. Water-screened materials will be air dried and then sent to SRI's laboratory facility for sorting and analysis.

Mechanical Stripping and Screening, Phase II

Small 1-by-1-m units are well suited to providing data on midden constituents. The issues of social organization that are central to SRI's general research questions, however, cannot be addressed through data gathered that way. Instead, we need to locate and excavate house floors, activity areas, burials, and other extramural features and map these features relative to each other to explore questions of site structure. To do so, we must expose and investigate larger areas of the site.

If conditions allow, geophysical techniques, such as magnetometer surveys, are an excellent approach to locate subsurface cultural features, such as hearths or pits. Unfortunately, at LAN-211/H, buried utility lines and fill material containing construction debris may preclude the use of such techniques. An alternative approach would be to excavate a very large number of manual excavation units. The disadvantages of this method are the extreme costs, and the likelihood that no greater yield of information would be obtained.

The method SRI advocates entails the use of a backhoe or mechanical excavator to strip soils until the archaeological targets are encountered. Soils are removed in increments of approximately 10–20-cm levels by a backhoe or excavator fitted with a flat blade that will make a clean, level cut. Soils are removed in 4-by-4-m blocks identified within a grid system placed over the site prior to excavation. An archaeologist monitors the stripping and notes any soil changes or artifact concentrations. As features are encountered, large areas surrounding them are left untouched so that later excavation will recover the entirety of the feature. Each 4-by-4-m block is excavated in 10–20-cm levels, with the fill stockpiled for later screening. Excavation will proceed in this manner until the entire area of impact or boundaries of the site have been removed and screened.

A mechanical sorter will be used to screen the bulk samples. Mechanical sorters are diesel-powered machines, usually used for sorting gravel, that allow for high-speed screening of large amounts of soil. The screening plant is fitted with two decks of heavy duty screens—the upper one with $^{3}/_{4}$-inch-mesh screen, and the lower one with $^{1}/_{8}$ inch. A large hopper is fed a bulk unit of soil, which then passes through a system of conveyers and the screening box, collecting the larger items in the box. The soil is recycled back through to the hopper and screened again until a sufficient amount of less than $^{1}/_{8}$-inch matrix has been sifted out and discarded. After completing a cycle of screening, the residue is then bucketed, labeled with its specific provenience designation, then sent to the water-screening facility for further processing. After this material has been water screened through ⅛-inch mesh hardware cloth and sun dried, it is sent to the lab for sorting.

The bulk sample is collected for the purposes of recovering temporally diagnostic or unique artifacts that may be useful in dating the site. Artifacts such as shell and stone beads, projectile points, and other rare artifacts will be saved, whereas faunal materials will not usually be collected. Data from manual control units will be used for faunal and lithic analyses because the materials were recovered in a systematic and comparable fashion.

Feature Recovery

If features are encountered during the second phase of mechanical stripping, additional units will be excavated by hand. Feature recovery will follow the same procedure described above under the manual excavation units, with features being described, drawn, and photographed. Unique provenience designation numbers will be assigned to each 10-cm level in the 1-by-1-m excavation units and to any other samples that may be collected. Floatation, pollen and phytolith, soil, and chronometric samples will be recovered from all features. Recording of features will involve mapping of horizontal and vertical locations of artifacts, creating measured drawings, photographing, and collecting special samples.

Native American Participation and the Treatment of Human Remains and Associated Grave Goods

All archaeological work at Playa Vista is monitored by Native Americans affiliated with the area. Affiliation was determined by the California NAHC, and a list was provided to SRI. After human remains were encountered in the project area during excavations at LAN-193/H in August 2000, the NAHC officially designated Robert Dorame, Tribal Chairperson for the Gabrielino Tongva Indians of California Tribal Council, as Most Likely Descendant for the Playa Vista project. Archaeological work in the BLAD complies with a written plan of action submitted by the Gabrielino Tongva tribe (Dorame 2000) that includes the results of consultation and provides for the disposition of affected materials excavated intentionally or discovered inadvertently.

In the event that human remains, funerary objects, sacred objects, or objects of cultural patrimony are discovered during data recovery or construction monitoring at LAN-211/H, ground-disturbing activities will cease in the immediate area, and SRI will contact the Los Angeles County Coroner's office. If the remains are determined to be of Native American origin, the Coroner's office will inform the NAHC, and the Most Likely Descendant will be contacted, who will consult with SRI regarding the preferred treatment of the remains, in accordance with NAGPRA and state law. All care will be taken to record and recover human remains with respect, under the supervision of the Most Likely Descendant. Disposition of the human remains and associated grave goods will be in accordance with procedures and requirements set forth in California Health and Safety Code Section 7050.5 and Public Resources Code 5097.98.

Analysis and Report

Analysis will be conducted on the following classes of material, as appropriate: flaked stone, ground stone, shell artifacts, bone artifacts, vertebrate faunal, invertebrate faunal, soils, paleobotanical, and chronometric samples. Analytical methods have been set forth in the PVAHP research design (Altschul et al. 1991) and have been refined during the course of the last decade. Analysis of LAN-211/H collections will provide data comparable to other work within the Ballona and on a regional scale. Methods for each class of material are described below, with the exception of the lithic analysis methods, which are presented in its entirety in Appendix C.

Worked Shell and Bone Artifact Analysis

All culturally modified shell and bone artifacts will be analyzed. Shell artifacts will be classified according to established types (Bennyhoff and Hughes 1987; King 1981). Artifacts will be separated first by species, and then a variety of attributes will be assessed, including type of manufacture, size, placement and size of hole, and type of perforation. The chronological placement of shell beads will be based on King's (1981) study of Santa Barbara Channel beads. Bone tools will be typed following categories defined by Gifford (1940). Attributes recorded for each specimen will include species, size, portion of artifact, percentage complete, presence of incising, nature of design, presence and intensity of polish.

Vertebrate Faunal Analysis

Specimens will be identified to taxon using comparative material at the Natural History Museum of Los Angeles County and other repositories as needed. Additionally, field guides and reference works will be consulted. Identifications will be made to the most specific taxonomic level possible. When a specific identification cannot be made, a bone will be placed to class and size. Additional information recorded for each specimen will include element, side, portion of the element, percentage of the element present, fusion, breakage, presence of gnawing, whether the bone has been worked, the degree and nature of weathering, burning patterns, and weight.

Measures such as the NISP and the MNI will be calculated, if appropriate: both measures assume that the collection reflects a single cultural component. Our objective is to discern such units; if we do, both measures would be appropriate. For general midden contexts, however, both measures are largely meaningless. Measures of dietary contribution of each taxon, based on carcass weight, will be used if strong contexts are discerned.

Invertebrate Faunal Analysis

During the sorting process, all whole shells and shell fragments larger than 12 mm (e.g., the size of a U.S. nickel) with umbos (hinges) will be saved. Because the fill from units will be water screened, there will be little need to clean the assemblage. Species identification will be aided by SRI's comparative collection (Troncone et al. 1992) and standard shell references (e.g., Abbott 1968; McLean 1978).

Geoarchaeological Analysis

The geoarchaeological study will involve both field and laboratory phases. Fieldwork will consist of recording site stratigraphy and relating the depositional units represented to natural processes. The field director and crew chief will be assisted by SRI's geomorphologist and soil scientist Dr. Jeffrey Homburg in deciphering the stratigraphy and ensuring that profiles are created in a standard manner.

Laboratory tests will include pH and particle-size analysis on a sample of units if considered necessary by Dr. Homburg. Soil-reaction (or pH) determinations will be made on a 1:1 soil-and-distilled-water slurry. Particle-size analysis will be performed using the pipette and sieve methods, with samples pretested with sodium hexametaphosphate to deflocculate the clay, and hydrogen peroxide to digest organic matter.

Paleobotanical Analysis

Both microbotanical and macrobotanical analyses will be performed. Microbotanical analysis will focus on fossil pollen, which will be extracted from 5-cm^3 sediment samples using acid digestion to remove inorganic matter and easily dissolved organic matter. Ground stone wash samples will be centrifuged and extracted from a 5-cm^3 aliquot of the centrifugate. Tracers, in the form of one Lycopodium tablet, will be added to each sample to determine the concentration of pollen and aid in the calculation of sedimentation rates. Three hundred pollen grains of upland plants will be counted per sample. In the case of low pollen abundance, identification will be continued until 200 grains are counted; additional slides will be prepared as necessary.

The macrobotanical samples consist of 1-liter bags of fill. These samples will be processed first by flotation and poured through 1.0-mm (in the field) or 0.25-mm (in the laboratory) mesh. The resulting light fraction will then be passed through a series of nested screens (2.0, 1.0, and 0.5 mm). Residue smaller than 0.5 mm will be scanned, and only whole seeds will be removed. Next, each screen will be examined under a binocular microscope (10–40×) for the presence of carbonized plant remains. Charcoal wood will be removed and its weight calculated. If the weight is negligible (less than 0.005 g), then only its presence will be noted. Larger charcoal and all other carbonized remains will be identified to genus and species using a modern reference collection and seed-identification manuals.

Chronometric Analysis

We anticipate that most of the datable organic material will consist of seashells. SRI will attempt to use only shells that can be associated with features from archaeological contexts. In using shell samples, we will correct the dates for the reservoir effect. It also is possible that we will find charred seeds in the flotation analysis; if these derive from annual plants, they too may be dated (use of annuals obviates the "old wood" problem).

Report

A technical report of publishable quality will be prepared upon the completion of all analyses. The document will begin with a summary of the research goals and objectives of the data recovery project, highlighting its place with the family of PVAHP projects. Field results will include detailed maps showing results of geomorphological studies, all trenches and excavation units, and the location of any features found. Profiles of representative hand-excavated units and trenches also will be presented. Analytical results will be presented in tabular and written form. The report will incorporate a synthetic component devoted to addressing the research questions posed in the treatment plan.

Parties to the programmatic agreement will be provided draft copies of the technical report for comment. SRI will incorporate these comments in a final report, which will be distributed as part of the Playa Vista Monograph Series through a cooperative agreement with the University of Arizona Press.

Schedule

Data recovery fieldwork at LAN-211/H will require approximately 3 months (Table 37). Another 4 months has been allocated for the screening, processing, sorting of material recovered in the field. Analysis of the remains will begin in April 2004 and continue through the year. A draft report will be prepared during the first quarter of 2005 and be available for review in May 2005. A final report is anticipated to be submitted to the COE in August 2005, with curation completed by the end of 2005.

The level of effort required to complete these tasks is presented in Table 38. Nearly 9 person years of effort have been allocated to the data recovery. A third of this effort will be expended in the field, with the balance dedicated to analysis, report, and curation.

Table 37. Schedule of Tasks

Task	Start Date	Completion Date
Field logistics and preparation	September 2, 2003	September 30, 2003
Mechanical stripping and trenching	November 3, 2003	November 21, 2003
Manual excavation	November 24, 2003	December 31, 2003
Mechanical screening	December 8, 2003	December 31, 2003
Water screening	December 8, 2003	December 31, 2003
Laboratory sorting	January 5, 2004	March 31, 2004
Analysis	April 1, 2004	December 31, 2004
Draft report	January 1, 2005	April 31, 2005
Review	May 1, 2005	June 1, 2005
Final report	June 1, 2005	August 1, 2005
Curation	August 1, 2005	December 31, 2005

Curation

All project-related notes, records, photographs, and sorted materials (except those repatriated under California State burial law) will be curated at a repository that meets federal standards and in accordance with 36 CFR 79. The curation agreement between the University of California, Los Angeles, and the Playa Vista project managers is presented in Appendix D.

Table 38. Level of Effort (Field and Laboratory Hours) for Data Recovery at LAN-211/H

Position	Adminis-tration	Field Preparation	Excava-tion	Mechanical Screening	Water Screening	Laboratory	Analysis	Report	Total Hours by Position
Principal investigator	40	—	24	—	—	16	40	120	240
Research director	40	24	40	—	—	40	80	320	544
Project manager/ operations manager	80	24	40	8	—	40	80	320	592
Project director	40	160	320	16	8	160	320	480	1,504
Database manager/ quality assurance	16	—	—	—	—	120	160	160	456
Lab director	24	40	40	16	80	160	80	40	440
Crew chief	—	40	440	160	—	480	—	640	1,760
Crew II	—	—	1,120	—	240	—	—	—	1,360
Crew I	—	—	480	—	—	—	—	—	480
Laborer	—	—	400	320	1440	—	—	—	2,160
Lab tech	—	—	—	—	—	1,920	—	—	1,920
Lithic analyst	16	—	—	—	—	—	240	240	496
Faunal analyst	16	—	—	—	—	—	240	240	496
Geomorphologist	—	8	80	—	—	80	80	240	488
Ethnohistorian	—	—	—	—	—	—	480	240	720
Faunal analyst	—	—	—	—	—	—	240	240	480
Assistant analysts	—	—	—	—	—	—	720	720	1440
Illustrator/CAD operator	—	—	40	—	—	160	80	320	600
Editor	—	—	—	—	—	160	—	320	480
Typist\clerk\data entry	—	—	80	48	—	680	80	240	1,128
Production manager	—	—	—	—	—	—	—	240	240
Safety monitoring	—	—	320	—	—	—	—	—	320
Total hours by task	272	296	3,424	568	1768	4,016	2,920	5,120	18,344

APPENDIX A

Soils

Tables A.1a–d. Trenches West of LAN-211/H

Table A.1a. Trenches 1-7–1-9, 2a, 2b, and 2-3–2-12

Facies & Landform, by Trench	Soil Horizon	Depth[a] or Stratum (feet)	Color	Texture	Description
Trench 1-7					
Hill slope Toe slope	fill	0–3.0 feet	brown	sand	Historical-period fill; contains glass, ceramics, concrete, brick, and wood fragments. Extensive rodent and root disturbance.
	C	3.0–4.0 feet	light brown	loamy sand	Probable historical-period flood deposits. Bedded sands with shallow channels.
	2A1b	4.0–7.0 feet	dark brown	loamy sand	A horizon material. Similar to A horizons within the sites, but no artifacts were found.
Alluvial plain Floodplain	2A2b	7.0–7.5 feet	black	loam	Marsh deposits. Contains roots, charcoal and some freshwater gastropods (species not noted).
Trench 1-8					
Alluvial plain Floodplain	C1	0.0–3.0 feet	brown	loamy sand	Flood deposits. Poorly sorted, bedded sand. Small, 0.3-m-deep channel in north end of trench. Extensive krotovina.
	C2	3.0–10.0 feet	olive green	loamy sand	Marsh deposits.
Trench 1-9					
Alluvial plain Floodplain	fill	0.0–6.0 feet	dark brown	loamy sand	Historical-period fill, includes chunks of asphalt and glass bottles. Deposits are banded light to dark brown, may indicate combination of natural and cultural deposition.
	C	6.0–10.5 feet	dark brown	loam	Marsh deposits. Grades from brown to green with depth. Freshwater gastropods are present in the bottom of the trench.
Trench 1a and b					
Alluvial plain Floodplain	fill	0.0–5.5 feet	brown	loamy sand	Historical-period fill. Extensive evidence for burning. Large pieces of charcoal present. Lenses of burned sand at 0.3 and 0.6 m below the surface.
	fill	5.5–11.0 feet	reddish brown	sand	Historical-period fill. Sand is similar to matrix from bluffs to south, but contains historical-period artifacts. Either intentional fill or historical-period colluvium with trash.
	C	11.0–11.5 feet	greenish gray	sandy loam	Marsh deposit. Oxidation streaks indicate frequent drying.

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Facies & Landform, by Trench	Soil Horizon	Depth [a] or Stratum (feet)	Color	Texture	Description
Trench 2a and b					
Alluvial plain Floodplain	C	0–11.0 feet	yellowish brown	sand	Historical-period flood deposits. Yellowish brown sands banded with grayish brown bands. Bands appear to be layers of burnt organics. Contains asphalt chunks, plastic bottles, and wire.
	2A1b	11.0–12.0 feet	dark grayish brown	sandy loam	A horizon. Upper portion of marsh. Contains small freshwater gastropods. Extensive bioturbation. One piece of historical-period glass was discovered.
	2A2b	11.0–12.0 feet	black	clay loam	A horizon. Has blocky structure. Contains small freshwater gastropods.
Trench 2-3					
Alluvial plain Floodplain	fill	0–11.5 feet	black	sand	Historical-period fill. Layered dark and light sands, containing lenses of pebbles and cobbles. Contains historical-period artifacts.
	C1	11.5–11.7 feet	greenish gray	sandy loam	Marsh deposits. Greenish gray silt with laminated black clay lenses.
	2Ab	11.7–12.0 feet	greenish black	clay loam	A horizon in marsh deposits. Small chunks of charcoal, also small worm and insect burrows are present.
Trench 2-4					
Alluvial plain Floodplain	fill	0–10.0 feet	reddish brown	sand	Historical-period fill. Layered dark and light sands, containing lenses of pebbles and cobbles. Contains rebar and nails.
	2Ab	10.0–10.5 feet	greenish black	clay loam	A horizon in marsh deposits. Small chunks of charcoal, also small worm and insect burrows are present. Blocky structure.
Trench 2-5					
Hill slope Toe slope	C	0–2.5 feet	pale brown	loamy sand	Historical-period colluvium. Appears to be material washed down-slope for adjacent bluff.
	—	2.5–3.0 feet	black	asphalt/cinder	Layer of either burned asphalt or cinder 3–5 cm thick.
Alluvial fan Toe slope	2C1b	3.0–6.0 feet	dark brown	loamy sand	Historical-period fan deposits. Bedded sands that probably represent material washed out of the bluff as a fan deposit.
	2C2b	6.0–11.0 feet	dark brown	sand	Historical-period colluvium/alluvium. Bedded sands that probably represent material washed out of the bluff as a fan deposit. Contains a few chunks of concrete at 2.9 m below surface.

Facies & Landform, by Trench	Soil Horizon	Depth [a] or Stratum (feet)	Color	Texture	Description
Hill slope Toe slope	2C3b	11.0–11.2 feet	greenish gray	sand	May be historical-period in age. Based on the color, this material appears out of sequence. Typically greenish gleyed sediment occurs below the black marsh soils in this location. May be redeposited from nearby excavation.
	3A2b	11.2–12.0 feet	black	clay loam	A horizon that represents the top of a marshland soil. Two pieces of rusted metal were recovered from this layer, suggesting that it was exposed during historical-period times.
Trench 2-6					
Alluvial fan Toe slope	C	0–2.0 feet	pale brown	loamy sand	Historical-period colluvium/alluvium. Bedded sands with silt laminations probably represent material washed out of the bluff as a fan deposit.
	2A1b	2.0–2.3 feet	dark brown	sandy loam	A horizon that is similar to those on project sites that contain midden and artifacts. No artifacts were found in this trench.
	2AB2b	2.3–5.0 feet	brown	loamy sand	Either a part of the A horizon or the B horizon for this soil.
	3Ab	5.0–5.5 feet	greenish black	clay loam	A horizon that represents the top of a marshland soil.
Trench 2-7					
Alluvial fan Toe slope	A	0–1.5 feet	dark brown	fine sandy loam	A horizon that is similar to those on project sites that contain midden and artifacts. Contained considerable roots. A piece of *Chione* was collected. Also contained historical-period glass.
	B	1.5–2.0 feet	pale brown	fine sandy loam	B horizon mottled with darker brown (possibly rodent burrows rather than mottling) and some roots.
	C1	2.0–4.0 feet	brown	fine sandy loam	C horizon with calcium carbonate nodules.
	C2	4.0–11.0 feet	brown	fine sandy loam	
	C3	11.0–11.5 feet	olive green	fine sand	Gleying indicates saturation of this layer.
Trench 2-8					
Hill slope Toe slope	C1	0–2.0 feet	pale brown	sandy loam	Historical-period colluvium/alluvium. Bedded sands with dark brown silt laminations probably represent material washed out of the bluff as a fan deposit.
	C2	2.0–2.2 feet	dark brown	sandy loam	May be redeposited site material based on color and texture of sediment.

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Facies & Landform, by Trench	Soil Horizon	Depth[a] or Stratum (feet)	Color	Texture	Description
	C3	2.2–8.0 feet	dark brown	clay loam	Historical-period fill or colluvium/alluvium. Toothbrush found at 0.8 m and chunks of concrete at 1.4 m. Heavily bioturbated.
Trench 2-9					
Hill slope Toe slope	C1	1g	brown (10YR 4/3)	sandy loam	Modern fill. Appears to be redeposited A horizon material and sediment washing off of the hill slope to the south. Full of large chunks of asphalt. The abrupt, straight contact with Strata 1h and 3d indicate that this area was mechanically excavated prior to deposition of Stratum 1g. Includes lenses of site material (Stratum 1d) containing artifacts.
	C2	1h	very dark grayish brown (10YR 3/2)	sandy loam	Lens of redeposited A horizon with midden or artifacts.
Alluvial fan Toe slope	C3	5d	pale brown (10YR 6/3)	sand	Flood/alluvial fan deposits. Layered sands deposited either by the alluvial fan in the Lincoln gap or as flood water deposits.
	2Ab	3d	very dark grayish brown (10YR 3/2)	sandy loam	A horizon with midden or artifacts in primary depositional context. Artifacts are fairly dense in the profile, particularly shell. The contact with underlying Stratum 4t is wavy and irregular. May be the result of bioturbation or unconformity. If the latter, it is most likely a mechanical disturbance and would therefore make Stratum 3d redeposited rather than in primary depositional context.
	2Cb	4t	brown (7.5YR4/3)	loamy sand	C horizon consisting sandy material similar to that found in the sand dunes on the bluff tops to the south. Probably part of alluvial fan from the Lincoln gap.
Trench 2-10					
Alluvial fan Toe slope	fill	0–2.0 feet	black	loamy sand	Modern. Appears to be a mix of fill and redeposit A horizon material and sediment washing off of the hill slope to the south. Contains brick, saw-cut bone, and bottle glass.
	fill	2.0–3.5 feet	reddish brown	sand	Modern fill. Contains brick, saw-cut bone and glass.
	fill	3.5–6.0 feet	dark brown	sandy loam	Modern fill. Mixture of silty and sandy material used as fill.
	Ab	6.0–8.5 feet	black	clay loam	A horizon that represents the top of a marshland soil.

