CALIFORNIA MARITIME ARCHAEOLOGY

A San Clemente Island Perspective

L. MARK RAAB, JIM CASSIDY, ANDREW YATSKO, AND WILLIAM J. HOWARD

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Dedication

To the late Dr. Roy A. Salls, a constant collaborator and friend in the early phases of our San Clemente Island research. Roy's enormous energy and talents as a researcher and teacher were instrumental in making San Clemente Island an archaeological laboratory in the sea. Hundreds of students and colleagues carry these legacies far beyond the island.

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Foreword

Islands have long fascinated archaeologists, not only because of their isolation, but also for the opportunities they provide to examine profound cultural changes in circumscribed environments. The various controversies over the first settlement and ecological devastation of Rapa Nui (Easter Island), for example, suggest that students of ancient societies are attracted to remote land masses. Relative to its size, Rapa Nui has one of the densest concentrations of archaeologists in the world. Quite apart from its enigmatic *moiae*, the ancestors who presided over now-vanished societies, fieldworkers flock there to answer fundamental questions about island societies.

Southern California's Channel Islands have long been a crucible of archaeological investigation. Generations of fieldworkers have delved into the origins and development of the maritime Chumash societies of the Santa Barbara Channel, one of the most complex hunter-gatherer societies on earth. A huge literature now encompasses both the mainland and island Chumash, especially in the context of the close relationships between the Northern Channel Islands and mainland communities.

Numerous important studies have focused on the reasons for emerging social complexity on both sides of the channel. Debates about the increasing sophistication of Chumash societies have revolved around many issues, notably those of trade in shell beads, acorns, and other commodities, and also seafaring. The remarkable

Chumash *tomol*, a distinctive planked canoe with excellent seafaring qualities, has long been at the center of these discussions—which is hardly surprising, given the unique nature of the *tomol*'s design and impressive handling in open water. When did these remarkable craft come into being, and where did they originate? Were they the catalysts for more complex maritime societies in the Santa Barbara region? These questions are hotly debated and still unresolved. The scope of the debates has widened over the past twenty years, with the publication of important paleoclimatic data from tree rings on land and deep-sea cores of impressive resolution from the Santa Barbara Channel itself. After over a century of research, we are on the verge of major breakthroughs in our understanding of ancient island societies.

The Channel Islands are also playing an important role in a new generation of research into the first settlement of the Americas. Archaeology, genetics, and linguistic evidence all agree that tiny numbers of settlers crossed into the Americas from Siberia at least 15,000 years ago, though the signature of their crossing is so exiguous that we will probably never have a precise chronology. The traditional scenario had them passing southward into the heart of North America down the so-called ice-free corridor between the Laurentide and Cordilleran ice sheets. However, an increasing number of experts believe that the first settlements developed along the Pacific coast, where, obviously, rising sea levels have covered any archaeological evidence of their passage. There are fleeting clues, and it is here that the Channel Islands assume considerable importance, notably with the skeleton of the 13,000-year-old Arlington Springs Woman on Santa Rosa Island and evidence of settlement as early as 12,000 years ago on nearby San Miguel Island. At the time, sea levels were considerably lower, so that it would have been possible for Paleo-Indians to cross from the mainland to Anacapa Island to the east in dugouts or reed boats capable of navigating open-water passages of about six miles (9.65 km). This is a very different matter from long coastal voyages, even with the illusory protection of kelp beds, or from trips across 24 miles (39 km) or more of unprotected water between island and mainland, where groundswells can be a problem even on calm days—to say nothing of boisterous afternoon westerly winds.

Until recently, the Southern Channel Islands—San Nicolas, Santa Catalina, and San Clemente—have figured little in the long-running debates over first settlement, growing social complexity, and interactions between mainland and island communities. This is partly because of military activity in the region and because both San Nicolas and San Clemente lie much farther offshore and suffer from more severe weather conditions. Now Mark Raab and his colleagues have produced carefully documented evidence of flourishing human settlement on San Clemente Island as early as 9,000 years ago, a discovery that places this remote place dead center in debates over early maritime settlement along the Pacific Coast. It is easy to envisage open-water passages between the mainland and Anacapa Island to the north when only a few miles of exposed seaway were involved. San Clemente, which is 43 miles (69 km) from Point Fermin on the mainland, is quite another matter. Even if a canoe paddled across to Catalina Island, usually a relatively benign passage, there is still a further 22 miles (35 km) to traverse, over waters fully exposed to ocean swells and wind waves that are often four feet (1.2 m) or more. Some years ago, I argued (2003, 2004) that open-water passages would have required some form of canoe with higher topsides than those of a dugout or reed vessel and that, theoretically speaking, these craft would have been some form of simple planked canoe. Such a watercraft could have been a remote ancestor of a *tomol*. My main essay on the subject (2003), which was explicitly a theoretical argument based on my seafaring experience and certainly not on archaeological evidence—there is none—caused a momentary frisson among students of Chumash canoes, who believe that such craft came into being much later. However, the Eel Point site on San Clemente throws down an intellectual gauntlet to proponents of early Pacific seafaring. It stretches credibility to bring generations of islanders to their offshore home in dugouts or reed craft. The latter soon become waterlogged, probably too soon for a long ocean passage. As for skin boats, there are no hides available on the mainland that would make for strong, weatherproof hulls. Nor are there traditions of such vessels in the ethnographic record. The excavations, radiocarbon dates, and meticulous analyses of stone artifacts and food remains in this book hint that the first, and very early, settlers of at least some of the Channel Islands may have relied on surprisingly sophisticated watercraft. The challenge for future generations of researchers is to find the archaeological evidence for them.

This important monograph offers far more than a firm scenario for early island settlement. San Clemente, by its very remoteness, has not suffered from the rampages of burrowing animals or human looters. The military personnel have been conscientious stewards of a virtually undisturbed archaeological laboratory, which survives into an era of fine-grained multidisciplinary research. Raab and his colleagues have taken full advantage of this treasure chest of archaeology, with spectacular results. They have documented expert dolphin hunts in rocky coves, found evidence of sedentary settlement in the form of a dwelling that is one of the earliest in western North America, and established that there were close, and regular, contacts between San Clemente and Santa Catalina, and between the island and the mainland. The offshore settlements on this windy, resource-poor land mass were very much part of a wider ancient native American world. The contacts may have been sporadic, perhaps confined to calm days in winter when the prevailing winds were down, but the excavations and surveys in these pages leave us in no doubt that San Clemente's people cherished kin ties and long-term relationships with communities on the mainland. As the authors point out, their survival depended on such links.

California Maritime Archaeology is a landmark publication, one of the few occasions when a team of archaeologists has documented in a single volume an entire island history from its first ancient settlement to the historical era. This important book is, I hope, only the beginning of generations of research on San Clemente that see the small populations that once lived far offshore as part of a much wider world. Like all cutting-edge research, these pages pose more questions than they answer, notably about the complexity and mainland ties of San Clemente communities, and so they should. Above all, they highlight the importance of achieving a far closer understanding of ancient seafaring along the California coast, which apparently took canoes of some kind much farther offshore much earlier than we suspected. Doubtless those who undertook such voyages were cautious, expert mariners. Judging from sparse historical accounts, their journeys involved many casualties. Until recently, we have not given sufficient credit to those who plied these waters long before Chumash *tomols* became symbols of cultural complexity.

This provocative, thorough study ranks as a definitive contribution to California archaeology. It also challenges archaeologists everywhere to make new efforts to decode the ocean as perceived by the ancients. Now we have to find more archaeological evidence of watercraft to fill in the picture.

Brian Fagan
Santa Barbara, California
February 2009

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The research reported in this book would never have been possible without the generous support and encouragement of the United States Navy, the conscientious and forward-looking steward of San Clemente Island's natural and cultural resources. The navy provided invaluable logistical support for all of our efforts on the island, for which we are most grateful. This book reflects the efforts of hundreds of student and professional colleagues—far too many to acknowledge by name. We would be remiss, however, not to acknowledge the guidance and advice offered by Terry Jones, Paul and Judy Porcasi, Alice Hale, Jon Erlandson, Michael Glassow, Michael Moratto, Lynn Gamble, Glenn Russell, Daniel Larson, Douglas Kennett, Brian Byrd, Rene Vellanoweth, Patricia Martz, Steve Schwartz, Claude Warren, and the late Clement Meighan. Of course, we are responsible for any errors of fact or interpretation that have crept into this volume, not our colleagues. We are also thankful to our spouses and families, who tolerated sometimes lengthy sojourns to San Clemente Island in search of what we report in this volume.

I

INTRODUCTION

1

California Galapagos

L. Mark Raab and Andrew Yatsko

Birth Places of Maritime Culture

When Euro-American explorers, settlers, and scholars reached the coastlines of North America, they found native maritime societies fringing the continent, including the California Indian groups included in this book. During the last century, archaeological thinking generally consigned these coastal groups to the last stages of cultural development in prehistoric North America. For reasons we examine below, researchers theorized that distinctively maritime cultural adaptations, including seafaring and primary dependence on marine foods, took shape only after Ice Age big-game hunters of the continental interior were able to retool their cultures for life on the oceans. After many thousands of years of cultural experimentation on the continent's shores, terrestrial foragers morphed into seafarers and fishers, with "fully developed" maritime societies appearing only a millennium or two before European contact.

This traditional foundation of maritime cultural origins is fracturing under the weight of new archaeological evidence. Among this evidence are the case studies presented in this volume, discoveries that show that traditional accounts of maritime prehistory paint a far too simplistic picture of the role of coastal peoples in California and North American prehistory. It is increasingly evident that prehistoric maritime cultures reflect a time-depth and developmental dynamism rivaling the terrestrial mainland cultures that have long claimed the interest of most archaeologists.

It should come as no surprise that archaeological investigation of Pacific North America's fringing islands is helping to transform our understanding of maritime prehistory. Based on rapidly accumulating archaeological evidence, these islands hosted a sea-borne trek by maritime colonists near the end of the last Ice Age. Implications of this evidence for the long-standing archaeological debate about the peopling of the New World have justifiably attracted great interest. The discovery that California's Channel Islands were occupied during the Late Pleistocene has, for reasons outlined below, helped to reshape debate about the extent to which the "Clovis-first" model of New World cultural origins remains valid.

Yet the importance of maritime prehistory reaches far beyond its Ice Age origins. Insular cultural traditions continued to unfold in distinctive and dynamic ways across the whole of the prehistoric era. Based on the San Clemente Island data, insular settlement demanded not only sea travel and economies geared toward the ocean, but also social, demographic, economic, and ideological networks that necessarily linked the island to continental North America. San Clemente Islanders were challenged, for example, to obtain mates, vital raw materials, and trade items from off-island settings. As we shall see in following chapters, however, San Clemente Island was by no means simply a pawn of mainland cultural developments. A variety of archaeological evidence shows that islanders were active agents of economic, technological, and ideological innovation; participants in spheres of cultural interaction felt in some cases deep into the interior of western North America.

While we cannot consider them in detail here, the sea islands of Pacific North America presented a diverse range of challenges and opportunities for prehistoric settlers. The Vancouver and Gulf Islands off the coast of British Columbia, for example, afforded abundant terrestrial and marine food resources within easy reach of the mainland. Cedros Island, about 15 miles off the central Pacific coast of the Baja California Peninsula, offered abundant water, rich fisheries, and prolific sea mammal colonies. While all of these islands attracted some degree of prehistoric settlement, it was California's Channel Islands that sustained some of the earliest human colonists and today yield some of the oldest, most diverse, and best preserved archaeological evidence of maritime cultural origins (Rick et al. 2005).

From the border of Mexico to Point Conception, roughly between the cities of San Diego and Santa Barbara, the coastline forms the 250-mile arc of the Southern California Bight, some of the best-known seafront real estate in the world. Sheltered within this arc are the eight Channel Islands, ranging in size from one to 150 square miles (Santa Barbara and Santa Cruz islands, respectively). The Northern Channel Islands—San Miguel, Santa Rosa, Santa Cruz, and Anacapa—form an east-west oriented chain off the Santa Barbara coast (figure 1-1). The Southern Channel Islands, including Santa Catalina, San Nicolas, Santa Barbara, and San Clemente, are more widely dispersed than their northern counterparts, fringing the southern half of the California Bight, roughly between the cities of San Diego and Los Angeles.

As we describe below, the Northern Channel Islands were home to one of the most extensively studied and reported native groups of California, the Chumash Indians of the Santa Barbara coastal region. Later, some of the earliest coastal archaeological sites of the Americas, dating between about 8,000 and 10,000 BC (Rick et al. 2005), were discovered in these islands (chapter 3). Not surprisingly, then, the northern islands and adjacent mainland coast have been synonymous for decades with the study of Channel Islands archaeology and California maritime prehistory (Arnold 2001a; Chartkoff and Chartkoff 1984; Erlandson et al. 2008; Moratto 1984; Rick 2007; Rick et al. 2005; Rogers 1929). Despite their undeniable importance, however, the Northern Channel Islands do not encompass the full story of Southern California coastal prehistory, in terms of either archaeological discoveries or information about the islands' native inhabitants.

Like their northern counterparts, the Southern Channel Islands have been investigated by archaeologists for well over a century (Moratto 1984; see also chapter 3). While the archaeological significance of the southern islands has been recognized for over a century, it was research advances of the last two decades that underscore the importance of these islands to the larger picture of maritime prehistory. Nowhere are these discoveries better illustrated than on San Clemente Island, which has emerged as one

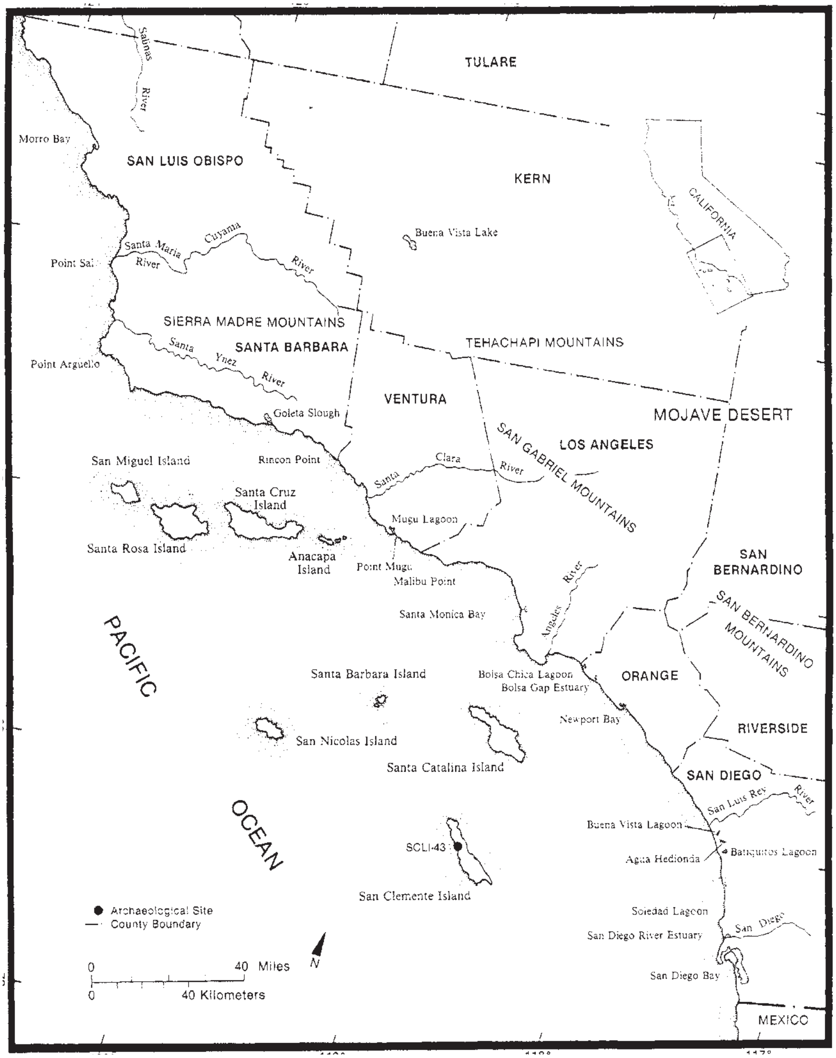


Figure 1-1. Southern California Bight.

of the most productive locales for archaeological research on the North American Pacific Coast. Yet, despite this record, and despite being located less than 50 air miles from the second-largest city in the United States, San Clemente Island tends to be either unknown or the object of unfortunate stereotypes.

Santa Catalina Island, easily the best known the Southern Channel Islands, is a popular destination connected to the Port of Los Angeles by commercial air and sea travel. Located only about 25 miles southeast of Santa Catalina Island and its tourist centers, San Clemente Island has been a naval reservation since 1934, barring most civilians from the island. When observers have any impressions of San Clemente Island, these are often inaccurate. The island has served for decades as a range for gunnery and bombing practice, leading some to imagine a devastated insular landscape. In reality, small areas are reserved for bombardment, leaving much of the island relatively well preserved. In recent decades, the island has come under the monitoring and protection of the environmental management programs of the U.S. Navy. Contrary to stereotypes, many of the island's archaeological sites are better preserved than sites located on the mainland coast of California, and less likely to be damaged or obliterated by the kinds of urban-industrial expansion that continue to transform the mainland coast. From the point of view of archaeological preservation, San Clemente Island can be viewed as something of a time capsule in the sea.

Although San Clemente Island is off limits to most non-military personnel, scores of archaeologists have been working on the island in recent decades. Some of these researchers have worked under cooperative research agreements with academic institutions, while others were contracted by the navy to conduct studies mandated by federal environmental protection laws. The navy's cultural resources management program was a key source of support for the research that is reported in this volume. As a result of this work and the island's remarkable degree of archaeological preservation, we now have the outlines of a maritime cultural odyssey that began at least 9,000 years ago and likely considerably earlier. This odyssey began with sea voyages reaching back in time nearly to the last Ice Age (chapter 2) and ended with some of the earliest cultural collisions between Native Americans and European explorers of North America, including the rise of the California Indian *Chingichngish* (chi-nish-nish) religion, named after its principal messianic figure (chapter 11). During the intervening millennia, and contrary to San Clemente Island's seemingly remote insular status, the island was linked at times to spheres of cultural interaction spanning vast regions of the North American West (chapter 7). From earliest to latest, many of these patterns are coming into focus for the first time, following a century of remarkable archaeological progress that, as we shall see, nonetheless tended to marginalize the study of coastal prehistory.

Toward a Synthesis of Maritime Prehistory

The authors of this book had the great fortune to participate in many field and laboratory projects on San Clemente Island over the last two decades. Our desire to share the results of this work motivated the writing of this book. Despite our enthusiasm for this task, we quickly confronted two challenges in distilling San Clemente Island archaeology into a book. One of these challenges is summarizing the large and diverse body of information that has been collected in recent decades by island researchers. A second challenge is making this information accessible to target audiences. Both of these considerations shaped the content and organization of the present volume.

For its size (57 mi^2 / 148 km^2) San Clemente Island is one of the best-documented archaeological settings in California, if not all of North America. Over 2,500 prehistoric archaeological sites, spanning a time range from the Early Holocene to Spanish contact in the mid-sixteenth century, are currently recorded on the island (not to mention scores of nineteenth- and twentieth-century historical sites). The island has been surveyed repeatedly by archaeologists, including a statistically determined sample of 15 percent of the island's total surface, discussed in chapter 9. Scores of archaeological sites have been excavated to one extent or another over the last two decades, yielding samples of artifacts numbering in the hundreds of thousands. The island's prehistoric cultural chronology is buttressed, at present, by around 400 radiocarbon dates. Much of the information presented in subsequent chapters derives from eight summer archaeological field schools directed by the authors between 1988 and 2003—projects involving over 200 undergraduate and graduate students. San Clemente and other Channel Islands have proven to be exceptional learning environments for students, instilling research skills and professionalism in future generations of archaeologists (Perry 2004, 2006).

Hundreds of professional archaeologists, at the authors' invitation, participated in field schools, site surveys, laboratory research, and other projects on San Clemente Island over the last two decades, including researchers whose theories and interpretations of maritime prehistory diverge from our own. Part of the research reported in this book was supported by grants, including funds from the National Science Foundation (Erlandson et al. 1998) and the United States Congress, opening up the island's archaeological research program to comment and evaluation by peer reviewers. The products of these efforts are too numerous to list here, but include theses and dissertations on file with universities, chapters in books and monographs, and articles published in journals with regional, national, and international circulation. Readers will find references to these works in following chapters.

Sound chronological controls are, of course, essential to archaeological research. Radiocarbon dating is integral to many of the advances made by California coastal archaeology in recent decades, as we shall see throughout this book. Even so, certain challenges remain. First, radiocarbon dates in the archaeological literature, particularly dates obtained more than two decades ago, rarely include information about how they were processed in the laboratory, and are reported in diverse formats (calibrated or uncalibrated, radiocarbon years before present, years BC or AD, etc.). We reference such dates as they are reported. Dates for which we have sufficient information to derive a calibrated age are reported as years cal BC/AD, using the *Calib* (v. 5.01) computer program of the Quaternary Isotope Laboratory of the University of Washington, Seattle. Despite these caveats, published dates are useful indicators of broad chronological trends. Second, research on San Clemente Island during the last quarter century is supported by scores of radiocarbon dates. Citations of these dates follow the widely adopted format of the journal *American Antiquity*, presented in corrected and calibrated years BC/AD.

Data and their technical contexts certainly matter in warranting the conclusions of archaeological research, but sometimes we need to move beyond description to the identification of larger patterns formed by the data. In conveying what we have learned about prehistoric maritime cultural development in this book, our approach is to tell time, not to describe how to build a watch. We believe that San Clemente Island's exceptionally long, diverse, and well-documented archaeological record justifies this synthetic approach. In doing this, we hope to sketch some large-scale patterns of cultural development for the value these may have in understanding maritime prehistory, arguably North America's greatest remaining archaeological frontier, and for shaping new and better research strategies in the future.

Natural Island Laboratory

Ever since Charles Darwin's voyage to the Galapagos Islands astonished the nineteenth-century world with the wonders of evolution, islands have become famous for some of the most varied and distinctive patterns of biogeography on earth (MacArthur and Wilson 1967). Equally important, researchers recognize islands as highly useful natural laboratories:

> Ecosystems are usually very difficult to manipulate experimentally, and hence much of modern ecology has had to rely upon exploitation of "natural experiments"—situations in which one (or a few) factor(s) affecting a community differ between two (or more) ecosystems. For this reason, ecologists have long been especially interested in islands, which constitute some of the finest natural ecological experiments. (Pianka 1974:256)

This approach has proven attractive to archaeologists as well, who have turned to islands as settings well suited, at least potentially, to the comparative study of human cultural behavior. The extent to which islands lend themselves to such "natural experiments" requires careful consideration, however. Fitzpatrick et al. (2007:231) caution that:

> Islands can offer just as many complexities as comparable areas in continental settings. It is widely recognized that human seafaring capabilities, although highly variable through space and time, are fundamentally different than the dispersal capabilities of other organisms; that climatic or environmental phenomena mediate the frequency and intensity of movement; and that, culturally few islands were completely isolated.

These cautions are well taken. Islands are not exempt from the complexities that attend archaeological research in any setting, nor can island archaeology be pursued to best advantage in geographical or intellectual isolation.

Just the same, we should not overlook the opportunities offered by island archaeology. Researchers have used insular settings, including the California Channel Islands, to excellent advantage in understanding the origins and cultural effects of seafaring; development of maritime economies; cultural-environmental interactions; invention, diffusion, and migration of peoples and cultural patterns, and other topics (Arnold 2001a; Fitzpatrick 2004; Keegan and Diamond 1987; Kennett 2005; Kirch 1979, 1983; Kirch and Hunt 1997; Rick 2007; Rick et al. 2005; Rick and Erlandson 2008). In that California's Channel Islands are home to some of the longest- and best-preserved coastal archaeological records in North America, these islands are rightly seen perhaps as a California Galapagos for the study of coastal prehistory. In a similar vein, we believe that San Clemente Island offers an excellent vantage point for comparative study of prehistoric maritime cultural development in Southern California.

Exceptional Archaeological Preservation

San Clemente Island contains comparatively high-resolution archaeological records, bringing sequences of culture change into sharper focus than is frequently possible in mainland situations. The archaeological record of the southern California coastal mainland has suffered serious degradation by natural and cultural forces. Pocket gophers, rabbits, ground squirrels, and other digging animals have inflicted some of the most serious losses. A study of the effects of "faunalturbation" in coastal Santa Barbara County concluded that "the effects of gopher and other animal burrowing upon archaeological sites will be homogenization of cultural deposits, with blurring of discrete features, activity areas and strata" (Erlandson 1984:789). This same study estimated that the artifacts present within such sites may be animal-transported at a rate of 5 percent per century (Erlandson 1984:789). Glassow

(1996:10), also working in Santa Barbara County, offers an equally sobering assessment:

> Only in the last 15 years have archaeologists working in California come to grips with just how extensive the mixing of archaeological deposits by gophers has been. . . . Earlier, some archaeologists naive to the effects of rodent burrowing assumed that a site with no apparent stratification of cultural deposits represented one occupation lasting only a short time or a continuous occupation over many hundreds, if not thousands, of years. Consequently, many cultural changes have been viewed as a series of gradual transformations. . . . In many instances these effects are simply too great to overcome.