Facies & Landform, by Trench	Soil Horizon	Depth[a] or Stratum (feet)	Color	Texture	Description
Trench 2-11					
Alluvial fan Toe slope	fill	0–3.5 feet	brown	sandy loam	Modern fill. Contains brick, metal and marine shell, predominantly oyster.
	fill	3.5–4.5 feet	reddish brown	sandy loam	Modern fill. Heavily bioturbated.
	fill	4.5+ feet	dark brown	clay loam	Modern fill. Contains brick and concrete. Heavily bioturbated.
Trench 2-12					
Alluvial fan Toe slope	C	0–4.0 feet	pale brown	sandy loam	Modern alluvial fan deposits. Thin banded layers of laminated silts and sands. Probably alluvial fan deposits of material washing off of the bluff slope to the south. Heavily bioturbated.
	fill	4.0–4.6 feet	black	sandy clay loam	Possibly modern fill. The color and the clay content in this layer suggests that it was originally a marsh soil, probably an A horizon, that was redeposited. Heavily bioturbated.
	fill	4.6–5.2 feet	greenish gray	sandy loam	Possibly modern fill. Heavily bioturbated.
	fill	5.2–7.5 feet	greenish gray	loam	Possibly modern fill. Heavily bioturbated mixture of greenish and black silts. This description suggests redeposition of native marsh deposits by mechanical means.

[a] Below surface

Table A.1b. Trenches 101–103

Cultural Material Present?	Soil Horizon	Depth (m)	Color	Texture	Description
Trench 101					
—	fill	0–0.3 (south) 0–2 (north)	very pale brown, brownish yellow, very dark brown, yellowish brown (10YR 7/4, 10YR 6/6, 10YR 3/2, 10YR 5/6)	gravelly, loamy sand; gravelly, loamy sandy loam	Fill with numerous historical-period artifacts (glass, ceramics, metal, and construction debris). Also lenses of A horizon soils that have likely come from nearby. Also contains prehistoric materials such as a large metate fragment, shell, and other lithics. Wavy abrupt lower contact.
Yes	A1	0.3–0.5 (south)	dark brown (10YR 3/3)	sandy loam	Intact, contains prehistoric cultural materials including shell, lithics, bone. Upper portion appears truncated. Slopes downward drastically from south end of trench to north where it thins and disappears. Wavy abrupt upper contact, wavy clear contact with lower stratum.
Yes	A2	0.5–0.8 (south)	very dark grayish brown (10YR 3/2)	sandy loam, loam	Thin lens only seen in south end of trench for 1 m. Contains same cultural material as A1, also follows slope of A1. Wavy clear contact with upper and lower stratum.
Yes	A3	0.8–1.6 (south)	dark grayish brown	sandy loam, loam	Thick lens of A horizon soil, also contains sparse cultural materials like those seen in A1 and A2. Wavy clear contact with upper and lower soil stratum.
Yes	AC	1.6–2.2 (south)	very dark brown with mottles of yellowish red (10YR 2/2, 5YR 5/8)	sandy loam, loamy sand	Mixed A and C horizon soils, mottled with oxidized root casts at the base. Some cultural materials likely a result of bioturbation.

Cultural Material Present?	Soil Horizon	Depth (m)	Color	Texture	Description
Trench 102					
Yes	fill	0.0–0.47 (south)	grayish brown, light grayish brown, dark grayish brown, yellowish brown (10YR 5.5/2, 10YR 4.5/2, 2.5Y 6/4)	extremely gravelly loamy sand, loamy sand	Consists of an upper layer of decomposed granite, and a thick deposit of fill containing historical-period and modern refuse: both domestic and industrial materials. Gradually slopes from south end for approximately 8 m, then slopes drastically. Also lenses of A horizon material with some prehistoric material. Abrupt smooth boundary with lower A horizon soils.
Yes	A1	0.47–1.0	grayish brown (10YR 5/2)	sandy loam	Intact deposit sloping gently from south end of trench, then drops off dramatically and thins. Contains sparse cultural deposit with lithics, shell, bone, fire-affected rock. Abrupt smooth lower boundary, abrupt wavy upper boundary.
Yes	A2	1.0–1.5	light gray to light brownish gray, yellowish brown mottles (10YR 6/1.5, 10YR 5/8)	loam	Intact deposit also sloping gently to north, and then drastically drops; similar cultural materials as in A1 horizon.
Yes	AC	1.5–2.2	gray, dark gray, yellowish brown (10YR 4.5/1, 10YR 5/8)	loamy sand, mottles	Intact, transitional with mottles of A and C horizon soils, some containing cultural materials, likely the result of bioturbation.
Yes	Cg	2.2–4.0 (south)	light gray, gray, yellowish brown (10YR 5.5/1, 10YR 5/8)	loamy sand, fine to medium mottles	Intact C horizon with some mottles, some cultural materials, likely the result of bioturbation, hand trench and auger excavated in portion of south end of trench, water table encountered at 3 m. Laminated deposit in northern end of trench.
Trench 103					
No	fill	0–3.0	grayish brown, light grayish brown, dark grayish brown, light yellowish brown (10YR 5.5/2, 10YR 4.5/2, 2.5Y 6/4)	gravelly loamy sand, loamy sand	Fill containing historical-period artifacts such as ceramics, glass, saw-cut bone, construction debris (metal, asphalt, concrete, brick). Mottled with lenses of A horizon soils, likely cut and used as fill. Some prehistoric cultural materials, likely from A horizon soils that were cut and used as fill. Very unstable soils: could not enter trench to profile.

Table A.1c. Trenches 104–108

Intact Cultural Material Present?	Soil Horizon	Depth (m)	Color	Texture	Description
Trench 104					
No	fill	0–3.0	grayish brown, light grayish brown, dark grayish brown, light yellowish brown (10YR 5.5/2, 10YR 4.5/2, 2.5Y 6/4)		Similar to Trench 103, although fill contains slightly more historical-period artifacts such as ceramics, glass, saw-cut bone, construction debris (metal, asphalt, concrete, brick). Mottled with lenses of A horizon soils, likely cut and used as fill. Some prehistoric cultural materials, likely from A horizon soils that were cut and used as fill. Very unstable soils, could not enter trench to profile, groundwater at 3 m.
Trench 105					
No	fill	0–2.5	yellowish brown, mottles of dark gray	sandy silt, loam with clasts of clay	Same as fill in Trenches 103 and 104, also lenses of A horizon soils containing cultural materials.
Yes	A	2.5–3.0	dark gray	sandy silt, loam	Appears to be thin, intact layer of A horizon soil containing cultural materials such as shell, bone, and lithic artifacts, also a mortar or bowl fragment pulled from backdirt while excavating through this layer. Possible feature at 12 m from south end of trench appears to contain mano and fire-affected rock; could not enter trench because of highly unstable sidewalls from fill.
Trench 106					
No	fill	0–2.5	orangish brown, yellowish brown	sandy silty loam, with some mottles of clay	Same fill as in Trenches 103–105. Also lenses of A horizon soils containing prehistoric cultural materials. Very unstable.
Yes	A	2.5–2.75	dark gray	sandy silt, loam	Thin intact A horizon containing cultural materials such as shell, lithics, bone, and ground stone (one whole metate recovered from this layer). Probably represents the bottom of a mechanically cut cultural deposit. Lower boundary is mottled and appears to represent intact stratigraphic profile.

Intact Cultural Material Present?	Soil Horizon	Depth (m)	Color	Texture	Description
No	C	2.75–3.0	dark gray, black	clayey silt, clayey loam	Intact upper-marsh deposit containing large amount of decomposing organic materials such as roots, also oxidized root casts, and some small rounded pebbles. No cultural material noted. Upper boundary is mottled with A horizon. Looks very similar to 2A2b seen in Trench 1-7.
Trench 107					
No	fill	0–1.3	yellowish brown, orangish brown	sandy loam with some mottles of clay	Fill similar to that noted in Trenches 103–106, also contains lenses of A horizon soils. Gently slopes from south end of trench, thickening to 1.6 m.
Yes	A	1.3–2.3	dark gray	sandy silt, loam	Intact A horizon, likely containing cultural materials, gently slopes to the north, where it continued below the depth of the trench. Groundwater at 2.3 m, and trenching halted. Could not enter trench, highly unstable.
Trench 108					
	fill	0–1.3	gray, yellowish brown, very dark grayish brown, very dark gray (10YR 5/1, 10YR 5/4, 10YR 4/2, 10YR 3/1, 10YR 3/2)	loam, loamy sand, sandy loam, clay loam	Fill similar to that in other trenches, moderate amount of historical-period materials and construction debris, also lenses of A horizon soils. Slopes gently to north end of trench where it thickens to 1.6 m.
	A	0.94–1.26	gray (10YR 5/1)	clay loam	Intact A horizon containing sparse cultural materials including shell and lithics, gently sloping to north end of trench.
	Cg	1.26–2.33	dark gray, very dark grayish brown, yellowish brown mottles (10YR 3/1.5, 10YR 5/8)	mottled clay loam	Intact C horizon, likely marsh deposits containing some organic materials and oxidized root casts, no cultural material noted.

Table A.1d. Trenches 109–122

Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
Trench 109				
Fill	0–0.20	brown (10YR 5/3)	sandy loam	Same as fill seen in other trenches, sparse amount of historical-period and modern artifacts. Gently slopes to the north, the depth and thickness of the deposit varies, smooth to wavy contact with lower soil layer
A	0.20–0.60	gray (10YR 5/1)	sandy loam to loam	Intact A horizon containing cultural materials including lithics, fire-affected rock, and shell; clear smooth boundary, top has likely been truncated.
BA	0.60–0.85	light brownish gray (10YR 6/2)	sandy loam	Intact, mixed B and A horizon soil with sparse cultural materials probably moved through bioturbation, smooth boundary.
Bk	0.90–1.30	gray (10YR 6/1)	sandy loam	CaCO-enriched lens within BA horizon, no cultural materials noted, appears in trench at 4 m from south wall; rodent activity noted through this zone.
2Ab1	0.85–1.30	dark grayish brown, brownish yellow mottles (10YR 4/2, 10YR 6/8)	loamy sand to sandy loam	Intact, buried soil horizon containing sparse cultural materials, also subject to bioturbation; abrupt, smooth boundary.
2Ab2	1.30–1.70+	dark grayish brown, brownish yellow mottles (10YR 4/2, 10YR 6/8	loamy sand	Intact, buried soil horizon, saturated sparse cultural materials noted, lower portion of this layer (1.8 m below surface) encountered ground water
Trench 110				
Fill	0–0.75	brownish yellow (10YR 6/6)	sandy loam	Fill material similar to that seen in other trenches, although slightly less historical-period material, mostly construction debris; gently slopes from bluff edge to the west, with thickness varying.
Bk	0.75–0.95	dark grayish brown (10YR 4/2)	sandy loam	CaCO-enriched zone with an abrupt wavy boundary, no cultural material noted.
Bw	0.95–1.15	very dark grayish brown (10YR 3/2)	sandy loam	

Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
2Ab	1.15–1.70	dark grayish brown, yellowish brown (10YR 4/2, 10YR 5/6)	loamy sand to sandy loam	Intact, buried soil horizon containing sparse cultural materials, also subject to bioturbation, abrupt smooth boundary
2ACb	1.70–2.15	dark grayish brown, yellowish brown mottles (10YR 4/2, 10YR 5/6	loamy sand	Intact, buried, mixed A/C soil horizon, containing sparse prehistoric cultural remains, clear smooth boundary.
2Cg	2.15–3.10+	gray, yellowish brown mottles (10YR 4/1, 10YR 5/6)	loamy sand	Intact, buried, gleyed C horizon soil containing sparse cultural materials that may be the result of bioturbation.
Trench 111				
Fill	0–0.60	grayish brown and light yellowish brown (10YR 5/2, 10YR 6/4)	sandy loam to loam	Alternating layers of fill materials that may relate to historical-period or modern cutting and filling episodes. Fill contains metal wire, nails, and pieces of plastic. The horizon slopes gently from the southern end of the trench, then at 3 m dips drastically, representing artificial cut into underlying A horizon soils.
A	0.60–0.70	dark gray with pale brown insect casts (10YR 4/1, 10YR 7/3)	loam	Possibly intact, A horizon containing sparse cultural materials, top has been truncated, gently slopes from south end of trench until 3 m, where it is cut drastically; abrupt wavy boundary.
Bw	0.70–0.97	grayish brown to dark grayish brown, with yellowish mottles (10YR 4.5/2, 7.5YR 5/8)	sandy loam	Contains some cultural materials and has been mechanically cut in the northern portion of the trench.
Bwk	0.97–1.13	dark gray with yellowish brown mottles (10YR 4/1, 10YR 5/8)	loam to sandy loam	No cultural materials noted.
2Ab	1.13–1.72	dark gray to very dark gray with yellowish brown mottles (10YR 3.5/1, 10YR 5/8)	sandy loam	Buried A horizon soil containing sparse cultural materials including shell and lithics. Gently slopes from south end of trench. Thickness varies from about 1.5 to about 0.5 m.
2ACb	1.72–2.02	gray with yellowish brown mottles (10YR 5/1, 10YR 5/8)	loamy sand	Buried A horizon transitional zone with some C horizon characteristics. Some shell noted that may be cultural.
2Cg1	2.02–2.35	dark gray with yellowish brown mottles (10YR 4/1, 10YR 5/6)	loamy sand	Marsh deposits underlying buried A horizon, no cultural materials noted.
2Cg2	2.35–3.18	dark grayish brown (10YR 4/2)	loamy sand	Continuation of marsh deposits, mottles not seen in this layer, no cultural materials noted.

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Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
Trench 112				
Fill	0–1.0	dark grayish brown with yellowish brown mottles (10YR 4/2, 10YR 5/4)	sandy loam	Fill similar to that of other trenches containing sparse historical-period and modern construction debris and other refuse, layer is fairly level across unit, implying artificial cut into the underlying A horizon, abrupt smooth boundary.
A	1.0–2.4	dark gray to very dark gray (10YR 3.5/1, 10YR 2.5/1)	sandy loam to loamy sand	Intact A horizon, that has been mechanically truncated on upper surface. Likely represents upper marsh deposits. A thin lens at approximately 0.9–1.2 m may represent cultural deposit, as it appears very similar to that of adjacent trenches. No cultural materials identified, water encountered at about 2 m below surface.
Trench 113				
Fill	0–2.8	dark greyish brown mottled with light olive brown (10YR 4/2, 10YR 4/2.5	sandy silt to sand	Fill similar to that seen in other trenches containing historical-period artifacts and construction debris, as well as some prehistoric materials in lenses of A horizon soils. Fill gradually slopes to the north, then at approx 3.5 m from south end, makes abrupt drop where it has been mechanically cut.
BA	1.3–1.5	dark grayish brown mottled with yellowish brown (10YR 4/2, 10YR 5/6)	loamy sand	Mixed B/A horizon zone gradually sloping to north, has been mechanically truncated on upper surface. No cultural materials noted while excavating.
2Ab1	1.5–1.9	very dark gray with mottles of yellowish brown	sandy loam	Intact, buried A horizon soil containing cultural materials including lithics, shell, and FAR. Gently slopes from south end of trench to north where it appears to have been mechanically truncated. Likely the same as A1 soil horizon seen in Trench 2.
2Ab2	1.9–2.1	dark gray to very dark gray (10YR 3.5/1)	sandy loam	Intact, buried A horizon, containing cultural materials, gently sloping to north, continued into bottom of trench.
2ACb	2.1–2.4	dark gray (10YR 4/1)	loamy sand	Intact, buried transitional A/C horizon, slopes gently to the north, no cultural material noted.
2Cg	2.4–2.6 (bottom of trench)	very dark gray (10YR 3/1)	sandy clay loam	Intact, C horizon soils, likely marsh deposits, no cultural materials noted.

Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
Trench 114				
Fill	0–2.6	grayish brown, light grayish brown, dark grayish brown, light yellowish brown (10YR 5.5/2, 10YR 4.5/2, 2.5Y 6/4)	gravelly loamy sand, loamy sand	Trench excavated to confirm presence of cultural materials in nearby bucket auger units, no intact A horizon or cultural materials encountered. Fill containing historical-period artifacts such as ceramics, glass, saw-cut bone, construction debris (metal, asphalt, concrete, brick). Mottled with lenses of A horizon soils, probably cut and used as fill. Some prehistoric cultural materials, likely from A horizon soils that were cut and used as fill. Very unstable soils: could not enter trench to profile.
Trench 115				
Fill	0–1.5	orangish brown, brown, light yellowish brown	sandy loam, clay, sand	Fill material containing construction debris such as asphalt, concrete, brick, and unidentifiable metal. Large block of cement in southern section of trench. Water table encountered at 1.5 m, and excavation halted.
Trench 116				
Fill	0–1.25	orangish brown, brown, light yellowish brown	sandy loam, clay, sand	Fill material containing construction debris such as asphalt, concrete, brick, and unidentifiable metal. Large block of cement in southern section of trench.
A	1.25–1.5	very dark brown (10YR 3/2)	loamy sand	Possibly intact A horizon, no cultural material noted, could not profile or sample as water table was encountered at this level, and filled trench.
Trench 117				
Fill	0–1.5	orangish brown, brown, light yellowish brown	sandy loam, clay, sand	Fill material containing construction debris such as asphalt, concrete, brick, and unidentifiable metal. Water table encountered at 1.5 m, and excavation halted.

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Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
Trench 118				
Fill	0–0.1	light olive brown (2.5Y 6/4)	gravelly loamy sand	Thin lens of road base, abrupt wavy boundary.
Fill	0.1–2.6	grayish brown to dark grayish brown with very pale brown mottles (10YR 4.5/2, 10YR 7/3)	sandy loam to loamy sand	Fill material similar to that in other trenches, contains sparse amount of historical-period materials, the depth is highly variable ranging from 20 cm in south end to more than 2 m in north end of trench. In places, has been mechanically truncated, and appears layered. Fill also contains lenses of A horizon soils, and also contains some prehistoric artifacts.
A1	0.20–0.64	dark grayish brown (10YR 4/2)	sandy loam	Intact A horizon sloping gently from south end of trench to north, then abruptly drops where it has been mechanically truncated, and disappears approximately 3 m from south end of trench. Contains sparse amount of prehistoric cultural materials including marine shell, lithics, and burnt bone. Abrupt smooth boundary.
A2	0.64–1.38	very dark grayish brown (10YR 3/2)	loam	Intact, A horizon, slightly darker than overlying A1, slopes gently from southern end of trench where it has been mechanically truncated at approximately 3 m from south end of trench. Contains sparse amount of cultural materials. Clear smooth boundary.
AC	1.38–2.1	very dark gray (10YR 3/1)	loamy sand	Mixed A/C horizon, intact, relatively flat to approximately 5.5 m from south end of trench where it had been mechanically truncated and fill placed. Some prehistoric cultural materials, likely the result of bioturbation. Clear smooth boundary.
Cg	2.1–2.2	dark gray with yellowish brown mottles (10YR 4/1, 10YR 5/8)	loamy sand	Intact C horizon, likely marsh or upper marsh deposits. Relatively flat, then truncated at approximately 7 m from south end of trench. No cultural materials noted.

Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
Trench 119				
Fill I	0–2.0	yellowish brown, very dark grayish brown, grayish brown, brown, and olive yellow (10YR 5/4, 10YR 3/2, 10YR 5/2, 10YR 4/3, 2.5Y 6/6)	loamy sand, sandy loam, sandy clay loam	Layered bands of lighter sandy soils and darker redeposited A horizon soils, appear to have been mechanically placed. Historical-period artifacts including sparse amounts of glass, metal, ceramics and construction debris. Relatively flat with abrupt smooth boundary.
Fill II	1.5–2.7	dark brown with layers of dark gray (10YR 3/3, 10YR 4/0)	sandy loam, silty clay	Fill layer, with lenses of silty clay. Relatively flat, with steep dip at approximately 5 m from south end of trench. Sparse historical-period artifacts including ceramics, metal, and glass.
AC	1.9–2.7	black (10YR 2/1)	clayey loam	Mixed A/C horizon soil layer. Contains sparse cultural materials, probably the result of bioturbation from overlying A horizon removed mechanically at some time in the past. Marine shell and burnt bone, but no lithics. Gently sloping from southern end of trench to approximately 4 m where it has been mechanically truncated.
Trench 120				
Fill I	0–0.97	brown, dark grayish brown, yellowish red, dark gray (10YR 5/3, 10YR 4/2, 5YR 5/8, 5Y 4/1)	sandy loam, clay	Fill layer similar to that seen in other trenches, gently sloping to north, thickness varies from 0.8 m (south end) to 2 m (north end). Contains sparse amounts of historical-period materials such as metal, glass, ceramics and construction debris such as asphalt and concrete. Also contains patches of clay and lenses of A horizon soils likely with prehistoric cultural materials. Abrupt wavy boundary.
Fill II	0.97–2.17	brown, dark grayish brown, light yellowish brown, dark gray (10YR 4/3, 10YR 4/2, 10YR 6/4, 5Y 4/1)	sandy loam, loam, loamy sand, clay	Fill layer similar to Fill I, gently sloping to north, with patches of clay and sparse historical-period materials as well as prehistoric materials and lenses of A horizon soils. Large section approximately 20 cm thick of dark gray clay may represent ponding or standing water from approximately 8.5 to 13 m from south end of trench.

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Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
A	2.17–2.58	dark gray with yellowish brown mottles (10YR 4/1, 10YR 5/8)	sandy loam	A horizon soils similar to that seen in other trenches, containing sparse prehistoric cultural materials such as marine shell, lithics, and bone. Deposit is gently sloping from the south end of the trench, and quickly disappears at approximately 2.5 m, where it appears to have been mechanically truncated.
AC	2.58–2.79	dark gray with yellowish brown mottles (10YR 4/1, 10YR 5/8)	clay loam	Mixed A and C horizon soil, gently sloping to north, contains sparse prehistoric cultural materials, likely the result of bioturbation.
Cg1	2.79–2.90	gray to light gray with yellowish brown mottles (10YR 6/1, 10YR 5/8)	sandy clay loam	Likely marsh or upper marsh deposits containing decomposing organic material and oxidizing root casts. No cultural materials noted. Clear smooth boundary.
Cg2	2.90–3.04+	gray with yellowish brown mottles (10YR 4/1, 10YR 4/6)	sandy clay loam	Likely marsh or upper marsh deposits containing decomposing organic material and oxidizing root casts. No cultural materials noted. Clear smooth boundary, continues to bottom of trench.
Trench 121				
C1	0–0.63	yellowish brown (10YR 5/4)	loamy sand	
C2	0.63–0.78	pale brown (10YR 6/3)	loamy sand to sandy loam	
C3	0.78–0.90	yellowish brown with laminations of dark brown to very dark grayish brown (10YR 5/4, 10YR 3/2)	sandy loam, clay loam	
C4	0.90–0.96	brown with thin laminations of dark brown to very dark grayish brown (10YR 4.5/3, 10YR 3/2)	loamy sand	
C5	0.96–1.04	yellowish brown (10YR 5/4)	loamy sand	
C6	1.04–1.31	yellowish brown (10YR 5/4)	loamy sand	
C7	1.31–1.41	yellowish brown (10YR 5/4)	loamy sand	
C8	1.41–1.49	yellowish brown (10YR 5/4)	loamy sand	
C9	1.49–1.59	yellowish brown (10YR 4/2)	gravelly sandy loam	

Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
C10	1.59–1.67	yellowish brown (10YR 5/4)	loamy sand	
C11	1.67–1.72	yellowish brown (10YR 5/4)	loamy sand	
C12	1.72–2.02	brown (10YR 4.5/3)	loamy sand	
2Ab	2.02–2.40	very dark gray with brown mottles (10YR 3/1, 7.5YR 5/8)	sandy loam to sandy clay	Buried A horizon, possibly upper fresh water marsh or marsh deposit, contains sparse cultural material including lithics. Relatively flat across trench, clear wavy boundary.
2ACb	2.40–2.55	dark gray with brown mottles (10YR 4/1, 7.5YR 5/8)	sandy loam to sandy clay loam	Buried mixed A and C horizon soil, likely marsh deposits with decomposing organic material. No cultural materials noted, abrupt wavy boundary.
2Cg	2.55–3.10	gray with brown mottles and light gray threads (5Y 5/1, 7.5YR 5/8, 10YR 7/1)	sandy clay loam	Gleyed C horizon containing organic materials, likely representative of marsh deposits. No cultural materials noted, and water table encountered at 2.92 m below surface.
Trench 122				
Fill	0–0.25	yellowish brown with layers of brown (10YR 5/6, 10YR 5/3)	sandy loam and loamy sand	Thin lens of fill material similar to that seen in other trenches, containing sparse historical-period materials as well as modern construction debris.
A	0.25–0.4	yellowish brown (10YR 5/4)	loamy sand	Intact, thin lens of A horizon, slightly sloping to north, disappears at approximately 4.5 m from south end of trench. No cultural material noted.
C1	0.44–0.7	light yellowish brown (10YR 5/4)	loamy sand	Intact C horizon, gently sloping to north, then flattens at approximately 4 m from south end. The thickness varies from about 30 cm to 70 cm. No cultural materials noted, clear smooth boundary.
C2	0.76–1.0	light yellowish brown (10YR 6/4)	loamy sand to gravelly loamy sand	Intact, C horizon, gently sloping to north, then flattens at approximately 4 m from south end of trench. Distinguished from C1 by gravel lenses in the upper 10–15 cm near the contact between C1 and C2. No cultural materials noted, clear smooth boundary.

continued on next page

Soil Horizon, by Trench	Depth (m)	Color	Texture	Description
2Ab	1.01–2.01	dark grayish brown (10YR 4/2)	sandy loam	Intact, buried A horizon gently sloping to north, then flattening at approximately 2.8 m from south end of trench. Sparse cultural materials in this layer including lithics. This lens is similar in composition to other A horizons identified in previous trenches, but appears lighter in color with less cultural material, abrupt smooth boundary.
3Ab	2.01–2.45	very dark gray (10YR 3/1)	silt loam to silty clay loam	Intact, buried A horizon, slopes to the north, then flattens at approximately 1 m from south end of trench. Contains sparse cultural materials including shell and lithics. Similar to 2Ab in Trench 21. Abrupt, smooth boundary.
3ACb	2.45–2.78	very dark gray with brown mottles (10YR 3/1, 7.5YR 5/8)	silt loam to silty clay loam	Intact, buried, mixed A/C horizon may contain sparse cultural materials as a result of bioturbation. Clear, smooth boundary.
3Cg1	2.78–3.15	gray to light gray with brown mottles (10YR 6/1, 7.5YR 5/8)	silty clay loam	Gleyed C horizon, likely marsh deposits containing some decomposing organic material. No cultural material present, clear smooth boundary.
3Cg2	3.15–3.25+	light brownish gray (10YR 6/2)	silty clay loam	Gleyed C horizon, likely marsh deposit, contains some decomposing organic material. No cultural material present, smooth boundary, groundwater encountered at 3.25 m below the surface.

Table A.2. Trenches at LAN-2769

Facies & Landform, by Trench	Soil Horizon	Depth (feet)	Color	Texture	Description
Trench 1-1					
Hill slope Toe slope		0–0.5		asphalt	Parking lot surface.
	Fill I	0.5–5.0	yellowish brown	fine sand	Modern fill.
	Fill II	5.0–8.0+	brown	loamy sand	Modern fill; heavy volume of trash, including brick fragments; concrete and metal, including airplane parts.
Trench 1-2					
Hill slope Toe slope		0–0.5		asphalt	Parking lot surface.
	Fill II	0.5–5.0	brown	loamy sand	Modern fill; contains concrete, brick fragments and wire.
	Fill I	5.0–8.0	yellowish brown	fine sand	Modern fill; sand from the bluff with some brick and wire.
Alluvial plain Floodplain	C1	8.0+	greenish gray	silt	Marsh deposits; bioturburbated greenish gray silt with black mud; contains small chunks of charcoal.
Trench 1-3					
Hill slope Toe slope		0–0.5		asphalt	Parking lot surface.
	fill	0.5–1.5	brown	loamy sand	Modern fill; contains concrete, brick fragments and wire.
		1.5–2.0		asphalt	Buried parking lot surface.
Alluvial plain Floodplain	C1	2.0–2.5	black	loam	Marsh deposits; contains chunks of charcoal and small roots.
	C2	2.5–3.5	green	silt	Marsh or freshwater deposit; color and texture, coupled with the presence of gastropods, suggests this may be shallow freshwater deposit.
Trench 1-4					
Hill slope Toe slope		0–0.5		asphalt	Parking lot surface.
	fill	0.5–1.5	gray	gravel	Road base.
	C1	1.5–3.8	dark brown	sand	Historical-period flood deposit; bedded sand with small, shallow channels.

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Facies & Landform, by Trench	Soil Horizon	Depth (feet)	Color	Texture	Description
Alluvial plain Floodplain	2Ab	3.8–4.5	brown	sandy loam	A horizon with rodent disturbance.
	2Cb	5.0–8.0	green	loam	Marsh deposit.
Trench 1-5					
Hill slope Toe slope		0–0.5		asphalt	Parking lot surface.
	fill	0.5–1.5		gravel	Road base.
	C1	1.5–3.8	dark brown	sand	Historical-period flood deposit; bedded sand with small, shallow channels.
Alluvial plain Floodplain	2Ab	3.8–4.5	brown	sandy loam	A horizon with rodent disturbance.
	2Cb	5.0–8.0	green	loam	Marsh deposit.

Table A.3. LAN-2769 Unit Soils

Facies & Landform, by Unit	Soil Horizon	Stratum	Color	Texture	Description
Unit 1					
Hill slope Toe slope	fill	1a	brown (10YR 5/3)	sandy loam	Redeposited fill or colluvium; contained glass and a probable cow bone. Deposited after parking lot was built, because stratum sits on asphalt in part of the unit.
	fill	1b	light brownish gray (10YR 6/2)	sandy loam	Redeposited fill or colluvium; contained glass, plastic and rubber; deposited after parking lot was built, because stratum sits on asphalt in part of the unit.
	fill	1c	dark grayish brown (10YR 4/2)	very fine sandy loam	Redeposited fill or colluvium; deposited after parking lot was built as it sits atop asphalt in part of the unit; probably redeposited from a horizon upslope.
	fill	1d	brown (10YR 5/3)	very fine sandy loam	Redeposited fill or colluvium; deposited after parking lot was built, because stratum sits on asphalt in part of the unit; may be same as Stratum 1a.
	fill	1e	light grayish brown (10YR 6/2)	sandy loam	Modern alluvium and colluvium.
	A1b	2a	dark grayish brown (10YR 4/2)	sandy loam	A horizon without artifacts; may be disturbed or redeposited..
	A2b	3a	dark gray (10YR 4/2)	sandy loam	A horizon with low artifact density; may be disturbed or redeposited.
	C1b	4a	yellowish brown (10YR 5/6)	sand	Appears to be relatively unweathered hill-slope matrix.
	C2b	4b	dark yellowish brown (10YR 4/4)	sand	Appears to be relatively unweathered hill-slope matrix.

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Facies & Landform, by Unit	Soil Horizon	Stratum	Color	Texture	Description
Units 2 and 3					
Hill slope Toe slope	C1	1f	brown (10YR 5/3)	sandy loam	Modern alluvium and colluvium; contained numerous bottles and some aluminum cans. Appears to be redeposited A horizon material and sediment washing off of the hill slope to the south; may have been result of mechanical sculpting of hill slope to south.
	C2	1g	brown (10YR 6/2)	fine sandy loam	Historical-period/modern alluvium and colluvium; contains chunks of light yellowish brown (10YR 5/4) sandstone. It is likely that this material was deposited during the 1920s when the sewer line was built.
	2Ab	3b	very dark gray (10YR 3/1)	loamy sand	A horizon with low artifact density.
	2ACb	4c	dark yellowish brown (10YR4/4)	gravelly loamy sand	Mostly C horizon mixed by bioturbation with very brown gray A horizon matrix.

Table A.4. LAN-211/H Trench Soils Data

Facies & Landform, by Trench	Soil Horizon	Stratum or Depth	Color	Texture	Description
Trench 11					
Alluvial plain Toe slope		1a			Asphalt paving for parking lot.
		1b	light yellowish brown (2.5Y 6/4)	gravelly sand	Decomposed granite; commonly used on the Hughes Aircraft Company property as base for roads, runways, and parking lots.
		1c	light gray (10YR 7/1)	sandy gravel	Fill in modern trench.
		1d	light gray (10YR 7/1)	sandy gravel	Fill in modern trench.
		1e	light gray (10YR 7/1)	sandy gravel	Fill in modern trench.
		1f	pale brown (10YR 6/3)	sand	Modern fill. A mix of the primary material and black (10YR 2/1) silt loam.
	C1	5a	pale brown (10YR 6/3)	sand and silt	Alternating layers of well sorted course to pale brown sand capped by thin layers (up to 4 cm thick) of dark grayish brown (10YR 4/2) silt; probably flood deposits capped by runoff from nearby slope deposited in shallow standing water.
	C2	5c	pale brown (10YR 6/3)	sandy gravel	Poorly sorted, coarse to fine sand mixed with pebbles and cobbles; possibly stream-deposited gravel bar.
Alluvial fan Toe slope	2A1b	3c	very dark gray (10YR 3/1)	sandy loam	A horizon with midden or artifacts in primary depositional context.
	2A2b	4g	very dark grayish brown (10YR 4/1)	sandy loam	A horizon with low artifact density; artifacts are most likely present as a result of bioturbation of the overlying Stratum 3b.
	2Bt1b	4q	brown (10YR 5/3)	sandy loam	B horizon developed in an alluvial fan deposit; no artifacts noted.
	2Bt2b	4r	dark yellowish brown (10YR 4/6)	sandy loam	B horizon developed in an alluvial fan deposit; no artifacts noted.
	2Cb	4s	brown (10YR 5/3)	very gravelly loamy sand	C horizon developed in an alluvial fan deposit; no artifacts noted.

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Facies & Landform, by Trench	Soil Horizon	Stratum or Depth	Color	Texture	Description
Trench 1-6					
Hill slope Toe slope	C	0–1.8 m (0.0–6.0 feet)	brown	loamy sand	Possible slump; bisected by stream channel 1–1.5 m (3–5 feet) wide
	2Ab	1.8–2.9 m (6.0–9.5 feet)	dark brown	sandy loam	A horizon material; similar to A horizons within the site, but no artifacts were found in the trench.
Alluvial plain Floodplain	2Cb	2.9–3 m (9.5–10.0 feet)	green	silt	Marsh deposit; weak bedding, with increasing clay to the north.

Table A.5. LAN-211/H Unit Soils

Facies & Landform, by Unit	Soil Horizon	Stratum	Color	Texture	Description
Units 1–4					
Alluvial fan Bench	C1	2a	dark brown (10YR 3/3)	fine sandy loam	Modern alluvium and colluvium; appears to be redeposited A horizon material and sediment washing off of the hill slope to the south; may have been result of mechanical sculpting of hill slope to south.
	C2	2b	light grayish brown (10YR 6/2)	fine sandy loam	Historical-period/modern alluvium and colluvium; lenses of sand and thin layers (< 1 cm thick) of clay are present at the upper and lower contacts. Contains rusted nails and wire, suggesting a modern origin. May have been result of mechanical sculpting of hill slope to south.
	C3	2c	pale brown (10YR 6/3)	fine sandy loam	Alluvium and colluvium of undetermined age.
	2A1b	3a	very dark grayish brown (10YR 3/2)	sandy loam	A horizon with midden or artifacts in primary depositional context.
	2A2b	4a	dark grayish brown (10YR 4/2)	sandy loam	A horizon with low artifact density; artifacts are most probably present as a result of bioturbation of the overlying Stratum 3a.
	2A3b	4b	very dark grayish brown (10YR 4/1.5)	sandy loam	A horizon with low artifact density. Artifacts are most likely present as a result of bioturbation of the overlying Stratum 3a.
	2Bt1b	4c	dark grayish brown (10YR 4/2)	sandy loam	One of a series of clay layers (lamellae) developed in alluvial fan deposit (CB horizon); no artifacts noted.
	2CB1b	4d	brown (10YR 5/3)	fine sandy loam loamy sand	Predominantly C horizon with alternating lamellae (Bt horizon) developed in an alluvial fan; no artifacts noted.
	2Bt2b	4e	dark grayish brown (10YR 4/2)	sandy loam	One of a series of clay layers (lamellae) developed in alluvial fan deposit (CB horizon); no artifacts noted.
	2CB2b	4f	brown (10YR 5/3)	fine sandy loam loamy sand	Predominantly C horizon with alternating lamellae (Bt horizon) developed in an alluvial fan; no artifacts noted.
	2Bt3b	4g	dark grayish brown (10YR 4/2)	sandy loam	One of a series of clay layers (lamellae) developed in alluvial fan deposit (CB horizon); no artifacts noted.

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Facies & Landform, by Unit	Soil Horizon	Stratum	Color	Texture	Description
	2CB3b	4h	brown (10YR 5/3)	fine sandy loam loamy sand	Predominantly C horizon with alternating lamellae (Bt horizon) developed in an alluvial fan; no artifacts noted.
	2Bt4b	4i	dark grayish brown (10YR 4/2)	sandy loam	One of a series of clay layers (lamellae) developed in alluvial fan deposit (CB horizon); no artifacts noted.
	2CB4b	4j	brown (10YR 5/3)	fine sandy loam loamy sand	Predominantly C horizon with alternating lamellae (Bt horizon) developed in an alluvial fan; no artifacts noted.
	2Bt5b	4k	dark grayish brown (10YR 4/2)	sandy loam	One of a series of clay layers (lamellae) developed in alluvial fan deposit (CB horizon); no artifacts noted.
	2CB5b	4l	brown (10YR 5/3)	fine sandy loam loamy sand	Predominantly C horizon with alternating lamellae (Bt horizon) developed in an alluvial fan; no artifacts noted.
	2Bt6b	4m	dark grayish brown (10YR 4/2)	sandy loam	One of a series of clay layers (lamellae) developed in alluvial fan deposit (CB horizon); no artifacts noted.
	2CB6b	4n	brown (10YR 5/3)	fine sandy loam loamy sand	Predominantly C horizon with alternating lamellae (Bt horizon) developed in an alluvial fan; no artifacts noted.
Units 5–7 and 10					
Alluvial fan Bench	C1	2c	brown (10YR 4/3)	sandy loam	Modern alluvium and colluvium; appears to be redeposited A horizon material and sediment washing off of the hill slope to the south; may have been result of mechanical sculpting of hill slope to south.
	C2	2d	brownish yellow (10YR 6/6)	sandy loam	Historical-period/modern alluvium; may have been result of mechanical sculpting of hill slope to south.
	2A1b	3b	very dark grayish brown (10YR 3/2)	sandy loam	A horizon with midden or artifacts in primary depositional context.
	2A2b	4o	dark grayish brown (10YR 4/2)	sandy loam	A horizon with low artifact density and mixing of the overlying and underlying strata due to bioturbation.
	2A3b	4p	dark grayish brown (10YR 4/2)	loamy sand	A horizon lacking artifacts; predates occupation of the site.

Facies & Landform, by Unit	Soil Horizon	Stratum	Color	Texture	Description
Unit 9					
Alluvial plain Toe slope		1a	dark brown (10YR 3/3)	fine sandy loam	A horizon with midden or artifacts in primary depositional context.
		1b	light yellowish brown (2.5Y 6/4)	gravelly sand	Decomposed granite; commonly used on the Hughes Aircraft Company property as base for roads, runways, and parking lots.
	C1	5a	pale brown (10YR 6/3)	sand and silt	Alternating layers of C horizon with low artifact density. Artifacts are most likely present as a result of bioturbation of the overlying Stratum 3a. Well-sorted coarse to pale-brown sand capped by thin layers (up to 4 cm thick) of dark grayish brown (10YR 4/2) silt. Probably flood deposits capped by runoff from nearby slope, deposited in shallow standing water.
	C2	5b	pale brown (10YR 6/3)	sandy gravel	Poorly sorted course to fine sand mixed with pebbles and cobbles. Possibly stream-deposited gravel bar.
	2A1b	3c	very dark gray (10YR 3/1)	sandy loam	A horizon with midden or artifacts in primary depositional context.
Unit 11					
Alluvial fan Bench	A1	3d	dark brown (10YR 3/3)	fine sandy loam	A horizon with midden or artifacts in primary depositional context.
	A2	4e	light grayish brown (10YR 6/2)	sandy loam	A horizon with low artifact density. Artifacts are most likely present as a result of bioturbation of the overlying Stratum 3a.