The absence of such burrowing animals on San Clemente Island results in dramatically better stratigraphic integrity in the island's archaeological deposits than is often the case on the mainland. For instance, the well-defined cultural strata of the Eel Point archaeological site (CA-SCLI-43), one of the island's most intensively studied localities, permit a level of detail in reconstructing maritime cultural patterns that would be much more difficult to attain from mixed deposits (see chapter 5, figure 5-1). While San Clemente Island was used for animal grazing early in the twentieth century and for various military purposes since 1934, archaeological deposits survive in an excellent state of preservation over an estimated 80 percent of the island, owing to the absence of significant ground-disturbing development (Raab and Yatsko 1990).

Prehistoric cultural patterns on San Clemente Island can be reconstructed with a comparatively high degree of detail and chronological resolution, affording a basis for comparison with synchronous cultural patterns of the mainland coast and even regions far removed from the southern California littoral. The island's cultural deposits, as attested to in many of the chapters in this book, may approximate a "maritime Pompeii" as closely as any in the world.

Paleoenvironmental and Ecological Forces

As the inhabitants of a comparatively small, remote land mass (chapter 2), San Clemente Islanders were highly vulnerable to any climatic or marine environmental conditions that affected the availability of vital resources such as food and water. This circumstance is of considerable interest in relation to recent hypotheses that link prehistoric culture change in coastal southern California to certain paleoenvironmental and ecological forces. Recent investigations show, for example, that southern California, along with western North America, was struck by extreme, persistent droughts during the medieval era (ca. AD 800 to 1300)—events that, in combination with cultural factors, appear to have been stressful enough to induce major changes in cultural patterning (Jones et al. 1999; Raab and Larson 1997). In chapter 9, we look at evidence that San Clemente Islanders likely were affected by these "epic droughts" of the medieval era (Stine 1994).

Stresses making for prehistoric culture change did not arise from the natural environment alone, but also seem to have been generated by islanders themselves. California archaeologists have assumed for decades that prehistoric humans had no appreciable impact on the abundance of plant and animal food resources or that ancient peoples maintained such resources through various conservation practices (Blackburn and Anderson 1993; Gamble 2008). Other researchers debate these conclusions, arguing that land and sea mammals (and other highly ranked food resources) were subjected to intense harvest pressures during prehistoric times, forcing coastal populations to shift to new patterns of hunting and gathering over time (Broughton 1994a, 1994b; Hildebrandt and Jones 1992; Broughton and O'Connell 1999). This research suggests that ancient humans were not passive residents of nature or necessarily resource conservationists. Instead, it appears that prehistoric humans had the capacity to alter significantly their ecosystems, and the resulting changes helped to drive culture change. In chapter 8, we examine how patterns of this kind come into particularly clear resolution in an island setting.

Culture Contact

As a relatively small, remote island off the southern California coast, San Clemente Island may not at first appear a promising venue for understanding cultural patterns across broad expanses of time and space. Yet the island's high-resolution archaeological deposits allow patterns of culture contact to be discerned in a way that is often more difficult amid the "noise" introduced into the mainland archaeological record by site destruction and mixing of cultural deposits. As it turns out, San Clemente Island was never as remote from larger cultural patterns as many might suppose. Two lines of research illustrate this point. Chapter 7 presents evidence that San Clemente Island was part of a distinctive sphere of cultural interaction that linked portions of the southern California coast with the Great Basin about 5,000 years ago. These data suggest that San Clemente Island was part of one of the largest spheres of prehistoric trade and cultural interaction in North America.

San Clemente Island was also part of one of the most momentous chapters of cultural interaction in human history: first contact between native North Americans and Europeans. San Clemente Island was among the places visited by Juan Rodríguez Cabrillo and his sailors in 1542, the first Europeans to contact Native Californians. Chapter 11 examines some of the first cultural reactions to this contact, including the likely appearance of a new "crisis religion" among southern California Indian groups in the more than two centuries that elapsed between initial contact with Europeans and the first European settlement of California (Mission San Diego, 1769).

Research Support

Despite all of the conditions that make San Clemente Island a natural laboratory for archaeological research, the results reported in this book would not have been possible without the research environment that has prevailed on the island over the last two decades. No matter how informative the available archaeological records, the research advances reported in this book would have been impossible in the absence of appropriate research support. Like all land-holding agencies of the U.S. government, the U.S. Navy is required to manage San Clemente Island's natural resources, including the island's numerous archaeological sites, in accordance with federal laws and regulations. The navy's response to this obligation has been exemplary in the case of San Clemente Island.

Since the 1970s, the vast bulk of archaeological research in the United States has been carried out under the authority of federal and state laws, and implemented through research contracts with universities and private corporations. While this type of "cultural resources management" (CRM) archaeology has clearly made huge contributions, it also has a propensity to spin off "hit and run" archaeology in which researchers, working under the pressure of short-term research contracts, do not have the opportunity to synthesize available data or pursue research directions that are promising on purely intellectual grounds. Fortunately, resource managers for San Clemente Island have combined contract investigations with basic research, including archaeological field schools, grants, and academic theses and dissertations (Raab et al. 1994). Unlike many land-managing agencies, which support archaeological research only when forced to do so by development projects, the navy has taken a more forward-looking approach on San Clemente Island, supporting a strong base of both basic and applied studies. In our view, this is an approach that deserves careful study by other land-managing agencies. Chapter 3 of this volume chronicles some of these efforts.

Fall and Rise of Coastal Prehistory

Before we look at specific examples of San Clemente Island research—and how these advances help us to understand maritime prehistory far beyond the island—it may be helpful to consider the substantial challenges that confronted, and continue to confront, the study of coastal prehistory. The twentieth century might well be described as the century of American archaeology. It was during this time that the presence of Ice Age humans in North America was established, the "stratigraphic revolution" allowed excavators to outline prehistoric cultural developments across the continent, radiocarbon dating was added to the tools of the discipline, and many other accomplishments firmly established archaeology as a professional academic discipline in the United States (Fagan 2005; Trigger 1989; Willey and Sabloff 1993). Yet the study of coastal prehistory remained the Rodney Dangerfield of North American prehistory, commanding little respect from many archaeologists.

Jennings (1983:29) aptly describes the view of maritime cultural origins that prevailed during much of the last century: "Land-locked American scholars rarely look at either the ocean or the beaches and are, in consequence, highly myopic as to even the possibilities of a sea-borne passage, a long trek along the beaches, or a combination of these approaches in the first settlement of the West Coast."

Although some archaeologists championed the importance of coastal research (Fladmark 1979), the perspective described by Jennings reflects a number of long-standing problems. Among these were biases against maritime cultural groups, a record of sensationalism in claims of very early coastal occupation, and scarcity of reliable information about coastal archaeological sites of any age. This conflicted legacy overshadows many geographic regions, but California exemplifies the difficulties that undercut the development of maritime archaeological research for decades.

Some of these problems date to the beginnings of professional archaeology in the United States. Working in San Francisco Bay, influential archaeologists of the early twentieth century pronounced coastal foragers among the "lower classes" of North America's prehistoric peoples (Uhle 1907). Prejudicial judgments of this sort stemmed from the belief that some coastal groups had survived on little more than shellfish collecting, a way of life that demanded only the most rudimentary cultural arrangements. Against this background, the 1920s and 1930s saw a series of discoveries in the American Southwest, where dramatic "kill sites" where found containing technologically sophisticated hunting gear (fluted projectile points) used to dispatch Ice Age mega-fauna such as mammoths and bison (Fagan 2007:142–56). Between the two world wars, electrifying evidence of Ice Age hunters in the interior of North America decisively shifted the search for the continent's ancestral cultures to the Paleo-Indians and the terrestrial hunting traditions they gave rise to. This state of affairs is changing, as we shall see in chapter 4, where we examine much earlier evidence of seafaring than archaeologists once imagined.

Following World War II, coastal archaeology received periodic attention but not always with favorable results. In southern California, a succession of claims touted Pleistocene human occupation of the coast (Moratto 1984:75–113). Carter (1957), for example, argued that the San Diego coast was colonized perhaps 100,000 years ago, based on the discovery of allegedly "Paleolithic" stone tools. Attention turned a few years later to the Northern Channel Islands, where it was claimed that humans hunted an endemic species of pygmy mammoths as early as 30,000 years ago (Orr 1968). In the following decade, human burials were reported to be around 40,000 years old on the mainland coast, based on an experimental dating technique (Bada et al. 1974). Each of these cases unraveled under rigorous scrutiny (Erlandson and Colten 1991; Moratto 1984), linking the search for early maritime cultural origins with what some perceived as an unfortunate penchant for sensationalism and questionable science (Erlandson 1994; Moratto 1984).

In the meantime, some of the most basic facts of coastal prehistory, notably the age of the earliest coastal archaeological sites, remained imponderable. California investigators pointed out that certain coastal sites, such as Malaga Cove (Walker 1951) and Zuma Creek (Peck 1955), appeared to reflect maritime cultural adaptations of great antiquity. Unfortunately, these prescient suggestions were never able to rise above informed speculation, since radiocarbon dating became widespread in California coastal archaeology only in the 1970s, and routinely employed only during the last two decades of the century. Indeed, not until the closing decades of the twentieth century were archaeologists able to firmly establish an Early Holocene occupation of the California coast on the basis of radiocarbon dates (Erlandson 1994; Erlandson et al. 2008; Moratto 1984; Raab et al. 1994).

Extravagant claims of coastal antiquity and ambiguous chronologies were only part of the problem, however. Archaeological orthodoxy enforced decades of rigid thinking about maritime cultural origins and development. California archaeologists steadfastly maintained that maritime cultures developed progressively over the span of the Holocene, reaching a Late Holocene climax with the appearance of historic coastal groups such as the Chumash Indians of southern California. The centerpiece of this orthodoxy was an ostensible lack of maritime subsistence practices in what appeared to be the oldest coastal archaeological sites: "The virtual absence of marine shell and fish and sea mammal bones in the refuse of certain village sites suggests that the earlier coast dwellers had not yet realized the full possibilities of ocean resources" (Wallace 1978:28).

This curious situation was based on the assumption that the first groups to reach the coast were oriented strongly toward terrestrial hunting and gathering, and this condition "limits the things people can do in a new environment until they adjust to it and respond to its pressures for change" (Chartkoff and Chartkoff 1984:40). According to this view, the sea was all but ignored for thousands of years because groups living on the coast lacked the knowledge or inclination to use marine resources. This scenario presented theorists of prehistoric culture change with an obvious challenge. Historic native groups, including the Chumash and Gabrielino Indians of the southern California coast and the Channel Islands were heavily maritime in economic orientation (chapters 3, 4, 8, and 10). The economies of both groups were based to a substantial degree on fishing and sea mammal hunting, often employing a distinctive seagoing canoe fashioned of wooden planks (Fagan 2004; Gamble 2002, 2008; see also chapter 4). How and when did the "coastally challenged" come to embrace such an exuberantly maritime way of life?

One of the most popular scenarios assigns the emergence of "fully developed" maritime cultural traits, including seagoing watercraft, intensive fishing, sea mammal hunting, and residential sedentism, to a distinctive cultural climax that ushered in the historic era:

> From about 4,000 years ago (2000 B.C.) to 1769, cultures in California underwent a transformation from small groups of seasonally wandering hunters and gatherers to large groups in sedentary settlements, with a form of cash economy and the beginning of larger political organizations. This transformation is the story of the Pacific Period. (Chartkoff and Chartkoff 1984:146)

> The Late Pacific is known in the archaeological literature as the Protohistoric Period because it was then that the historically known California Indian cultures took their final form. . . . During the Late Pacific, almost all the economic, technological, and social traits characteristic of the historical cultures were fully developed. Riverine and ocean fishing reached their greatest productivity. Population levels rose markedly and societies became increasingly complex. . . . The development of oceangoing canoes, fish dams, and specialized storage structures at this time

> demonstrates how focal these economies had become. (Chartkoff and Chartkoff 1984:180)

As cultural ecology became firmly established in American archaeology by the 1970s, practitioners of this theoretical orientation offered their own rendition of the "late maritime" scenario. Arguing that marine foods are generally an inferior source of calories in comparison to terrestrial alternatives, it was suggested that maritime adaptations arose only after land-based hunting and gathering failed to provide adequate subsistence—perhaps as a result of trans-Holocene population growth and environmental change (Osborn 1977; Yesner 1987). According to this model, intensively maritime economies did not appear anywhere in North America earlier than about 5,000 years ago. This reasoning led to the conjecture that the eight Channel Islands off the southern California coast probably were not occupied in any permanent way until perhaps 4,000 to 5,000 years ago, owing to insular resource scarcity. This is a topic we return to in chapter 5.

Despite any differences of theoretical orientation between the progressive cultural evolutionists and the cultural ecologists, neither camp questioned the developmental priority of terrestrial adaptations, and the late advent of maritime cultural adaptations during the prehistoric era. If a Clovis-first model dominated thinking about prehistoric cultural development in North America, its counterpart was "coastlines last."

Moratto (1984) was one of the first investigators to offer a serious challenge to this scenario. In an influential synthesis of California prehistory, Moratto (1984:104–13) proposed a California Paleo-Coastal Tradition—i.e., the existence of distinctively maritime cultural adaptations on the California coast during the Early Holocene. Unlike previous suggestions along these lines, Moratto's proposal enjoyed a key advantage: mounting empirical evidence of early coastal occupation. The advent of contract archaeology during the 1970s greatly expanded the scope of coastal research in California. This trend, employing modern data recovery techniques and funding for radiocarbon dating, quickly produced two interesting results. The first was a small but revealing sample of early radiocarbon dates from coastal sites. For instance, localities such as Rancho Park North (southern California) and Diablo

Canyon (central California) yielded dates between about 6,000 and 6,400 BC (Moratto 1984:104–13; Porcasi 2007). Second, these discoveries included clear evidence of mixed marine-terrestrial economies, including substantial reliance on shellfish and sea mammals (Moratto 1984:104–8).

A decade later, at least twenty-five radiocarbon dates ranging from cal 6,500 to 9,500 BC were known from the central and southern coasts of California (Jones 1991, 1992; Erlandson and Colten 1991). Nor was the pattern exclusive to California. By the close of the 1990s, a minimum of forty Late Pleistocene/Early Holocene coastal sites had been identified on the North American Pacific Coast (Dixon 1999; Erlandson and Moss 1996).

Progress was not confined to chronology, however. A quickening pace of coastal research produced decisive insights into the nature of early maritime economies. Among other advances, coastal studies helped to resolve the question of what should be defined as a true maritime adaptation by tackling the problem on the basis of Yesner's (1980:728) "50% solution"—i.e., a subsistence pattern that demonstrably derives at least 50 percent of calories or protein from the ocean. Several studies show that the Santa Barbara coastline was occupied by groups who satisfied most of their protein needs from marine resources, mainly shellfish, between about cal 4,000 and 7,000 BC (Erlandson 1991a, 1994; Erlandson et al. 2008; Glassow 1996). Combined with small, hard seeds, marine protein resources sustained a highly productive coastal economy during the Early Holocene (Erlandson 1991b; 1994). What about the traditional perception that early coastal dwellers all but ignored marine foods? Early coastal excavators rarely screened cultural deposits or used other techniques capable of recovering evidence that modern investigators regard as essential to accurate reconstruction of subsistence practices. Effectively, the true scope of maritime subsistence practices was invisible to early coastal researchers.

Mainland archaeological sites provide only part of the emerging Paleo-Coastal picture, however. Some of the earliest and most intensively maritime coastal occupations are found in the California Channel Islands. Daisy Cave (CA-SMI-261) on San Miguel Island and Arlington Springs (CA-SRI-173) on Santa Rosa Island convincingly demonstrate settlement of these islands during the Pleistocene-Holocene transition. At Daisy Cave, basketry and cordage remnants date between about cal 6,000 and 8,850 BC, making these usually perishable materials among the oldest of the North American Pacific Coast (Connolly et al. 1995). The earliest of these dates point to one of the earliest human settlements of the North American Pacific Coast (Erlandson et al. 1996). A series of radiocarbon dates from a human skeleton from Santa Rosa Island ("Arlington Woman"), along with associated organic materials, date between about 9,500 and 11,000 cal BC, a time range comparable to the initial occupation of Daisy Cave (Johnson et al. 2000).

What evidence suggests that these early islanders were true maritime foragers and not, as die-hard progressive evolutionists or cultural ecologists might insist, merely terrestrial hunter-gatherers on an island holiday? In the first instance, it seems difficult to imagine what might have attracted dedicated terrestrial foragers to the Channel Islands. The depauparate terrestrial floral and faunal communities of these islands never supported more than a fraction of the plant and animal species found on the mainland (Power 1980). In sharp contrast to the terrestrial situation, however, the Channel Islands marine environment was prolific with shellfish, fish, sea mammals, birds, and other resources (see chapters 3, 4, and 8).

Based on some of the largest studies of Channel Islands archaeofaunal remains, less than 3 percent are of terrestrial origin (Garlinghouse 2000; Porcasi et al. 2004; Porcasi and Fujita 2000), a finding that is consistent with isotopic indicators of diet. Although stable isotope (carbon 13 and nitrogen 15) data are not available from the skeletons of the island's earliest inhabitants, human skeletons from the Channel Islands that date between about 3,000 and 5,000 cal BC reveal isotopic signatures strikingly like those of sea lions, indicating an overwhelmingly marine diet (Foley 1987; Lambert and Walker 1991). Interestingly, these heavily marine isotopic signatures are similar to those reported by Dixon (1999:117) for a human skeleton dating close to cal 7,800 BC from Prince of Wales Island, Alaska (49-PET-408, On Your Knees Cave).

By the last decade of the twentieth century, it was possible to demonstrate initial human occupation of the southern California coast, including the Channel Islands, during the terminal Pleistocene, with widespread coastal occupation by the Early Holocene. Always basic to archaeology, these discoveries created additional challenges to developing suitable regional cultural chronologies. Southern California coastal archaeology spawned a plethora of chronological schemes over the last century—a proliferation more likely perhaps to create confusion than understanding (e.g., Chartkoff and Chartkoff 1984:15; Erlandson and Colten 1991; Moratto 1984; Rogers 1929; Wallace 1955, 1978; Warren 1968). In this volume, we adopt Erlandson and Colten's (1991:1–2) three-part division of California coastal prehistory:

> In much of California, the Early-Middle Holocene transition, roughly dated to between 6000 and 7000 RYBP [radiocarbon years before present, or ca. cal 4,000 to 5,000 BC], is when mortars and pestles first appear widely, presumably for processing acorns and other plant foods. Hunting and fishing technologies also diversify in many areas about this time, and the importance of sea mammals and fish seems to increase relative to shellfish. During the Middle-Late Holocene transition (ca. 3000 to 3500 RYBP) [ca. cal 1,000 to 1,500 BC], a further diversification in subsistence, technology and ornaments occurs in many coastal areas.

Maritime Prehistory in Deep Time

Despite the advances in coastal archaeology outlined above, traditional models of maritime prehistory continue to exert a powerful influence not only on thinking about ancient California but also New World cultural origins. In the past, theories of maritime cultural development seldom veered from the notion of a single, trans-Holocene evolutionary trajectory, leading progressively to a Late Holocene maritime climax. The popularity of these interpretations is easy to understand. Only during the last two decades has proof emerged that true maritime foragers occupied the southern California coast and the Channel Islands as far back in time as the Late Pleistocene or Early Holocene. The challenge of understanding coastal cultural origins in "deep time" has really just begun, including the dynamic development of these maritime societies between Late Pleistocene/Early Holocene colonization and the appearance of Europeans off the coastlines of Pacific North America. This book is offered as a step in this direction.

2

San Clemente Island

Andrew Yatsko and L. Mark Raab

A naval reservation since 1934, San Clemente Island is not open to civilians, except by permission of the military authorities. Most civilian encounters with the island are by fishing or dive boats or sport sailors, all of which are obliged to limit their activities to the waters surrounding the island. Even so, these visitors encounter much the same insular environment that greeted the island's first sea-borne human explorers near the end of the last Ice Age (see chapter 4). In stark contrast to the kelp forests and teeming sea life of its surrounding seas, much of the island's terrestrial environment is marked by arid, rock-strewn landscapes and scant vegetation. Life's purchase on the land seems far more precarious than in the sea. This impression is not mistaken, but rather captures a central challenge to prehistoric human settlement of San Clemente Island. In this chapter, we take a brief bio-geographic survey of the island, the varied environmental conditions encountered by its ancient inhabitants. As we shall see in chapters that follow, the island's terrestrial and marine habitats sustained a succession of varied cultural adaptations spanning the Holocene (post–Ice Age era), particularly near the end of this period (chapters 9 and 10).

Geography and Geology

Southernmost and fourth largest of the California Channel Islands, San Clemente lies about 32 km (20 mi) from its better known island neighbor, Santa Catalina, and 72 km (46 mi) from the Palos Verdes Peninsula, the nearest point on the southern California mainland (Yatsko 1990; figure 2-1). Aligned on a northwest-southeast trending axis, the island is 34 km (24 mi) in length, ranges in width from 2.5 to 6.5 km (1 to 4 mi), and encompasses a total of 148 km^2 (58 mi^2). San Clemente Island has a diverse topography as the result of tectonic and climatic dynamics. The island is composed mainly of Miocene andesite (15.5 Ma), with lesser amounts of dacite, rhyolite, and marine sedimentary rock (Merrifield et al. 1971; Olmsted 1958). Quaternary sediments, including dune sands, eolianite, alluvial fans, and marine terrace deposits overlie this Neocene bedrock over much of the island (Crittenden and Muhs 1986:293).

Water was perhaps the single most important limiting resource for prehistoric human settlement, and this was strongly conditioned by the island's geology. As we shall see in chapter 9, the island is in general a poor aquifer, with most of the relatively scant precipitation that falls on the island rapidly running off relatively impermeable volcanic rock. The result is a paucity of surface water. However, the island's sedimentary deposits, including dunes and debris-filled canyons did capture significant amounts of water, which was likely available as surface water from seep springs and "rock tanks." During periods of extreme drought, these features played a critical role in structuring prehistoric settlement patterns (chapter 9).

San Clemente Island is an uplifted structural block along the submerged San Clemente Fault (Lawson 1893; Muhs 1980:8; Smith 1898). Exposure of the island block above sea level occurred in the Early Pleistocene (Ridlon 1969). Uplift since that time appears to have continued at a rate of between 20 cm and 40 cm per thousand years (Muhs 1980). The island's maximum elevation (Mt. Thirst) is presently 599 m above sea level.

San Clemente Island's tectonic activity has been fundamental to the evolution of its landscape. Sea cliffs and shore platforms along the island's west coast were eroded and marine deposits laid down during eustatic sea level fluctuations across the Pleistocene (Muhs 1980; Whitney 1865). These features have since been elevated by tectonism. During emergent intervals, marine sediments on offshore shelves were transported by prevailing onshore winds onto adjacent uplands as dune deposits. These dune fields have modified and masked some wave-cut terrains.

Figure 2-1. Relief map of San Clemente Island.

Bathymetric studies show no evidence that fluctuating sea level through the Late Pleistocene ever created a dry land link between any Channel Island and the mainland (Vedder and Howell 1980). The Northern Channel Islands are grouped significantly closer to the mainland than any individual island in the southern group (figure 1-1), except Santa Catalina Island. However, even at the time of significant sea-level lowering during the last glacial maximum (17,000–18,000 years BP), San Clemente Island was not significantly closer to any other land mass than it is now (Vedder and Howell 1980). There was no prehistoric settlement of San Clemente Island without sea travel, a reality we examine in chapter 4.

Island Terrains

Research by Fred Reinman and colleagues on San Nicolas Island demonstrated the value of a terrain-stratified approach to the study of prehistoric settlement patterning (Reinman 1985; Reinman and Lauter 1984; see chapter 3). The value of this approach stems from the fact that terrain variation plays a fundamental role in access to various vital resources, including food and water. A similar approach was adopted in San Clemente Island research. Based on Muhs's (1980) topographic divisions, six terrains were defined on San Clemente Island: Coastal Terrace, Upland Marine Terraces, Plateau, Eastern Escarpment, Major Canyons, and Sand Dunes (Yatsko 2000c, 1987a, 1987b).