Table A.6. Bucket Augers Containing Fill Soils or in Disturbed Contexts (Categories 3, 4, 5, and 6)

Bucket Auger	Soil Category	Auger Depth (AMSL) in m (feet)			Total Lithic Count	Total Faunal Weight (g)	
		Top	Bottom	Total		Vertebrate	Invertebrate
3	5	4.24 (13.9)	−0.06 (−0.2)	4.30 (14.1)	—	—	—
5	4	3.75 (12.3)	−0.15 (−0.5)	3.90 (12.8)	—	5	< 1
9	4	3.87 (12.7)	0.12 (0.4)	3.75 (12.3)	—	1	—
15	4	3.87 (12.7)	−0.49 (−1.6)	4.36 (14.3)	—	< 1	< 1
16	5	3.87 (12.7)	−0.03 (−0.1)	3.90 (12.8)	—	—	—
20	3	3.51 (11.5)	0.12 (0.4)	3.38 (11.1)	—	75	7
28[a]	4	4.30 (14.1)	0.37 (1.2)	3.93 (12.9)	—	21	3
32	3	2.47 (8.1)	−0.12 (−0.4)	2.59 (8.5)	—	122	9
33	3	2.77 (9.1)	0.03 (0.1)	2.74 (9.0)	1	17	1
34	3	3.26 (10.7)	0.09 (0.3)	3.17 (10.4)	—	64	9
36[a]	3	6.71 (22.0)	1.83 (6.0)	4.88 (16.0)	2	4	2
42	3	3.11 (10.2)	0.03 (0.1)	3.08 (10.1)	1	6	4
48	4	4.08 (13.4)	−0.24 (−0.8)	4.33 (14.2)	—	< 1	—
50[a]	5	2.68 (8.8)	1.01 (3.3)	1.68 (5.5)	—	< 1	—
51	3	3.23 (10.6)	−0.73 (−2.4)	3.96 (13.0)	—	14	< 1
52	3	3.84 (12.6)	1.04 (3.4)	2.80 (9.2)	1	19	2
60	3	3.11 (10.2)	−0.85 (−2.8)	3.96 (13.0)	1	18	7
62	3	3.87 (12.7)	−0.70 (−2.3)	4.57 (15.0)	—	188	10
66	5	2.23 (7.3)	−0.06 (−0.2)	2.29 (7.5)	—	—	—
80	4	3.68 (12.1)	−0.20 (−0.6)	3.87 (12.7)	—	—	1
84[a]	4	3.78 (12.4)	0.37 (1.2)	3.41 (11.2)	—	—	2
87	5	3.81 (12.5)	0.12 (0.4)	3.69 (12.1)	—	—	< 1
88[a]	6	3.29 (10.8)	0.37 (1.2)	2.93 (9.6)	—	—	—
92[a]	5	2.35 (7.7)	0.43 (1.4)	1.92 (6.3)	—	—	—
97	4	4.21 (13.8)	0.09 (0.3)	4.11 (13.5)	—	< 1	2
111	4	2.49 (8.2)	1.12 (3.7)	1.37 (4.5)	—	—	1
114	4	5.09 (16.7)	0.67 (2.2)	4.42 (14.5)	—	—	< 1
123	4	5.58 (18.3)	1.13 (3.7)	4.45 (14.6)	—	< 1	< 1
130	4	2.62 (8.6)	1.25 (4.1)	1.37 (4.5)	—	2	—
134	5	4.63 (15.2)	0.49 (1.6)	4.15 (13.6)	—	—	—
141	4	5.30 (17.4)	1.16 (3.8)	4.15 (13.6)	—	—	< 1
144	4	6.10 (20.0)	2.90 (9.5)	3.20 (10.5)	—	< 1	—
148	4	4.51 (14.8)	1.16 (3.8)	3.35 (11.0)	—	< 1	< 1
150	4	5.03 (16.5)	1.07 (3.5)	3.96 (13.0)	—	1	3
154	4	4.33 (14.2)	2.35 (7.7)	1.98 (6.5)	—	< 1	< 1
160	4	4.54 (14.9)	2.01 (6.6)	2.53 (8.3)	—	—	—

Bucket Auger	Soil Category	Auger Depth (AMSL) in m (feet)			Total Lithic Count	Total Faunal Weight (g)	
		Top	Bottom	Total		Vertebrate	Invertebrate
162	4	4.45 (14.6)	2.01 (6.6)	2.44 (8.0)	—	—	—
164	4	3.54 (11.6)	1.26 (4.1)	2.29 (7.5)	—	< 1	1
166	5	2.56 (8.4)	0.73 (2.4)	1.83 (6.0)	—	—	—
170	4	4.24 (13.9)	2.41 (7.9)	1.83 (6.0)	—	< 1	—
177	5	6.28 (20.6)	1.10 (3.6)	5.18 (17.0)	—	—	< 1
178	4	4.05 (13.3)	0.85 (2.8)	3.20 (10.5)	—	3	< 1
180	5	3.26 (10.7)	1.37 (4.5)	1.89 (6.2)	—	—	—
184[a]	4	3.96 (13)	1.92 (6.3)	2.04 (6.7)	—	< 1	—
186	5	3.90 (12.8)	1.58 (5.2)	2.32 (7.6)	—	—	—
190	4	3.17 (10.4)	−0.49 (−1.6)	3.66 (12.0)	—	< 1	< 1
191	4	3.32 (10.9)	1.19 (3.9)	2.13 (7.0)	—	—	—
194	4	5.91 (19.4)	1.92 (6.3)	3.99 (13.1)	—	< 1	< 1
195	4	3.84 (12.6)	1.10 (3.6)	2.74 (9.0)	—	—	< 1
197	5	3.18 (10.4)	1.65 (5.4)	1.52 (5.0)	—	< 1	< 1
204	4	4.08 (13.4)	1.95 (6.4)	2.13 (7.0)	—	< 1	< 1
208	4	3.32 (10.9)	0.12 (0.4)	3.20 (10.5)	—	< 1	—
213	4	5.73 (18.8)	2.59 (8.5)	3.14 (10.3)	—	—	< 1
214	4	3.72 (12.2)	1.43 (4.7)	2.29 (7.5)	—	< 1	< 1
216	5	2.92 (9.6)	1.55 (5.1)	1.37 (4.5)	—	—	—
224	4	4.36 (14.3)	1.80 (5.9)	2.56 (8.4)	—	< 1	< 1
229[a]	4	3.47 (11.4)	0.06 (0.2)	3.41 (11.2)	—	< 1	< 1
234	5	4.60 (15.1)	2.13 (7.0)	2.47 (8.1)	—	—	—
236	4	3.82 (12.5)	1.35 (4.4)	2.47 (8.1)	—	< 1	< 1
251[a]	3	3.78 (12.4)	0.82 (2.7)	2.96 (9.7)	5	2	6
252[a]	4	4.15 (13.6)	−2.26 (−7.4)	6.40 (21.0)	—	< 1	3
254	5	4.57 (15.0)	1.37 (4.5)	3.20 (10.5)	—	—	—
255	5	4.39 (14.4)	1.49 (4.9)	2.90 (9.5)	—	—	—
259[a]	4	3.90 (12.8)	1.10 (3.6)	2.80 (9.2)	—	24	< 1
266	5	4.94 (16.2)	1.92 (6.3)	3.02 (9.9)	—	—	—
267	5	4.82 (15.8)	2.23 (7.3)	2.59 (8.5)	—	—	—
271	5	4.54 (14.9)	2.56 (8.4)	1.98 (6.5)	—	—	—
274	5	4.57 (15.0)	2.53 (8.3)	2.04 (6.7)	—	—	—
291	4	4.48 (14.7)	1.89 (6.2)	2.59 (8.5)	—	—	—
201 (O2)	4	3.75 (12.3)	0.55 (1.8)	3.20 (10.5)	—	—	—
202 (O2)	4	3.66 (12.0)	1.07 (3.5)	2.59 (8.5)	—	—	—
203 (O2)	4	3.81 (12.5)	0.85 (2.8)	2.96 (9.7)	—	—	—

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Bucket Auger	Soil Category	Auger Depth (AMSL) in m (feet)			Total Lithic Count	Total Faunal Weight (g)	
		Top	Bottom	Total		Vertebrate	Invertebrate
204 (O2)	4	3.63 (11.9)	1.22 (4.0)	2.41 (7.9)	—	—	—
205 (O2)	4	3.75 (12.3)	1.43 (4.7)	2.32 (7.6)	—	—	—
206 (O2)	4	3.47 (11.4)	1.19 (3.9)	2.29 (7.5)	—	—	—
207 (O2)	4	3.99 (13.1)	0.58 (1.9)	3.41 (11.2)	—	—	—
208 (O2)	4	3.93 (12.9)	0.91 (3.0)	3.02 (9.9)	—	< 1	< 1
209 (O2)	4	4.24 (13.9)	0.79 (2.6)	3.44 (11.3)	—	—	—
210 (O2)	3	3.41 (11.2)	1.07 (3.5)	2.35 (7.7)	—	< 1	—
215 (O2)	4	8.26 (27.1)	0.34 (1.1)	7.92 (26.0)	—	—	—
216 (O2)	5	4.94 (16.2)	0.24 (0.8)	4.69 (15.4)	—	< 1	—
217 (O2)	4	5.43 (17.8)	0.73 (2.4)	4.69 (15.4)	—	—	—
218B (O2)	5	5.61 (18.4)	0.73 (2.4)	4.88 (16.0)	—	—	< 1
220 (O2)	5	2.19 (7.2)	0.37 (1.2)	1.83 (6.0)	—	—	—
221 (O2)	5	0.55 (1.8)	−1.07 (−3.5)	1.62 (5.3)	—	—	1
222 (O2)	4	4.88 (16.0)	0.58 (1.9)	4.30 (14.1)	—	—	—

[a] 12-inch buckets; all others are 16 inch.

APPENDIX B

Beads and Ornaments from LAN-211/H and LAN-1932/H

Unit, by Site	Quad.	Lev.	PD	Cat. No.	Material	Description	Type [a]	L [b]	W [b]	Th [b]	Perforation		Mod.
											Size [b]	Type	
LAN-211/H													
4		3	27	12	glass	cobalt cane bead	C1a	3.1	3.2	1.3	1.1	s	n
4		5	130	532	stone	steatite disk	—	5.6	11.1	2.3	—	—	—
4		9	80	4	glass	green cane bead	C3a	3.0	3.2	2.5	1.0	s	n
5		2	50	8	glass	red with green interior	C6a	3.8	3.9	2.3	1.1	s	n
5		4	59	20	glass	green cane bead	C3a	3.2	3.3	2.0	1.0	s	n
5		8	78	10178	*Olivella biplicata*	disk fragment	G2?	4.3	0.0	0.8	1.2	b	n
6		2	51	11	glass	copper blue cane bead	C2a	2.9	2.9	2.5	1.2	s	n
6		3	53	20	glass	clear cane bead	C5a	3.3	3.6	2.6	1.1	s	n
6		4	60	16	glass	cobalt cane bead	C1a	3.6	3.8	4.0	1.2	s	n
6		4	88	19	glass	red wire wound	W6e	7.0	7.0	6.6	2.3	s	n
7		3	61	14	glass	cobalt cane bead	C1a	3.5	3.9	2.4	1.2	s	n
7		3	61	221	*Haliotis* sp.	shell frag with asphaltum	—	10.0	20.0	—	—	—	n
8		1	49	1	glass	green cane bead	C3a	2.9	3.0	2.1	1.2	s	n
8		4	66	1427	stone	steatite disk	—	—	—	1.3	—	—	—
8		5	70	9	glass	red with green interior	C6a	3.5	3.6	2.6	1.3	s	n
8		5	70	13	glass	cobalt cane bead	C1a	3.0	3.1	2.1	1.0	s	n
8		8	82	15	glass	cobalt cane bead	C1a	3.1	3.3	1.9	1.0	s	n
9		1	88	18	glass	copper blue cane bead	C2a	3.0	3.2	2.2	0.9	s	n
9		1	89	17	glass	copper blue cane bead	C2a	3.2	3.3	2.6	1.2	s	n
9	NE	1	89	10180	*Olivella biplicata*	rough disk	H2a	5.1	5.2	0.9	1.1	b	n
9	NE	1	89	10181	*Olivella biplicata*	thin lip oval	E1b	6.3	7.1	2.1	2.2	b	n
9		1	90	5	glass	green cane bead	C3a	3.2	3.6	2.5	1.3	s	n
9		1	90	6	glass	green cane bead	C3a	3.5	3.6	3.2	1.2	s	n
9	SE	1	90	15000	*Olivella biplicata*	rough disk	H2a	4.2	5.5	0.9	1.0	s	n
9	SW	1	90	10194	*Olivella biplicata*	ground disk	H1a	5.0	0.0	0.9	1.0	b, s?	n
9	SE	1	90	10195	*Olivella biplicata*	semiground disk	H1b	4.7	5.0	1.3	1.2	b80v	n
9	SW	1	90	10196	*Olivella biplicata*	cup	K1	4.7	0.0	1.6	1.8	c	y
9		1	90	1016	stone	steatite disk	—	4.0	4.0	1.4	—	—	—
9	SW	1	91	10186	*Olivella biplicata*	rough disk	H2a	5.4	5.6	0.8	1.1	b	n

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Unit, by Site	Quad.	Lev.	PD	Cat. No.	Material	Description	Type [a]	L [b]	W [b]	Th [b]	Perforation		Mod.
											Size [b]	Type	
9	SW	1	91	10187	*Olivella biplicata*	cup with diagonal incising	K1	4.0	4.1	1.8	1.5	c, v	n
9	SW	1	91	10188	*Olivella biplicata*	cup with diagonal incising	K1	3.9	4.0	1.3	1.3	b80v	n
9	SW	1	91	10189	*Olivella biplicata*	tiny saucer	G1	3.4	3.5	1.2	1.3	c, v	n
9	SW	1	91	10190	*Haliotis rufescens*	disk epidermis	—	4.9	5.0	1.4	1.2	b	n
9	SW	1	91	10191	*Olivella biplicata*	tiny saucer	G1	3.3	3.4	1.0	1.4	c, v,	n
9	SW	1	91	10192	*Olivella biplicata*	spire removed, large	A1c	11.2	0.0	19.4	2.2	—	n, Sg
9		2	10	10	glass	copper blue cane bead	C2a	3.6	3.7	3.0	1.1	s	n
9	NW	2	99	10197	*Olivella biplicata*	cup	K1	3.6	0.0	1.9	1.3	c, v	y
9	NW	2	99	10198	*Olivella biplicata*	tiny saucer	G1	3.5	4.0	1.3	1.4	c, v	n
9	NE	2	100	71	Veneridae	unmodified fragments	—	—	—	—	—	—	n
9	NE	2	100	10199	*Olivella biplicata*	rough disk	H2a	4.3	4.9	1.2	1.1	b	y
9	NE	2	100	10200	*Olivella biplicata*	disk	—	4.7	5.8	1.8	1.0	b	n
9	NE	2	100	10201	*Olivella biplicata*	cup	K1	3.6	3.7	2.0	1.6	b70v	y
9	NE	2	100	10202	*Olivella biplicata*	cup	K1	3.9	4.0	1.9	1.8	b80v	n
9	NE	2	100	10203	*Olivella biplicata*	ground disk	H1a	4.4	4.9	0.9	1.1	s	n
9	SE	2	100	10204	*Olivella biplicata*	tiny saucer	G1	3.4	3.5	1.0	1.3	b	n
9		2	101	7	glass	green cane bead	C3a	2.5	2.6	1.8	1.3	s	n
9	NE	2	101	304	Veneridae	unmodified fragments	—	—	—	—	—	—	n
9	SE	2	101	10205	*Olivella biplicata*	full lip fragment	E2	8.5	0.0	2.1	2.0	c, v	n
9	SE	2	101	10206	*Olivella biplicata*	saucer?	G2	8.1	0.0	1.8	2.0	s	n
9	SE	2	101	10207	*Olivella biplicata*	full lip fragment	E2a	10.0	0.0	2.8	2.2	c, v	n
9	SE	2	101	10208	*Olivella biplicata*	rough disk	H2	5.3	5.6	1.3	1.1	b	n
9	SE	2	101	10209	*Olivella biplicata*	rough disk	H2	4.8	4.9	1.0	1.0	s	n
9	SE	2	101	10210	*Olivella biplicata*	cup with diagonal incising	K1	3.6	3.8	1.3	1.2	c, v	n
9	SE	2	101	10211	*Olivella biplicata*	cup	K1	3.8	4.0	1.7	1.7	c, v	n
9	SE	2	101	10212	*Olivella biplicata*	tiny saucer	G1	3.4	3.5	1.0	1.2	c, v	n
9	SE	2	101	10213	*Olivella biplicata*	tiny saucer	G1	3.5	4.2	0.9	1.6	b	y
9	SE	2	101	10214	unidentified shell	waterworn/burnt fragment	—	8.8	0.0	1.6	0.0	—	y
9	SE	2	101	10215	*Haliotis* sp.	worked shell, fishhook?	—	16.1	0.0	3.1	0.0	b	n
9	SW	2	102	10182	stone	steatite disk	—	3.9	4.0	1.3	1.5	b	n
9	SW	2	102	10184	*Olivella biplicata*	cup with diagonal incising	K1	3.5	3.5	1.5	1.2	c, v	n

Unit, by Site	Quad.	Lev.	PD	Cat. No.	Material	Description	Type [a]	L [b]	W [b]	Th [b]	Perforation		Mod.
											Size [b]	Type	
9	SW	2	120	10183	*Haliotis rufescens*	disk epidermis	—	3.5	3.6	1.3	1.2	b	n
9		3	88	3	glass	green cane bead	C3a	3.5	3.6	2.1	1.2	s	n
9	SW	3	103	10185	*Olivella biplicata*	irregular wall disk	—	3.8	3.9	0.6	1.2	b	n
11	S	1	133	10216	*Olivella biplicata*	irregular wall disk	—	4.4	5.3	1.5	0.8	s	n
11	S	3	136	10217	*Olivella biplicata*	semiground disk	H1b	4.0	4.4	0.6	1.1	s	n
11	N	3	137	10218	*Olivella biplicata*	semiground disk	H1b	4.8	5.3	1.0	1.1	s	n
LAN-1932/H													
6		2	16	139	*Olivella biplicata*	full lip	E2a	7.8	9.8	3.6	2.2	b90v	n
6		2	16	140	*Olivella biplicata*	fragment, lip?	E	0.0	4.8	1.8	3.0	c, v	n
7		2	19	141	*Olivella biplicata*	full lip	E2a	6.8	7.4	3.3	2.0	c, v	n
9		2	18	142	*Olivella biplicata*	full lip	E2a	6.7	7.5	2.9	1.9	b80v	n
9		2	20	143	*Olivella biplicata*	full lip	E2a	8.7	9.2	3.0	2.4	b80v	n
10		2	20	144	unidentified shell	disk	—	3.3	3.4	1.3	1.3	b	n
11		2	21	145	*Olivella biplicata*	tiny saucer	G1	2.9	3.4	0.8	1.2	b	n
13		2	23	146	*Olivella biplicata*	thin lip round	E1a	6.0	5.6	2.4	2.2	b80v	n
13		2	23	147	*Olivella biplicata*	tiny saucer	G1	3.9	4.0	1.0	1.4	b60v	y
13		2	23	148	*Olivella biplicata*	wall disk with abraded perforation	—	5.5	6.1	0.9	1.4	p	n
13		2	23	149	*Olivella biplicata*	oblique spire-removed	A2a	9.4	0.0	5.9	2.0	—	n, Sg
14		2	24	150	*Olivella biplicata*	thin lip oval	E1b	7.2	8.1	2.8	2.4	b60v	n
14		2	24	151	*Olivella biplicata*	thin lip round	E1a	5.4	5.7	2.2	2.0	c, v	n
15		2	29	152	*Olivella biplicata*	cup	K1	2.9	3.0	1.7	1.4	c, v	n
16		2	28	153	*Mytilus californianus*	disk	—	3.6	3.7	1.3	1.4	b	n
16		2	28	154	*Olivella biplicata*	cup with diagonal incising	K1	3.3	3.5	1.5	1.4	c, v	n
18		2	26	155	*Olivella biplicata*	cup	K1	3.6	3.7	1.4	1.2	c, v	n
21		2	30	156	*Olivella biplicata*	thin lip oval	E1b	7.1	7.8	3.0	2.2	b80v	n
21		2	30	157	*Olivella biplicata*	cup with “X” incising	K1	3.3	3.6	2.2	1.4	c, v	n
22		2	31	158	*Olivella biplicata*	full lip	E2a	6.8	7.6	2.6	2.4	b80v	n
22		2	31	159	*Olivella biplicata*	disk	—	4.1	4.2	1.7	1.3	b	n
22		2	31	160	*Olivella biplicata*	disk	—	3.0	3.0	1.0	1.3	s	n
23		2	32	93	*Olivella biplicata*	deep large lip	E3b	8.2	9.7	3.2	2.3	c, v	n

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Unit, by Site	Quad.	Lev.	PD	Cat. No.	Material	Description	Type [a]	L [b]	W [b]	Th [b]	Perforation		Mod.
											Size [b]	Type	
23		2	32	94	*Olivella biplicata*	full lip	E2a	7.1	7.9	3.3	2.4	b80v	n
23		2	32	95	*Olivella biplicata*	thin lip oval	E1b	6.6	6.7	2.4	2.4	b80v	n
23		2	32	161	*Olivella biplicata*	thin lip oval	E1b	5.0	5.8	1.7	2.0	c, v	n
24		2	33	96	unidentified shell	worked shell disk	—	6.3	6.5	1.5	—	—	n
24		2	33	97	*Olivella biplicata*	cup	K1	3.4	3.6	1.5	1.5	c, v	n
24		2	33	98	*Olivella biplicata*	semiground disk	H1b	4.2	4.4	1.0	1.0	s	n
25		2	34	99	*Olivella biplicata*	lip bead	E2a	—	—	—	—	—	n
25		2	34	100	*Olivella biplicata*	wall disk	J	4.0	4.6	0.9	1.2	b	n
25		2	34	101	*Olivella biplicata*	tiny saucer	G1	3.4	4.3	0.8	1.3	b60v	n
25		2	34	102	unidentified shell	disk	—	5.6	0.0	1.2	1.4	b	n
26		2	35	103	*Olivella biplicata*	tiny saucer	G1	3.6	3.8	0.8	1.4	b	n
26		2	35	104	*Olivella biplicata*	tiny saucer	G1	3.4	3.5	1.2	1.5	c, v	n
26		2	35	105	*Olivella biplicata*	fragment, lip?	E2a	8.2	—	1.7	2.0	b	y
27		2	36	1000	glass	green cane bead	C3a	3.1	3.3	3.3	1.0	s	—
27		2	36	106	*Olivella biplicata*	wall disk	J	3.9	4.1	0.9	1.0	b?	n
27		2	36	107	*Olivella biplicata*	cup	K1	3.3	3.4	1.7	1.5	b80v	n
28		2	37	114	unidentified material	natural fragment	—	—	—	—	—	—	—
29		2	38	108	*Olivella biplicata*	thin lip round	E1a	4.3	4.6	2.0	2.3	c, v	n
29		2	38	109	*Olivella biplicata*	cup	K1	4.0	4.1	1.9	1.6	b80v	n
29		2	38	110	*Olivella biplicata*	full lip	E2a	7.3	8.1	2.5	2.1	b80v	n
29		2	38	111	*Olivella biplicata*	full lip	E2a	—	—	—	—	—	n
30		2	40	112	*Tivela stultorum*	natural fragment	—	6.8	—	4.9	—	—	n
30		2	40	113	*Tivela stultorum*	shell with scratches	—	19.1	—	4.0	—	—	n
Trench 10		1	101	6108	canid tooth	drilled	—	22.9	8.8	—	1.58	—	—

[a] *Olivella* beads typed using Bennyhoff and Hughes (1987); glass beads typed using the Buenaventura Mission typology (Gibson 1976).
[b] All dimensions in millimeters.
Key: Cat. No. = catalog number; L = length or diameter; Lev. = level; Mod. = modification types; PD = provenience designation; Quad = quadrant; Th = thickness; W = width or diameter
Perforation key: b = biconical, c = conical, p = perpendicular, s = straight, number indicates percent of perforation drilled from either the ventral (v) or dorsal (d) face
Modification key: n = not burnt, y = burnt, Sg = spire ground

APPENDIX C

A Lithic Research Design for the Ballona Lagoon Archaeological District

Robert G. Elston

This research design is for the study of lithic artifacts recovered during the Playa Vista Archaeological and Historical Project (PVAHP) in the Ballona Lagoon Archaeological District (BLAD). The archaeological record of the Ballona is large and complex, yet important questions remain to be answered there. Many of these questions can be subsumed under four broad topics: chronology, relationships between people of the Ballona and those of the great coast and inland deserts, tool function, and the nature of Ballona settlement and subsistence.

In the following discussion, I first outline our theoretical orientation for Ballona lithic studies, and then discuss a series of key questions regarding Ballona lithics, framing hypotheses and expectations for each. I identify the classes of data required to operationalize each research question and test each hypothesis, and specify the methods of data collection and analysis to be employed.

Theoretical Orientation and Research Questions

As objects of study, lithic artifacts have both positive and negative qualities. For example, they preserve no genetic material nor utter any phonemes. Unlike organic remains, lithic artifacts do not directly reflect diet. Lithic tools may comprise a limited range of functions, and these are often difficult to pin down. Many lithic artifacts were components of composite tools (e.g., projectile points) of which the organic parts have not survived. Compared to organic remains, however, lithics are resistant to decay and transformation, and are much more likely to be preserved in the archaeological record. Lithic tools often exhibit relatively unambiguous evidence of manufacturing processes and maintenance strategies. Stages of lithic tool manufacture and maintenance are often time-transgressive (at scales of days to months), and performed at different places in landscapes, thus contributing to lithic assemblage variability. Tool stone can be linked to its source to inform of its economic value and place in the sphere of annual range and regional relationships.

Lithic artifacts are the material consequences of ideas, decisions, strategies, and behaviors by which people have interacted with, and modified, their environment. Deriving prehistoric behavior from the study of lithic artifacts requires frameworks linking archaeological residues to systems of human culture and adaptation. One is a cultural-temporal framework in which change through time and space can be monitored (e.g., Moratto 1984). Another framework is that of middle range theory (Binford 1977a) constructed from experimental and ethnographic data, allowing assignment of tool function from morphology and wear patterns (e.g., Keeley 1980). A third framework known as technological organization (Bamforth 1991a, 1991b; Binford 1977b, 1979; Bleed 1986; Elston 1986b, 1992a; Johnson and Morrow 1987; Kelly 2001), is emphasized in this research design. Technological organization informs of settlement and subsistence by focusing on strategies for procuring, manufacturing, using, transporting, and discarding raw materials and tools (Nelson 1991:57). By such strategies folks respond to problems encountered in their physical, biological, and social environments (Carr 1994b:1); for example, the distribution, abundance, and predictability of food resources, and constraints on access to them.

The study of technological organization requires several assumptions. First, we assume that variation in the contexts of activities (both within and between sites and localities) is a primary source of variability in archaeological lithic assemblages (artifact density, presence or absence of tool or debitage types, proportions of various artifact classes and raw materials, and so on). We also assume that human individuals are decision makers within a variable environment who try to maximize fitness by improving cost/benefit ratios of choices, including technological ones (Boone and Smith 1998). Finally, we assume that residential mobility strongly conditions the economics of tool stone procurement and use.

Lithic Technology and Temporal-Cultural Boundaries

Lithic technology figured importantly in southern California archaeology from its beginning, used to define and trace, largely on the basis of shared lithic technological and typological traits, spatial and temporal distributions of prehistoric cultures, complexes and phases (e.g., Campbell et al. 1937; Elsasser 1978; Kowta 1969; Moratto 1984; D. B. Rogers 1929; M. Rogers 1939; Treganza and Bierman 1958; Wallace 1962, 1978). Of course, constructing and refining culture histories and temporal frameworks remain essential tasks of archaeology, and since we are interested in change (or lack thereof) through time in the Ballona, we must also define salient technological and stylistic attributes and develop chronological control independent of change in technology or style.

Ballona Chronology

The chronology of human occupation in the Ballona is poorly understood because existing chronological data are patchy (cf. Altschul, Homburg, and Ciolek-Torrello 1992; Altschul et al. 1999; Altschul et al. 2003). To date, evidence of early Holocene occupation in the Ballona has failed to materialize. However, surveys in the 1940s and 1950s identified 15 sites on upper Ballona Creek and two sites on the Del Rey bluff top (LAN-61 and LAN-206) with Millingstone period components (milling stones, cog stones, large tanged projectile points) that could date as early as 7500 B.P. (Ciolek-Torrello and Grenda 2001). Many questions remain about the precise time of initial occupation, the frequency of occupation during the Millingstone period, whether there is gap in bluff-top occupation between 4700 and 3000 B.P., and the timing of bluff-top abandonment and occupation of lowland sites. In contrast to bluff-top sites, lowland sites have many fewer radiocarbon dates, and no obsidian hydration studies of artifacts. Samples of lithic artifacts from securely dated contexts (stratified deposits; discrete, well-dated features) are uncommon. Thus, whereas regional studies have established temporal boundaries for several coastal and interior lithic technologies and artifact types such as microlithics, cog and disk stones, milling stones, mortars, scraper planes, and certain projectile point types (Arnold 1987b; Arnold, ed. 2001; Ciolek-Torrello and Grenda 2001; Koerper, Schroth, Mason, and Peterson 1996; Koerper et al. 1994; Kowta 1969; Moratto 1984; Van Horn 1990; Vaughn and Warren 1987), the lack of fine chronological control in the Ballona makes it difficult to correlate local and regional lithic technologies and types. Absolute age estimates for lithic artifacts may be available through radiocarbon assay and relative dates through stratigraphic position and obsidian hydration.

• *Can obsidian hydration provide relative dates for obsidian artifacts?*

Obsidian hydration is a technique for direct dating of artifact that takes advantage of the propensity for freshly exposed glass surfaces to absorb atmospheric water vapor (hydration) at a rate dependent on the effective hydration temperature (EHT) and glass chemistry (see Gilreath and Hildebrandt 1997 for a recent review). The EHT is the mean annual temperature (MAT) to which the glass has been exposed since the fresh surface was created. Hydration changes the refractive index of the glass to produce a hydration "band" or "rim" visible and measurable in thin section (hydration value), the thickness of which is proportional to hydration time since the creation of the fresh surface. However, the rate at which the hydration rind develops is not linear, and many factors may influence it. For example, EHT varies with climate and depth of burial. Artifacts in the same site that have been repeatedly exposed and buried will experience a different EHT than artifacts deeply buried, or those remaining on the surface. Scavenging, use, and maintenance of older artifacts may create younger surfaces on them that can be confusing. The difficulty of controlling all of the variables affecting hydration rates has led to the development of empirical hydration curves derived from paired hydration values and radiocarbon dates (Basgall 1990). Most of the obsidian in Ballona assemblages is believed to come from the Coso Volcanic Field, south of Owens Valley. The equation describing the curve for obsidian from Coso is:

$$\text{LOG } Y = (2.32 (\text{LOG}(X * a)) + 1.50$$

Where,

Y = years before present
X = hydration value in microns
a = EHT correction factor for climate zone

The EHT correction factor is an empirically derived number that "corrects" for differences in MAT due to climate; the larger the number, the higher the MAT. Several of these correction factors have been derived (Basgall 1990), including one for Malibu (0.9946) that should apply to obsidian from the Ballona.

As a test, I compiled the obsidian hydration data from Van Horn's (1987) excavation of bluff-top sites as given in Freeman (1991). Box plots of the 156 raw hydration values by site are shown in Figure C.1. The plots suggest that LAN-59 has the smallest values and LAN-61A the greatest (with the exception of three very large values from LAN-63). A one-way ANOVA test on the raw values confirms that the mean hydration value of LAN-59 (4.048) is significantly lower from LAN-61 (undifferentiated), LAN-61A, LAN-61B, and LAN-63 ($p < .05$–.001). When the raw values are converted to years before present using the equation given above, however, the differences between sites as shown in box plots (Figure C.2) seem less. This is confirmed by a one-way ANOVA test in which the only significant difference between sites is that between LAN-59 and LAN-63 ($p = .0083$). The box plots for LAN-63 (see Figures C.1 and C.2) indicates that this is entirely due to the three very large hydration values from this site, almost certainly from unmodified or natural surfaces on the artifacts. Figure C.3 is a histogram of all years B.P. age estimates for bluff-top sites. This plot suggests a bimodal distribution, with several age estimates falling between 6,000 and 3,500 years B.P., the majority in the 3500–1000 B.P. range, and a few between 1000 and 0 B.P. These estimates are quite similar to those derived from radiocarbon dates (Altschul et al. 2003; Van Horn 1987) suggesting infrequent Early period occupation of the bluff-top, intensive use of the bluff-top during the Intermediate period (3000–1000 B.P.), and infrequent occupation thereafter.

This analysis should be viewed with caution since the number of samples from any particular site is small, no hydration values are from lowland sites, and no chemical identification of the obsidian

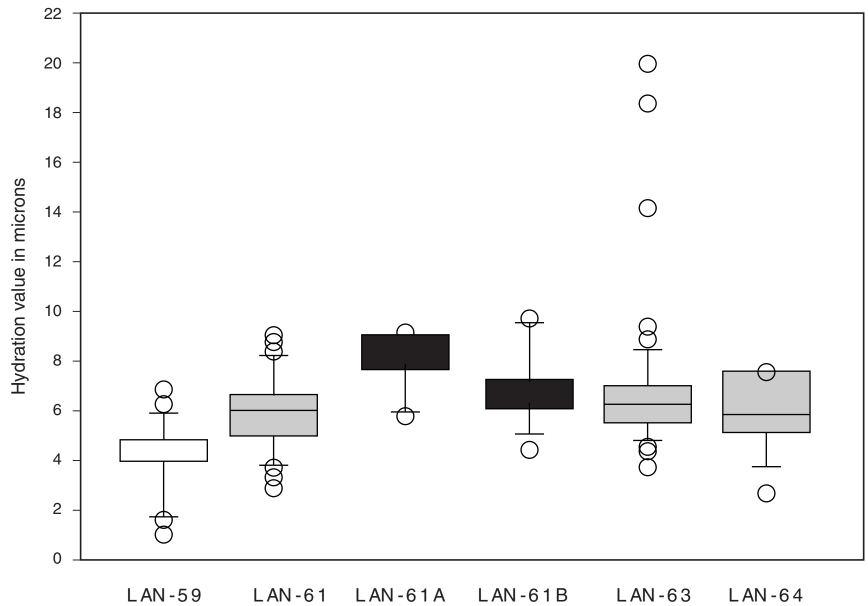

Figure C.1. Box plots of obsidian hydration readings from various bluff-top sites and localities.

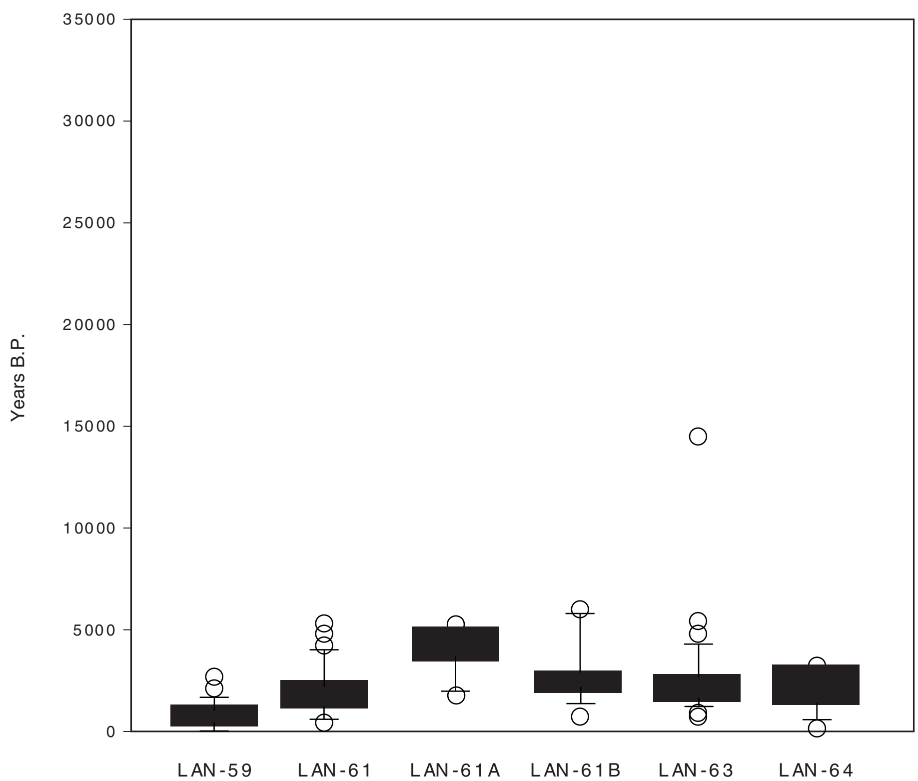

Figure C.2. Box plots of obsidian hydration dates from various bluff-top sites and localities.

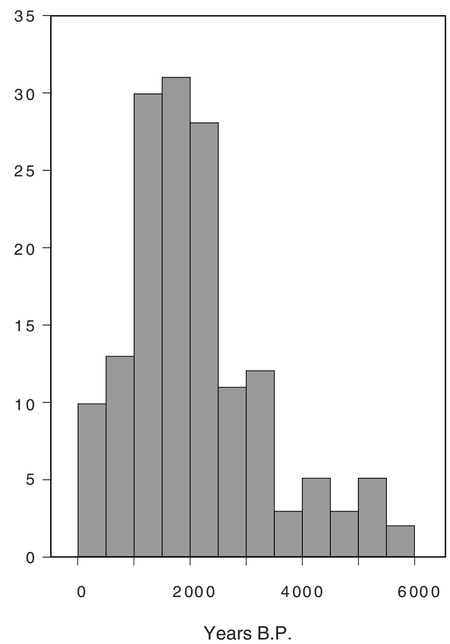

Figure C.3. Bimodal distribution of obsidian hydration dates from bluff-top sites.

source(s) have been made. Nevertheless, it demonstrates the potential of obsidian hydration analysis as a chronological tool in the Ballona.

Data Needs

Additional hydration data are required, both to increase sample size for the bluff-top sites, as well as to obtain the first such data from lowland sites. As a first step, all formed obsidian artifacts (bifaces, projectile points, drills, etc.) and a sample of debitage should undergo X-ray fluorescence for chemical identification of the tool stone source (Gilreath and Hildebrandt 1997; Hughes 1984). Each of these artifacts should then be cut and hydration values observed. If insufficient formed artifacts are recovered, items of debitage can be substituted. Ideally, hydration values can be obtained from all sites, as well as from all significant stratigraphic divisions and discrete features within individual sites. Every effort should be made to obtain chemical identification of the Ballona artifacts for which hydration values have already been obtained (Freeman 1991).

• *Is morphological variability among Ballona projectile points temporally sensitive?*

This question has two parts. One is whether there is local temporal variation among projectile points. The second part of the question is to what degree morphological variability among Ballona points is correlated with that of extra-regional points, particularly those from the California Desert, which many archaeologists believe to be time sensitive.

Variation of the first kind appears to be likely for arrow points, but presently not well demonstrated. Small leaf-shaped Canaliño points and Cottonwood Triangular points are thought to be coeval with the Late and protohistoric periods, 1000–350 B.P. (Towner 1992; Van Horn 1983; 1984; Van Horn and Murray 1985). The temporal placement of the somewhat larger stemmed and corner-notched Marymount points (Van Horn 1983, 1990) is more problematic. Van Horn argues that this type postdates 1500 B.P. because: (1) the points are arrow points; (2) the points are found primarily in the upper parts of the bluff-top middens; (3) the points are typologically equivalent to the Rose Spring Corner-notched type of interior California and the western Great Basin which dates between 1300 B.P. and 700 B.P. (Thomas 1981). However, Altschul (personal communication 2001) observes that Marymount points are not restricted to the upper middens, and could be much older than 1500 B.P. Review of illustrated points (Towner 1992; Van Horn 1983, 1987, 1990; Van Horn and Murray 1985) suggests that considerable variability is rolled into the Marymount type. Treatment of the base and stem ranges from contracting stems and sloping shoulders to deeply corner notched. Larger Marymount points may grade into smaller Gypsum or Elko points, which substantially predate 1500 B.P. in interior California. Similarly, side-notched points are grouped together but differ greatly in size, treatment of the base, and shape and placement of notches. Some resemble Desert Side-notched points of the interior deserts (Thomas 1981), whereas larger specimens resemble Large Side-notched points of the Santa Barbara Extraños phase dating between 5000–4500 B.P. (Moratto 1984). Other large points from the Ballona resemble point styles (Lake Mojave, Pinto, and Gypsum) used in the interior deserts through the early and mid-Holocene. The lack of formally described Ballona point types complicates any attempt at extra-regional correlation with more tightly defined point types of the California Desert and Great Basin.

Another complication in such correlation is that the temporal significance of projectile point morphology in the Great Basin and California has been a matter of some controversy. Archaeologists working in the central and western Great Basin observed what they interpreted as temporally bound morphological change among Great Basin dart and arrow points. During particular intervals, hunters tended to make points that varied little outside a certain formal range. When it occurred, change to a new form was relatively rapid and complete (i.e., Rose Spring replaced by Desert and Cottonwood points), sometimes driven by change in technology (darts to arrows), but more often inexplicable (or unexplained). This formal variation was described in terms of named point "styles," ordered chronologically through seriation and radiocarbon dated stratigraphy (Heizer and Hester 1978). The Berkeley point typology was further refined and formalized by D. H. Thomas (1981) who devised a hierarchical key for Monitor Valley projectile points.

There are problems with this scheme: one is that while the Thomas (1981) key was developed specifically for use in the central Great Basin, it is applied widely through the Great Basin and adjacent parts of California with sometimes little success (cf. Eighmey 1998; Koerper et al. 1994). In addition, the time range of side-notched and corner-notched dart points begins much earlier in the eastern and northern Great Basin than elsewhere (Beck 1995). However, the most serious critique is by Flenniken and his associates (Flenniken and Raymond 1986; Flenniken and Wilke 1989; Titmus and Woods 1986; Wilke and Flenniken 1991), who argue that reworking destroys morphological continuity on dart points. Flenniken and Wilke (1989) later suggested that all Great Basin Archaic dart points began as one of two "prototypes" and all of the various "types" are the result of reworking these two. However, subsequent analysis of archaeological assemblages by other Great Basin archaeologists does not support these claims (Basgall and Hall 2000; Beck 1995; Bettinger et al. 1991; Elston and Budy 1990; Hockett 1995; O'Connell and Inoway 1994). Moreover, Wilke and Flenniken (1991) seem unable to suggest further tests of their hypotheses using archaeological data of the type we are ever likely to observe.

This impasse is far beyond the scope of the Ballona project, but we are well advised to think about other approaches to morphological variability among points and its chronological order (if any). Both ethnographic and archaeological data (see Bartram 1997; Ellis 1997; Elston 1986c:Figure 6; Greaves 1997; Griffin 1997; Hitchcock and Bleed 1997; Keeley 1982; Warren and Crabtree 1986:Figure 5; Wiessner 1983) suggest that projectile construction and point morphology are very much constrained by function and economics. Arrows and darts are composite tools; because the costs of the parts are unequal (Keeley 1982), strategies for conserving or expending different components are likely to vary with type of prey hunted and its economic importance, risks involved, access to tool stone, and so on. Considering these elements from the perspective of design theory (Bleed 1986; Nelson 1997) may allow us to provide, in addition to rejuvenation (Koerper et al. 1994), additional explanations for the considerable morphological variability of coastal dart points.

For example, consider that even though stone points are costly to make, they are less expensive than the fletching, or shaft/foreshaft. Some projectiles are merely a sharpened shaft, or employ a sharpened foreshaft (cf. Bartram 1997; Elston 1986c:Figure 6). But when a stone point is mounted, the shaft/foreshaft must be made to accommodate the particular hafting strategy used (which determines whether points have stems or not, or notches or not, and where these are located), and the hafting strategy may be functionally significant (Christenson 1997). For example, unnotched and contracting stem points can be inserted into sockets or notched shafts with mastic; sinew may be used to bind the shaft to keep it from splitting, but does little to secure the point, which is likely to detach inside the prey once the mastic becomes warmed (cf. Warren and Crabtree 1986:Figure 5). Notched points, secured with both mastic and sinew, are less likely to detach in the prey unless broken. A broken notched point, rejuvenated into an unnotched form, will not function in the same way as the notched point; indeed, it may not fit the shaft element designed for a notched point, and may change the overall balance of the projectile. Thus, in situations where hunting is economically important, we might expect to find less variability in stone points than in situations where game resources are less critical and hunters are relatively indifferent to weapon performance or need for replacement of points with narrow functional requirements.

Data Needs

To determine if point morphology is temporally sensitive requires collection of two kinds of data. First, detailed morphological data must be collected for all Ballona projectile points, following Thomas (1981); the data to be collected are described in the Laboratory Procedures for Lithic Artifacts section (see below). Three independent approaches to projectile point taxonomy will be employed. In one approach, points will be manually sorted into groups on the basis of overall size, shape, and raw material. To see how closely Ballona points resemble “desert” point styles, and independently of the manual sort, we will run all the Ballona point data through keys that distinguish among those types (e.g., Basgall and Hall 2000; Thomas 1981; Vaughn and Warren 1987), and compare the Ballona data to type descriptions of point styles lacking keys. Attributes of both keyed and manually sorted groups will be compared using the t-statistic. A third check for patterned variability will be subjecting the nominal data to cluster analysis following Basgall and Hall (2000).

Having specified what we think is relevant variability among Ballona points, we must test these hypotheses against temporal data: every obsidian point will be chemically identified as to source by X-ray fluorescence (Gilreath and Hildebrandt 1997; Hughes 1984), and cut to observe hydration value(s). Since some point styles (e.g., Marymount) are preferentially made of fused shale or chert, rather than obsidian, it will be critical to analyze projectile points with regard to stratigraphic position and association with radiocarbon dates.

• *Are other Ballona lithic technologies time sensitive?*

Towner (1992) describes four basic flaked stone technologies employed in the Ballona: biface, flake core, bipolar core, and microlith. To these must be added ground stone and drilled stone (Brown and Freeman 1991).

The most unique is microlithic technology. True microliths are rare in North America south of the Arctic, and are associated with manufacture of shell beads in the late Woodland and Mississippian societies of the Southeast and in coastal southern California (Arnold, ed. 2001; Parry 1994; Pope 1994). On the California coast, Arnold (Arnold 1987b; Arnold et al. 2001) has documented two phases of microlithic development. Small flake drills appeared on Santa Cruz Island in the mid-Intermediate period (ca.