Three terrains—Coastal Terrace, Upland Marine Terraces, and Plateau—are largely a product of emergent marine terraces mentioned earlier. Structurally, these terraces consist of wave-cut platforms, sea cliffs, and post-emergent colluvial wedges covering the platforms at the bases of sea cliffs. These terrace terrains can be segregated on the basis of their relative age (age increases with elevation), and the degree of erosion or deposition of terrace surfaces, a primary factor in archaeological preservation. The proximity of these terraces to shorelines, the islander's principal sources of subsistence (chapters 4, 5, and 8), is a significant factor in understanding the island's ancient settlement patterns.

Coastal Terrace

The Coastal Terrace consists of the first two marine terraces above sea level: the one currently being cut by the sea and the youngest emergent terrace. Cut during the last interglacial about

125,000 years BP (Muhs 1980), the second terrace is a gently sloping (<10%), narrow coastal plain. Rising in elevation from sea level to about 30 m at the base of the Upland Marine Terraces terrain, the Coastal Terrace terrain is featureless except for scattered bedrock seastacks (towers of eroded volcanic rock). It averages 300 m to 400 m in width, but some stretches narrow to only 50 or 75 m. Thin soils cover most of the terrace, except where colluvial wedges have built up at the base of cliffs and certain of the Major Canyons have deposited substantial alluvial fans. The Coastal Terrace is continuous along the northern, western, and southern coastlines, except where interrupted by the Sand Dunes in the northwest or where sea cliffs rise directly from the shoreline into the Upland Marine Terraces (figure 2-2). Overall, this terrain covers approximately 8.5 percent of the island's land area. The island's coastal terraces contain some of the highest densities of archaeological sites on the island—between 200 to 400 sites per km^2 (Yatsko 2000c). Often small (>15 m) and shallow (>40 cm), these shell-bearing middens (deposits of dietary shell and related cultural material) undoubtedly reflect proximity to the shoreline and its food resources, and the relatively high level of intensity with which this terrain was exploited during Late Holocene times (Raab 1992; see also chapters 8 and 10).

Figure 2-2. Marine terrace facing northwest from Eel Point.

Upland Marine Terraces

The Upland Marine Terraces incorporate a well-expressed vertical sequence of emergent marine terraces that ascend the island from the rear of the Coastal Terrace platform to the top of the fossil sea cliff defining the margin of the Plateau terrain. These terraces date from around 215,000 years BP to 1.5 million years BP or older (Muhs 1980). In elevation, this terrain extends above the 30 m contour to 450 m elevation at mid-island. Soil conditions are similar to those on the Coastal Terrace. Found mostly along the western or southern exposures of the island, the Upland Marine Terraces are laterally continuous in their northwest extent (figure 2-3). South of mid-island, however, this lateral continuity is increasingly dissected by the Major Canyons. This is the largest San Clemente Island terrain, with a total area of about 37 percent of the island's surface. Like the Coastal Terrace, this terrain contains a relatively high density of archaeological sites.

Plateau

The Plateau is open, rolling, peripherally dissected upland terrain, composed of emergent marine terrace features that have been

Figure 2-3. Marine terraces of San Clemente Island's west shore.

Figure 2-4. San Clemente Island's central plateau.

altered or masked to such a degree by erosional and depositional processes that they are often difficult to discern (figure 2-4). Erosion has significantly degraded the Plateau's sea cliffs, while over much of its northern extent, stabilized dune deposits also have buried both sea cliffs and platform surfaces. This composite terrain is continuous along the central spine of the island, with only occasional interruptions by steeply sloped topography. It rises from about 120 m in the north to 599 m mid-island and grades gradually down slope to 275 m at its southern margin above Pyramid Cove. The Plateau's margins are defined by the upper limits of the Upland Marine Terrace terrain and the comparable upper edge of the Eastern Escarpment. This lateral boundary is increasingly irregular toward the south due to dissection by the Major Canyons. The Plateau is the second-largest island terrain area, covering 34 percent of the island. The Plateau contains archaeological sites of mixed character, ranging from small, apparently short-term camps to some of the largest, most complex sites on the island (chapters 6, 7, 10, and 11).

Eastern Escarpment

The remaining three terrains, Eastern Escarpment, Major Canyons, and Sand Dunes, are byproducts of other erosional,

Figure 2-5. San Clemente Island's eastern escarpment.

depositional, and tectonic processes that continue to shape San Clemente Island's landscape. The precipitous, dissected Eastern Escarpment is the fault scarp of the submarine San Clemente Fault mentioned earlier. With slopes often in excess of 45 degrees, this terrain is continuous along the entire eastern side of the island (figure 2-5). Oriented north-northeast, the Eastern Escarpment is a cooler and moister island terrain. It covers elevations from sea level up to 150 m in the north, 599 m at Mt. Thirst, and 230 m in the south near Pyramid Head. The Eastern Escarpment comprises a little more than 11 percent of the island surface. Owing to steep terrain of the Eastern Escarpment, this terrain contains few archaeological sites of an occupational nature, but specialized sites, such as stone raw material quarries, do exist there (Howard 1991).

Major Canyons

Fifteen narrow but deeply incised drainages along San Clemente Island's southwestern slope collectively make up the Major

Figure 2-6. Head of Major Canyon on western San Clemente Island.

Canyon terrain. The product of erosion accompanying rapid tectonic uplift, these canyons severely dissect the other terrains they traverse, especially the southern Upland Marine Terraces. While constituting only about 5 percent of the island's area, these canyons create some of the island's more dramatic and isolated topography (figure 2-6). The canyon walls drop off sharply from the bordering terrace platforms, in some cases descending nearly vertically to depths of up to 150 m. These walls of rock shelter from prevailing winds and produce relatively cool and moist conditions on the canyon floors, supporting a Canyon Shrubland/Woodland flora. "Rock tanks" formed below waterfalls hold significant amounts of runoff water, even during the driest periods of the year. As noted in chapter 9, these canyons represent one of the areas where San Clemente Island's prehistoric population sought drinking water during a period of Late Holocene climate stress.

Sand Dunes

Composed of active or recently active calcareous (fragmented marine shell) sands, the Sand Dunes overlie portions of the Coastal Terrace and Upland Marine Terraces. The Sand Dunes form a gently rolling, brilliantly white terrain with large areas bare of

Figure 2-7. Sand dunes on the northwest coast of San Clemente Island.

vegetation, except where vegetation has begun to stabilize dune surfaces (figure 2-7). Present sea level has cut off their sand source, and this change is rapidly removing their seaward face while their windward slopes progressively deflate. There were originally four sand dune areas at the northern and southern extremes of San Clemente Island. These consisted of three separate but proximate dune fields in the north covering an area over 3.5 km^2 and a fourth smaller field located on China Cove in the south. Two of the northern fields were destroyed by construction of the island airfield in the late 1950s. The surviving northern dune field encompasses approximately one km^2 along the island's northwest shore.

Climate

At first glance perhaps, San Clemente Island does not appear to be a particularly severe environment for human occupation, but appearances can be deceiving. Native islanders faced substantial challenges from the paleoenvironment—some of a constant nature and some episodic. As discussed in chapter 9, Late Holocene climate change of the medieval era, felt by groups across Western

North America (Jones et al. 1999), appears to have radically altered the size and distribution of San Clemente Island's population.

The climate of southern California is classified as Mediterranean, with warm, dry summers and cool, wet winters. Climatic diversity is least in coastal areas, whereas conditions change rapidly toward the interior. The cooling effects of evaporation and heat transfer between water and air moderate temperature extremes in the coastal zone. In the case of San Clemente Island's climate, the influence of the Pacific Ocean is reflected in modest temperature ranges and the lack of frost.

Elevation and distance from the sea determine variability in microclimates across San Clemente Island. These microclimatic factors exist within larger-scale, regional circulation systems such as prevailing winds and subtropical pressure systems. Southern California's climate is influenced by a semi-permanent, subtropical high-pressure cell centered over the north Pacific (Kimura 1974). The region's weather system is dominated by this cell, especially during the spring and summer months. Under its influence, a well-mixed boundary layer, up to 500–600 m deep, is formed when warm and moist Pacific air drifts over comparatively cold waters off the southern California coast, creating a persistent bank of fog. This marine layer results in high humidity and a large number of cloudy days on San Clemente Island. Above this layer, conditions are relatively warm, dry, and cloudless. This layer of cool, moist marine air usually migrates onshore in the evening, evaporating in the afternoon during peak hours of sunshine.

In the winter months, the ridge of high pressure weakens (Kimura 1974). Winter frontal storms, generated in the north Pacific, move into California from the west. As these storms move into southern California from the southwest, tropical, moisture-filled air is entrained in the low-pressure system, resulting in generally abundant precipitation throughout the coastal region. However, San Clemente Island departs from these coastal precipitation trends, typically receiving only a fraction of mainland rainfall totals. In recent decades, however, climatologists have come to understand better the El Niño-La Niña cycle as a perturbing influence on this Mediterranean climatic pattern (Amaral 1995). An ENSO (El Niño-Southern) event is an oceanic and atmospheric response to a heating of the ocean surface in the southwest Pacific that induces the net eastward migration of warm surface waters. A typical ENSO event lasts for 14 to 22 months and decays when there is no longer enough warm water to sustain the cycle. ENSO events tend to dry out Australia and south Asia, bring heavy rains to the west coast of South and Central America, and typically (but not always) supply California with well above average winter precipitation. La Niña is the cold counterpart of the ENSO cycle in which sea surface temperatures in the eastern Pacific drop below normal. These occur following some (but not all) ENSO years. La Niñas are characterized by warm winters in the southeastern United States, colder than normal winters from the Great Lakes to the Pacific Northwest, and below average precipitation in California.

The potential effects of these cycles on prehistoric settlements can be estimated from observed changes in San Clemente Island's ecosystems during the ENSO cycles of 1982–1984 and 1997–1999. During both of these intervals, warm El Niño waters had a considerable effect in reducing the abundance of kelp along the island's western coast. Rising sea temperatures result in the starvation of kelp, depressing the abundance of the many marine species (Raab et al. 1995a). Conversely, cooler SSTs (sea surface temperatures) during the La Niñas of 1983–1984 and 1998–1999 resulted in heavy kelp growth.

Earlier generations of archaeologists, as we point out in chapter 9, assumed that prehistoric California coast was an exceptionally benign, unchanging natural province. Modern paleoenvironmental and archaeological research refutes this assumption (Raab and Jones 2004; Jones and Klar 2007). Changing SST has been identified by archaeologists as a major driver of marine ecosystem productivity in southern California, with corresponding influences on prehistoric maritime economies (Pisias 1978; Raab et al. 1995a; West et al. 2007). Arnold (1992), for example, correlated elevated SST with food crises in the Northern Channel Islands, helping to trigger the emergence of Chumash Chiefdoms (chapters 3 and 10). Deep sea cores drilled into the submarine basins surrounding the Channel Islands revealed significant changes in SST during the Holocene, likely linked to variation in regional climate, including major Late Holocene droughts (Kennett and Kennett 2000; see chapter 9, this volume). It appears that San Clemente Island's prehistoric population was able to cope with these cycles during most years. However, evidence suggests that late in the island's prehistory, between about AD 800 and 1300, moisture conditions deteriorated dramatically, resulting in severe, prolonged droughts and alterations to cultural patterns on the island (chapter 9). Significant variation in maritime economy, human health, rates of interpersonal violence, and settlement patterns have been correlated with changing marine and terrestrial climates of the Northern Channel Islands (Kennett and Kennett 2000; Raab et al. 1995a; Lambert 1993; Lambert and Walker 1991). While San Clemente Island did not entirely escape such forces, it appears that southern and northern Channel Islands by no means responded in lock-step to paleoenvironmental stresses (chapter 10).

Until recently, San Clemente Island's climate characteristics have been derived from averaged weather records collected in 1962 and 1977 by the U.S. Navy at the island's main airfield, located on the extreme north end of the island. These data suggest the island received on average slightly more than 150 mm of precipitation per year (6 in), with a range from 80 mm (3.2 in) to 290 mm (11.6 in)—precipitation levels comparable to mainland regions classified as deserts. By contrast, the Los Angeles Basin and Santa Catalina Island receive about 380 mm (15.2 in) per year on average. Based on these data, San Clemente Island seems almost impossibly arid. We now know, however, that moisture conditions on the island were probably more favorable than these figures suggest. Formal collection of island weather data was discontinued in the late 1980s, but to fill this information gap, a new system of three, self-reporting meteorological stations was installed across the center of the island in 1993. These meteorological stations traverse a range of island terrains and associated environmental zones, including the Coastal Terrace, the Plateau, and the Eastern Escarpment. This microclimatic monitoring system has significantly improved baseline weather data for the island. The new stations have reported average annual rainfall totals doubling those from the airfield, or around 300 mm (12 in) per year.

These new data suggest that the extreme aridity previously characterized for the island is more a function of weather record sampling error than actual conditions. Moreover, the new records point to greater variability across the island. For instance the island's Plateau and leeward Eastern Escarpment receive more rainfall than the Coastal Terrace. Clearly, however, San Clemente currently receives, and probably received in the past, less precipitation than the surrounding mainland coastal region. Despite the improved estimates of annual precipitation, the island still must be regarded as semi-arid. While this relative aridity contributes to the island's excellent state of archaeological preservation, it was perhaps the single most important constraint on prehistoric settlement. Aside from limiting sources of drinking water, aridity enforced the island's depauperate terrestrial food resources, decisively shifting the prehistoric quest for subsistence toward the sea.

Terrestrial Ecology

The geographic isolation of islands produces unique life forms. The flora and fauna of San Clemente Island exemplify this characteristic of island biogeography. The island's flora includes 14 endemic species or subspecies—the greatest number among the California Channel Islands. An additional 29 plants occur only on San Clemente Island, and one or more of the other Channel Islands and Mexico's Guadalupe Island. Eight major plant communities have been described for San Clemente Island. These include Grassland, Maritime Succulent Scrub (with four segregated phases), Maritime Sage Scrub, Canyon Shrub/Woodland, Coastal Salt Marsh, Coastal Strand, Sand Dune, and Sea Bluff Succulent (Kellogg and Kellogg 1994). Most of the island is covered by Grassland and the various Maritime Succulent Scrub phases (e.g., *Lycium* phase, *Opuntia* phase, *Cholla* phase).

On the emergent marine terraces, plant communities are composed principally of different combinations of xeric Maritime Succulent Scrub vegetation phases, which include cacti, box-thorn (*Lycium californicum*), and other drought-resistant species. Cacti, such as the prickly pear (*Opuntia littoralis*), provide edible "pads" and fruits. Sage species, particularly *Salvia columbariae*, were a valuable source of seeds for prehistoric peoples.

The Plateau terrain presents a marked contrast to the coastal terraces, dominated by the island's Grassland plant community. Before the devastation of the island by introduced European grazing animals, the Plateau probably supported stands of shrub species. These are now in the process of recolonization following feral animal removal. In the past, species such as malva rosa (*Lavatera assurgentiflora*) and Mormon tea (*Ephedra sp.*) were probably more widespread, affording considerable cover and sources of fuel. The Plateau may have been an important location for collecting vegetal resources, such as acorns, seeds, fibers, and corms, including San Clemente Island brodiaea (*Brodiaea kinkiensis*), a small, starchy bulb.

Across the island, native perennial grasses have been replaced by exotics since European occupation. Although they once had a wider distribution, trees are now confined to moist environments of the canyons and the Eastern Escarpment because of historic overgrazing. Among these, oaks (*Quercus tometella*) survive as isolated stands, and native shrubs and grasses are only beginning to rebound. These conditions make it difficult to estimate the prehistoric productivity of terrestrial plant resources for prehistoric hunter-gatherer populations, including availability of acorns.

Currently, there is no archaeological or paleontological record of native land mammals of economic significance on San Clemente Island. Mammalian species such as the island fox (*Urocyon littoralis*), the white-footed deer mouse, and the domestic dog are the only ones likely to have produced terrestrial meat sources. All of these are known or likely to have been introduced prehistorically by humans. The house-cat-size island fox appears to have been introduced by humans throughout the Channel Islands during the prehistoric era, and is one of the canid species whose ritual burials are described in chapter 11 of this book. The largest terrestrial species not expected to have been a product of human introduction is the Island night lizard (*Xantusia riversiana*), for which there is no evidence of use as a subsistence resource.

Marine Ecology

San Clemente Island occupies a portion of the Southern California Bight bounded on the north by the submarine Santa Catalina Basin and on the west by the San Nicolas Basin. To the southeast of the island is the San Clemente Basin, and the Tanner Bank and Cortes Bank seamounts are located 60 km and 80 km, respectively, to the southwest. San Clemente Island is principally exposed to the warm waters of the north-flowing Southern California Countercurrent, although water temperatures are generally slightly lower on the western side of the island, particularly during summer months, owing to localized upwelling and the influence of the offshore California Current. The near-shore waters support a diverse assemblage of fishes and invertebrates as well as several species of marine mammals.

The rocky intertidal zone of the "outer," windward shoreline that fringes the Coastal Terrace possesses extremely rich biological communities, with affinities to warmer-water systems to the south and occasional representation of colder-water forms (Murray and Littler 1978). The biota of the leeward intertidal zone at the base of the Eastern Escarpment has its greatest affinities with the southerly warm-water systems. Further, because the Eastern Escarpment's steep contour continues sub-tidally to a depth of more than 900 m, the immediate offshore waters along the island's eastern shoreline are ecologically pelagic.

The Coastal Terrace of the island's west shore affords the primary access to the shoreline, where the bulk of the faunal component of the prehistoric islanders' marine diet was obtained. This intertidal zone provided shellfish, including abalone (*Haliotis sp*.), mussels (*Mytilus sp*.), and gastropods (*Tegula sp*.). The shore and near-shore habitats, including the rocky intertidal, shallow rocky reef, deep rocky reef, kelp bed, and soft bottom, were also highly significant as sources of fish, a principal component of the prehistoric diet (Andrews 2000; Garlinghouse 2000; Salls 1988; see also chapter 8, this book). Mainstay species of the prehistoric fish diet, such as the California sheephead (*Semicossyphus pulcher*), were easily taken from shore or near the shore (Raab et al. 1995b; Salls 1988).

Sea mammals were also available along the kelp bed zone. Included among these are the sea otter, *Enhydra lutris*. Since the island contained no terrestrial mammals larger than the island fox mentioned earlier, the pinnipedia (seals and sea lions) would have been important sources of meat, fat, skins, and other resources. The Coastal Terrace supported pinniped rookeries and "haulouts," where these animals could be easily captured (Hildebrandt and Jones 1992; Jones and Hildebrandt 1995; Porcasi et al. 2004). Currently, resident pinniped populations include the California sea lion (*Zalophus californianus*), northern elephant seal (*Mirounga angustirostris*), and harbor seal (*Phoca vitulina*). Although the island currently supports significantly smaller pinniped populations than seen on Northern Channel Islands such as San Nicolas or San Miguel Islands, there is no question that these large, blubber-bearing animals were a principal prehistoric prey item. In chapters 4, 5, and 8, we look at sea mammal hunting on San Clemente, showing that human predation likely played a major role in depressing the island's stocks of pinnipeds over the course of the Holocene.

The island's shoreline was a source of other valuable resources as well. The prevailing north-northwesterly winds and currents carried driftwood (for fuel and construction) to San Clemente Island—wood that could have been used for watercraft and other kinds of construction (chapter 4). We have no evidence that the prehistoric peoples of southern California hunted whales, but dead or dying whales were cast up on San Clemente Island's shores, no doubt affording a welcome "flesh fall," as well as bones for the type of house construction described in chapter 6.

The introduction of domestic sheep and goats on San Clemente Island during the eighteenth and nineteenth centuries (chapter 3) occasioned severe impacts on the island's native vegetation, with subsequent heavy erosion in some areas. Despite these recent modifications, the majority of San Clemente Island's terrains have likely changed relatively little since the prehistoric era. Accordingly, the terrains visible today would have constrained prehistoric settlement patterning in various ways. Overall, the island could be described as challenging for its prehistoric inhabitants, owing to cyclical aridity, long- and short-term marine and climatic environmental cycles, and depauperate terrestrial resources. At the same time, San Clemente Island clearly reflects a long-term pattern of successful human occupation. In following chapters, we look at some of the technoeconomic and social adaptations that allowed distinctive and successful maritime lifeways to be fashioned from the island's resources.

3

San Clemente Island Archaeology and the Island Gabrielino

L. Mark Raab

California's Channel Islands became the property of the United States in 1848 at the close of the Mexican-American War, followed by statehood in 1850. During the nineteenth and early twentieth centuries, San Clemente Island was home mostly to sheep ranchers, sport fishermen, and recreational hunters in search of the island's population of feral goats. San Clemente's historic Gabrielino Indian population was gone by the time of California statehood (Johnson 1988). Early Euro-American visitors found abundant evidence of the island's ancient human inhabitants in the form of stone, bone, and shell artifacts; large deposits of shells and other food remains (shell-bearing middens); and human burials. This pattern of discovery repeated itself across the Channel Islands, attracting relic collectors from around the world, and then archaeologists dedicated to acquiring information about the islands' ancient history rather than merely objects. In this chapter, we look briefly at patterns of archaeological discovery on San Clemente Island and at the island's last native inhabitants, the Island Gabrielino.

A Century of San Clemente Island Archaeology

1877–1950: The Antiquarians

Spanning more than a century, San Clemente Island archaeology evolved from uncontrolled artifact collecting, to the arrival of investigators with scientific objectives, to current programs of research and resource management based on public laws. The first of these developments takes us to Europe and the United States during the nineteenth century, when interest in natural history was surging, including a fascination with the origins and development of “primitive” cultures. Charles Darwin’s revelations about evolution, advances in geological science, and the emergence of archaeology and anthropology as academic disciplines all played a role in whetting the public’s appetite for information about the prehistoric past. The Victorians wondered whether ancient human societies might be understood from archaeological and ethnographic studies.

In an age before electronic media, this curiosity took concrete form in the public’s enthusiasm for natural history museums, including exhibits of archaeological materials. Since archaeology was only emerging as a profession between about 1860 and 1900 (Trigger 1989:127–28), self-trained adventurers often led an intensely competitive search for museum-quality archaeological specimens from around the world. Often driven more by romanticism than science, these early investigators seldom concerned themselves with specific research goals, methodological rigor, or detailed records of their activities.

By the 1870s, the Channel Islands were the scene of spirited competition between American and European artifact collectors, including the rivalry between Paul Schumacher, representing various American interests, and Jean Leon de Cessac of France (Moratto 1984:120–22). Paul Schumacher (1877, 1878) is San Clemente Island’s first recorded archaeological investigator, visiting the island at least twice during the 1870s. Employed by the U.S. Coastal and Geodetic Survey as a land surveyor, Schumacher was engaged in mapping coastal California, which had been part of the United States for less than three decades when he visited the Channel Islands in the 1870s. His job offered a perfect opportunity to pursue his real passion, which was archaeological exploration and artifact collecting. Employed at various times by the Smithsonian Institution and the Harvard Peabody Museum, Schumacher collected artifacts from the larger of the California Channel Islands, including San Clemente (Baldwin; 1996; Putnam 1879).

Like other collectors of his era, Schumacher was keen to find museum-quality artifacts ahead of his competitors. Burial sites were the usual targets, since these were the most expedient source of high-quality artifacts sometimes interred with the dead. Again like most collectors of his time, Schumacher kept only the most rudimentary records, leaving unknown the specific locations of his visits to San Clemente Island. It is a reasonable guess that he spent some of his time in the dunes of the Island's north end (chapter 2). Prevailing winds constantly shifted the sands of these dunes, exposing ancient burials and artifacts. He clearly surveyed other parts of the island, however, because he offers a relatively detailed description of a stone mortar/bowl manufacturing site (at a currently unknown location) on the south end of the island (Schumacher 1877:157–58). Putnam (1879) also makes numerous references to artifacts collected from San Clemente Island by Schumacher in the report of Army Lieutenant Wheeler's scientific and geographic survey west of the 100th Meridian.

Bits and pieces of archaeological information emerged from other activities on San Clemente Island. Blanche Trask's pioneering botanical studies during the 1890s included incidental comments on archaeological sites that she encountered during her field work on San Clemente Island (Trask 1897). Earlier, naturalists aboard the U.S. Fish Commission steamship *Albatross* put in at San Clemente Island during their Norfolk, Virginia, to San Francisco voyage of "Deep Sea Exploration" in 1887–1888. A small archaeological collection of approximately 12 items made during this visit is now housed in the Smithsonian Institution (Hatheway and Greenwood 1981).

Charles Frederick Holder, avid sportsman and founder of the Tuna Club on Santa Catalina Island (still extant in the City of Avalon), excavated dune sites located on the northwest shore of San Clemente Island in the late 1880s (Holder 1896:658–62). Working with J. Neal Plumb, Holder collected human skeletons and related artifacts. These artifacts, including several deer tibia "flutes," became part of the Plumb collection in Islip, Long Island, New York, later to be donated to the Smithsonian Institution.

These episodes hardly compare to the professional "pothunting" pursued by others. Ralph Glidden, based on Santa Catalina

Island, and one of the more relentless looters of archaeological sites in the Channel Islands during the period between the world wars, apparently collected several hundred prehistoric human burials from San Clemente Island (Legler 1977). Reminiscent of Schumacher's activities, a part of this collection was amassed during a 1923 expedition to San Clemente Island financed by the Heye Foundation of the American Indian. Photographs taken by Glidden during this project, showing a number of locations on San Clemente Island, along with an inventory of the materials that he collected, are housed at the Catalina Island Museum.

Glidden achieved considerable notoriety from his efforts. Newspaper accounts, sometimes featuring attractive female assistants, regularly chronicled his exploits. Glidden also used his home in Avalon, Santa Catalina Island, for displays of some of the specimens brought back from his collecting forays. Foregoing any sort of historical or scientific accuracy, these exhibitions consisted of bizarrely arranged assortments of human bones and artifacts. The whole affair can only be described as appalling by any current legal, ethical, or scientific standards. Even so, Glidden achieved what appears to have been his real purpose, which was to make his cottage a regular stop for tourists willing to pay a fee for admission to his "museum."

Glidden was by no means the only collector of San Clemente Island antiquities during the early twentieth century. In 1926, Theo Murphy and his wife, Lettie, arrived on San Clemente Island. Murphy, the island's last sheep rancher, had gone into partnership with E. G. Blair to manage a flock of approximately 20,000 animals (Hatheway and Greenwood 1981:31). When the U.S. Navy took control of the island in 1934, Murphy was hired as a civilian guard to protect the island from trespassers. These duties took him to many parts of the island, in the course of which he could indulge his avid interest in collecting prehistoric Indian artifacts. At one time, his collection totaled about 14,000 specimens (Smull and Cox 1989:4). Murphy collected antiquities on San Clemente Island until his death in 1944. After his death, Lettie Murphy donated Theo's collection to the San Diego Historical Society. Through the efforts of Andrew Yatsko, staff archaeologist of the Natural Resources Office, Naval Air Station North Island, the Murphy collection was returned to Navy ownership in 1988. The collection is now curated with the Department of Anthropology, California State University, Fullerton (Smull and Cox 1989).

At the same time, a variety of circumstances probably moderated the degree of destruction to San Clemente Island's archaeological resources. By the early decades of the twentieth century, Glidden and others had rendered many of the better-known prehistoric site localities into landscapes pocked by looters' pits. San Clemente and other Channel Islands came to be viewed as "dug out." This notion undoubtedly spared many sites from extinction. San Clemente Island's generally treeless and dry landscape, coupled with a basic lack of amenities, also helped to discourage potential visitors.

Control of San Clemente Island by the U.S. Navy during the last 70 years has also helped to avert what would have almost certainly been a far greater impact from looters. Since 1934, when San Clemente Island became a naval reservation by an act of the United States Congress, the island was closed to members of the public. Contrary to public perceptions, as much as 80 percent of the island has not been impacted by Navy operations, leaving literally thousands of archaeological sites out of reach by land developers and site looters.

Investigations by Arthur Woodward, with the support of the Los Angeles County Museum of Natural History (LCMNH), bring to a close the era of early exploration and artifact collecting. Coleman and Wise (1994) report that between 1939 and 1941, the LCMNH launched 12 Channel Islands expeditions, including work on San Clemente. What was to have been a five-year project documenting the natural history of the islands was cut short by the entry of the United States into World War II in 1941. The style of Woodward's expedition, with its emphasis on natural history, was reminiscent of the nineteenth century. On the other hand, the growing professionalism of archaeology during the first quarter of the twentieth century inspired a rigor in Woodward's excavation techniques and record-keeping that was far superior to any nineteenth-century account of San Clemente Island. This project was a crucial transition from the collecting expeditions in vogue during the Victorian era to more modern, problem-oriented scientific research.

Woodward employed a survey of San Clemente Island's archaeological sites, albeit an extremely cursory effort, as a basis for selecting sites for excavation (Coleman and Wise 1994:184–86; Ehringer 2003). Big Dog Cave (CA-SCLI-119), located on the island's south end, was selected for complete excavation. The cave was probably well known to relic collectors on the island before Woodward's arrival, as he seems to have been directed to the cave by accounts of extraordinary artifacts being unearthed there. Situated about 7 m above the surf, the cave at times receives spray from crashing waves. The highly saline conditions that resulted were an exceptional environment for the preservation of organic materials within the cave's archaeological deposits. Woodward's excavation recovered human and animal burials (including the renowned "big dog" burial wrapped in sea otter skin); trade cloth from the Spanish missions; and various wooden, metal, bone, and shell artifacts. Artifacts from Big Dog Cave are presently curated at the Los Angeles County Museum of Natural History. Woodward himself never fully reported his activities on San Clemente Island, offering only a brief summary of the Big Dog Cave excavation (Woodward 1941).

A report by Salls (1990a) relates the results of a 1985 excavation at Big Dog Cave by a team of UCLA investigators. This project was undertaken to salvage what was left of the cave's archaeological deposits after Woodward's excavation, and after the cave was struck by waves resulting from exceptionally fierce storms of 1982 and 1983. The UCLA excavation showed that, unfortunately, little remained of the cave's original archaeological deposits. Just the same, the last native occupants of Big Dog Cave left behind an archaeological record indicative of the interaction of San Clemente Island Indians with Europeans, including the Spanish missions (Erhringer 2003; Hale 1995; Johnson 1988; Rechtman 1985). In chapter 11, we look at evidence of a native "crisis religion" with roots on San Clemente Island, including Big Dog Cave's animal burials.

Organized archaeological work on San Clemente Island ceased during World War II and the following five years. Interest in the island's history was by no means extinguished, however. In 1942, Navy Lieutenant Commander S. E. Flynn, an amateur archaeologist and artifact collector, published a history of San Clemente Island in the *U.S. Naval Institute Proceedings*. This account (Flynn 1942) concerned itself, in part, with Woodward's discoveries at Big Dog Cave, particularly noting evidence for contact between

San Clemente Island Indians and the Spanish missions during the early historic era.

1950–1970: Culture History and Ecology

The second major period in San Clemente Island archaeology began shortly after World War II. By about 1950, attention was once again being focused on Channel Islands archaeology by the academic community. Unlike the collectors and swashbucklers of the late nineteenth and early twentieth centuries, academic researchers now reflected the considerable scientific maturation of American archaeology between the world wars. In fact, two distinctive paradigms of scientific research reached the Channel Islands, including San Clemente, from the larger discipline of archaeology during this period. One of these paradigms was culture history, with its emphasis on chronology building and plotting the time-space distribution of culturally indicative artifact types (Trigger 1989; Willey and Sabloff 1993). This had proven an immensely successful research program, yielding the first comprehensive models of prehistoric cultural development in North America.

The 1950s and 1960s witnessed increasing interest among American archaeologists in cultural evolution and adaptation. These topics, subsumed under the rubric of cultural ecology, retained the methods and interpretations of culture history but launched new types of research aimed at understanding how culture change was influenced by the interaction of prehistoric natural and cultural environments. A major innovation in this regard was interdisciplinary research that integrates the work of archaeologists, biologists, botanists, and many other scientific specialists (Trigger 1989; Willey and Sabloff 1993).

Both of these paradigms demanded considerably higher standards of excavation and scientific record-keeping than was common in earlier archaeological investigations. Just the same, mid-century excavations were more variable than contemporary research with regard to standards of artifact recovery, recording of excavation procedures and observations, and sampling of archaeological sites. The fact, for example, that some investigators did not employ screens to recover artifacts during excavations of the 1950s and 1960s is a significant factor in assessing the comparability of data from earlier studies with information collected by contemporary researchers (Erlandson 1994; Raab et al. 1995a).

Directly or indirectly, culture historical and ecological orientations influenced archaeological research on San Clemente Island. In the early 1950s, a project that included students and faculty from UCLA and other institutions set out to survey and excavate archaeological sites located on three of the Southern Channel Islands (Santa Catalina, San Clemente, San Nicolas). The fundamental aims of this project, headed by Professor Clement Meighan of UCLA (Meighan and Eberhart 1953), were to document the antiquity and development of the islands' prehistoric cultures. This conception of Channel Islands archaeology was a significant conceptual advance in that it envisioned a research program dedicated, in part, to an inter-island study of cultural ecology. This was a significant break with past practice, in which investigators, even if they worked on several islands, nearly always focused their analytical efforts on individual sites or islands.

Although the ambitious goals of this program were never fully realized, notable successes followed. Between 1953 and 1955, Clement Meighan of the Department of Anthropology, UCLA, carried out excavations at the Little Harbor site (CA-SCAI-17) on Santa Catalina Island (Meighan 1959), now recognized as a pioneering effort in archaeological cultural ecology. As documented by Martz (1994), this project spawned a host of other investigations, including three decades of work by Fred Reinman on San Nicolas Island, work on various Channel Islands by Charles Rozaire, an expedition by Marshall McKusick and Claude Warren to San Clemente Island, and many others. In the latter project, McKusick and Warren conducted a brief site survey and excavation project on San Clemente Island during 1958.

The McKusick and Warren project was perhaps the first archaeological study of San Clemente Island to address contemporary scientific goals. Among other locations, this project selected the Eel Point site (CA-SCLI-43) for excavation (McKusick and Warren 1959). Their study was the first to document the immense volume, richness, and time depth of Eel Point's archaeological deposits. Prompt publication of results (McKusick and Warren 1959) is another outstanding feature of this work. In keeping with their attempt to elucidate cultural chronology on the island, McKusick and Warren defined a sequence of three cultural complexes (McKusick and Warren 1959:136–38): Milling Stone Complex, Mortar and Pestle Complex, and Big Dog Complex. Although this scheme never caught on with subsequent investigators, it reflects an attempt to go beyond purely descriptive studies to a higher level of historical synthesis. Several chapters in this book reflect the richness and importance of Eel Point's deposits.

The 1950s and 1960s saw at least two other brief field projects on San Clemente Island, albeit not nearly as well documented as the efforts of McKusick and Warren. Spencer Rogers of San Diego State College excavated sites located on the northern half of the island, including site CA-SCLI-120 in Wilson Cove, for a few days during 1950. This work languished unreported for decades. Fortunately, in an outstanding example of what can be done with "cold" artifact collections and records, Noah (1987) produced an MA thesis that offers a useful synthesis of Roger's work.

The archaeological Survey Association of Southern California conducted excavations in 1963 at the Ledge Site (Redfelt 1964). Taking its name from a rock ledge on which the site is situated, Ledge (CA-SCLI-126) is an example of the comparatively shallow but highly complex midden deposits and cultural features found in some of the sites located on the island's central plateau. Excavators were apparently drawn to Ledge by reports of unauthorized digging by pothunters. The Ledge excavations by Redfelt (1964) demonstrated a Spanish mission-era occupation of the island, and the presence of well-preserved pit features and occupation loci are similar in certain respects to those documented earlier at Big Dog Cave. While most of this work went unreported, it set the stage for work by UCLA teams at the Ledge site during the 1980s (Rechtman 1985).

Despite the fact that between 1950 and 1970 a solid scientific orientation arrived on the Channel Islands, including San Clemente, certain basic problems persisted. Research on the islands involved substantially greater logistical burdens than mainland projects of comparable scope. The myriad demands of archaeological field work such as providing transportation, field subsistence, and essential gear were greatly magnified by the islands' remoteness and often primitive working conditions. This problem imposed a kind of Catch-22 that worked against research progress. Lacking major research funding or substantial logistical support, it was difficult to attain a "critical mass" of research findings, which in turn did little to encourage long-term research planning or to convince funding agencies to support work that seemed endlessly exploratory. Viewed in this context, the fact that ambitious inter-island research projects launched in the 1950s never achieved their full potential is understandable. Indeed, the progress that was achieved is a tribute to the energy and commitment of these pioneering researchers. In fact, it would not be until the 1980s, with the advent of formal archaeological resource management programs on San Clemente and other Channel Islands (Martz 1994; Raab et al. 1994), that these logistical constraints were eased.

1970–1983: Conservation Archaeology

Archaeological research on San Clemente Island after about 1970 reflects not only a quickening pace, but also a new ethic of resource conservation fostered by the passage of laws and regulations designed to protect archaeological resources (King 2004). For the first time, public agencies were required by law to assess the potential impact of their activities on archaeological and historical properties. Put another way, archaeological sites, artifacts, and related records had to be viewed not merely as objects of interest primarily to scholars or scientists, but as resources to be managed wisely for their benefit to society at large.

This shift in orientation quickly made one point clear about San Clemente Island: Huge gaps existed in knowledge about the character and extent of the island's archaeological resources, and about the accuracy of much of the archaeological information that had been collected previously. Resource managers had long recognized this reality, of course, but when treatment of archaeological resources essentially reflected academic agendas, "data gaps" were of little significance except to scientific specialists. On the other hand, resource managers were faced with the need to make important policy and preservation decisions based on the same imperfect data—actions that could not be put off until some unknown point in the future when traditional scientific research might deliver a comprehensive understanding of San Clemente Island prehistory. One implication was clear: Future archaeological research priorities had to involve a partnership of resource managers and scientists that would enhance the U.S. Navy's ability to manage the island's archaeological resource base, as well as advance traditional science and scholarship.

By the mid-1970s, the initial development of such partnerships had already begun to alter historical patterns of archaeological research practice. Notably, excavation was no longer perceived automatically to be the centrally important archaeological research activity. Clearly, excavation remains an indispensable tool of archaeological research, but recognition that a reliable inventory of archaeological sites is fundamental to any informed resource management program began to elevate the importance of site surveys. Even so, this orientation is a departure from past research practice that, as we saw earlier, tended to view surveys merely as a means of locating sites worthy of excavation. The new emphasis was on creating a comprehensive, well-documented database containing information about the character, number, and location of archaeological sites on San Clemente Island.

Michael Axford (1984) and students from San Diego Mesa College began the first systematic surveys on San Clemente Island between 1975 and 1980 in an attempt to create a complete and detailed inventory of archaeological sites. The success of these efforts can be gauged in part by comparing McKusick and Warren's (1959:113) inventory of sites on San Clemente Island with Axford's (1984) more systematic efforts. McKusick and Warren (1959) reported a total of 120 known sites. A quarter-century later, Axford (1984:3) had recorded 1,634 sites. Of course, it would be unfair to suggest that these two projects should have produced anything like comparable results, given that the two projects approached the problem of site survey with quite different objectives in mind. After all, McKusick and Warren were only on the island a short time and primarily interested in locating sites for excavation, not creating a comprehensive inventory of archaeological resources. Even so, the vastly different picture of the size of San Clemente Island's archaeological resource base that resulted from these two projects drove home two important realities.

First, by the 1980s it was clear that the island's archaeological sites numbered in the thousands, occupying every major topographic province. At the time of this writing, it is estimated that

San Clemente Island contains at least 7,000 archaeological sites, ranging from small scatters of artifacts to multi-hectare, deeply stratified shell-bearing middens. Granted that these numbers have changed over the years owing to disparate definitions of what constitutes a site and differing survey methods and objectives, there is no question that San Clemente Island contains one of the highest recorded site densities in California, if not North America. Certain parts of the island, for example the marine terraces on and above the island's west shore, contain between 200 and 400 sites per km^2 (see chapter 2). Second, there could be no doubt that a suitably comprehensive and accurate inventory of these sites must be carefully planned, systematically implemented, and, of necessity, carried out over a period of many years, perhaps even decades.

Other benefits accrued from Axford's project as well. Axford began development of a radiocarbon-based island chronology in the late 1970s. By the early 1980s, Axford had collected at least 20 radiocarbon dates from a variety of sites—these dates spanning a period from the eighteenth century to about 8,000 radiocarbon years before present (Breschini et al. 1992:50–51). This essential tool of modern archaeological research, not widely employed anywhere in coastal California until the cultural resources management (CRM) "boom" of the 1970s, was entirely lacking on San Clemente Island prior to Axford's efforts. Axford should also be credited with bringing the island's research potential in this regard to the attention of others, including Professor Clement Meighan of UCLA. Meighan (1984:21) was impressed in particular by the relatively early dates obtained from the Eel Point site; dates in the range of 5,000 to 8,000 radiocarbon years before present (RYBP). This information was influential in convincing Meighan eventually to launch a program of research on San Clemente Island during the 1980s. The research results presented in chapters 4, 5, 8, and 10 of this book draw heavily on work at the Eel Point site (CA-SCLI-43), demonstrably one of the most important on San Clemente Island.

By the beginning of the 1980s, all of these developments prompted a formal overview of the island's cultural resources. A report by Zahniser (1981) attempted to synthesize existing information about San Clemente Island history and prehistory, as well as summarize what was known about the spatial distribution of archaeological sites on the island. This document offers an important synthesis of information about San Clemente Island archaeology through the 1970s. As we shall see next, innovations in resource management strategy after 1981 quickly introduced a new, more proactive stage of archaeological investigation on San Clemente Island.

1983–Present: Cultural Resources Management

By the 1980s, it was clear that San Clemente Island's archaeological resource base is simply too large and complex to be managed effectively in a purely reactive, piecemeal fashion. Two important actions followed this recognition. First, a permanent staff archaeologist position was created within the Natural Resources Office (NRO) of the Naval Air Station North Island (NASNI). Andrew Yatsko was hired in 1983, initiating the Cultural Resources Management Program (CRMP), largely with the purpose of developing more effective approaches to managing San Clemente Island's archaeological resources.

Second, the CRMP immediately began development of a two-pronged resource management strategy, following sections of the National Historic Preservation Act (NHPA) of 1966. Here, we can simply note that section 106 of the NHPA, familiar to federal land managers and consulting archaeologists, essentially provides procedures for assessing the potential impacts of federally funded or sponsored construction projects on archaeological resources. Federal agency compliance with section 106 is typically achieved by hiring archaeological consultants to perform the necessary technical studies. These procedures can be described as "reactive" in that a section 106 action is triggered when construction plans are proposed (King 2004).

However, a second component of the CRMP's strategy can be described as "proactive." Section 110 of the NHPA (as amended) encourages federal agencies to make inventories of archaeological and historical properties on their lands, and to conduct such studies on these properties as are required to create a reliable basis for cultural resources management. This provision of the NHPA allows for more timely, consistent, and focused improvements in our knowledge of archaeological resources than is often possible in the context of impact-mitigation studies. It had become obvious, in other words, that on San Clemente Island a strict reliance on 106 actions is never likely to move resource management capabilities ahead of a very steep scientific learning curve. Instead, a combination of impact-mitigation studies and more basic, longer-term investigations offer a better prospect of achieving the objectives of timely and cost-effective regulatory compliance and advancement of archaeological knowledge.

Beginning in 1983 (and continuing to the present), the Cooperative Research Agreement (CRA) became an important tool for implementing long-term site inventory and other types of basic archaeological research on San Clemente Island. At the discretion of the CRMP, a partnership may be created between the U.S. Navy and an academic institution, private firms, or an individual researcher. These agreements generally sanction basic research, provided that such projects serve a defined resource management objective. Logistical support (but not funding) is provided for this work by the navy in return for joint-use of the resulting research products. The result is a resource management tool that is flexible, cost-effective, and as we shall see, scientifically productive. This tool is an ideal application to certain problems. Long-term site survey projects, for example, can be sustained by CRAs. Test excavation of archaeological sites damaged by past land-use practices or natural erosion are another candidate for CRAs. At the same time, excavation projects aimed at obtaining baseline scientific information that can be used to manage the entire island resource base are another possibility.

An agreement formed between North Island Naval Air Station and UCLA in 1983 launched the CRA program. Since that time, CRAs have been established with a variety of institutions and individual researchers. A complete list of CRAs is presented here, but it may be worthwhile to summarize the results of the two principal institutional CRAs that have been in effect since 1983—first with the University of California, Los Angeles, and then with California State University, Northridge. Under terms of these agreements, archaeological field school excavations were conducted on San Clemente Island between 1983 and 1987 under the supervision of UCLA professor Clement Meighan and a number of graduate students, including Roy Salls.

In this phase of the development of San Clemente Island archaeology, indeed to the advancement of California maritime archaeology, the contributions of Roy Salls deserve special note. After finishing a career as a homicide detective for the Los Angeles Police Department, Roy entered the archaeology doctoral program at UCLA, specializing in the zooarchaeology (analysis of animal bones in archaeological contexts) of coastal southern California. Roy's extraordinary energy, organizational skills, and ability to frame significant research problems helped to launch a number of successful research initiatives on the island during the 1980s and 1990s, creating a foundation for many of the studies reported in this volume.

The UCLA investigations produced several academic theses and dissertations (Foley 1987; Rechtman 1985; Salls 1988; Scalise 1994; Titus 1987). Excavations by UCLA ranged widely over the island, including the Nursery site (CA-SCLI-1215), the Ledge Site (CA-SCLI-126), Big Dog Cave (CA-SCLI-119), the Old Airport site (CA-SCLI-1487), the Columbus site (CA-SCLI-1492), and others. Interim reports of this work were produced by Armstrong (1985) and Meighan (1984, 1986). Records and artifact collections from the UCLA excavations are on file at the Institute of Archaeology, UCLA.

Some of the highlights of the UCLA investigations include work at the Nursery site (named for its close proximity to a native plant nursery), a large, complex shell-bearing midden deposit and related cultural features encompassing an area of perhaps 15,000 m^2. The Nursery site, like nearly all of the sites investigated by UCLA, was selected for test excavation because the site had been damaged in past decades by military construction projects and other sources of disturbance. The fundamental objective of the UCLA work was to determine whether intact cultural deposits exist in the site and, if so, to document the character, extent, and state of preservation of these deposits. Work at the Nursery site by UCLA in 1983 demonstrated the presence of several prehistoric pithouse structures, as well as other cultural features. Discoveries at the Nursery site are described in chapter 6 of this volume.

By way of contrast, the Old Airport, Ledge, and Columbus sites all contained early historic cultural components. The Old Airport site, impacted by construction of a World War II airfield, revealed 22 cache pits filled with fragments of bowls fashioned of steatite (soapstone) thought to be from Santa Catalina Island, beads, and other artifacts. Based upon historic glass trade beads found within this site, Meighan (1986:9) estimated an occupation span between

1769 and 1800. Similarly, the Ledge site mentioned earlier had been damaged over a period of decades by military activities. Work at the site in the early 1980s by UCLA archaeologists resulted in an MA thesis by Rechtman (1985) documenting an occupation between about 1800 to 1820. The Ledge site reflects an intriguing blend of Indian and European technological and subsistence elements, inviting comparison with the items found by Woodward at Big Dog Cave.

Excavators from UCLA also turned attention to "Xantusia Cave" (also known as North End Shelter and Night Lizard Cave—CA-SCLI-1178) near the island's north end. This sea cave contains dense deposits of shell, including an abalone midden more than 1 m in thickness. A radiocarbon date of 6,300 ± 90 RYBP (radiocarbon years before present; correction and calibration unknown for these dates) is estimated from the base of archaeological deposits in Xantusia Cave (Foley 1987:3). Two other dates were obtained from this sea cave, 4,950 ± 90 and 5,130 ± 55 RYBP, the latter from a human burial in the abalone shell deposit (Foley 1987:11). The burial from this site is the only instance to date of a stable isotope reconstruction of prehistoric diet from San Clemente Island, confirming the heavy reliance of the islanders on seafood (Raab et al. 1994).

The 1985 field season proved exceptionally productive for UCLA archaeologists. One team excavated Big Dog Cave, as noted earlier. Another team returned for a second season at the Eel Point site, the locality of the work by McKusick and Warren (1959) noted earlier. The UCLA investigators divided this large site into areas A, B, and C (Aycock 1983:1), with area A corresponding to the dune area where McKusick and Warren worked in 1958. These investigations revealed cultural components spanning a timeframe from the Early Holocene to European contact, effectively doubling previous estimates of the antiquity of human occupation of San Clemente and other Channel Islands. These excavations also produced significant new data on the maritime economy of the island's prehistoric peoples. Research by Salls (1988, 1989, 1990a, 1990b) on prehistoric marine fishing practices in southern California was based to a significant degree on data derived from this work.

During 1988, the Northridge Center for Public Archaeology (NCPA) of California State University, Northridge, began investigations on San Clemente Island. Between 1988 and 2003, the NCPA, in cooperation with the CRMP, conducted eight archaeological field schools on San Clemente Island, as well as scores of other excavation and site survey projects. Since this book summarizes the results of these investigations, only a general chronology of the NCPA projects on San Clemente Island is presented in this chapter.