A.D. 600–900) prior to the appearance of true microblades. These artifacts, made on ordinary chert flakes, resemble shouldered and shoulderless microdrills recovered from LAN-61 (compare Van Horn and Murray 1985:Figures 24, 25 and 61; and Freeman and Van Horn 1987:Figures 43 and 44; with Arnold et al. 2001:Figure 5.4).

On both the Santa Barbara coast and islands, true microblade technology involving production of fine drills used in shell bead production appears between A.D. 900 and 1200 and slowly intensifies. Microblades tend to be trapezoidal in cross section, struck from multifaced cores with one or two (opposed) platforms. Few specimens recovered from Ballona bluff sites by Van Horn (1987) and Van Horn and Murray (1985) resemble trapezoidal microblades, and a large proportion of Ballona microblade cores are bipolar, rather than faceted. Between A.D. 1300 and 1770, a specialized, highly intensified microblade industry appeared in the Channel Islands. Most microblades of this period were struck from prepared ridges (as crested blades, or *lame à crête*), resulting in faceted dorsal surfaces and triangular cross section; cores produced only one or two microblades before discard or rejuvenation. Some of the microliths described from LAN-63 seem to be faceted, but Freeman and Van Horn (1987) do not describe their sections.

A working hypothesis to explain the Ballona bluff-top microblades is that bead manufacture was a wide spread phenomenon that extended to the Ballona in the period between 600 and 1200 years ago, only to become restricted to the islands after developing into an intensive specialization. The chert outcrops on eastern Santa Cruz Island supplied plentiful and easily defended raw material for microblade cores, part of an economic system in which the production of drill and shell bead making craft specialists was distributed by a few leaders, canoe owners, and traders (Arnold 2001). This, however, does not explain the quartz microliths from Late period LAN-47 described by Towner (1992).

Alternatively, Ciolek-Torrello and Grenda (2001) suggest that Ballona microliths might be related in some way to the lithic technologies of Mojave Desert groups, thus demonstrating a coast-desert connection. There is ample evidence of trade and contact between these areas (Sutton 1996), but while desert projectile points grow smaller in the late prehistoric, large bifaces continued to be manufactured at Rose Spring (and Coso) after the introduction of the bow and arrow (Yohe 1998), and otherwise, there is no evidence of microlithic technology in the Mojave Desert.

Data regarding artifact frequencies (Rosenthal and Benaron 1998; Rosenthal and Taşkıran 1999) from Ballona sites suggest differences between bluff-top and lowland sites that could have temporal signifycance. For example, lowland sites have lots of cores, flake tools, bifaces, and manos, whereas bluff-top sites are rich in microdrills, mortars, metates and hammer stones. On the other hand, these differences might reflect such factors as site function and relative mobility.

The availability of new types of raw materials in protohistoric and historical times, especially glass and metal, should have affected lithic technologies. When such materials become available, they may rapidly replace stone tools. On the other hand, old technologies, such as those for seed processing, may persist indefinitely. Replacement may be complicated, however, by differential access to new materials among groups as in the Channel Islands (Graesch 2001). For example, groups directly contacted by Spanish explorers Cabrillo, Vizcaíno, and Gaspar de Portolá are more likely to have obtained metal than people in distant groups. Or, if Native Americans escaped from Mission peonage were hiding out in the Ballona, they may have found it difficult to obtain metal tools. Another possibility is differential access to new raw materials within groups along lines of status or gender: some people will have them, and others will do without. For example, if males control access to metal, hunting gear (stone knives and projectile points) may employ the new material while women continue to use stone for processing tasks such as hide preparation. Possession of the new materials may enhance the status of the individuals possessing them, or offer technological advantages to a metal-using group in competition with a stone using groups. Because there is so little information about the protohistoric and historical-period Ballona, it is difficult to predict exact technological and social adjustments to new materials, but we will seek evidence of them in the archaeological record.

Finally, certain ground stone technologies are thought to be temporally diagnostic. Milling stones and manos (hand stones) occur between 8500 and 7500 B.P., while globular mortars and pestles appear about 4000 B.P. along with steatite vessels, and "flower pot" mortars and long pestles in the late prehistoric period (Moratto 1984).

Data Needs

Data needs to determine the temporal sensitivity of particular technologies and raw materials are essentially the same as those for projectile points: obsidian hydration data, stratigraphic position, and associated radiocarbon dates.

Regional and Extra-Regional Relations

Questions about the relationships between the people of the Ballona and those of the interior desert arise because a coastal adaptation appears to have been established early in prehistory (cf. Moratto 1984), and yet, the Gabrielino who occupied the Ballona were Takic speakers with linguistic roots in the deserts of southern California (Bean and Smith 1978; Sutton 1994). For example, we would like to know the evidence for cultural continuity, or lack thereof, between the people of the Early Millingtone, Intermediate, and Late periods in the Ballona. Does the Intermediate period represent an incursion of desert people or technological ideas? If so, were these the precursors of the ethnographic Gabrielino, or did Gabrielino arrive about 1000 B.P. to usher in the Late period?

The likely axes of possible large scale movement and contact for people of the Ballona are north and south up and down the coast, and east and west from coast to the interior deserts. In the early Holocene (10,000–8000 B.P.), with the lowest human populations, mobile foragers should have been most free to exploit the most productive resource patches along a north-south axis focused on the coast, coastal estuaries, and adjacent terrestrial areas (Moratto 1984). Although there was evidence of such an early occupation at Malaga Cove a few miles to the south (Walker 1937, 1952), it is so far absent in the Ballona. Between about 8,000 and 7,500 years ago, artifacts thought diagnostic of the interior (Pinto points, scraper planes, and milling stones) begin to appear on the coast, suggesting the establishment of an east-west axis of technological movement, if not of people (Kowta 1969; Warren et al. 1961). Nevertheless, the distribution of enigmatic stone cogs and discs, restricted to the Los Angeles Basin and adjacent coast, suggests that at least the entailed technology and ideas were restricted to a relatively small region on the west side of the Transverse Ranges. Kowta (1969) suggests that as climate continued to become warmer and dryer in the middle Holocene, people of the Transverse Ranges began to move toward the coasts; mixed coastal and inland traditions resulted in the Sayles and Late Topanga complexes. With the expansion of Takic-speaking people from the Mojave Desert to the coast (Sutton 1994), the east-west axis is likely to have been strengthened. Northward movement was restricted by the Chumash, but movement through the Los Angeles Basin and beyond may have been possible for Ballona people finding local conditions difficult for some reason.

The analysis of lithic technology can be expected to yield good answers to technological problems such as the relationship between the Ballona microlithic industry, and that from the Channel Islands discussed above. In contrast, lithic artifacts cannot inform directly of the ethnicity, spoken language, or genetics of the people who used them. It is often impossible to detect archeological differences in the material culture of groups known to have spoken very different languages in ethnographic times (Elston 1994; Jones 1994). As summarized in Table C.1, while there can be many different kinds of outside influences (immigration, invasion, diffusion), and while there can be many responses of natives to such outside influences, the resulting effects on material culture are often equifinal. Outside people may immigrate, acculturate, and assimilate with little or no change in material culture, or they may invade and adopt the native material culture because it is better suited to the environment or conveys a higher status.

Table C.1. Possible Responses of Native Gene Pool, Language, and Material Culture to Outside Influences

Native Population	Outside Influence	Immigrants	Gene Pool	Language	Material Culture
Stable	none	none	unchanged	unchanged	unchanged
Remain	immigration	acculturate / assimilate	mixed	unchanged	unchanged
Remain	diffusion	none	unchanged	different	unchanged
Replaced	immigration/invasion	acculturate/adapt	different	different	unchanged
Replaced	immigration/invasion	adapt	different	different	different
Remain	diffusion	none	unchanged	unchanged	different
Remain	none-innovation /adaptation	none	unchanged	unchanged	different

In either case, the result is the same as if the native population and culture had remained stable. On the other hand, a native population may innovate or adopt different material culture without changing language or genes. Clearly, genetic questions are best addressed through bioarchaeology and genetics, and language questions through linguistics.

And yet, lithic artifacts can provide some information concerning relationships between the lithic technology used by the Ballona people and that of others in the coastal region or those more distant in the interior desert. Two questions address these relations.

• *How much do Ballona lithic technologies resemble those from the California desert and other coastal areas?*

In the discussion of temporal variability in Ballona lithic technology we asked whether Ballona lithic technologies changed through time, and whether any such changes were correlated with similar changes documented in other regions. By seeking correlations, we will be addressing this question as well.

Data Needs

This essentially the approach proposed for analysis of projectile point style described in a previous section. For example, the degree to which projectile point technology and ideas of projectile point form were shared can be estimated by monitoring the presence in the Ballona of artifacts and artifact styles thought to be diagnostic of other regions (e.g., Gypsum or Desert Side-notched projectile points).

• *What does variability in proportions of local and exotic tool stones in Ballona assemblages say about the economics of tool stone procurement?*

The economics of tool stone procurement and use are discussed in some detail in a subsequent section. Suffice it to say here that the proportion of nonlocal tool stone in Ballona lithic assemblages should be affected primarily by distance to source and access to source (Bamforth 1990b; Elston 1990a, 1992a, 2001). All other things being equal, the proportion of exotic tool stones in lithic assemblages should decrease with distance to source. Of course, all things are often not equal. Access to tool stone sources may be affected by the size of annual range or the presence of other people at the source. We assume that the most unimpeded access of Ballona people to distant tool stone sources was in the Early period because mobility was greatest then; proportions of exotic tool stones at that time should most directly reflect distance to source. Through time, increased population, lower residential mobility, and smaller annual range should have affected access to distant tool stone sources, which should be reflected as variability in abundance of exotic tool stone, the form in which it arrives at the Ballona, and in efforts to conserve it. North of the Ballona, growing population increasingly stressed inland terrestrial resources, making exchange of acorns for marine products feasible (Hildebrandt 2001; Hildebrandt and Levulett 1997). It seems reasonable to assume that inland tool stone sources would also have been involved in such exchange. Exotic tool stones obtained primarily by trade will arrive in a fully formed state; flake cores and early stage bifaces of these materials will be rare or absent. Use intensity should vary with stress on lithic resources. When people find themselves with few tools and reduced access to high-quality lithic sources, they may employ strategies of repair and recycling to make supplies of exotic stone go further, use more locally available, lower-quality tool stone as expedient tools for certain tasks, and even substitute other raw materials (i.e., shell) for some tasks previously accomplished with stone tools.

Data Needs

This question requires monitoring the frequencies of exotic tool stones in lithic assemblages, attending the form in which such materials arrive at the Ballona, and measuring the intensity of their use. For bifaces and projectile points, measures of use intensity estimate how much of the tool remains at discard. Artifact weight is one simple measure. For example, intensive tool resharpening and reshaping, or bi-polar reduction of expended or broken tools will result in more small tool fragments (Elston 1986b, 1988; Kuijt et al. 1995). Another measure is biface intactness (Kelly 2001): how many of the three-dimensional axes (length, width, thickness) of the artifact can be measured? For example, all three dimensions of an intact biface can be measured; only two dimensions can be measured if the biface has a broken tip, and if the biface has been subjected to bipolar reduction (Elston 1986b), not even thickness can be measured. A third measure is the edge unit (EU) ratio. As discussed in more detail in a subsequent section, under conditions of tool stone shortage, people may be more likely to employ a single flake tool for a variety of tasks or maintain tool margins instead of discarding a tool as soon as its working edge feels a little dull. Either of these techniques should result in more EUs on tools at discard, and higher EU ratio (number of EUs divided by number of tools).

• *Did access to new raw materials in protohistoric and historical times affect trade for exotic lithic raw materials?*

We have mentioned in a preceding section that introduction to stone-using groups of materials such as metal and manufactured glass may impact both lithic technologies and social structure. Use of new materials such as glass were incorporated into native technologies in mission contexts (see Hoover and Costello 1985), but whether these materials were plentiful enough to replace traditional materials in other contexts is questionable. Certainly, traditional use of chert for manufacture of bifaces and shell bead drills was maintained in the Channel Islands (Pletka 2001) in spite of some access to manufactured glass, iron nails and blades, and the apparent abundant availability of steel needles used for bead drilling (Graesch 2001). After the establishment of the west-coast-provisioning port at San Blas in 1768 and the Franciscan mission in San Diego in 1769, European goods were plentiful in California and distributed to Native Americans in the interests of pacification and trade (Graesch 2001). This may have stimulated trade in some contexts. For example, trade in steatite quarried on Santa Catalina Island apparently increased (Graesch 2001), along with shell bead production (Arnold et al. 2001) in the early historical period. It is possible that mainland trade in obsidian underwent a similar early historical increase.

However, this question is complicated by the relatively short length of time between the appearance of European goods and the extirpation of native technologies in later historical-period times; the archaeological record in the Ballona may be too coarse to detect such fine-grained change. Additionally, if the Ballona was used as a hideout in the Mission period, renegade Native Americans were probably not involved in much trade for exotic tool stone. As we have observed, it is difficult to predict how this would have played out in the Ballona, but we will be alert to changes in frequencies of artifact classes by raw material that could signal such changes.

Data Needs

Data needed are frequencies of artifact classes by raw material, stratigraphic position, association with European- or mission-manufactured goods, and radiocarbon dates.

Lithic Technology and Tool Function

The lithic material culture of the Ballona has been characterized as unlike that found elsewhere in coastal California (Altschul et al. 2003), but perhaps this is more apparent than real. Ballona assemblages contain the same range of artifact types as other coastal assemblages. The major differences seem to be in the technique for producing microlithic tools, in the presence of Marymount points, and in the presence of "potato" flakes employed as tools. Van Horn and Murray (1985) suggest that unlike the technique used in the Channel Islands for microblade production, the Ballona technique relies on bipolar reduction, using both linear spalls and bipolar cores as microtools. As discussed above, Marymount points do not seem to be a well-defined artifact type. Potato flakes, which are derived from reducing river cobbles, may owe their existence entirely to the nature of lithic resources locally available in Centinela and Ballona creeks.

Perhaps of greater importance is that the function of certain tool types in the Ballona is unknown, or not well described. Only Towner (1992) has employed use-wear analysis. For example, without any use-wear analysis, Van Horn (1987; Van Horn and Murray 1985) classified large, lanceolate or leaf-shaped bifaces from bluff-top sites as "knives," whereas referring to all smaller tanged and leaf-shaped bifaces as "projectile points." Van Horn and Murray (1985) recovered hundreds of small, linear flakes from the Loyola-Marymount site (LAN-61A, LAN-61B, and LAN-61C), which they classified as "microliths," and interpreted as drills and or gravers. Although noting retouch on these items, they do not report use-wear analysis. Freeman and Van Horn (1987) report a similar assemblage of microliths from the Del Rey site (LAN-63), again without use-wear analysis. In addition, several small retouched linear flakes were interpreted as inset "barbs" for slotted bone or wooden projectiles; the function of other small flake tools was unknown.

Thus, several questions regarding Ballona lithic technology can be asked (Altschul et al. 1991: 26–27).

• *What is the functional nature of the Ballona microlith tradition?*

There are three parts to this question. First, exactly what are the points of technological similarity and difference between Ballona and Channel Island microlith production technology? Second, how much of the difference can be explained by tool stone quality accessible to Ballona knappers? Finally, what was the function of lithic tools in the Ballona?

Data Needs
The first part of the question requires detailed technological analysis of Ballona microlithic technology accompanied by comparison of examples of the Channel Island technology (Arnold 1987b; Arnold et al. 2001; Preziosi 2001). The second part of the question can be addressed by a program of experimental bipolar microlith production using materials employed by Ballona knappers (Kuijt et al. 1995). The third part of the question asks for what tasks were the Ballona microliths employed? Van Horn (Van Horn 1987; Van Horn and Murray 1985) suggests these tools were used for a wide range of tasks, with only a few items actually used to drill shell beads. The answer requires use-wear analysis coupled with use-wear experiments. Towner (1992) observed polish on the distal ends of a small sample of quartz microliths from LAN-47 that support their use as drills, possibly used on beads. Others (Preziosi 2001; Yerkes 1983) have identified specific types of microscopic use wear that should be present on Ballona microliths if they were bead drills.

• *What is the nature of the potato flake technology?*

Potato flakes were made by breaking the end off of an elongate stream cobble, and striking flakes from the cobble end by striking perpendicular to its long axis of the cobble. The resulting flake has an arcuate, cortex-covered platform. Perhaps a more descriptive image is of a salami slice. In any case, this technique produces flakes with a cortex back. It is quite possible that potato flakes are merely one of the possible results of knapping stream cobbles available in the Ballona. Are they just another form of utilized flake tool, or were they used to perform some special function or functions?

Data Needs
The answers to questions concerning potato flake technology require technological analysis of their production, collection of data regarding their proportion in assemblages, and use-wear analysis (see below) to discover if they performed any special set of functions for which other flake tools were not used.

• *What were the functions performed by artifacts previously classified as bifaces, projectile points, scrapers, and flake tools?*

In his analysis of the small sample of lithic artifacts from LAN-47, Towner (1992) noted the absence of impact fractures on medium to large leaf-shaped bifaces, suggesting they were not used as projectile points. Towner (1992) also observed microflaking and striations on four narrowly pointed medium-sized artifacts that confirmed their use as drills. Perhaps some tanged bifaces were employed as knives or scrapers; perhaps leaf-shaped bifaces in other sites were used as dart or harpoon tips. Were flake tools multipurpose? Were "scrapers" sometimes used for cutting? For what tasks were flaked and utilized shells (Erickson 1988; Maxwell 1999d; Troncone and Altschul 1992) employed?

Information about tool function can be obtained through use-wear analysis. While the gross characteristics of a tool edge (e.g., edge angle, plan form, shaped or unshaped; bifacial or unifacial) can provide clues to function, more definitive functional indications are provided by microscopic indications of tool wear, or attrition: the degree to which tool surfaces are rounded, smoothed, and polished, and (especially) by the frequency, size, and orientation of scratches or striae (Ataman 1992; Hayden 1979; Keeley 1980; but see also Brose 1979). The latter are important because their orientation vis-à-vis the tool margin directly indicate the orientation of the tool edge to the working surface, as well as the direction of movement of the tool against the work piece. For example, straight striae perpendicular to the edge indicate the tool was pushed or pulled against the work surface in a scraping motion. Straight bifacial striae parallel to the edge suggest movement of the tool along the axis of the working edge in a cutting or sawing motion. Straight diagonal striae may suggest scraping or whittling, depending on the edge angle, condition of the edge itself, and whether the striae are bifacial or unifacial. Different patterns or sizes of striation occurring on the same tool margin may suggest its use in two or more functional modes (e.g., cutting and scraping). Moreover, from the way striae overlap, it is sometimes possible to determine the order in which different modes were used (e.g., first cutting, then scraping).

Different raw materials vary in their use wear behavior (Elston 2001). Edges of tougher materials such as chert and basalt tend to stabilize rather quickly and develop rounding, smoothing and polish on edge apices and flake scar arrises. Obsidian is relatively soft and easily scratched by grit on the work piece, so striae are often easily seen under even low magnification. On the other hand, until attrition makes the obsidian tool margin thick enough to stabilize, development of substantial fine-grained attrition (smoothing, rounding and polish) cannot develop; in many cases the tool is discarded before stabilization occurs. Quartzite tool margins may develop little observable use wear because of the particulate nature of quartzite The quartz grains are all the same size, highly reflective, and random in orientation. Under magnification, individual quartz grains protrude from edges, giving them a ragged appearance; surfaces are bumpy and uneven. The hard quartz grains resist scratching and rounding, so even when edges become rounded and smoothed, quartz grains never exhibit striae. For this reason, detection of use-wear on quartz crystal (Sussman 1985) and amorphous quartz is highly problematic as well.

Use wear can also be obscured or obliterated by non-use processes such as trampling and aeolian erosion. Because of its relative softness, obsidian tends to suffer the most non-use attrition, but all tool stones exposed to wind-blown sediments will be modified by this process: edges and ridges become rounded; obsidian and basalt surfaces are pitted and etched, while harder chert and quartzite can become polished. Aeolian erosion may completely obliterate fine-grained indications of use attrition.

Residue analysis to discover resources captured or processed with flaked stone tools is more problematic and controversial, but many researchers claim success. The pros and cons of this analysis are discussed in more detail below in the question regarding ground stone tools.

Data Needs

Tool function will be addressed by observation and description of edge damage and use wear of tools from selected proveniences, concentrating on microlithic tools, bifaces, shell scrapers, and smaller samples of abundant flake tools, following standard procedures outlined in Laboratory Procedures for Lithic Artifacts (see below) (Ataman 1992; Cerico et al. 1986; Elston 1986a; Havercroft and Elston 1990; Keeley 1980; Knudson 1979; Pope 1994; Preziosi 2001; Towner 1992; Tringham et al. 1974; Yerkes 1983). Selected flake stone tools will be subjected to residue analysis (cf. Puseman 1994). It is critical that only flaked stone tools discovered in situ during excavation (not in the screen) be employed for residue analysis. Such a tool should not be allowed to contact the excavator's skin, and should be transferred immediately to a sterile plastic bag (WhirlPak) and sealed. A sample of soil in which the artifact was embedded should be placed in a separate sterile bag and sealed. The artifact should not be washed or cleaned, but submitted directly to the residue analyst in the original bag.

• *What can use wear and residue analysis tell us about ground stone tools' function and resource processing?*

Analysis of ground stone tool form, size, weight, use intensity, condition at discard, and residue analysis can inform of mobility, and intensity of resource processing, and under the right conditions, identify which resources were processed.

Ground stone tools that are unshaped, small, and lightweight suggest design for portability rather than intensive use; frequently the degree of wear on such tools is less than on tools designed for heavy in situ use (Bullock 1994b). Condition at discard may also signal mobility, because mobile foragers who gear up with relatively expedient portable milling stones for use on a logistic foray, may leave them intact and little used at logistic camps and processing stations, in order to increase their ability to transport the processed resource (Metcalfe and Barlow 1992). Sedentary foragers, in contrast, are more likely to completely "use up" ground stone tools before discarding them or recycling them into hammer stones or hearth rocks.