The Lemon Tank Site (CA-SCLI-1524) was partially excavated in 1988 and 1989, revealing a multi-component occupation. A prehistoric cultural component was reflected in numerous superimposed living surfaces, hearths, cache pits, refuse deposits, animal burials (domestic dogs, foxes, and raptors), and other features described by Hale (1995). Perishable materials, including seed caches, netting, cordage, and basketry were exceptionally well preserved in the site. A historic component was reflected as well in glass trade beads, wheel-thrown ceramics, and glass. The Lemon Tank Site, like the Ledge Site, is a comparatively large and complex site located on the plateau near the center of the island. Discoveries at Lemon Tank are detailed in chapter 11.

In 1989, studies were made of midden constituents from three "Tegula midden" sites on the upper Marine Terraces of the island's west shore: CA-SCLI-1318, -1319 and -1325. These investigations yielded important data on patterns of shellfish collecting and the impact of this collecting on nearshore marine ecosystems (Raab 1992; Raab and Yatsko 1992).

Discoveries at the Stone Quarry 1 site, located adjacent to Stone Station (Natural Resources Field Station; ca. 10 miles south of Wilson Cove), have demonstrated the existence of lithic quarrying sites (Howard 1991). These sites contain midden deposits as well as substantial quantities of debitage (waste flakes from stone tool manufacture). Outcrops of cryptocrystalline volcanic (dacite or rhyodacite) stone exposed at the edge of the eastern escarpment were exploited as a source of material for the production of small bifacial tools that can be found in a variety of site contexts across the island (Howard 1991).

In 1991, one of authors (Andrew Yatsko) received funding from the Legacy Heritage Resources Program of the Department of Defense to conduct a site survey of San Clemente Island, based on a statistical probability sample of survey quadrats that covered approximately 15 percent of the island's surface. This study forms part of the foundation of the research project discussed chapter 9. A follow-up site-testing program yielded a sample of radiocarbon-dated cultural components from across the island, affording a basis for estimating prehistoric island demographic trends and spatial and temporal variation in prehistoric technoeconomic patterns. These data also proved useful in gauging the impacts of climate change on San Clemente Island settlement patterning during the Late Holocene, as discussed in chapter 9.

Excavations at the Nursery site (CA-SCLI-1215) in 1990 and 1993 resulted in documentation of several prehistoric pithouses and related cultural features (see chapter 6). Work at the Nursery site led to recognition of sedentary maritime communities on San Clemente Island during the Middle Holocene (Salls et al. 1993). As shown in chapter 7, this work was instrumental in linking San Clemente Island to a Middle Holocene cultural interaction sphere linking large areas of California and the Great Basin (Howard and Raab 1993; Jenkins and Erlandson 1997; Raab and Howard 2000).

Excavations at the Eel Point site (CA-SCLI-43) by the NCPA and CRMP in 1994 and 1996 resulted in several research advances featured in this volume (chapters 4, 5, and 8). In 1998, two of the authors (Mark Raab and Andrew Yatsko, with Jon Erlandson), received a National Science Foundation grant for comparative research on the Early Holocene cultural records at Eel Point and Daisy Cave, San Miguel Island (Erlandson et al. 1998). An archaeological field school at Eel Point in 2003, sponsored by the NCPA and CRMP, augmented these efforts. This concerted focus on Eel Point, as noted earlier, yielded one of the longest and most detailed archaeological sequences of maritime cultural development on the North American Pacific Coast, including a radiocarbon chronology spanning the period from about cal 7,000 BC to European contact.

The Island Gabrielino and *Quinquina*

As noted in chapters 1 and 2, Native American coastal dwellers greeted the first Spanish and Mexican sailors to reach the southern California coast in the fifteenth century. Occupying villages on the mainland coast and Channel Islands, these seafarers were among the most maritime-adapted native peoples of North America. With the exception of chapter 11, much of this volume deals with the millennia preceding European contact. Just the same, historic cultural patterns that existed on San Clemente Island and surrounding coastal regions cannot be ignored in trying to understand maritime prehistory much deeper in time. The central issue here is that southern California's historic coastal groups have long been seen as the "fully developed" terminus of the gradual, trans-Holocene shift from terrestrial to maritime foraging discussed in chapter 1. But in light of recent advances in maritime archaeology, is it reasonable to view these groups as the end stage of a single, slowly evolving maritime cultural stream unique to southern California? The following ethno-historic summary, including San Clemente Island, frames this increasingly important question. We offer some answers to this question in the last chapter of this book, based on the window into maritime prehistory that has been opened on San Clemente Island.

The Gabrielino

In 1771, Mission San Gabriel was established on the Los Angeles Plain, opposite the Southern Channel Islands. Aiming to convert the Indians to Christianity and instruct them in the European traditions of agriculture and commerce, this mission also lent the name *Gabrielino* to the native peoples of the Los Angeles Basin. Although some contemporary observers refer to this population as the *Tongva*, scholars are not able to discern with any degree of certainty the name(s) that Indians of this region used to refer to themselves. In any case, the closest kin of the Gabrielino inhabited the Southern Channel Islands, with the result that these islanders, including the early historic native people of San Clemente Island, have frequently been described under the rubric of "Island Gabrielino."

According to ethnohistorians, the Gabrielino Indians vied with their Chumash Indian neighbors as one of the most populous and influential native societies in southern California. Linguistic, religious, and ritual traits scattered among many native groups of the region hint at this influence (see chapter 11 for an example in the sphere of Native American religion). And yet, despite these connections, the Gabrielino culture declined so quickly after European contact, it remains little more than a cipher to anthropologists. Kroeber (1925:621), in a sketch of Gabrielino culture, notes the irony of this situation:

> They certainly were the wealthiest and most thoughtful of all of the Shoshoneans in the State, and dominated these civilizationally wherever contacts occurred. Their influence spread even to alien peoples. They have melted away so completely that we know more of the fine facts of the culture of ruder tribes; but everything points to these very efflorescences having had their origin with the Gabrielino.

Linguistic information, combined with mission documents, early records of the Pueblo of Los Angeles, and other data (Johnson 1988), show that the Gabrielino occupied much of present-day Los Angeles County, portions of northern Orange County, and the Southern Channel Islands. The Cupan language of the Gabrielino belongs to the Takic group of the Uto-Aztecan linguistic stock. Although Kroeber (1925) identified six Gabrielino divisions, four major dialects of this language were defined by Harrington (1962): (1) Gabrielino proper, spoken in the Los Angeles Basin; (2) Fernandeño, spoken in the San Fernando Valley area; (3) a Santa Catalina Island dialect, and (4) Nicoleño, a San Nicolas Island dialect. Kroeber (1925:620) identified Santa Catalina Island as clearly Gabrielino in speech. Johnson (1988) shows that during early historic times, San Clemente Islanders frequently married Gabrielino Indians from Santa Catalina Island and were related to others in the Pueblo of Los Angeles. This research also reveals a Gabrielino name for San Clemente Island: *Quinquina* (Johnson 1988).

Some scholars envision precontact Gabrielino cultural patterns in a fashion that closely parallels traits attributed to their better documented and researched neighbors, the Chumash Indians, who occupied the Northern Channel Islands and Santa Barbara coast (Gamble and Russell 2002; McCawley 1996). Owing to the relative disparity of information about these two groups, such comparisons should probably be approached with caution. Nevertheless, based on archaeological and ethno-historic information, the mainland

Gabrielino population at the time of European contact appears to have occupied perhaps 100 major villages or "rancherias" containing 50 to 100 inhabitants each (Bean and Smith 1978). Much less is known about island Gabrielino settlements, since many of these appear to have been abandoned before they could be described by Euro-American observers.

Apart from linguistic, religious, and other cultural traits that differentiated the Gabrielino and the Chumash, both groups possessed a similar technological base and hunting and gathering economy, including seagoing plank canoes (Gabrielino *Ti'at* and Chumash *Tomolo*; see chapter 4). Like the Chumash, the island Gabrielino depended heavily on marine resources. The basic similarity of maritime economic practices among the Chumash and Gabrielino, including fishing, sea mammal hunting, and shellfish gathering, prompted Rogers (1929) to assign both groups to a "Canaliño" culture type (People of the California Channel).

Spanning the sixteenth and seventeenth centuries, Santa Catalina and San Clemente Islands were among the most frequently described by members of the California Channel Islands. This is not surprising, in that Santa Catalina and San Clemente Islands are separated from one another by less than 25 miles. Ships traversing the coast in sight of land are likely to encounter one or both of these islands. This appears to have been the case in October of 1542, during the exploration of the Alta California coast by Juan Rodríguez Cabrillo. It is not clear whether Cabrillo visited San Clemente Island, but his ships spent several months exploring the Channel Islands, leaving open the possibility that one of Cabrillo's ships made landfall on San Clemente Island (Johnson 1988:2; Wagner 1929:333–34). In any case, the first maps of coastal southern California appeared by 1559, showing the relative position of all of the Channel Islands (Wagner 1924, 1929, 1937; Kelsey 1986:115).

The California Channel Islands were on the Spanish Manila Galleon route during the sixteenth and seventeenth centuries, which brought ships to the region with some regularity (Erlandson and Bartoy 1995). Ships returning from the Philippine Islands crossed the north Pacific and made landfall on the California coast, where they turned south for Mexico. One of these galleons, the *San Agustin*, was wrecked at Drakes Bay in northern California in 1579. Sebastian Rodríguez Cermeno, the ship's pilot, and his crew continued south toward Acapulco, Mexico, in the ship's launch (Wagner 1924:15).

Among the earliest recorded landfalls in the Southern Channel Islands was a visit by Sebastián Vizcaíno to Santa Catalina Island in 1602. The narratives of the expedition by Fray Antonio de Ascención and Vizcaíno provide some of the first descriptions of the native culture of Santa Catalina Island, which can probably be considered at least broadly representative of Indian lifeways in the southern islands. The chief pilot of the expedition drew maps of the two southern islands, which he named Isla de Santa Catalina and Isla de San Clemente. Although San Clemente Island probably was not visited by the Vizcaíno expedition, the name has been retained since the seventeenth century (Wagner 1937:112).

An early recorded voyage to San Clemente Island was that of the *San Antonio*, a ship sailing in support of the Portolá expedition of 1769, the first overland exploration of Alta California by Europeans. Brief observations regarding the native San Clemente Islanders emerged from this voyage. Native plank canoes were described as covered with asphaltum (natural petroleum tar), painted red, and decorated with shell inlays along the gunwales. Indian tools and implements were described, including twisted sea otter skin robes held together with fiber cords, fishing line made from a hemp-like cord, quartz crystals, red ocher, a mineral stone (probably Catalina Island steatite), three-pronged fish harpoons, stone knives with wooden handles (carried in the hair), abalone shell, and a stick approximately a yard long, with a tassel of black feathers and fiber tufts tied to it in the fashion of a flag (Vizcaíno 1959:13–16). This contact between native San Clemente Islanders and Europeans is described in more detail in chapter 11, where we describe the rise of a "crisis religion" among Indian groups of southern California.

The coming of the Spanish missions to southern California described earlier certainly accelerated the destruction of Indian cultural patterns, but the missions were by no means the only source of disaster for the native islanders. Sea otter hunting was an appreciable source of stress in the southern islands. In 1741, a Russian expedition under a Danish commander, Vitus Bering, reached the coast of Alaska (Krause 1956:12). Through the report of George Wilhelm Steller, the expedition naturalist, the wealth of fur-bearing animals in the region, particularly the sea otter, was widely appreciated. Efforts to tap this source of wealth eventually extended to the whole North American Pacific coast: "The Russian merchants were encouraged to undertake numerous ventures which left Okhotsk and first were limited to the Aleutians, but later spread from the island to islands further east to the Alaskan peninsula and the neighboring coast of the American mainland" (Krause 1956:15).

With the increased Russian presence in this region, the Spanish government, after paying little attention to California since the Cabrillo expedition, set about constructing the Alta California missions and presidios to reinforce their hold on the region (Cleland 1944:50). Spanish involvement in the sea otter trade began in 1784 with a complex system involving the Indians, missions, and merchants involved in the Manila galleon and China trade. Indian sea otter hunters exchanged otter skins for European and Mexican goods, with the missions acting as a holding agent for both Indian pelts and exchange goods. The European exchange items often included blankets, fabrics, metal tools, clothing, and glass beads. The fabric fragments excavated from the Big Dog Cave site (CA-SCLI-119) on San Clemente Island appear to be derived from this trade (Coleman and Wise 1994; Ehringer 2003; Rozaire 1959; Woodward 1941). Similar materials are also present in the Murphy artifact collection noted earlier (Rozaire 1989).

The closing decades of Indian life in the southern islands reflect tragedy and ruin. The Russians brought Alaskan Aleut Indians to the Channel Islands to hunt sea otters, while Americans introduced native Hawaiians for the same purpose (Hatheway and Greenwood 1981). The weapons of the Island Gabrielino were no match for firearms brought by these fur hunters. Indian communities in the islands were constantly at risk of attack by Euro-Americans and their agents (Johnston 1962:102). Even before the appearance of fur hunters, something more lethal than guns had arrived in the Channel Islands: infectious diseases of European origin to which the islanders, and many other native groups of the New World, had little or no immunity (Erlandson and Bartoy 1995). San Clemente Island, as we shall see in chapter 11, was likely among the first places in North America struck by one of the greatest biologically induced disasters in human history, the spread of European pathogens described in Jared Diamond's (1997) Pulitzer Prize–winning *Guns, Germs, and Steel*.

There can be little doubt that stresses of this kind drove surviving Indian groups to forsake the Channel Islands for mainland communities in the first quarter of the nineteenth century (Johnston 1962:102; Meighan and Eberhart 1953). Indeed, by the end of this period, it appears that the southern islands were all but devoid of their native occupants. The last recorded historical account of aboriginal San Clemente Island offers a glimpse into how difficult island life had become. In March of 1803, Captain Richard Cleveland, master of the ship *Lelia Byrd*, sailing out of Boston, commented that:

> We were becalmed near San Clement's Island, where perceiving a smoke, we landed abreast of it, and found that it proceeded from a cave formed in the side of a hill, by some overhanging rocks and earth but insufficient to afford shelter from the weather, with any other than northerly winds. In this miserable domicile resided eleven persons, men, women and children: and although the temperature was such as to make our woolen garments requisite, they were all in a state of perfect nudity. Their food was exclusively fish, and having no cooking utensils, their only resource was baking them in the earth. We could not perceive that they possessed a word of any other dialect than their own, of which we understood nothing. I had been familiar with Indians inhabiting various parts of the western coast of America, but never saw any so miserable, so abject, so spiritless, so nearly allied to the brute. (Cleveland 1885:194)

This bleak picture is not surprising, when we understand that by the time of the *Lelia Byrd*'s voyage, the few remaining islanders were victims of epidemic disease, shattered native cultural networks, and the persecution of violent outsiders. Early nineteenth-century religious and civil records from the Pueblo of Los Angeles and surrounding regions suggest that the last Indian inhabitants of San Clemente Island departed about 1829 (Johnson 1988). With their departure, a San Clemente Island maritime cultural saga reaching back in time to the last Ice Age ended. We turn to a reconstruction of this remarkable history in the chapters that follow.

II

EARLY HOLOCENE

4

The Ancient Mariners of Eel Point

L. Mark Raab and Jim Cassidy

The Channel Islands were destined to be among the first places where European and Native American cultural worlds collided. Much of continental North America remained beyond the reach of European explorers for centuries, but the latter's ships brought them to coastal southern California less than a half century after Columbus. The result was a sea-borne meeting of mariners from two very different worlds. The log of Cabrillo's voyage (1542) provides the first glimpses of southern California's native seafarers, as they boarded the Spanish ships from seagoing canoes (Gamble 2008). Over two hundred years after Cabrillo's *entrada*, Spanish sailors were similarly met off San Clemente Island (1769), repeating a kind of sea-borne culture contact that must have occurred many times during the sixteenth through the eighteenth centuries.

The consequences of these encounters persisted long after their fleeting duration. Europeans almost certainly introduced deadly pathogens, along with technologies and ideologies previously unknown to the native Channel Islanders. An archaeological window on the beginning of the end of native cultural autonomy, Clemente Island was dramatically transformed by these powerful agents of culture change.

Ironically, as Island Gabrielino and Chumash communities were being driven toward extinction, fascination with the ancient Channel Islands was on the rise in the rapidly growing Euro-American population of the region and beyond. Even before Cabrillo's voyage, the

Channel Islands region was viewed as mysterious. In *Las Sergas de Esplandián*, a popular Spanish romance novel of 1510, California was envisioned as an island off the west coast of North America ruled by Calafia, an Amazon queen, seen by some historians as a likely source of modern California's name (Jones and Raab 2004). Discovery of the Channel Islands replaced Calafia with the mystery of the islands' real native inhabitants. Later discovery of the islands' abundant archaeological remains deepened public and scholarly curiosity, helping eventually to launch Channel Islands archaeology (chapter 3). Archaeologists are still trying to answer a question posed by the first sea-borne encounters: Who were the islands' earliest mariners? Today, this question takes on even greater significance in an intensifying debate about the peopling of the New World and the role that coastal groups may have played.

Until recently, direct archaeological evidence of early Channel Islands seafaring was almost vanishingly small. As a result, inferences about the age and development of sea travel were little more than set pieces in research models focused on other topics. In one example, the main question was why the prehistoric Channel Islands were targeted for settlement. According to this model (Yesner 1987), the Channel Islands offered bleak prospects for obtaining food and other resources, as compared to mainland environments, causing the islands to be colonized only after competition for mainland food supplies intensified about 4,000 to 5,000 years ago (compare this scenario with the one explored in chapter 5). If mainland coastal dwellers possessed seagoing watercraft prior to this time, they ostensibly had no motive to use them for island settlement. This interpretation reinforced the long-standing model of North American prehistory discussed in chapter 1—namely, that true maritime cultures developed only a millennium or two before European contact.

More recent studies also argue for the late development of seafaring, but this time in the context of a research model aimed at explaining the emergence of chiefdoms among the Chumash Indians of the Santa Barbara coast and northern Channel Islands. As noted in chapter 3, when Spanish explorers reached the southern California coast, they saw Chumash Indians using the *Tomolo* (also referred to as the *Tomol*), a seagoing canoe constructed of wooden planks (Gamble 2008). Five meters or more in length and capable of carrying more than a ton of cargo, these boats were used for a variety of purposes, including fishing, sea mammal hunting, exchange of trade goods, and travel to Channel Islands settlements (Arnold 2001b). The Island Gabrielino used the *Ti'at*, a boat of similar construction to the *Tomolo*, for voyages to San Clemente and the other Southern Channel Islands.

According to Arnold, the *Tomolo* was a critical technological innovation that helped to catalyze the ascendancy of Chumash chiefs (Arnold 1992, 2001b). Munns and Arnold (2002:141) hypothesize that:

> In short, the Tomol facilitated power building, aggregation, large ceremonial gatherings, intensive production and exchange, and improved maritime resource exploitation, all of which certainly contributed in some way to the major sociopolitical changes that occurred circa A.D. 1150 to 1300. We suggest that the development and refinement of the canoe probably did not precede the major changes of the Transitional period [A.D. 1150–1300] by more than a few hundred years.

A major component of chiefly power, according to this scenario, was control of this powerful new tool of economic production, travel, and social networking. Of interest to the present discussion, however, is the familiar model of progressive cultural evolution on which this scenario depends. Once again, archaeologists argued for decades that true maritime cultures emerged from centuries of incremental technoeconomic development. This model makes a similar claim in suggesting that the first "refined" canoes appeared only a few centuries before the appearance of chiefdoms, perhaps by about AD 500. Following the logic of such reconstructions, Munns and Arnold (2002) conjecture that the *Tomolo* was preceded by an earlier, more primitive "littoral" phase of sea travel:

> In places where less stable boats or rafts were used occasionally to venture into open waters only on calm days, or boats were not used at all and resource collection occurred from the shore, Lyman prefers to use the term "littoral" to describe a group's primary use of marine resources. We subscribe to these same definitions here, with the implication that the pre-Tomol Chumash in the channel area . . . were principally littoral. (Munns and Arnold 2002:141)

Other researchers disagree with this analysis, at least in terms of the timing of the *Tomolo*'s appearance. Gamble (2002) argues that the plank canoe may have appeared as early as 4,000 years ago, based on radiocarbon dates obtained from plank fragments and the appearance of a type of stone drill thought to have been used in canoe construction. Davenport et al. (1993) place the *Tomolo*'s appearance around 2,000 years ago, based on the observation that it was likely used to capture the swordfish found in Late Holocene coastal middens (domestic refuse deposits) of the Chumash area. In yet another perspective on this problem, Jones and Klar (2005) hypothesize that, based on archaeological and linguistic data, Polynesian sailors may have introduced the technology behind the *Tomolo*, and the word *Tomolo* itself, to southern California sometime after AD 800.

Understanding the rise of social complexity among southern California's maritime foragers is a fascinating and important research challenge (see chapter 10). Munns and Arnold (2002) may be correct that the plank canoe played a significant role in the rise of Chumash chiefdoms. Efforts to understand the appearance of this interesting maritime technology, one of the most sophisticated in native North America, are certainly warranted.

Yet the "*Tomolo* debate" illustrates how entrenched ideas continue to influence theories about seafaring origins. The notion of a littoral phase of sea travel, when coastal dwellers possessed watercraft too primitive to venture regularly off shore, is clearly a useful device for supporting some theories of emergent Chumash social complexity. However, when considered in the context of recent advances in coastal archaeology, this model leaves important questions unanswered. For example, if early watercraft were too primitive to permit voyages beyond the mainland littoral margin, how do we explain settlement of the Channel Islands in pre-*Tomolo* times? Were these settlements populated by castaways or sea travelers who occasionally took advantage of calm seas? Was the *Tomolo* the first and only true seafaring tradition in the region? A few decades ago such questions could be ignored, when theories of progressive maritime cultural development were in vogue and archaeologists lacked solid evidence of early Channel Islands occupation. Today, these questions must be answered if we are to gain an understanding of seafaring origins consistent with recent advances in southern California maritime prehistory. The ancient mariners of San Clemente Island's Eel Point archaeological site suggest some ways that we might go about getting answers.

Whatever the role of the *Tomolo* in Chumash culture history, the Channel Islands evidence indicates much-earlier seafaring. As Dixon (1999) points out, the Channel Islands were never connected to the mainland, even during the lowest Ice Age sea levels, making the presence of humans in these islands during the Late Pleistocene the oldest circumstantial evidence of sea travel in North America. The northern Channel Islands contain archaeological deposits dating between about 11,000 and 9,500 cal BC (Erlandson et al. 2007a:57; Rick et al. 2005:177). Among these is "Arlington Springs Woman" of Santa Rosa Island, from which Johnson et al. (2000) have obtained a range of dates based on bone from the skeleton itself and mouse bones from the same depositional stratum. A variety of uncertainties attached to these dates exist, including lack of a precise marine reservoir correction factor (Taylor 1987), but Rick et al. (2005:177) conclude that Arlington Springs Woman died in the interval between 9,500 and 11,000 cal BC. This makes the Arlington Springs skeleton among the oldest in the New World. Daisy Cave on San Miguel Island also reveals an occupation beginning in the terminal Pleistocene, based on radiocarbon dates ranging between about 9,500 and 6,600 cal BC (Connolly et al. 1995; Erlandson et al., 1996, 2007a; Rick et al. 2005:177–80).

These developments reveal a striking gap in our understanding of California maritime prehistory: Approximately 8,000 to 10,000 years elapsed between the earliest sea travel to the Channel Islands and the appearance of the *Tomolo*. Bridging this gap is one of the major research challenges confronting California coastal archaeology. Archaeological evidence of boats and seafaring technology antedating the Late Holocene remains scarce. The organic materials used for early watercraft, such as wood, fibers, and animal hides, are poor candidates for preservation, particularly in humid coastal environments. Fortunately, there are research avenues that may help to circumvent these limitations, including studies that go beyond ethno-historic data on seafaring to look at techno-functional and environmental contexts of sea travel.

Toward a General Model of Seafaring

We reiterate the importance of historic patterns of seafaring, including the *Tomolo*. The cultural achievements epitomized by this watercraft are intrinsically important, not least to descendent Gabrielino and Chumash communities. This tradition also affords valuable comparative data, as we point out below, to researchers interested in the technological correlates of prehistoric seafaring. Just the same, the limitations of the historic record of native seafaring must be recognized.

The large temporal gap between the *Tomolo* and early sea-borne settlement of the Channel Islands casts considerable doubt on the notion that effective forms of sea travel appeared for the first time during the Late Holocene. It also calls into serious question a "littoral" phase of maritime cultural development, when boats were generally too primitive to allow off-shore voyages, including passages to the Channel Islands. Instead, researching seafaring origins requires archaeologists to frame general investigative models, capable of working around the apparent limitations of prevailing models based on historical data (Ames 2002).

Model-building in this area, from our perspective, should incorporate technological principles and characteristics of the marine environments in which prehistoric watercraft were used. As Gould notes, this contextual approach has been employed relatively little in archaeology to date, but is a promising step toward understanding the conditions that shaped prehistoric seafaring: "While winds, currents, weather, and general sea conditions are universally acknowledged by mariners to be of paramount importance in voyaging, archaeologists have only recently begun to deal with these factors in a systematic way" (Gould 2000:79). This approach is one of the ways that the Channel Islands might lend themselves as a natural laboratory of archaeological research of the type discussed in chapter 1.

Space does not allow a comprehensive discussion of ancient boat-building traditions, but it seems safe to assume that these traditions were influenced by certain basic factors, including available construction materials and extant cultural traditions, including the technological capabilities of boat wrights. However, Channel Islands voyagers of all time periods logically confronted fundamental challenges.

Paleo-Coastal Geography

During the Late Pleistocene glacial maximum, sea level was approximately 130 m below current shorelines, creating Santarosae, the progenitor of today's northern Channel Islands (chapter 1). The eastern end of this "super-island" lay less than 15 km from the mainland coast, enjoying an environment relatively protected from winds and heavy seas by Point Conception (Masters and Aiello 2007:36). The island also sustained a relatively extensive terrestrial ecosystem, including a Pleistocene-era pygmy mammoth (*Mammuthus exilis*) population (Moratto 1984; Orr 1968). Based on these conditions, an assumed colonization of the Northern Channel Islands using relatively rudimentary forms of watercraft seems reasonable (Arnold 2001b; Gamble 2002).

However, the Southern Channel Islands presented substantially more rigorous challenges to early maritime settlement than the occupation of Santarosae. The southern islands were never appreciably closer to the mainland coast than they are at present, requiring a sea passage of at least 30 km (Masters and Aiello 2007:36). One result was the necessity of mastering more challenging marine conditions, since the southern islands do not benefit from the relatively sheltered sea conditions afforded the Northern Channel Islands by Point Conception (Power 1980). Nor did early settlers of the southern islands enjoy the potential subsistence benefits of exploiting the relatively extensive terrestrial ecosystem of Santarosae. San Clemente Island settlers, throughout the prehistoric era, encountered a depauperate terrestrial environment that made dependence on marine food resources essential to survival (Porcasi et al. 2004; Raab et al. 1994). In chapters 5 and 8, we examine some of the islanders' responses to these conditions.

Watercraft Design and Construction

Watercraft design and construction cannot be divorced from environmental and cultural factors. The fabrication of bark canoes, for example, was limited to locations where birch or beech trees were available. The apparent association of skin boats, such as the Umiak of North America and the Curragh of Ireland, with frigid northern waters may be related to the solubility of animal-fat sealants (Adney and Chapelle 1983), which dissolve in more temperate waters. Where large trees such as cedar or redwood were available, large dugouts were feasible, as employed by native groups from northern California to southeastern Alaska (Jobson and Hildebrandt 1980). Reed boats, such as tule balsas, were favored in estuaries or relatively calm near-shore waters. Composite constructions of various kinds, such as plank boats—the *Tomolo* being a good example—were fabricated where sufficient straight-grained woods could be formed into multi-component hull members.

The construction techniques noted above resulted in a variety of watercraft types, but these craft were not equally suitable for open-sea voyages. Unless constructed from very large trees, for instance, the low gunwales of simple dugouts are prone to swamping in heavy seas. Arnold (2001b) suggests that this problem may have been a key factor in the development of the *Tomolo*, as Chumash boat wrights added planks to dugouts, eventually evolving a hull structure formed entirely of planks. Tule balsas could have been used to travel from their mainland points of manufacture to the Channel Islands (where reeds are generally unavailable), but apparently not without fitting these craft with additional bundles to form gunwales to prevent swamping (Hudson et al. 1978). The fact that reed boats soon became saturated, require periodic replacement of damaged reed bundles, and periodic recoating with bitumen (also generally unavailable on the Channel Islands) makes them far from ideal for regular, open-water journeys and prolonged use in off-shore locations.

Effective open-sea vessels tend to exhibit specific design characteristics. Above all, watercraft must maintain buoyancy and stability. Buoyancy is achieved through the displacement of water with a near-watertight hull, while stability is achieved through a relationship between buoyancy and the boat’s hydrodynamic qualities (Steffy 1994). Minimization of wind drift, the ability to cut through waves, and maintenance of directional stability are all critical elements of hull design. This generally implies the construction of a keel running the length the boat and a hull of sufficient strength and flexibility to sustain working loads on the boat. The bow and the stern to a lesser degree contribute to hydrodynamic efficiency if they are pointed and curved. As noted above, the gunwales should be sufficiently high to prevent swamping by waves and sea swells, and they must be far enough apart to permit placement of crew members and cargo (Adney and Chapelle 1983; Gould 2000; Steffy 1994). Cassidy (2006) reports a possible chipped-stone effigy of similar configuration, recovered from a hearth in the basal (Early Holocene) stratum of Eel Point.

It seems reasonable to assume that logs suitable for forming such craft from a single billet of wood were rarely available in coastal southern California. If so, boats that incorporate the design features noted above must be of composite design, i.e., assembled from separate pieces of available construction materials. Drawing on acknowledged expertise in sailing small craft in the waters of the California Bight and in California archaeology, Fagan (2004) concludes that only such sophisticated boats would have been capable of regular sea travel to the Channel Islands, including, but not necessarily limited to, examples such as the historic *Tomolo*.

In addition to the availability of appropriate natural resources and technological know-how, archaeological tool assemblages should provide clues regarding watercraft construction. For example, the manufacture of bark canoes might be associated with wood-cutting implements for stripping bark from trees and punches to make holes so the craft could be lashed together. Skin boat construction should be associated with similar woodworking tools, as well as those employed in the processing of animal hides. Dugout canoes are commonly associated with the presence of axes and adzes suitable for heavy wood-working. Reed boats may be accompanied by the presence of knives to cut the reeds and the processing of fibrous plants for lashing materials. As we shall see below, the fabrication of composite structures, such as plank canoes, necessitated an extensive tool kit, including wedges for splitting wood, scraper-planes, perforating implements, caulking chisels, abraders, and sealants. Systematic examination of archaeological tool assemblages, accompanied by appropriate studies such as replication and use-wear experiments, are logical avenues for understanding the types of watercraft constructed in coastal and insular prehistoric sites. While these investigations are not likely to reveal exact watercraft form, they can make a useful comparative assessment of the technological capabilities of seafarers at different times and locations.

Selective Pressures of Seafaring

While distances separating the Southern Channel Islands from the mainland and each other are relatively short (ca. 25 to 100 km), sea passages between these are by no means simple undertakings (Fagan 2004). Wind, weather, waves, sea currents, and water temperature can easily make small-craft voyages life threatening. For this reason, we believe that regular, open-sea voyaging has always exerted a powerful influence on watercraft design and construction. This activity did not necessarily result in a single type of watercraft, but probably did select for boats that adhered, in general functional terms, to the technoenvironmental pressures described earlier. The selective pressures that enforce such a process are powerful and likely to stabilize optimal watercraft designs quickly during any time period: Successful watercraft designers lived to reproduce themselves and their technological traditions (Ames 2002:44). Based on evidence from the Eel Point archaeological site, this process likely produced competent open-ocean watercraft from the earliest phases of Channel Islands settlement.

Eel Point Archaeological Site

Contemporary visitors to the Eel Point archaeological site (CA-SCLI-43) find a relatively long and narrow headland of volcanic rock, flanked on both sides by cliffs rising about 30 m above the ocean waves at their base. Shell-bearing middens cover perhaps 2 ha of the point, some of which rise 3.5 m above bedrock. More than 90 percent of these deposits appear to have accumulated during the last 3,500 radiocarbon years, but the site's earliest cultural stratum has yielded radiocarbon dates ranging from the Late Pleistocene to the Early Holocene (Cassidy et al. 2004; Raab et al. 1994, 1995b).

Today, Eel Point scarcely resembles the place encountered by its first inhabitants. The site's initial occupants selected a shallow natural depression on the lee of a stone outcrop to establish their residential base, probably enjoying a degree of protection from prevailing winds. Here we also find the earliest evidence supporting the possibility of watercraft construction. We cannot be certain why this area was selected for early settlement, but it may have been positioned to maximize access to important resources. San Clemente Island's relative aridity (chapter 2) made water perhaps the single most important limiting variable to prehistoric human occupation, a topic that we take up in chapter 9. Major canyons drain the central part of San Clemente Island onto the marine terrace on which Eel Point is situated (chapter 2), perhaps affording access to drinking water. Most of the ancient islanders' food supply came from the sea, flanking this same terrace (chapters 5 and 8). Whatever their settlement strategy, Eel Point's initial settlers occupied an area perhaps 30 m in diameter in the lee of a rock ridge, probably gaining protection from prevailing winds. There, they created habitation structures, hearths, storage pits, work areas, and "toss zones" containing food bones, stone tools, and other artifacts in the few centimeters of water- or wind-deposited sediments covering volcanic bedrock (Cassidy et al. 2004). This area also contains the earliest clues regarding early seafaring.

Early Holocene Settlement

The first recorded investigation of Eel Point, as we saw in chapter 3, was a brief excavation by Marshall McKusick and Claude Warren in 1958 (McKusick and Warren 1959). This work demonstrated abundant, well-preserved faunal remains and artifacts, but lacked the resources to assess fully the extent of the site's cultural deposits or age. However, these studies were instrumental in attracting researchers from UCLA a quarter century later, whose work at Eel Point produced evidence of Early Holocene occupation (Salls 1988:359). Following up on these studies, the authors conducted five seasons of excavation at Eel Point between 1994 and 2003. These investigations revealed a remarkably well-preserved sequence of maritime cultural development, ranging in time from the Early Holocene to European contact—as shown in table 4-1—and perhaps longer.

A total of about 5 cubic meters (5 m^3) of Early Holocene cultural deposits have been recovered from an exposed area of around 23 m^2 (Cassidy et al. 2004). While this is a comparatively small sample, it contains diverse cultural features and artifacts from a

Table 4-1. Eel Point Radiocarbon Dates by Year of Collection and Provenience

Lab Number	*Provenience*	*^{14}C Age*[a]	*δ^{13}C*	*^{13}C Adj.*	*Material*	*Calibrated Years BC/AD*[b]
			1994 Dates			
Excavation Unit A:						
Beta-76132	Stratum 4a	2000 ± 90	−23.6	2020 ± 90	Charcoal	118 BC–69 AD
Beta-76133	Stratum 5a	2540 ± 60	−24.7	2540 ± 60	Charcoal	648–549 BC
Beta-76130	Basal stratum, occupation floor	7500 ± 70	+1.4	7930 ± 70	Shell[c]	6,329–6,136 BC
Excavation Unit B:						
Beta-76134	Stratum 5a	2360 ± 70	+2.0	2800 ± 70	Shell	1,029–892 BC
Beta-76135	Stratum 6	3560 ± 70	+2.1	4010 ± 70	Shell	1,800–1,675 BC
Beta-76136	Stratum 6a	3990 ± 80	−1.6	4370 ± 90	Urchin	2,407–2,133 BC
Beta-76137	Stratum 6b	4000 ± 100	−25.0	4000 ± 100	Charcoal	2,666–2,397 BC
Beta-76138	Stratum 7b	4090 ± 90	−25.1	4090 ± 90	Charcoal	2,707–2,566 BC
Beta-76139	Stratum 9, Feature 2	5260 ± 80	+1.6	5700 ± 80	Shell	4,133–3,908 BC
Beta-76140	Stratum 10	4860 ± 190	−25.5	4860 ±190	Charcoal	3,805–3,496 BC
Beta-75092	Stratum 11	5060 ± 50	+2.2	5510 ± 50	Shell	3,756–3,632 BC
Beta-75555	Stratum 11	5470 ± 160	−23.4	5500 ± 160	Charcoal	4,520–4,226 BC
Excavation Unit C:						
Beta-76141	Stratum 2b	1380 ± 60	−24.2	1390 ± 60	Charcoal	596–681 AD
Beta-76142	Stratum 3c	1620 ± 100	−24.0	1640 ± 100	Charcoal	326–539 AD
Beta-76143	Stratum 6	5330 ± 80	+2.0	5780 ± 90	Shell	4,145–3,899 BC

Beta-75093	Basal stratum	7490 ± 70	+0.7	7910 ± 70	Shell	6,286–6,092 BC
Beta-76021	Basal stratum	8120 ± 310	−25.3	8110 ± 300	Charcoal	7,371–6,695 BC
Excavation Unit 2N/35E:						
Beta-76144	Stratum 3	1020 ± 50	−24.8	1020 ± 50	Charcoal	970–1,044 AD
Beta-76145	Stratum 4	1890 ± 50	−24.4	1900 ± 50	Charcoal	51–139 AD
Beta-76146	Stratum 5	1970 ± 60	−22.5	2010 ± 60	Charcoal	59 BC–65 AD
Beta-76147	Stratum 6	1990 ± 90	−23.4	2020 ± 90	Charcoal	118 BC–69 AD
Beta-76148	Stratum 7	2490 ± 60	−23.5	2510 ± 60	Charcoal	693–541 BC
Beta-76149	Stratum 8	3050 ± 90	−25.9	3030 ± 90	Shell	736–482 BC
Beta-76150	Stratum 9	3240 ± 80	−23.9	3250 ± 80	Charcoal	1,613–1,443 BC
Beta-76151	Stratum 10	3320 ± 110	−25.2	3320 ± 110	Shell	1,065–794 BC
Beta-76153	Stratum 11	2890 ± 50	−23.7	2910 ± 50	Charcoal	1,133–1,017 BC
Beta-76152	Stratum 11	7720 ± 130	+0.5	8140 ± 130	Shell	6,581–6,287 BC
Excavation Unit 24.5S/77E:						
Beta-77956	Stratum 3	580 ± 60	−26.0	570 ± 60	Charcoal	1,309–1,361 AD
Beta-77957	Stratum 8	1770 ± 150	−23.1	1800 ± 150	Charcoal	65–404 AD
			1996 Dates			
Excavation Unit 27N/21E:						
Beta-100564	Lower floor	5700 ± 60	+1.4	6140 ± 60	Shell	4,451–4,316 BC
Beta-100565	Upper floor	5220 ± 60	+1.9	5660 ± 60	Shell	3,939–3,781 BC

(*continued*)

Table 4-1. (*Continued*)

Lab Number	*Provenience*	*^{14}C Age*[a]	*$\delta^{13}C$*	*^{13}C Adj.*	*Material*	*Calibrated Years BC/AD*[b]
Excavation Units D-G:						
Beta-100566	Floor, 5m profile	4110 ± 60	+2.1	4560 ± 60	Shell	2,623–2,428 BC
Excavation Unit F:						
Beta-100567	Basal stratum, occupation floor	7530 ± 80	+1.5	7960 ± 80	Shell	6,365–6,170 BC
Excavation Unit 28/29N-16E:						
Beta-95900	Stratum 4B	5140 ± 80	+2.3	5590 ± 80	Shell	3,892–3,693 BC
Beta-95897	Basal stratum	7790 ± 60	+0.5	8210 ± 60	Shell bead	6,567–6,428 BC
Beta-95898	Basal stratum	7150 ± 210	-24.0	7160 ± 210	Charcoal	6,235–5,836 BC
Beta-95899	Basal stratum	7670 ± 90	+1.2	8110 ± 90	Shell	6,496–6,287 BC
			1999 Dates			
Excavation Unit 29N15E:						
Beta-133328	Basal stratum	7690 ± 50	+0.9	8120 ± 50	Shell	6,469–6,350 BC
Beta-133329	Basal stratum	8910 ± 70	-23.5	8940 ± 70	Charcoal	7,589–7,512 BC
Excavation Unit 29N16E:						
Beta-133325	Basal stratum	7440 ± 90	+1.2	7870 ± 90	Shell	6,250–6,041 BC

Excavation Unit 29N/17E:						
Beta-133327	Basal stratum	7740 ± 30	+1.6	8180 ± 30	Shell	6,513–6,413 BC
			2000 Dates			
Excavation Unit 23S74.5E (Locus D):						
Beta-144025	Stratum 3	750 ± 40	-24.1	760 ± 40	Charcoal	1,279–1,328 AD
Beta-144026	Stratum 4	690 ± 40	-24.0	710 ± 40	Charcoal	1,263–1,298 AD
Beta-144027	Stratum 5	630 ± 40	-22.4	670 ± 40	Charcoal	1,279–1,309 AD
Beta-144028	Stratum 6	860 ± 40	-23.1	890 ± 40	Charcoal	1,151–1,211 AD
Beta-144029	Stratum 7	960 ± 40	-23.8	980 ± 40	Charcoal	1,016–1,049 AD
Beta-144030	Stratum 8	1310 ± 40	-22.9	1340 ± 40	Charcoal	648–692 AD
			2003 Dates			
Excavation Unit 29N15E:						
Beta-195128	Basal stratum	10,430 ± 40	-24.0	10,450 ± 40	Charcoal	10,652–10,507 BC
Excavation Unit 29N/17E:						
Beta-195122	Basal stratum	12,450 ± 50	-23.7	12,470 ± 50	Charcoal	12,763–12,353 BC

[a] Radiocarbon years before present, uncorrected for fractionation ($\delta^{13}C$).

[b] Dendrocalibrated age of samples in years BC/AD (present = AD 1950); 1-σ age range calculated by *Calib rev. 5.0.1* (Stuiver and Reimer 1993).

[c] All shell dates marine reservoir corrected (ΔR): (1) a time-dependent global ocean correction (402 years) incorporated into the program's marine calibration curve, and (2) a local ocean offset of 225 ± 35 years for southern California (Stuiver and Braziunas 1993:138, 155–56; see also Taylor 1987:129).

relatively discrete depositional context, sandwiched between bedrock below and a red sand layer above, virtually devoid of cultural material. Dates from cultural strata above the red sand range, depending on location, from 4,145–3,899 cal BC (Beta-76143—table 4-1) to 3,892–3,693 cal BC (Beta-95900—table 4-1), suggesting a hiatus in site occupation or, perhaps more likely, a pattern of occupation that shifted location across time. In any event, we find an Early Holocene (and perhaps earlier) cultural component largely sealed from later occupation of Eel Point, making the site's basal cultural stratum one of the earliest and best-preserved in the Channel Islands, if not the Pacific North American coast.

Two relatively discrete occupational loci have been identified in the Early Holocene cultural deposits at Eel Point (Cassidy et al. 2004). Locus 1 revealed a low-lying arc of stones. This feature appears to continue into the surrounding cultural deposits, perhaps forming a larger ring of stones with a diameter of about 5 m. This structure may have served as a low wall or foundation of a windbreak constructed by piling up natural stones. Inside this ring was a shallow pit containing faunal remains and natural stones. Nearby features and artifacts reinforce the residential character of Locus 1. Immediately south of the ring were two overlapping shallow hearths surrounded by 10-cm-thick deposits of ash, burned shell fragments, and faunal remains.

Numerous artifacts were found in these deposits, including six mussel shell disc beads. One of these beads produced a date of 6,567–6,428 cal BC (Beta-95897). Shell and charcoal samples from one of these hearths returned dates of 6,235–5,836 cal BC (Beta-95898) and 6,496–6,282 cal BC (Beta-95899), respectively. A charcoal sample from within the stone arc produced a date of 6,250–6,041 cal BC (Beta-133325). Locus 1 yielded a date of 7,589–7,512 cal BC (Beta-133329).

In Locus 1, a metate fragment and mano (stone milling slab and use-modified beach cobble), along with other flaked and groundstone tools and tool-working debris, were recovered around the hearths described above. Faunal remains of sea lions (*Zalophus californianus*), harbor seals (*Phoca vitulina*), and dolphins of various species collected from these contexts attest to the importance of sea mammal hunting and shellfish collecting as major economic pursuits, supplemented by fishing (see chapter 5). These patterns appear to establish Locus 1 as a focal point of domestic activities, centering perhaps on a residential structure of some kind.

At Locus 2, a somewhat less discrete concentration of domestic features, artifacts, and faunal remains was found about 9 m to the south of Locus 1. This area revealed a hard-packed surface containing at least one posthole feature. Three samples of shell in direct contact with this surface produced ages of 6,329–6,136 cal BC (Beta-76130), 6,286–6,092 cal BC (Beta-75093), and 6,365–6,170 cal BC (Beta-100567). A charcoal sample from the same surface yielded a date of 7,371–6,695 cal BC (Beta-76021). A mussel shell bead recovered from this surface was identical to specimens recovered from Locus 1. Like Locus 1, this area yielded chipped and ground stone tools and faunal remains. Thus, it appears that two adjacent Early Holocene domestic loci were occupied very close to one another in time, if not contemporaneously.

Based on the observed cultural features and deposits of artifacts, the Early Holocene cultural component at Eel Point reflects a substantial degree of residential permanence. The deposits of tools, food remains, and related features, including hearths and possible habitation structure, reflect the sort of "planning depth" (Binford 1980) associated with habitation areas occupied over considerable periods of time. Given the use of watercraft by San Clemente Island's occupants, this type of settlement is perhaps not surprising. As Ames (2002:34) points out, the use of watercraft encourages logistical activities centered on relatively permanent residential loci, where sea mammals and other food items can be transported readily for processing. Although data on Early Holocene coastal California are currently too scanty to allow firm conclusions to be drawn, perhaps we can expect settlement patterns based on the use of watercraft to more closely resemble Binford's (1980) "collectors," rather than "foragers."

Eel Point Lithic Technology

Stone Tool Assemblage Diversity

The Early Holocene stone tool assemblage at Eel Point offers considerable insight into the technoeconomic capabilities of the site's residents and also affords interesting contrasts with early fluted-point assemblages of mainland North America (Rondeau et al. 2007; see also chapter 12). Cassidy (2000) studied trans-Holocene patterns of tool use, identifying 24 stone tool types employed during the entire span of site occupation. Turning to a more detailed study of the Early Holocene cultural component, the key challenge was to accurately identify the tools' technological and functional attributes, prompting a three-step analytical process. First, gross morphological inspection was made of the tool assemblage from Eel Point, characterizing techniques of tool manufacture and patterns of damage or wear. Although this step led to hypotheses about tool use, we recognized that functional interpretations based solely on gross morphological characteristics are often misleading (Binford 1973; Binford and Binford 1966).

Eel Point's Early Holocene tools can be productively analyzed for some time to come. In fact, analysis of this assemblage continues by one of the authors (Cassidy, at the time of this writing). However, based on analysis to date, the functional diversity of the Early Holocene tools includes multi-directional cores, uni-directional cores, microlithic cores, a burin, a chopper, a hammerstone, a pitted-anvilstone, sandstone abraders, scraper-planes, retouched flakes, a wedge, drills, two types of reamers, a tar applicator, and the metate fragment and mano noted earlier (Cassidy et al. 2004). For purposes of the present discussion, our attention is focused on some of the wood- and stone-working tools from this assemblage, shown in figure 4-1.