It is sometime possible to discover which resources were processed with ground stone tools (more often to the family and genus level; more rarely, to the species level) through pollen/phytoliths/starch washes and animal residue analysis (Cummings and Puseman 1994; Puseman 1994; Sobilik 1996). There is little question that pollen, phytoliths, and plant starches can survive in the pores and interstices of ground stone tools for very long intervals. It must be observed, however, that many researchers are skeptical that blood and other animal products can survive on tools longer than days or weeks, or that if they do survive in some form that they can be correctly identified (Downs 1995; Eisley et al. 1995; Fiedel 1996, 1997). Yet proponents of blood residue analysis, while recognizing some of its deficiencies, defend its overall value (Loy and Dixon 1998; Newman et al. 1997). We conclude that blood reside analysis is worth attempting for selected ground stone artifacts.

Data Needs

Data regarding ground stone tool form, size, weight, use intensity, and condition at discard will be collected following the methods given in Bullock (1994a) and Adams (1996).

It is critical that only ground stone tools discovered in situ during excavation (not in the screen) be employed for residue analysis. Such a tool should not be allowed to contact the excavator's skin, and should be transferred immediately to a sterile plastic bag or wrapped air tight in sterile plastic film or aluminum foil. A sample of soil in which the artifact was embedded should be placed in a separate sterile bag and sealed. The artifact should not be washed or cleaned, but submitted directly to the residue analyst in the original bag.

Ballona Settlement Patterns and Site Function

Early California archaeologists were frequently vexed by the failure of artifacts and artifact assemblages to always conform to normative classes, variously attributing this to individual experimentation, external influences such as acculturation, trade, invasion, and so on (e.g., Elsasser 1978; M. Rogers 1939:20). However, over the last the several decades, archaeologists have become increasingly aware of the value of archaeological variability for informing of prehistoric human behavior (Binford 1989a; Trigger 1989). The fact is that groups of humans do not spend their lives in one place, repeating a limited number of tasks in the same way with identical tools. Rather, people react to their natural and social environments, varying the resources they seek, the amount of time they spend in different places, the number and types of tasks they perform, the materials they use to make tools, the amount of effort they put into tool manufacture and maintenance, how they use space, deal with waste, and so on. This behavioral variation results in dissimilar assemblages within and among archaeological sites that can reflect (among other things) the size and composition of groups, status of individuals, duration and frequency of occupation (i.e., residential mobility), feature and site function, and size and location of annual range.

Questions about the nature of Ballona settlement systems turn on mobility: the consensus is that mobility was high during the Early, Millingstone, and Intermediate periods. Sites were occupied for short periods of time, not very often, and at irregular intervals. Ethnography indicates that people generally should have become less mobile in the Late period. Before asking specific questions about how lithic artifacts can inform of changes in mobility we discuss the theoretical links between mobility, lithic variability, and settlement patterns.

Mobility and the Economics of Tool Stone Procurement and Use

Among pedestrian hunter-gatherers, the dominant cost factor for lithic resources is *mobility*, or strategies employed by foragers to position themselves with regard to resources (Binford 1980; Cashden 1992; Kelly 1983, 1992). Binford (1980) suggested that hunter-gatherer mobility strategies could be viewed as a continuum, with foraging and collecting at opposite poles. This model was never intended to pigeon-hole the strategy of any particular ethnographic or archaeological group, but to conceptualize the ways different mobility strategies at different scales might affect archaeological variability (Kelly 1992:45). Mobility conditions lithic assemblage variability by affecting tool stone supply and demand as well as site function.

Binford distinguishes between residential mobility (moving from base camp to base camp) and logistical mobility (making forays from the residential base and back). Residential mobility tends to be a major component of *foragers* who pursue resources in the vicinity of a residential base then move everyone to a new base when foraging returns fall below a threshold. Lithic assemblages of such short-term camps should contain relatively few artifact types, and little variability between assemblages. *Collectors* establish bases near key resources (water, fuel), move these infrequently, and emphasize logistical mobility to obtain resources at distant points and convene them at the base. Thus, a collecting strategy should produce more archaeological variability in landscapes because people occupy various places for different purposes and for unequal amounts of time. Lithic assemblages from long-term base camps should be the most diverse (contain more classes), whereas those of logistical camps should be less so. As well, variation between assemblages of logistical camps may reflect differences in prey items pursued, amount of field processing, and gender of field party. The distinction between *travelers* (highly mobile foragers focused on high ranked diet items such as large game) and *processors* (less mobile foragers who intensively pursue lower ranked resources such as seeds) is a similar concept, although tied as much to diet as mobility (Bettinger 1991; Bettinger and Baumhoff 1982). Binford (1983) also pointed out that as a strategy for dealing with large-scale resource variability, people may cycle through use of different parts of a large territory on an annual or decadal basis. Kelly (1992:45) argues that permanent migration to new territory is also a mobility strategy, which may be driven by various factors (but usually population growth), and accomplished in many ways.

Utility can be thought of as the amount the tool affects the return rate of the activity in which it is employed (Kelly 2001:123). It is important to recognize, however, that utility is the benefit gained from tool use *minus the cost of obtaining and maintaining it* (Andrefsky 1994, Elston 1990a, 1990b, 1992a, 1992b; Kelly 2001; Kuhn 1994). Cost may also include material or social currency employed in trade for raw materials or finished items. Moreover, the time spent in obtaining lithic tools is time not spent foraging for food, water and fuel, which together comprise opportunity costs. If such costs are too great, people are likely to economize on tool stone procurement by using lower-quality raw materials for many tasks and employing various strategies for extending utility or use-life of tools made of high-quality tool stone.

Mobility affects tool stone cost by affecting supply and demand. High residential mobility offers the advantage of flexibility and quick response to changing conditions (Torrence 1983, 1989). It is often correlated with low population density where competition for resources is low and groups have room to move. A group with high residential mobility should be able to access any tool stone source within its range, but the amount of lithic material that can be accumulated and transported at any particular time is limited (Elston 1990a:158). To meet long term and situational needs, highly mobile foragers, or collectors contemplating logistical forays, are likely to "gear up" with tools of high-quality raw materials between intervals of intensive tool use (Binford 1979; Goodyear 1979). Tools of highly mobile foragers often maximize utility through design flexibility, use of high-quality raw materials, large tool size, and standardized tool form, all of which promote rejuvenation and extension of tool use life. Bifacial technology is a common solution for mobile foragers because bifaces, which are reduced in three dimensions, may approach the optimum weight/utility ratio possible with lithic tools (Kuhn 1994:436), and biface thinning flakes are useful as tool blanks (Kelly 1988). Evidence of technological flexibility should be greatest in assemblages from procurement locations or short-term base camps. These assemblages are expected to mostly comprise debitage from maintenance of high-utility, curated tools (points, bifaces), expedient tools made on that debitage (bifacial thinning flakes), and occasional expedient tools made on broken or expended curated tools (Binford 1977b, 1979).

Low residential mobility can reduce access to, and availability of, raw materials. Scheduling conflicts between subsistence and lithic procurement may be intensified. People occupying sites for longer periods of time may experience shortfalls in tool stone, meeting this contingency by relying on locally available, lower-quality tool stone for most tools, obtaining higher-quality tool stone through trade, more economical use of high-quality tool stone, substituting quantity for quality (increases in simple flake tools), intensively recycling broken or expended chert and obsidian tools (Elston 1988), or substituting bone or shell tools (Erickson 1998; Maxwell 1999d; Troncone and Altschul 1992) in tasks previously performed by stone tools.

Low residential mobility can be a response to seasonal availability of key resources such as stored seeds, caribou, or salmon (Cashden 1992:251). Technological flexibility may become restricted to tool kits adjunct to logistical operations such as hunting (bifaces, projectile points), or tasks such as woodworking or bead manufacture that require specialized tools (scrapers, drills). Homogeneity of outputs may increase with regard to technological types (fewer types of flake or bifacial tools), but decrease with regard to morphology (no particular form favored). The greatest restriction on mobility, however, seems to be other people. Even if a territory is not actively defended by residents, emigrants may find residents already established in all the sweet spots. Moreover, emigrants will have to interact with residents at some level, and this can incur costs of various kinds.

In general, amounts of local tool stones in lithic assemblages are expected to increase with duration of occupation, along with intensive recycling of higher-quality, nonlocal materials, including frequent reworking of broken and expended tools (including smashing), scavenging items deposited in previous occupations, and increased use of bipolar reduction.

Settlement Patterns and Expected Variability in Ballona Lithic Assemblages

In research conducted in a wetland of the western Great Basin, the Stillwater Marsh (Elston 1988; Kelly 2001; Raven 1990; Raven and Elston 1988, 1989), as in the Ballona, important research questions also centered on the nature of residential mobility and the nature of resources offered by the marsh. Were Stillwater foragers in some sense sedentary, focused on marsh resources, and living for extended periods in the marsh? Or were they more mobile, using the marsh only occasionally in logistic forays from an upland base, or altogether mobile, with no long term base anywhere? To aid an extended analysis of data from a regional survey and excavations in the Carson Desert, Kelly (2001:Table 4.2) prepared a table of expectations regarding lithic assemblage variability, which I have modified as Table C.2 to fit the Ballona. This table summarizes expectations of lithic assemblages in two different contexts, *assuming those contexts can be isolated in the archaeological record.*

Table C.2. Diagnostic Responses of Lithic Technology to Variation in Residential Mobility

	High Residential Mobility or Logistical Mobility	Low Residential Mobility
High quality exotic tool stone	more common	less common
Lower quality local tool stone	less common	more common
Bifaces as cores	common	uncommon
Biface/flake tool ratio	high	low
Bipolar knapping/scavenging	uncommon	medium to common
Angular debris	uncommon	common
Biface completeness	medium to high	low
Flake tools	uncommon to medium	common
Flake cores	uncommon	common
Ground stone tools	rare to medium	common
Ground stone tools	small size, light wear	large size, heavy wear
Recycled ground stone	uncommon	common in hearths
Special purpose tools	uncommon	more common
Tool/debitage ratio	high	low
Complete flakes	common	uncommon
Site size/density	small/low	large/high
Site structure	simple	complex
Assemblage size/diversity	shallow slope	steep slope

• *How can we recognize high residential mobility or logistical mobility in the Ballona?*

This question refers to seasonal residential occupation of the kind advanced by Altschul et al. (2003:11), or logistical occupations of the kind postulated by Van Horn (1987) for Early, Millingtone, and Intermediate period forgers of the Ballona. Tool kits of people coming to the Ballona from elsewhere are expected to reflect necessary “gearing up” with tools of high-quality raw materials in anticipation of need. Because the target resources of mobile people would have likely included fish, sea mammals, and terrestrial large game, assemblages should contain bifaces, projectile points, and scrapers. Flake tools will be uncommon, but if made of high-quality tool stone, are likely to be derived from biface thinning flakes, rather than flake cores. Flake cores will be uncommon, as will evidence of bipolar knapping, scavenging and angular debris. Biface completeness will be relatively high because expended or broken tools are likely to be discarded without extensive reworking. If present, ground stone tools will be uncommon, small sized (for greater portability), and lightly worn. Special purpose tools (e.g., drills) will be uncommon. Tool to debitage and biface to debitage ratios will be high because few tools will be manufactured at these sites. Complete flakes will be more common because knappers will have exercised more control in order to conserve tool stone. Site area will be relatively small, and artifact density low. Sites will exhibit little site structure; features will be comprised mostly of hearths or fire-cracked rock clusters; space will be undifferentiated and there will be no evidence of secondary disposal. The assemblage size/richness regression line for a group of short-term residential or logistical sites is expected to be relatively shallow because for most occupations, the same tool kit will be employed.

• *How can we recognize low residential mobility in the Ballona?*

Altschul (1997) maintains that because LAN-63 and other bluff-top sites exhibit strong site structure, they are multiseasonal residential bases used by multiple residential groups. Tool kits of people residing in or adjacent the Ballona for long periods are expected to reflect multiple tasks. Assemblages are likely to contain more locally available tool stone, and relatively less exotic, high-quality raw material. Also reflecting availability of local materials from stream gravels, flake cores and flake tools will be abundant. Because low mobility foragers are expected to focus more on plants, lagoon fish and shellfish, tools kits will contain fewer bifaces and projectile points; biface/flake tool ratios will be lower. Flake tools derived from biface thinning flakes will be uncommon, but bipolar knapping, scavenging and angular debris will be common. To maximize utility of scarce high-quality raw materials, expended and broken tools will be intensively recycled, biface completeness will be low, and bipolar reduction and angular debris will be common. Ground stone tools will be common, large sized (since portability is less of an issue) and heavily worn. Special fabrication tasks are more likely in long-term residential bases, so special purpose tools (e.g., drills, microliths) should be common. Tool to debitage and biface to debitage ratios will be low because many tools will be manufactured at these sites. To compensate for lower utility of local tool stones, many more tools may be used and discarded. Complete flakes will be less common because knappers using abundant local materials will not depend as much on controlled reduction to conserve tool stone. Longer occupations will result in large site areas with high artifact density. Sites will exhibit strong site structure with differentiated use of space and multiple types of features (hearths houses, post holes, earth ovens, ritual space, etc.), and evidence of secondary disposal. The assemblage size/richness regression line for a group of long-term residential sites is expected to be relatively steep because of the multiplicity of tasks performed at such sites.

• *How can we recognize other possible settlement patterns in the Ballona?*

Other possible settlement pattern scenarios are summarized in Grenda and Altschul (1994a) and Altschul et al. (2003). Any of these would blur the dichotomous patterns outlined above. For example, in the *restricted mobility* model, individual domestic units move to different places in and adjacent the Ballona in response to resource conditions. This pattern would produce sites and assemblages with the characteristics of low residential mobility in Table C.1, but there would be little difference between sites. The *primary village* model is essentially the ethnographic model. One site is the chiefly center where most of the people live most of the time, with special purpose or seasonal satellite camps elsewhere in or adjacent the Ballona. This model would produce sites of two different sizes, but in many regards they all are likely to resemble the low mobility pattern in Table C.2 because of dependence on local tool stone, with little need to "gear up" for resource procurement. The primary site should, however, have the richest assemblage containing the most exotic tool stones, special purpose tools, and ritual or high-status items. In the *ranchería* system, high-status groups occupy optimal places in the landscape (sweet spots), and lower status groups occupy marginal locations that must be periodically abandoned because of flooding or drought. This model would produce sites resembling the low mobility pattern in Table C.2. However, the sites located in optimal locations are expected to be larger in area and higher in artifact density because they are occupied more continuously. Sites in sweet spots should also have more exotic tool stone, special purpose tools, and ritual or high status items.

Data Needs
Addressing these models will require analysis of several kinds of data collected from flaked stone and ground stone artifacts. Some classes of data are appropriate to collect for every artifact (e.g., raw material); others (length, width, thickness) only for formed tools. To ensure continuity with past efforts, we will employ, to the extent possible, artifact and data classes of previous researchers (Towner 1992, 1994; Rosenthal and Benaron 1998; Rosenthal and Taşkıran 1999; Van Horn 1987; Van Horn and Murray 1985), with the addition of a few modifications following Andrefsky (1998), Ataman (1992), Bullock (1994a), Elston (1986a, 1986b, 2001), Juell (1990), and Kelly (2001).

Ballona Settlement Patterns, Assemblage Size, Evenness, and Diversity

Archaeological assemblage variability is reflected in several different measures (see papers in Leonard and Jones 1989; Grayson and Cole 1998), including evenness (equability of item frequencies by class), assemblage richness (number of classes represented), or heterogeneity (an index of evenness and richness combined) (Grayson and Cole 1998; Shott 1989). The importance of variability in evenness is obvious. Evenness is what we are looking at when comparing assemblage class frequency histograms. The behavioral implications of an assemblage with perfect evenness (equal proportions of items in each class) are quite different than those for assemblages in which one, two, or more classes contain most items. Evenness and richness can vary independently Magurran (1988) because assemblages can be equally rich (same number of classes), yet one assemblage can be relatively even whereas another is dominated by a single class. Moreover, assemblages can be equally rich and not contain the same classes, or equally even and yet be dominated by different classes. Differences in evenness between assemblages are often attributed to functional or organizational differences between the behaviors that produced the assemblages (cf. Table C.2 above; Shott 1989).

Differences in assemblage richness (number of classes) in archaeological assemblages may reflect variable tool-using and discard activities as influenced by site function, length of occupation and access to tool stone (Elston 1990a, 1992a; Grayson 1984; Grayson and Cole 1998; Jones et al. 1983; Kintigh 1984; Rhode 1988; Shott 1989; Thomas 1983, 1988). Theoretically, the assemblage size-diversity relationship may be positive or negative (in either case, either linear or asymptotic), or null (Shott 1989). The relationship is very often positive, however, because richness is highly correlated with assemblage size: in a sampling universe divided into classes of things, the larger the sample, the more classes are likely to be represented in it. This is because the proportion of each class in the population determines the probability of its being selected in a particular random sample. The greater the proportion of a class in the sampling universe, the greater the probability that the class will be represented in a sample. Classes containing few items have a smaller chance of being represented. The larger the sample, however, the greater the chance it will contain rare classes. For any group of assemblages, this relationship can be expressed by a regression line with a particular origin and slope.

Although assemblage richness is correlated with assemblage size, Thomas (1983, 1988) suggested that regression-line slope may discriminate between groups of sites of different types. For example, we might expect artifact classes to be added over time at a relatively slow rate at short-term logistic camps used for a limited range of activities. People would transport some functional subset of their total artifact repertory to such sites, and only occasionally leave artifacts of other kinds there. The slope of the assemblage size/richness regression line for a group of such sites would be rather shallow. A much wider range of activities are expected to occur at long-term residential bases. People would tend to use a much wider subset of their total tool kit at such sites, as well as manufacture other types of tools for use elsewhere. The slope of the assemblage size/richness regression line for a group of residential sites should be relatively steep. Outliers, sites far above or below a regression line, may indicate some factor other than sample size that is contributing to variability. These posited relationships are only relative, however, and have never been ethnoarchaeogically tested (Kelly 2001:123). There are other reasons why slopes of regression lines for two groups of sites may differ (Shott 1989). For example, the slope for a group of short-term camps occupied for 5,000 years might be steeper than that of a group of long-term sites occupied for only 1,000 years. Palimpsest assemblages accumulated as sites vary in function seasonally, or change function through time because of environmental change or population growth may not show the expected patterns. Prehistoric scavenging and modern artifact collecting may skew assemblage data. Thus, while analysis of assemblage size/richness can be very helpful in the interpretation of assemblage variability when there are a number of sites to compare, it is not a panacea and must be used with care.

• *What are the implications of assemblage evenness among Ballona assemblages?*

More even assemblages (less variation in the frequencies of lithic classes) might be expected in archaeological units representing long-term residential sites where many different kinds of tools were manufactured, used and discarded. Less even assemblages are expected from units occupied for the short term, especially those representing task sites in which relatively few types of resources were procured or processed.

Evenness can be assessed with several techniques (Magurran 1988), one of which employs the Shannon-Weiner information statistic "H" as in H/log classes, which generates values between 0 and 1, with 1 as perfect evenness. Given a contingency table of class frequencies of two or more assemblages, the chi-squared statistic tests whether the variation between classes is random (the null hypothesis). The test of relative importance of the observed variation between classes, or the strength of dependent associations (if any) can be obtained by analysis of the difference between expected and observed values as chi-squared adjusted standardized residuals (Bettinger 1989; Everitt 1977; Haberman 1973). The greater the positive or negative residual value, the greater the positive or negative association between pairs of values in the same row or column. Adjusted residuals greater than ± 1.96 are significant at $p \geq .05$.

• *What are the relationships between Ballona assemblage size and diversity?*

As previously discussed, although assemblage richness (number of classes) is correlated with assemblage size, Thomas (1983, 1988) suggested that regression-line slope may discriminate between groups of sites of different types. To illustrate how this might work in the Ballona, let us assume for the moment that bluff-top sites were multiseasonal habitations (the locus of a wide variety of tasks), while sites on the lagoon are more likely to have been occupied for shorter intervals in the pursuit of particular sets of tasks. If this is true, bluff sites should exhibit more variety in lithic assemblages. That is, bluff lithic assemblages should be richer (i.e., contain more kinds or classes of lithic items) than those of lowland sites.

Table C.3 suggests this might be the case. For this analysis, we use data taken from Tables 7 and 8 in Altschul et al. (1999), from which we have removed debitage and potato flakes, leaving flake tools, microliths, and formed artifacts of various kinds. Average richness of bluff assemblages is a little over twice that of lowland assemblages.

But Table C.3 also shows that the average assemblage size of the bluff sites is an order of magnitude greater than that of lowland assemblages. Because there is usually a strong correlation between sample size and variability or richness, however, we are justified is suspecting the difference in assemblage richness between bluff and lowland sites is a matter of sample size alone.

Table C.3. Average Assemblage Size and Richness: Lowland and Bluff Sites

	Assemblage Size	Richness
Lowland	71.17	6.8
Bluff	963.50	15.33
Difference		8.53

Indeed, the best-fit relationship between log assemblage size and number of classes (Figure C.4) is log-linear and highly significant ($r = 0.904$, $p \leq .0001$). A bivariate plot split by locality (Figure C.5) shows that regression lines for bluff and lagoon assemblages have different slopes and origins. The correlation for bluff ($r = 0.85$, $p = .0306$) is significant, that for lowland ($r = 0.0682$, $p = .1354$) is not, perhaps due to the small sample size of lowland sites. And yet, to what degree are these differences due to sample size alone?