Among these tools were drills and reamers, recognizable by symmetrical wear patterns created by tool rotation—particularly as seen through damage to the tips and lateral edges. Based on specimens observed thus far, drills were fashioned from retouched flakes. Reamers were used to expand or smooth an existing depression or perforation, rather than actually drill a perforation. Two types of reaming tools were identified. One of these tool types, for want of a better name, might be described as a "blunt-nose" reamer. One such specimen was thinned at one end by removal of flakes, presumably to facilitate hafting. The working end of this reamer reveals two distinctly different types of use-wear patterns. This tool could never have been effective as a drill because of its rounded tip. This particular specimen (figure 4-1B) is stained with ochre and appears to have been employed to grind or apply red pigment. All

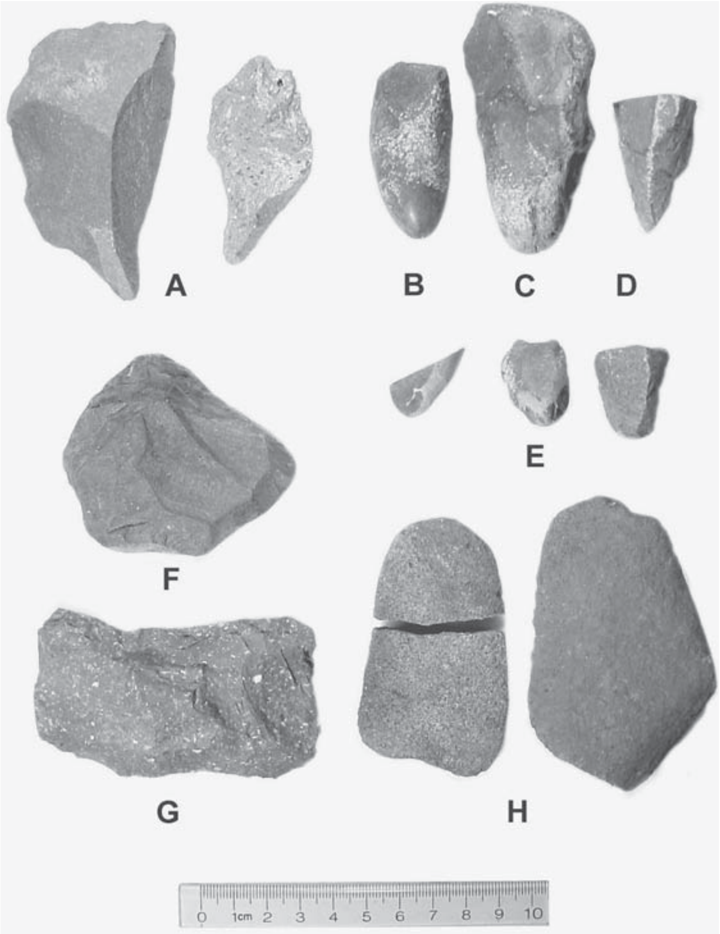


Figure 4-1. Eel Point radiocarbon dates.

of the reamers appear to have been formed by flaking, starting with elongated natural pebbles or flake performs. Some reamers seem clearly intended for hafting, while others were hand-held.

It appears that these reaming tools were used under high torque as they frequently broke during use, as illustrated by reamer tip fragments recovered from the site (figure 4-1E). A high degree of abrasion on the reamer edges suggests use under heavy loads and on relatively hard materials. Some reamers appear to have been hafted (figure 4-1B), while others were hand-held (figure 4-1C).

The second type of reamer can be described as a "triangular-pointed" variety (figure 4-1D) that is morphologically similar to the Chumash "canoe drill" (Gamble 2002). These reamers were flaked to produce a pointed tool with a triangular cross-section. Examination of the wear patterns on the triangular-pointed reamers reveals heavy abrasion of the tool's lateral edges but virtually no damage to the tip. These tools were clearly employed to expand an existing work orifice, rather than create an initial perforation.

Some of the most remarkable tools found in the Early Holocene component at Eel Point are the stone wedges (figure 4-1F). One is formed on a stout retouched flake of rhyodacite; the polished high-points on both faces of the tool show where it entered a comparatively soft material, almost certainly wood. On the opposite end of the wedge, distal from the cutting edge, are the crushing, pitting, and step-fractures that resulted from the blows required to drive it into a work piece.

Other tools appear well suited to shaping and finishing work pieces of wood, bone, and perhaps other materials. Figure 4-1G shows a large flake that was trimmed around its margins to produce a rectangular tool. These tools exhibit heavy, bi-facial wear on the long edges, consistent with use as a planning device, probably for shaping wood.

Sandstone abraders, a material that had to be imported to San Clemente Island, are shown in figure 4-1H. Tools of this kind would have been ideal for smoothing and shaping relatively soft materials such as wood and bone.

The assemblage at Eel Point also contains what appear to be microlithic tools (Rondeau et al. 2007). Four non-prismatic microcores have been identified thus far from the Early Holocene component at Eel Point. Although this sample is small, it should be recognized that the techniques involved in microcore and blade production are as distinctive and purposive as bifacial core-reduction techniques (Chun and Xiang-Qian 1989; Imamura 1996). The Eel Point microcores were manufactured from relatively small, blocky flakes. Characteristically, a top-spall was removed to create a platform suitable for flake removals along the oblique face of the flake core. Evidence of retouch to the platform in preparation for subsequent flake removals is also present on one of the cores (Cassidy et al. 2004:121).

These cores appear to be technologically analogous to those found on the Northwest coast of North America in Early Holocene deposits (Ackerman 1996; Ames and Maschner 1999; Davis 1996; Dixon 1999), and the littoral of Korea, Siberia, and Japan (Imamura 1996:37). However, the poor quality of the rhyodacite material available on San Clemente Island appears to have prohibited the development of truly prismatic blade cores. A burin was also found among the Early Holocene tools at Eel Point. Microscopic wear on the burin suggests its use in the cutting of grooves into wood. This is an essential requirement for the insertion of microliths into hafts or for the fabrication of composite cutting tools or projectile-type weapons. An examination of the stone flakes from these deposits revealed that approximately 10 percent were blade-like in character—that is, linear flakes that were less than 5 cm in length and at least twice as long as they were wide.

Analytic Techniques

Tools that exhibited a cutting edge or work surface were examined with a low-power microscope (10–50X) for use-wear damage (Odell and Odell-Vereechen 1980). Evidence of the presence of use-wear resulted in the selection of the burin, scraper-planes, drills, and reamers for further analysis employing an Olympic incident-light high-magnification microscope (100–200X), following established procedures (Keeley 1980; Semenov 1964). As a result of preliminary observations of the archaeological tools, replicas were manufactured and then used to work both wood and stone. The tools were replicated from volcanic (rhyodacite) beach cobbles available near the site, the overwhelmingly favored raw material employed at Eel Point throughout all periods of occupation.

A replicated tool was used to drill a hole into wood, after which a replicated reamer, with a rounded distal end, was employed to widen the hole. These experiments resulted in a high luster that spread across the utilized edges and into depressions in a diffuse pattern. An examination of the archaeological drills revealed an identical bright and smooth surface consistent with woodworking (Vaughan 1985:33). This type of use-wear was also consistent with surfaces on the archaeological wedge, scraper-plane, and burin tip. The sides of the reamers also exhibited heavy parallel striations, suggesting the use of a highly abrasive material such as stone. An experiment employing sand as an abrasive for reaming wood resulted in parallel grooves interspersed with polished bands (Vaughan 1985:38). The nose area of the archaeological reamer in figure 4-1B presents similar patterns. This suggests the possible grinding of a mildly abrasive substance, such as ochre, while using a soft platform, such as wood.

To differentiate stone- and wood-induced wear, a hole was pecked into a basalt cobble and a replicated reamer was employed to widen and smooth the hole. The experimental reamer exhibited substantial abrasive use-wear and parallel striations. This pattern is similar to the use-wear on the blunt-nose and pointed triangular reamers from the archaeological assemblage.

Technological Correlates of Watercraft Construction

As noted earlier, discussions by Arnold (2001b), Gamble (2002), Jones and Klar (2005), and Munns and Arnold (2002) have focused attention on the origins of native watercraft in coastal southern California. Some of these researchers, it will be recalled, hypothesize that seaworthy boats, capable of regular voyages to the Channel Islands, did not evolve until late in the prehistoric era. Arnold (2001b:14), for example, argues that such a capability arrived with the Chumash *Tomolo*, suggesting that the "plank canoe was likely not fully refined and reliably seaworthy until the A.D. 800–1000 era." If this hypothesis implies that no technologically sophisticated, seaworthy boats appeared in coastal southern California prior to the *Tomolo*, it is difficult to reconcile with the sea travel manifestly required to settle Eel Point.

The *Tomolo* does, however, present valuable comparative data on the technological capabilities of ancient Channel Islands seafarers. This can be seen in the notes of John Peabody Harrington, noted California ethno-historian, who collected detailed information on *Tomolo* construction from Chumash Indian boat wrights during the early twentieth century. Hudson et al. (1978:21–53), drawing on Harrington's notes, identified the following materials and tools involved in *Tomolo* building:

- Asphalt as a watertight adhesive and sealant.
- Driftwood, especially straight-grained species such as redwood or cedar.
- Wedges from stone, wood, bone, or antler for splitting planks.
- Fibrous plant material for making cordage.
- Caulking chisels made from wood or bone.
- Ochre to mark lines and color exterior coatings.
- Shell or stone chisels.
- Stone flakes for cutting and shaving wood.
- Pointed flakes for gouging holes into wood.
- Stone or shell scraper planes.
- Sandstone and sharkskin abraders.

This list of tools and materials describes the range of basic technological capabilities required to split wood into planks, shape the planks into hull members, lash these members together at their edges with cordage inserted through drilled holes, and finally waterproof the seams between planks. If these tools are indicative of technological capabilities sufficient to construct a sophisticated, seagoing boat, how do they compare to the tool kit at Eel Point?

This list is strikingly similar to the Eel Point tool assemblage described earlier. While there can be little doubt that driftwood and cordage were used at Eel Point, we find direct evidence of asphalt, ochre, and stone flakes suitable for gouging and cutting wood; drills, stone scraper planes, a sea mammal rib with a blunted work end, and asphalt smears suitable for use as a caulking chisel; asphalt-smeared slabs of stone; sandstone abraders; reamers; and wedges (Cassidy et al. 2004).

An examination of the functional characteristics of these woodworking tools is informative. Clearly they could have been, and probably were, employed in a number of different woodworking activities other than the construction and maintenance of watercraft. The full extent of these activities, such as the fabrication of various non-nautical gear, is difficult to determine but likely extensive. What we can infer from the tools, however, is that the splitting of wood was accomplished, perhaps including planks, by pounding the wedge into large pieces of wood, including the type of driftwood found on San Clemente Island's western shore today. We can also infer that the edges of these work pieces were probably smoothed with the scraper planes, and this procedure would be consistent with the joining of pieces together into composite structures. The presence of numerous sandstone abraders also attests to smoothing and joining activities for wooden parts. Further, the flake drills found in the deposits were of sufficient size and strength to perforate planks and permit the lashing of them together into composite constructions.

Pushing Back Seafaring Origins

In making the comparison between Chumash boat building and the Eel Point technological profile, we want to avoid confusion. We are not suggesting that the *Tomolo* or *Ti'at* were used at Eel Point, nor do we offer any suggestions regarding the antiquity of these types of watercraft or their developmental history. Our purpose in considering the *Tomolo* here is only for comparative assessment of technological capabilities.

It is important to understand what such comparison can and cannot tell us. Based on the evidence from Eel Point, technological analogies do not inform us as to the specific form of boats used by the island's first inhabitants. While these early watercraft may have employed plank construction similar to the *Tomolo* and Gabrielino Indian *Ti'at*, there are other possibilities, including combinations of wood, animal skin, cordage, and other materials combined into a variety of designs. However, if we assume that Channel Islands seafaring has always exerted the kinds of selective pressures noted earlier, it seems reasonable to conclude that even the earliest voyagers to San Clemente Island were using boats with sophisticated features that maximized the utility of these craft, if not survival of the boat users. Whatever the configuration of these early watercraft, it seems likely they employed relatively lightweight but strong and hydrodynamic hulls of composite construction. Boats of this kind would have offered superior stability at sea, comparatively low demands on the energy of crews paddling them, and thus the ability to make relatively rapid passages between the islands and the mainland. It seems likely this speed and efficiency offered the greatest survival edge at sea.

How long before Cabrillo's arrival did the first mariners appear on San Clemente Island? For answers to this question, we turn to figure 4-2, a timeline of the 13 radiocarbon dates from Eel Point's basal cultural stratum (from table 4-1). These dates form a relatively continuous temporal sequence between 5,836 cal BC and 7,589 cal BC, or between about 7,800 to 9,500 years before present. These dates unambiguously mark a human occupation, owing to their association with the cultural features and artifacts described earlier. It seems clear from this evidence that San Clemente Island was colonized by capable seafarers at least as early as the seventh millennium BC.

The two oldest dates in figure 4-2 are more difficult to interpret, but nonetheless pose intriguing possibilities. Beta-195122, the oldest radiocarbon date from Eel Point, is particularly problematic at 12,353 to 12,763 cal BC, in that it represents a temporal outlier separated by at least five millennia from the cluster of dates between Beta-95898 and Beta-133329. This date, based on a single fragment of charcoal, was not associated with a cultural feature, but rather derived from sediments resting on the same volcanic bedrock as

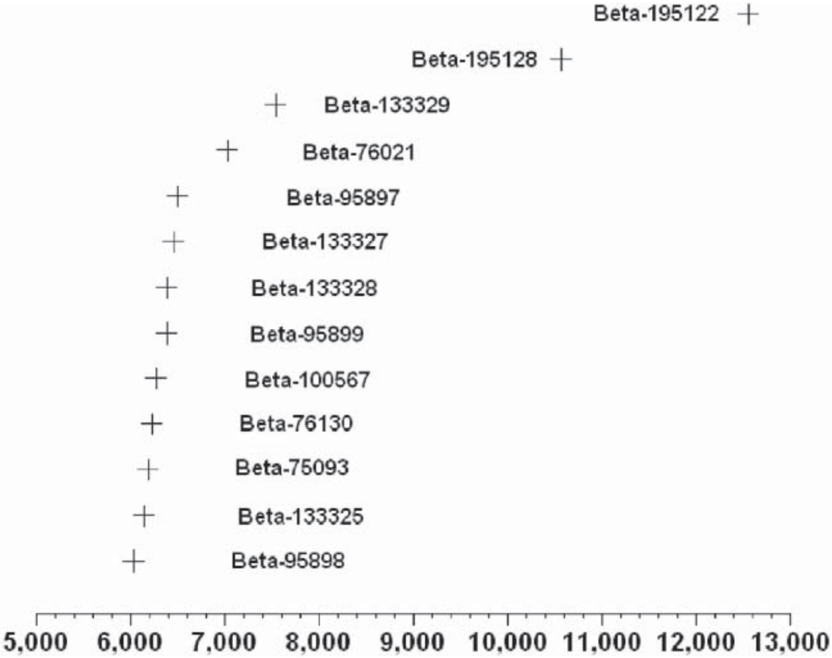


Figure 4-2. Distribution of Eel Point Early Holocene radiocarbon dates, cal. BC.

other cultural deposits in Eel Point's basal stratum. Under these circumstances, the "old wood" problem cannot be excluded; i.e., the possibility that wood charcoal of natural origin, such as wild fires, was deposited before the first human inhabitants arrived (Taylor 1987). If this specimen is of cultural origin, another conceivable source of dating error is contamination with asphaltum, or petroleum tar, used in prehistoric coastal southern California as a sealant and glue, including construction of watercraft. Additionally, this date is considerably outside the range of the oldest currently known cultural components of the Channel Islands. Until we have more data, this date will have to remain imponderable as regards its possible cultural origins.

Beta-195128, at 10,507 to 10,652 cal BC, seems more likely to be of cultural origin, despite its lack of association with a specific cultural feature. While this may be a chronological outlier in the context of the currently available Eel Point dates, it is not aberrant in the larger picture of early Channel Islands settlement. As we saw above, the Arlington Springs human skeleton discovered in the Northern Channel Islands (Santa Rosa Island) is assigned an age of about 9,500 to 11,000 cal BC (Johnson et al. 2002; Rick et al. 2005:177). Based on the reasonable assumption that all of the Channel Islands were within reach of early seafarers, occupation of Eel Point could by 10,500 cal BC be plausible, if not yet firmly established.

What is clear, considering all of the available evidence, is colonization of the Channel Islands by seafarers at the end of the Pleistocene. As noted by Rick et al. (2005), the importance of this discovery reaches far beyond coastal southern California: "These dates indicate that people with fully maritime capabilities were present in the Americas as much as 13,000 years ago, the contemporaries of Folson and Clovis peoples" (Rick et al. 2005:217). In the last chapter of this book, we examine some of the implications of early maritime settlement of North America.

Altogether, given this pattern of early Channel Islands settlement, it would appear the temporal gap between the appearance of Clovis Paleo-Indians and sea-borne settlement of Pacific North America has effectively closed, a topic we return to in the chapter 12.

5

The Dolphin Hunters

L. Mark Raab

The California Channel Islands are surrounded by some of the most prolific marine environments in the world, including kelp forests teeming with fish, birds, sea mammals, shellfish, and crustaceans (chapter 2). Despite this fact, California archaeologists concluded for decades, "The virtual absence of marine shell and fish and sea mammal bones in the refuse of certain village sites suggests that the earlier coast dwellers had not yet realized the full possibilities of ocean resources" (Wallace 1978:28). Why had the inhabitants of one of the globe's most bountiful coastlines failed to exploit the ocean's numerous subsistence potentials? Answers to this question, as we saw in chapter 1, were for decades the foundation of attempts to explain the origins of California's native maritime cultures.

Popular theories of progressive cultural evolution argued that the first people to reach the California shoreline lacked knowledge of marine resources, thus requiring millennia of trial and error to develop a taste for sea foods and the skills required to obtain them. A corollary of this scenario, examined in the previous chapter, held that such cultures were unable to blossom fully until the invention of seaworthy watercraft, an innovation that allowed mainland groups to colonize the California Channel Islands.

This model was understandable, given the limitations of early coastal archaeology. Worth noting again (see chapter 1), coastal excavations of the early to mid-twentieth century generally lacked techniques for recovering any but the most obvious marine food remains. The large amount of subsistence information overlooked by these investigations has only become apparent in recent years. Studies on the Santa Barbara coast, for example, have been extremely revealing in this regard (Erlandson 1991b; Erlandson 1994; Erlandson et al. 2008; Glassow 1996; Glassow et al. 1988). This research demonstrated that substantial quantities of shell and bone from marine species, often fragmentary, were effectively invisible to early investigators. Excavations in central California and the San Diego region have yielded similar results (Byrd and Raab 2007; Jones 1995; Jones et al. 2002). These projects also underscore the necessity of utilizing interdisciplinary teams of specialists to identify the recovered "ecofacts," something done relatively rarely in early California archaeology. The result is a revolution in our understanding of prehistoric California coastal economies. We now know that maritime economies existed in California from the earliest period of coastal settlement. As we shall see in this and later chapters, Channel Islands economies were, of necessity, based predominantly on marine resources. In mainland coastal settings, marine resources such as shellfish, fish, and sea mammals were combined with terrestrial faunas and plant carbohydrates, including seeds (Erlandson et al. 2008; Jones et al. 2002; Porcasi 2007).

Archaeological dating techniques were another critical limitation of early coastal research. Whereas coastal archaeologists had considerable success in developing cultural chronologies based on time-diagnostic artifact types such as marine shell beads (Hughes and Milliken 2007; King 1990), the resulting chronologies were "floating." Certain types of artifacts were known to be older or younger than others, but rarely could any of these be assigned calendar ages. Absolute dating of coastal sites, like archaeological sites throughout the world, had to await the widespread use of radiocarbon dating, a technique not routinely available to California archaeologists until recent decades (Moratto and Chartkoff 2007). As a result of the "radiocarbon revolution," we now know that coastal California was home to true maritime seafarers and foragers—like the Eel Point archaeological site examined in the previous chapter—far earlier than once believed.

Before these revolutionary changes in coastal archaeology came along, the place of the California Channel Islands in the larger scheme of North American prehistory seemed reasonably clear: These islands appeared to be among the last places in North America to receive human colonists. Augmenting the progressive-evolutionary model, some theorists offered demographic and ecological rationales for delayed island occupation:

> If . . . one of the best indicators of population pressure is the increasing use of more marginal habitats, then . . . continued population growth and pressure on resources have been occurring since mid-Holocene times. This expansion involves the use of microenvironments with less species diversity, such as straighter, less complex (and hence less biotically diverse) coastlines, as well as areas with lower species abundance, such as small, offshore islands. . . . Even for North America as a whole, it is possible to show that areas such as the *California Channel Islands* or the Florida Keys *were occupied relatively late in the prehistoric record*. (Yesner 1987:300–301; emphasis added)

Evidence of Channel Islands settlement reaching back in time to the Late Pleistocene or Early Holocene, including San Clemente Island's Eel Point, shows that these islands can no longer be seen as settlements of last resort. Instead, we are confronted with quite a different question: Why were San Clemente and other islands selected for settlement so early in the colonization of North America?

Theories of progressive maritime cultural development now make little sense, insofar at least as they argue that true maritime economies and effective sea travel appeared after the Middle Holocene, and only then after these were gradually perfected. A large and growing body of archaeological evidence, including the contents of this volume, shows that by the end of the last Ice Age or the beginning of the Holocene, California coastal groups, including Channel Islanders, were capable of regular sea travel and of obtaining the bulk of their proteins and/or calories from marine resources, the latter a fair gauge of "real" maritime economies (Yesner 1987).

What about the ecological model of late Channel Islands settlement that we saw above? How does this model fare in light of recent research advances? We suggest that the emphasis of Yesner's (1987) model on understanding the effects of the biosphere on Channel Islands settlement is a useful approach. However, this model needs to be revised to reflect what we have learned about the Channel Islands' prehistoric maritime economies during the last two decades. This is an area where, once again, the rich archaeological record of the Eel Point archaeological site proves highly informative. In particular, dolphin hunting on prehistoric San Clemente Island reveals an insular environment far more attractive to human settlement than once imagined.

Mystery of the Dolphin Hunters

During the early 1950s, one of the pioneers of California coastal prehistory, Professor Clement Meighan of the University of California, Los Angeles, conducted a series of excavations on Santa Catalina Island, located about 22 mi/34 km to the northwest of San Clemente Island. Excavations at the Little Harbor archaeological site (CA-SCAI-17) were particularly revealing, leading to a published summary of results (Meighan 1959). Meighan's Little Harbor report served for decades as one of the linchpins of theorizing about coastal prehistory. Little Harbor, perhaps the first California coastal site to be dated using the radiocarbon technique, was thought to be about 4,000 years old—at the time, one of the oldest known coastal occupations (Meighan 1959).

One aspect of the Little Harbor data remained puzzling, however: the surprisingly large number of dolphin bones found in the site's archaeological deposits. Injured or dead dolphins are known to occasionally beach themselves, where they might be found and eaten by coastal foragers. What made the dolphin bones at Little Harbor mysterious is that they rivaled the quantity of bones of the California sea lion (*Zalophus californianus*), a prime target of prehistoric maritime hunters throughout Pacific North America (Hildebrandt and Jones 1992). If the frequency of sea lion bones pointed to hunting, there was no getting around the conclusion that dolphins were also a major prey species (Meighan 1959).

But how could this be so? Unlike sea lions, which are easily attacked in their land-based breeding colonies (see chapter 8), dolphins are large, powerful, fast-swimming sea mammals that must be taken at sea. Dolphins present a wholly different set of challenges to maritime hunters than stalking sea lions on land. This is a challenge that requires distinctively maritime skills, not merely an extension of tactics employed by terrestrial hunters. Meighan (1959) tentatively concluded that dolphins might have been captured either by netting or spearing from boats. Still, the large number of dolphins at Little Harbor remained anomalous for decades in the larger picture of coastal prehistory. Was Little Harbor a unique case?

This question, among others, prompted a team of researchers from California State University, Northridge, to return to Little Harbor in the early 1990s to obtain more radiocarbon dates and to analyze another sample of the site's faunal remains. Raab et al. (1995a) confirmed the large number of dolphin bones reported by Meighan and showed that most of these were taken during the Middle Holocene, with radiocarbon dates on the dolphin-bearing strata clustering around 3,200 cal BC. This analysis suggested a possible connection between the presence of dolphins and changing sea temperatures but left open a number of questions, including how these were captured, if dolphin hunting was important on other Channel Islands, and if dolphin hunting predated the Middle Holocene.

These were some of the unanswered questions that encouraged us to undertake research at the Eel Point archaeological site on San Clemente Island, along with questions about seafaring described in the previous chapter. As we shall see below, these efforts were rewarded by discovery of a well-preserved, trans-Holocene record of maritime foraging, including dolphin hunting. In this chapter, we show how the dolphin hunters of Eel Point help us to understand why the Channel Islands were targeted for settlement so early during the human colonization of North America.

Dolphin Hunting at Eel Point

The Eel Point archaeological site (CA-SCLI-43), described in greater detail in the previous chapter, contains deep, well-preserved cultural strata, including abundant remains of the marine food items hunted and collected by San Clemente Islanders (figure 5-1). As pointed out in chapter 1, San Clemente Island has largely escaped the fate of mainland archaeological settings, where burrowing animals have often caused extensive mixing of cultural strata

Figure 5-1. Dr. Jennifer Perry and stratigraphic profile of Eel Point cultural strata.

(faunalturbation). Radiocarbon dates from Eel Point (table 4-1) are almost completely consistent with their stratigraphic ordering. This lack of dating "reversals" yields an unusually coherent chronological record. Together with generally excellent preservation conditions throughout the site's shell-bearing middens, Eel Point affords an exceptional trans-Holocene record of maritime foraging. Several analyses of Eel Point's faunal assemblages have been completed using this record (see, for example, Andrews 2000; Garlinghouse 2000; Porcasi and Fujita 2000; Porcasi et al. 2004; Raab et al. 1995b; Salls 1988, 1991, 1992; chapter 8, this volume). In the present discussion, our focus is on one aspect of this record—dolphin hunting—and what it tells us about colonization of the Channel Islands in relation to the comparative productivity of marine versus terrestrial hunting economies.