The regression equations for lowland and bluff assemblages are given in Table C.4, along with predicted richness values (numbers of classes) for assemblages (minus debitage and potato flakes) ranging in size from 10 to 3,000 classified artifacts (actual assemblages vary between 3 and 1521 items). The predicted differences range from 1.34 classes in assemblages of 200 items to 7.13 in assemblages of 3,000 items. The average difference between bluff and lowland richness in this simulation is only 2.51. Because this is less than half of the observed average difference (see Table C.4), we are justified in suspecting that the difference in slope of regression lines for bluff and lowland sites is *not* due much to assemblage size. In other words, the difference in slope suggests real differences between the two groups of sites.

Should we reassess our impressions of site location and site function based on these data? Perhaps not. Assemblage size is very unevenly distributed between bluff and lowland sites, with many very small assemblages in the latter. Moreover, the number of assemblages in each group is small (six). Larger numbers of assemblages and larger samples from lowland sites might produce different distributions and regressions.

This exercise also informs of the sample sizes needed to achieve the maximum richness possible, given the total number of artifact classes. Altschul et al. (1999) used 26 artifact classes, of which I eliminated two (debitage and potato flakes) for these analyses. The simulation in Table C.4 suggests that assemblages twice the size of any heretofore obtained (n = 1,521) will probably not include all possible classes. This is advantageous, because no variability can be seen when comparing two or more class-saturated assemblages.

Figure C.5 shows artifact class frequencies split between bluff and lowland sites. As we have just seen, lowland sites have fewer classes of artifacts, but artifact proportions are also very different between the two groups. Lowland sites have lots of cores, flake tools, bifaces, points, and manos, which might fit the model of short term occupation in the lowlands focused on hunting, local tool stone procurement, and plant processing. The bluff sites are notable for the large numbers of microlithic artifacts (specialized tools), milling stones, mortars, and manos (intensive plant processing), which might fit the model of longer-term occupation. Clearly, there are potentially significant differences between these two groups of sites, but in further analysis, we will look at different site groups as well (e.g., bluff top, creek side, lagoon).

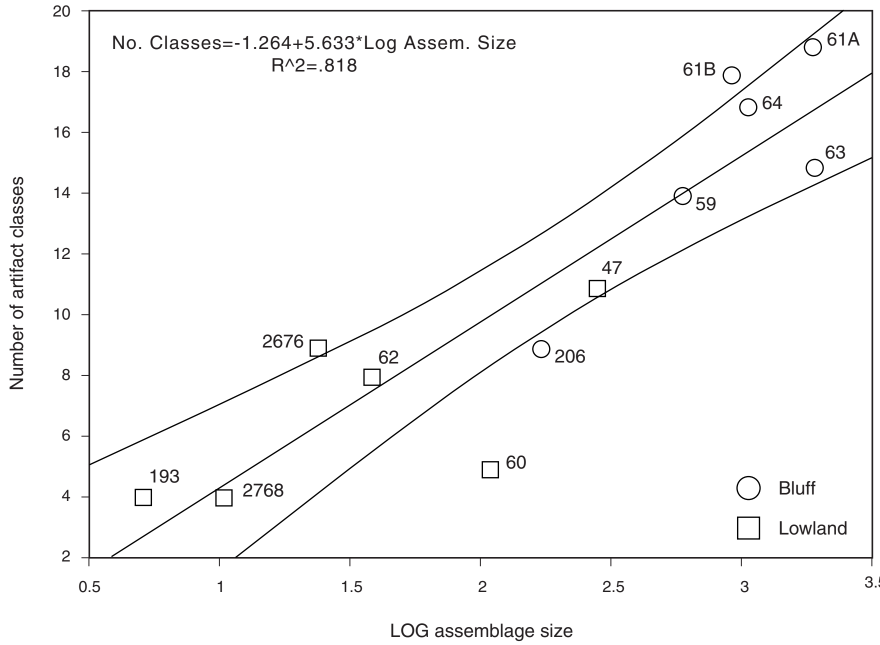

Figure C.4. Bivariate plot numbers of classes by log assemblages size, showing regression line within 95% confidence intervals.

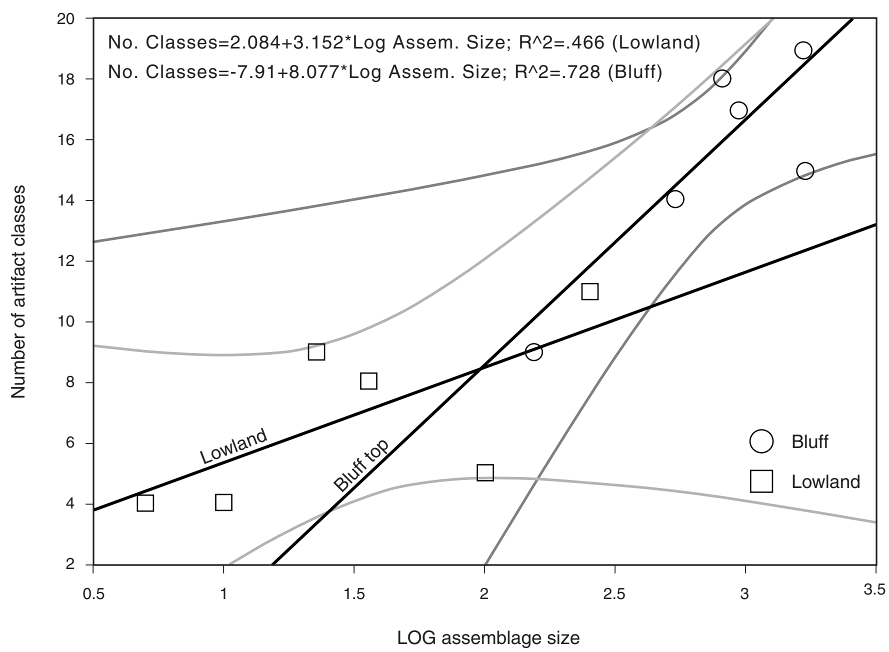

Figure C.5. Bivariate plot of numbers of classes by log assemblage size, split by bluff and lowland sites, showing regression line within 95% confidence intervals.

Table C.4. Regression Equations and Predicted Richness Values for Lowland and Bluff Lithic Assemblages

Regression equations

Lowland site richness = 2.084+3.152 * (Log assemblage size)

Bluff site richness = -7.91+8.077* (Log assemblage size)

Predicted richness values

	Tool Assemblage Size								
	10	**100**	**200**	**300**	**400**	**500**	**1,000**	**2,000**	**3,000**
Lowland	5.24	8.39	9.34	9.89	10.29	10.59	11.54	12.49	13.04
Bluff	0.17	8.24	10.68	12.1	13.11	13.89	16.32	18.75	20.17
Difference	-5.07	-0.14	1.34	2.21	2.82	3.3	4.78	6.26	7.13

Note: Average difference is 2.51.

• *Can Ballona archaeological assemblages be grouped through numerical taxonomy?*

Analyses of lithic assemblage evenness and diversity are designed to indicate differences between archaeological units (sites, components, features). As we have seen above, the contrast in geographic situation (lowland, bluff) seems to contribute to differences in assemblage richness. However, these differences vary along a continuum defined by the regression line of log assemblage size and number of classes. There is little to indicate how assemblages might be grouped along this line, nor or other dimensions of variability considered in this analysis. If we want to know which assemblages resemble each other considering more than two variables at a time, we must resort to a multivariate method such as cluster analysis, and if we want to know which variants contribute the most to the groupings, we must employ factor analysis.

Data Needs

Assemblage size/richness, evenness, class frequency and cluster or factor analyses require only simple counts of artifacts and the classes in which they occur.

Laboratory Procedures for Lithic Artifacts

Sampling

Without knowing lithic assemblage sizes, it is impossible to be specific about sampling strategies. However, certain classes of data will collected only from selected artifacts.

Debitage

Artifacts are screened in the field through sets of screens with 1-inch, $^1/_2$-inch, $^1/_4$-inch, and $^1/_8$-inch mesh, and bagged by size. The size sorting will be recorded and maintained through subsequent sorting, counting and weighing. Each lot of debitage will be sorted by raw material (basalt, quartzite, chert, chalcedony, petrified wood, andesite, obsidian, quartz, rhyolite, fused shale, glass). Debitage in each resulting subset will be counted and weighed. Care will be taken to identify and remove tool fragments from debitage for analysis in their appropriate class.

Additional data to be collected from debitage from *selected proveniences* will include sorting by debitage technological type (flake core reduction, biface thinning, pressure, notching, bipolar, and shatter) and by platform characteristics within each type (see Andrefsky 1998:118–122 and references therein).

Flaked Stone Tools

Observations on tools will include basic raw material and dimensions, along with data informing of tool manufacture, function, and maintenance. For example, intensive tool resharpening and reshaping, or bipolar reduction of expended or broken tools will result in more small tool fragments (Elston 1986b, 1988; Kuijt et al. 1995). Another measure of use intensity is biface intactness (Kelly 2001) indicated by how many of the three-dimensional axes (length, width, thickness) of the artifact can be measured. For example, all three dimensions of an intact biface can be measured; only two dimensions can be measured if the biface has a broken tip, and if the biface has been subjected to bipolar reduction (Elston 1986b), not even thickness can be measured. A third measure is the edge unit (EU) ratio. Under conditions of tool stone shortage, people may be more likely to employ a single flake tool for a variety of tasks, or maintain tool margins instead of discarding a tool as soon as its working edge feels a little dull. Either of these techniques should result in more EUs on tools at discard, and higher EU ratio (number of EUs divided by number of tools).

Observations on cores will include raw material, weight, maximum linear dimension, cortex, and technology (unidirectional, bidirectional, multidirectional, bifacial, bipolar).

Observations on hammer stones will include raw material, weight, length, width, thickness, cortex, number of battered facets, and facet location.

Observations on bifaces and drills will include raw material, status (intact, tip missing, base missing, lateral margin missing, medial fragment, tip fragment, basal fragment, lateral fragment, other fragment), cortex, weight, length, width, thickness, which of these dimensional measurement are complete (Kelly 2001), reduction stage (Callahan 1979), fracture type (none, bending, perverse or notching failure, impact), blank type, reduction technique (bipolar, percussion, pressure, percussion and pressure, bipolar).

Observations on projectile points will include all of those for bifaces, as well as those essential for characterizing point morphology (Thomas 1981). First, detailed morphological data must be collected for all Ballona projectile points. In addition to the standard weight, length, width, and thickness, are measures of basal shape, notch placement, notch size, and so on as defined in Thomas (1981). To see how closely Ballona points resemble "desert" point styles, we will run all the Ballona point data through keys that distinguish among those types (e.g., Thomas 1981; Vaughn and Warren 1987), and compare the Ballona data to type descriptions of point styles lacking keys.

Observations on individual flake tools and microliths will include raw material, status, cortex, flake scar count, platform characteristics, weight, length, width, thickness, which of these dimensional measurement are complete (Kelly 2001). For intact flake tools, the number of edge units (EUs) and EU location(s).

Ground Stone Stools

Observations on ground stone tools will follow Bullock (1994a) and Adams (1996), including raw material, weight, length, width, thickness, status, shaped or unshaped, number of worn facets, cups, and pits, wear location, presence of decoration or pigment, type of decoration, repair (presence of drilled holes, grooves, asphaltum); for manos and metates: plan outline (circular, oval, subrectangular, irregular), use wear (minimal, light, moderate, heavy), area of use wear, depth of use wear; for metates: type (slab, block, boulder, trough); for mortars: maximum diameter, maximum thickness, diameter of pit, depth of pit, pit bottom (flat, round, parabolic), pit sides (straight, tapered); for steatite vessels: maximum diameter, diameter of opening, wall thickness; for pestles: shape (cylindrical, tapered), single or double ended.

Obsidian Hydration

All formed obsidian artifacts (bifaces, projectile points, drills, etc.) and a sample of debitage should undergo X-ray fluorescence for chemical identification of the tool stone source (Gilreath and Hildebrandt 1997; Hughes 1984). Each of these artifacts should then be cut and hydration values observed.

Use-Wear Analysis

Flaked stone tool function will be addressed by analysis of edge damage and use wear of tools *from selected proveniences*, concentrating on microlithic tools, bifaces, shell scrapers, and smaller samples of abundant flake tools (Ataman 1992; Cerico et al. 1986; Elston 1986a; Havercroft and Elston 1990; Keeley 1980; Knudson 1979; Pope 1994; Preziosi 2001; Towner 1992; Tringham et al. 1974; Yerkes 1983).

Data collection and analysis will follow standard procedures. The unit of edge wear analysis is not the artifact, but the edge unit (Havercroft and Elston 1990:227–228), also known as employable unit or EU (Knudson 1979:17): an implement segment that was used to perform a specific task (e.g., cutting, scraping, perforating, drilling, etc.). The unit is indicated by edge morphology, deliberate shaping or retouch, use wear attrition, or all of these. Thus, a single tool may have more than one EU, each serving the same or different functions. If made on a flake, the tool is oriented with the dorsal face showing, and proximal (platform) end down. Its margins are traced in pencil on vellum. Such landmarks as prominent arrises and flake scars are also indicated. The drawing is attached to the recording form. Tool margins are carefully examined under low magnification (2–8×), then scanned at 75× and 150× using a stereomicroscope. Higher power magnifications (300–400×) are occasionally used to look at small surface areas and edge apices, but higher power does not necessarily resolve more details on lithic surfaces. For each EU, several attributes are recorded. EU location on the margin, condition, angle of the edge prior to, attrition or shaping edge angle, EU length, and EU plan (straight, concave, convex, irregular, notch, denticulate). In addition, attributes of attrition for each EU are recorded: dominant attrition form (short flake scars, long flake scars, nicks, wear facet); rounding, smoothing, and polish (each graded as heavy, moderate, light, or absent); presence and form of striae (absent, perpendicular, parallel, diagonal, crossed, random); and presence or absence of residue.

While the gross characteristics of a tool edge (e.g., edge angle, plan form, shaped or unshaped; bifacial or unifacial) can provide clues to function, more definitive functional indications are provided by microscopic indications of tool wear, or attrition: the degree to which tool surfaces are rounded, smoothed, and polished, and (especially) by the frequency, size, and orientation of scratches or striae (Ataman 1992; Hayden 1979; Keeley 1980; but see also Brose 1979). The latter are important because their orientation vis-à-vis the tool margin directly indicate the orientation of the tool edge to the working surface, as well as the direction of movement of the tool against the work piece. For example, straight striae perpendicular to the edge indicate the tool was pushed or pulled against the work surface in a scraping motion. Straight bifacial striae parallel to the edge suggest movement of the tool along the axis of the working edge in a cutting or sawing motion. Straight diagonal striae may suggest either scraping or whittling, depending on the edge angle, condition of the edge itself, and whether the striae are bifacial or unifacial. Different patterns or sizes of striation occurring on the same tool margin may suggest its use in two or more functional modes (e.g., cutting and scraping). Moreover, from the way striae overlap, it is sometimes possible to determine the order in which different modes were used (e.g., first cutting, then scraping). The nature of polishes also may indicate the type of material on which the tool was used. For example, Towner (1992) observed polish on the distal ends of a small sample of quartz microliths from LAN-47 that supports their use as drills, possibly used on beads. Others (Preziosi 2001; Yerkes 1983) have identified specific types of microscopic use wear that should be present on Ballona microliths if they were bead drills. Polish analysis is facilitated by comparison of archaeological specimens and experimental tools using materials employed by Ballona knappers (Kuijt et al. 1995).

Residue Analysis

Selected flaked stone and ground stone tools will be subjected to residue analysis by specialist laboratories (cf. Cummings and Puseman 1994; Puseman 1994; Sobilik 1996). It is critical that only tools discovered in situ during excavation (not in the screen) be employed for residue analysis. Such a tool should not be allowed to contact the excavator’s skin, and should be transferred immediately to a sterile plastic bag (WhirlPak), or covered with plastic film or aluminum foil and sealed. A sample of soil in which the artifact was embedded should be placed in a separate sterile bag and sealed. The artifact should not be washed or cleaned, but submitted directly to the residue analyst in the original bag.

APPENDIX D

Curation Agreement with the University of California, Los Angeles

AGREEMENT FOR CURATION OF ARCHAEOLOGICAL COLLECTIONS

Archaeological Collections Facility
Fowler Museum of Cultural History
University of California, Los Angeles
P.O. Box 951549
Los Angeles, CA 90095-1549
(310) 825-1864 FAX (310) 206-2826

1. Archaeological materials must derive from Southern California contexts or otherwise relate to Southern California research questions. In certain situations, collections derived from other localities may be accepted on a case-by-case basis. In that event, prior approval must be obtained from the Curator of Archaeology, Archaeological Collections facility (hereafter referred to as the "Facility").

2. The Facility will not accept for curation any human remains, grave associated materials, or items that are known or believed to be sacred items (i.e. anything that may be defined as items of "cultural patrimony" according to state or federal laws). If such items are discovered in collections offered or forwarded to the Facility, the Curator of Archaeology will not accept them into the permanent collection and will refund the appropriate curation fee, less a reasonable service charge and items returned to owner at owner's expense.

3. Archaeological materials requiring special care or equipment (i.e. climate humidity, or temperature controls; insect-proof storage cabinets; et.) cannot be accepted for curation in the Facility at this time.

4. All collections **MUST** be accompanied by provenience data. Such documentation necessarily includes a catalog (both a hard copy and in a Facility accepted database) and originals (or copies) of field notes, level records, and maps as well as charts, slides, photographs, and other documentation as appropriate.

5. Copies of reports describing, analyzing, or interpreting the materials **MUST** be submitted to the Facility as part of the documentation. This submission would be **in addition** to a submission to the appropriate Information Center.

6. Individual items (i.e. modified and/or diagnostic artifacts) must be marked with catalog numbers preferably using the Facility accession numbers (or attached to tags). The Facility will provide accession numbers upon request. Acceptable labeling procedures will be provided upon request, but must follow conservation guidelines and use reversible techniques. Guidelines and techniques are available upon request.

Individual items must be placed in polyethylene zip-lock bags with acid-free, 100% cotton-bond tags. The tags, at a minimum, should include the site number, unit number, depth, catalog number, and description. It is required that zip-lock bags be at least 4 mil. in thickness. It is requested that museum quality acid-free boxes be used for collection containers. Unsealed bags or containers will not be accepted

Separate catalog numbers are to be used for each different group of items (i.e., debitage, faunal remains, shellfish remains, soil samples, etc.) from a single level of an excavation unit. That is, one catalog number can be used for all the debitage from the same level of a unit. Groups of items must be placed in separate containers (i.e., zip-lock bag, cardboard box, etc.) with fragile items protected from heavy items.

All catalog numbers in a collection must be accounted for. If an item is initially assigned a number, and is subsequently deleted from a collection, or if a catalog number is otherwise not used, please indicate such on the final catalog submitted with the collection. That is, type "unused number" adjacent to the appropriate space on the catalog and leave all data fields empty. As such, that catalog number will not be considered to have missing items during future collection inventories or research investigations.

7. Individual items and groups of items must be appropriately packaged within the collection to facilitate their retrieval for inventory, examination, or exhibit.

8. Materials must be packed in standard archival (acid-free) boxes (15" X 12" X 10") with lids and must be appropriately grouped and packed with respect to weight and fragility. No box is to weigh more than forty (40) pounds. Labels should be attached to the outside of each box indicating the site number, accession number, box number (i.e., box #1 of 10 etc.), and heaviness of box (ie., light, medium, heavy). Special arrangements, and corresponding fee adjustment, will be made for small collections that do not require the standard box size.

9. Bulky items, such as oversized groundstone and certain historic period materials, not fitting into standard archival boxes, are charged on a per box basis as appropriate by weight (i.e., they will be counted as part of the total number of boxes comprising the collection). Examples include: a 40lb. groundstone item will equal one standard archival box; a two foot long historic artifact weighing 10lb. will equal a quarter standard archival box.

Curation fees are a one-time charge of $400 per standard archival box. The agency or archaeological contractor submitting materials to the Facility for permanent curation is responsible for meeting all curation obligations, including fee payments and signing Curation Agreements. Collections will not be accepted until all conditions are satisfied. **FEES ARE PAYABLE AT OR BEFORE THE TIME A COLLECTION IS SUBMITTED WITH NO EXCEPTIONS.** Checks or money orders may be made payable to Regents of the UC. Please return the signed original Curation Agreement when submitting collections.

Each collection must be properly arranged and cataloged as stated in sections 2, 6, 7, and 8 of this Agreement. The submitter agrees to reimburse the Facility for re-cataloging or significantly reorganizing a collection that does not meet the criteria as outlined in this Agreement. If the agency or its contractor does not wish to prepare the collection for curation, the facility staff has the ability to undertake the task at a rate to be determined by the Curator of Archaeology.

12. It is understood that once a collection is accepted for curation, it becomes the property of the Facility and all rights and privileges regarding ownership of the collection are relinquished at the time of submission (with exception as noted in Section 14 of this Agreement).

13. No charge is made for access to collections for legitimate research or for educational and/or scientific purposes. However, prior arrangements must be made with the Curator of Archaeology before access to the collection(s) is granted. This policy is subject to change at any time and without notice.

14. It is understood that the Facility reserves the right to lend, research, and publish any material for curation or for the documentation of collections. The Facility recognizes and respects the proprietary interest of the submitters to whatever initial publication rights may be involved UP TO TEN (10) YEARS FROM THE DATE THE MATERIAL IS ACCEPTED for curation.

15. A copy of this agreement **MUST BE SIGNED** and included with the collection documentation **BEFORE** acceptance of a collection by the Facility.

16. Special conditions or remarks regarding this collection: (Optional: to be completed by the submitter and/or the Collections Manager as needed).

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I agree to the above listed conditions:

Signature of Agency Representative Date

Printed Name Agency and/or Affiliation

Signature of Agency Representative Date

Wendy Teeter, Curator of Archaeology UCLA Fowler Museum of Cultural History
Printed Name Agency and/or Affiliation

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FOR OFFICE USE ONLY

Date Accepted Accession # # Boxes Invoice # Invoice Date

Received By Date Total Fees Paid Check #

Inventory Date Inventory By

Additional Fees Reason(s) For Additional Fees

GI/msword/curation agreement/12/10/96

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