For purposes of this discussion, data presented by Porcasi et al. (2004) offer an illustrative summary of sea mammal hunting trends at Eel Point, including dolphin hunting. These researchers divided Eel Point's cultural strata into five time periods. These include Early, Middle, and Late Holocene periods, based on directly associated radiocarbon dates (tables 4.1 and 5.1), with intervening

Table 5-1. Summary of Marine Mammal Bones from 1994, 1996 Excavations at Eel Point (from Porcasi et al. 2004:81)

	Late Period 1,500 cal BC–cal 1,400 AD		*Undated Late/ Middle Period*		*Middle Period 5,000–1,500 cal BC*		*Undated Middle/ Early Period*		*Early Period 7,000–5,000 cal BC*		*Total*
Animal	NISP	%[a]	NISP	%[a]	NISP	%[a]	NISP	%[a]	NISP	%[a]	**NISP**
Pinnipedia	355	9.2	90	8.8	284	6.2	32	7.7	30	13.0	**791**
Delphinidae	51	1.3	289	28.3	557	12.0	19	4.6	6	2.6	**922**
Otters	378	9.0	68	6.7	51	1.1	3	<1	1	<1	**501**
Large Cetaceans	32	<1	98	9.6	55	1.2	4	<1	0	0	**189**
Unidentified Mammals	3,041	7.8	477	46.7	3,646	79.4	359	86.0	192	83.8	**7,715**
Total	**3,857**	**100**	**1,022**	**100**	**4,593**	**100**	**417**	**100**	**229**	**100**	**10,118**

[a] Numbers are rounded off.

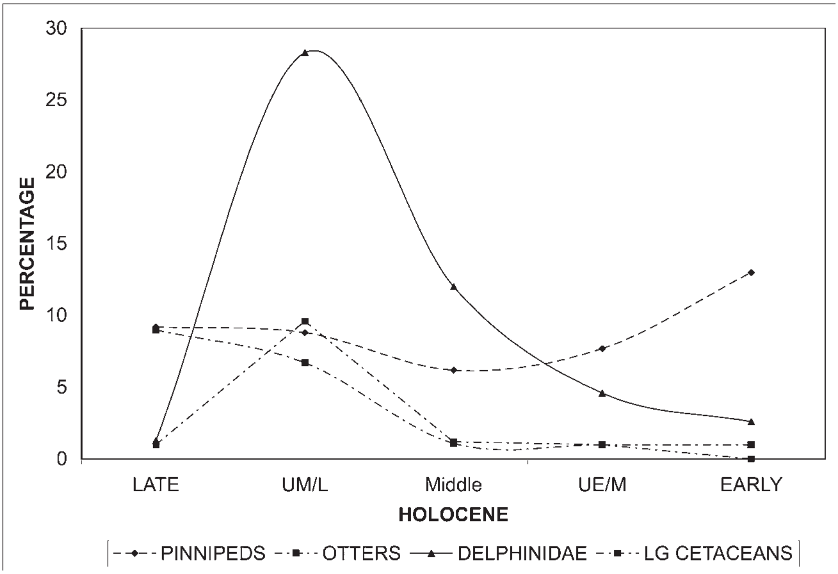


Figure 5-2. Trans-Holocene relative frequency of sea mammal bones at Eel Point.

Middle-to-Early and Middle-to-Late periods filled in by stratigraphic correlation. To obtain an overview of sea mammal hunting, the percentages of Pinnipedia (seals and sea lions), Delphinidae (dolphins), otters, large Cetaceans (whales and dolphins), and unidentified mammals were determined for each of the five time periods, based on the total number of individual specimens (NISP) recovered from all excavation levels assigned to each time period. The resulting trends are shown in table 5-1 and figure 5-2.

While these trends afford only a coarse-grained reconstruction of sea mammal hunting at Eel Point, they are useful in showing that dolphin hunting commenced on San Clemente Island in the interval between 6,000 and 7,000 cal BC and continued with variable intensity until the end of the dated time sequence (ca. cal AD 1400). Based on figure 5-2, dolphin hunting may have peaked in the Middle Holocene, for reasons yet to be explained. What seems clear, however, is that dolphins were a significant part of the Eel Point subsistence base across many millennia. It is difficult to conclude otherwise when we consider the frequency of dolphin bones relative to other sea mammals, such as otters and pinnipeds. The Eel Point data demonstrated that the inhabitants of Little Harbor on Santa Catalina Island were not alone in hunting dolphins, nor was such hunting exclusively a Middle Holocene phenomenon. Yet, despite demonstration that dolphins were a significant component of the sea mammal economy on San Clemente Island across the Holocene, we were initially no closer to solving the mystery that confronted Professor Meighan decades earlier: How were dolphins hunted?

Our research benefited from a research tool that could not have been imagined when Meighan excavated Little Harbor: The Internet. We searched the Internet for examples of research on ancient dolphin hunting in other parts of the world. This search, described by Porcasi and Fujita (2002), quickly showed that small cetaceans (dolphins and whales) were hunted in many parts of the world. Most surprisingly, we also discovered that these animals could have been taken with astonishingly simple but effective capture techniques.

Dolphins and some other cetaceans are "echo-locators," meaning they emit high frequency sound waves for navigational purposes. Much like sonar, these sounds help dolphins to maneuver around objects or locate themselves in situations were visual cues are ineffective. This aspect of dolphin behavior must have been independently discovered in many regions of the world during prehistory, leading maritime hunters to recognize that echo-locating dolphins (and other cetaceans) are fatally vulnerable to manipulation by sounds introduced into the water by the hunters themselves. These sounds appear to "jam" the dolphins' echo-locating capabilities, creating confusion in the animals about where it is safe to swim. The use of such techniques is documented in Japan and Oceania (Procasi and Fujita 2000). In the Solomon Islands, for example, hunters in boats were photographed striking stones together under water, using these sounds to drive dolphins into shallow water, where these animals were then captured by hand (Porcasi and Fujita 2000).

Despite these intriguing findings, it seems prudent to leave open the question of how sea mammals, including dolphins, were hunted at Eel Point. Many native groups along the North American Pacific Coast are known to have hunted sea mammals with boats, employing harpoons and other gear (Hildebrandt and Jones 1992). The fact that harpoon gear has yet to be identified in Eel Point cultural deposits of any time period does not necessarily rule out the possibility of such technology, given the small sample of the site's midden deposits (<1 percent) that has been excavated to date. These cautions aside, it seems apparent that dolphins could have been taken on San Clemente Island, and elsewhere, with the sonic "stealth technology" described above. The earliest settlers of San Clemente Island arrived by watercraft (chapter 4), the main piece of technology required for this mode of dolphin hunting. Since dolphin hunting was practiced by these early mariners, it may be a form of marine mammal hunting that arrived with them.

Dolphin Processing

Whatever hunting technique was employed, Eel Point's well-preserved cultural deposits afford a relatively detailed picture of how dolphins were processed for consumption. Figure 5-3, for example, shows part of a butchered dolphin's spinal column deposited with various kinds of refuse. The vertebrae that make up this segment of the (thoracic) spinal column are in their anatomically proper positions, indicating that these were still connected by their supporting ligaments when they were discarded. These vertebrae are attachment points for ribs and for dorsal spines that serve as anchor points for large muscles extending along the spine. Examination of the vertebrae shows that these ribs and spines were detached by heavy blows. Rib and spine fragments broken off in this fashion are visible in figure 5-3. Also found in close conjunction with the vertebrae and bone fragments were sharp flakes of volcanic stone, an example of which is shown in figure 5-4.

Together, these items suggest a pattern of butchery. Sharp stone flakes were certainly adequate for cutting through the skin of the dolphin, for removing organs from the thoracic and abdominal cavities, and for stripping away the larger muscles. Reducing the remaining carcass to manageable pieces presents another challenge. Breaking the ribs at their vertebral attachment points allows the resulting "rack of ribs" to be detached as a unit. This can be accomplished by striking these attachment points with a sharp-edged stone, then severing the ribs with a suitable cutting tool. The bones and tools shown in figures 5-3 and 5-4 appear to represent one such episode of dolphin butchery.

Figure 5-3. Vertebral column, stone tools, rib and dorsal spine fragments from dolphin butchery at Eel Point.

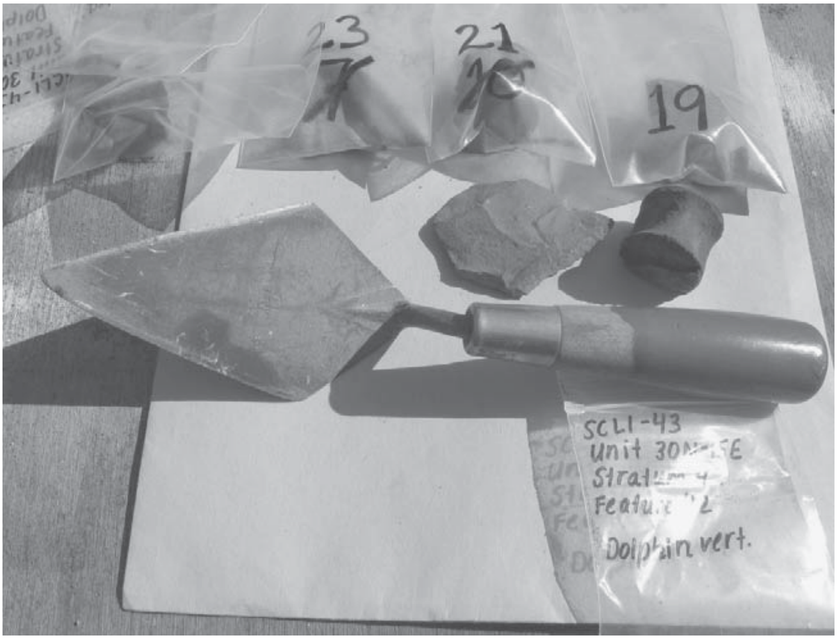


Figure 5-4. Dolphin vertebrae and stone tool used for dolphin butchery at Eel Point.

Dolphin Hunting and Island Settlement

An explanation of early Channel Islands settlement cannot be reduced to a single factor, but the dolphin data suggest that locations such as San Clemente Island were far more productive for maritime foragers than previously recognized. While fish, shellfish, pinnipeds, and other food items were clearly important components of the San Clemente Island diet, the dolphins nonetheless illustrate some factors that ought to be taken into account in reckoning the relative economic attractiveness of island and mainland settings for prehistoric human settlement.

One way of thinking about the relative productivity of dolphin hunting is within the theoretical framework of *foraging efficiency*, a topic taken up in greater detail in chapter 8 of this book. Essentially, models of foraging efficiency predict that food items will be added to the diet selectively, depending on the cost effectiveness of available food items. Dolphin hunting on San Clemente Island, and most anywhere else in a seafaring context, appears to be a relatively cost-effective pursuit, inasmuch as it apparently demanded minimal technological support, with the exception of watercraft. Moreover, the pursuit costs of taking dolphins could have been minimal if several animals were taken at a time, as in the Solomon Islands case. On the other hand, subsistence yields would have been relatively high. The large body size of dolphins, along with their stores of blubber, would have yielded considerable quantities of fats and proteins. The fats of sea mammals such as sea lions and dolphins, both exploited on San Clemente Island (see chapter 8), are valued for their caloric yield by many forager societies (Monks 2005).

One of the most effective tools of San Clemente Island's early maritime hunters, apart from boats, may have been their astute knowledge of the behavioral vulnerabilities of dolphins and pinnipeds. These "stealth weapons," rather than the bifacial implements characteristically employed by terrestrial hunters, expose a long-standing "biface bias" in reconstructing the productivity and sophistication of North America's prehistoric hunting economies:

> Paleo-Indian studies have been especially influential because the Paleo-Indian archaeological record, with its remarkable, finely executed bifacial forms, captured the fascination of North American archaeologists early on. . . . Later, these bifaces served as a powerful stimulus for the growth of flint knapping both as avocation and as a research strategy. . . . For chronological goals, Clovis and Folsom bifaces have served as exceptional temporal markers for Paleo-Indians . . . and have thus become paragons in the typological dominance of bifacial forms over non-bifacial lithic materials employed in the reconstruction of culture historical sequences throughout North American prehistory. (Steffen et al. 1999:133)

Given the near absence of bifacial stone tools and weapons at Eel Point, it might be tempting to dismiss San Clemente Island's hunting economy as "unsophisticated." This would be a mistake. To date, we have not undertaken a detailed comparison of the relative productivity of terrestrial and marine prey species of similar body mass—for example, comparison of deer or elk with pinnipeds or dolphins in relation to nutrient or caloric yields. Just the same, it seems reasonable to hypothesize that sea mammal hunting on San Clemente Island compared favorably with the pursuit of medium to large terrestrial animals in contemporaneous mainland settings.

Another point to consider is Eel Point's microlithic tools, discussed in chapter 4. These tools, as noted by Cassidy et al. (2004) and Rondeau et al. (2007), are derived from a fundamentally different technological tradition than the bifacial implements that have occupied the analytical efforts of so many North American terrestrial archaeologists since the discovery of the Paleo-Indians. Eel Point's microlithic technology may point to tools and weapons used in hunting, such as spears with stone insets. Equally important, these tools may echo maritime cultural traditions of Eastern Asia, not the Paleo-Indians, a topic that we return to in the last chapter of this book.

These insights are useful in developing new models of maritime prehistory. What the dolphin hunters remind us is that humans are highly mobile, opportunistic predators that readily occupy any niche that will afford them reproductive success. Early colonization of islands such as San Clemente is not simply a story of merely surviving on marine resources. The first Channel Islands colonists gained a competitive advantage by moving into productive foraging territories untapped by humans, thus avoiding competition with mainland groups. If this is so, we need to revise our traditional understandings of Channel Islands colonization. Far from discouraging early settlement, the marine ecological conditions afforded by San Clemente Island, and undoubtedly other insular settings, encouraged the development of maritime cultural niches reaching far back into the prehistory of North America. For generations, archaeologists have credited early terrestrial groups—armed with sophisticated bifacial hunting tools and targeting large terrestrial mammals—as the pioneering North American populations. We now need to acknowledge the importance of other technologies (e.g., watercraft and microlithic tools) and other prey species (e.g., marine mammals) in the early human colonization of North America.

III

MIDDLE HOLOCENE

6

This Old House

L. Mark Raab

When we looked earlier at the origins of seafaring in coastal southern California (chapter 4), we saw how Spanish explorers of the sixteenth through the eighteenth centuries were met by seagoing canoes, including the Chumash *Tomolo* and Gabrielino *Ti'at*. Gamble (2008) offers a detailed portrait of this lost world, including Chumash Indian villages that were home to some of these native mariners. Chumash village names live on in communities such as Malibu, famed today for movie stars and surfers rather than Indian seafarers. From Malibu to Santa Barbara, judging from Spanish descriptions (Gamble 2008), Chumash seaside villages were populated by groups ranging in size from a few families to more than 1,000 people. The well-constructed houses that sheltered these communities—dome-shaped, grass-thatched, and 8 m or more in diameter—leave little doubt about the permanence of these coastal villages. These communities, and their Channel Islands counterparts, are reckoned the capital settlements of Chumash chiefdoms (Arnold 2001b; Gamble 2008). For all these reasons, California archaeologists have conventionally viewed sedentism, or living in fixed residential communities, as one of the hallmarks of the Late Holocene maritime cultural climax that we discussed in chapter 1.

The importance of sedentism stems from its place in larger schemes of prehistoric cultural development. California's Early and Middle Holocene populations are thought to have followed seasonal patterns of hunting and gathering, utilizing a series of temporary camps. This kind of seasonal mobility is often referred to by North American archaeologists as the Archaic cultural stage (Willey and Phillips 1958; Chartkoff and Chartkoff 1984). Since high residential mobility logically discourages construction of substantial habitation structures, Archaic-stage cultures of California, as elsewhere in North America, were defined in part by the lack of permanently occupied dwellings or villages. In the case of southern California coastal groups, the Archaic stage was thought to have persisted until certain improvements in the productivity of coastal foraging—particularly development of seaworthy watercraft and intensified fishing and sea mammal hunting—made it possible to operate year round from a fixed residential locus, thus ending California's long night of the Archaic. This was a transition from "foraging" to "collecting" in the parlance of Binford's (1980) well-known model of hunter-gatherer settlement organization.

When Chartkoff and Chartkoff (1984:146) suggested that, "From about 4,000 years ago (2000 B.C.) to 1769, cultures in California underwent a transformation from small groups of seasonally wandering hunters and gatherers to large groups in sedentary settlements," they were identifying permanent settlements as a new stage of cultural complexity. According to this model, sedentism is an essential condition of the socioeconomically complex coastal societies encountered by California's Euro-American explorers and settlers, including the Gabrielino and Chumash. This trait also takes on considerable importance to archaeologists because substantial residential structures of the type occupied by the Chumash and other groups are likely to leave discernable traces.

Theorists may be correct that high degrees of social complexity took hold in sedentary coastal communities of the Chumash and Gabrielino, but was sedentism an innovation of these groups, as progressive-evolutionary theories imply? We saw in previous chapters how traditional scenarios of California coastal prehistory are increasingly out of step with advances in coastal archaeology. The advent of seafaring, Channel Islands colonization, and true maritime economies—to name three important developments—occurred far deeper in the past than once imagined. In this chapter, we examine evidence that maritime sedentism has an older and more complex history than traditional models of maritime cultural development have suggested.

San Clemente Island Houses

On San Clemente Island, archaeological evidence indicates that residential sedentism likely appeared during the Early Holocene but was certainly well established by the Middle Holocene. Discoveries at two archaeological locales, the Nursery site (CA-SCLI-1215) and the Eel Point site (CA-SCLI-43), reveal a record of residential construction and related domestic features spanning at least 8,000 years.

The Nursery Site

The most detailed information about prehistoric house construction on San Clemente Island comes from the Nursery site, named after a nearby native plant nursery. The site is situated at the margin of a Pleistocene-age dune field, stabilized by vegetation when the sediment source (shell fragments) was cut off by Pleistocene sea level fluctuations (chapter 2). The Nursery site extends for about 400 m along the eastern edge of these north-south tending dunes. Today, these dunes have the appearance of a long, linear hill rising perhaps 30 m above the site. Nestled against the lee of the dunes, this location offers excellent protection against the island's strong prevailing winds. Prehistoric San Clemente Islanders excavated house pits along the flank of the dunes, taking advantage of this sheltered location.

As currently understood, the site's occupation began between about 2,700 and 2,900 cal B.C. and continued at least intermittently until historic times (Raab et al. 1994). Three Nursery site houses have been dated by radiocarbon assay or time-diagnostic artifacts. The first of these structures came to light in 1984, when it was discovered by archaeologists from the University of California, Los Angeles (Rigby 1985). This structure, House Pit 1, was a saucer-shaped depression filled with shell-bearing midden. A circular house floor measured 4.70 m north-south by 4.0 m east-west by 0.50 m deep. Three features were encountered on the floor. These included a mold impression of a center support post (Rigby 1985:9) and hearths containing a burned sea mammal bone and charcoal. Eight post holes were found surrounding the rim of this house pit. A charcoal sample from one of the hearths (Feature 27) yielded a radiocarbon date (UCLA-2586) of 3,750 ± 35 radiocarbon years before present (RYBP) (Rigby 1985).

This work revealed a style of house construction documented in several coastal localities of central and southern California (Chartkoff and Chartkoff 1984; Moratto 1984; Salls et al. 1993). Essentially, houses of this kind were built in saucer-shaped pits, with domed roof structures fashioned of locally available materials such as wood or whale bone, covered with reeds, grass, animal skins, or earth.

In 1987, the authors (Yatsko and Raab) conducted a program of systematic soil-auger testing at the Nursery site in order to determine whether the pit house found by the UCLA archaeologists was an isolated feature or part of a larger occupation. This work detected at least 18 house structures of the type found by UCLA. In 1990 and 1993, the authors returned to the Nursery site with summer archaeological field schools to excavate a sample of the houses demonstrated by the soil-auger testing.

The 1990 excavation exposed a complete house structure, House Pit 2, described by Salls et al. (1993). Figure 6-1 shows House Pit 2 being cleaned for photography at the conclusion of the excavation. Like the UCLA discovery, this house was constructed in a circular pit 4.5 m in diameter, and about 0.50 m deep. This work showed that whale-bone roof members had once been set in holes between 10 and 30 cm in diameter at the floor perimeter. The stub of a whale rib was still in place in one of these holes. Large quantities of whale bone were found on the house floor, including masses of whale bone at the east and west periphery of the floor (Salls et al. 1993:186–88). These bones appear to have formed part of the entrance to the house, perhaps a screening wall at the edge of a hard-packed ramp of earth sloping upward toward the rim of the pit. It is important to note that no evidence exists of whale hunting on San Clemente Island or the prehistoric southern California coast. On the other hand, dead whales wash ashore in this region, providing coastal dwellers with a valuable “flesh fall” of resources, including large bones suitable for construction purposes. All of the

Figure 6-1. House Pit 2, nursery site (SCLI-1215), cleaning after excavation. Note storage pits, postholes, and masses of whale bone on floor.

whale bone on San Clemente Island appears to have been acquired in this way.

Domestic features were found in and around the house, including pits apparently used for storage. A hearth, burned to a red, bricklike consistency, was located on the house floor. Domestic debris was recovered from the surrounding hard-packed floor, including stone flakes, shellfish, and the bone of fish and sea mammals. A date of 2,737 to 2,985 cal B.C. (Beta-69355, 4,820 ± 80 radiocarbon years before present, corrected for fractionation; same marine calibration as table 4-1) was obtained from an abalone shell taken from a pit constructed in the floor of this house (Raab et al. 1994).

Two additional house pits at the Nursery site were partially excavated by the authors during a summer field school in 1993. These houses revealed many of the same features found in House Pits 1 and 2, including remnants of whale-bone roof structures, floor surfaces with artifacts, and pit features. All of these houses contained refuse thrown into them after abandonment, pointing to a shifting pattern of settlement in which houses were abandoned in favor of new ones, with the old house pits serving as refuse disposal features. House Pit 3, partially excavated in 1993, produced a date of 2,695 to 2,905 cal B.C. (Beta-66817, 4,790 ± 70 radiocarbon years before present, fractionation corrected; same marine calibration as table 4-1). This date is derived from a "basket load" of small turban snail (*Tegula sp.*) shells thrown onto the floor with other food debris not long after abandonment of House Pit 3. This mass of shells contained *Olivella* grooved rectangle (OGR) beads, a topic that we return to in chapter 7. Ten beads of this type were also found in refuse deposits thrown into House Pit 2, described earlier. These beads link the inhabitants of the Nursery site houses to a Middle Holocene sphere of cultural interaction reaching as far away as the state of Oregon.

Between about 2,600 and 2,900 cal BC, the Nursery site contained a community based on pit houses of similar size and design. Occupation of the Nursery site did not end with the Middle Holocene, however. As noted above, when the Middle Holocene houses were abandoned, they were filled with domestic refuse, including large amounts of shells, fish bones, sea mammal bones, chipped and ground stone tools, and other materials. Excavation of these deposits revealed post-Middle Holocene house floors. One such example produced a date of cal AD 1407 to 1514 (Beta-66816, charcoal; Raab 1997). It appears that the Nursery site continued to be occupied until historic times, as indicated by recovery of a small number of glass trade beads of European origin (excavation records on file at CSU Northridge). Another indicator of relatively intensive occupation is revealed in a Late Holocene cemetery at the Nursery site (Potter 2004).

Eel Point

As we have seen in previous chapters, the Eel Point archaeological site is one of the most important on San Clemente Island, owing to its comparatively long, well-preserved record of maritime technoeconomic change. The site's archaeological deposits reach depths of more than 4 m in some places, with well-defined cultural strata ranging in age from at least the seventh millennium BC to European contact in the mid-sixteenth century (chapter 4). Included in this exceptional record is evidence of several house structures, although none of these have been fully excavated to date. These houses were detected when excavators encountered their floors or floor profiles in the walls of excavation pits. Considering the large quantities of midden and cultural features that overlie these structures, complete excavation remains a formidable undertaking. Fortunately, Eel Point seems likely to be protected by the U.S. Navy for the foreseeable future, holding out the possibility that such excavations, if well justified, may eventually be undertaken.

Fiore (1998) described two of these structures. Like the houses at the Nursery site, the Eel Point structures were built in shallow, saucer-shaped pits with diameters of about 4.0 to 5.0 m. The floors of these houses were discernable from the shell-bearing midden deposits into which they were excavated. Careful examination of the floors revealed, for example, a "crush zone" of shell just below the floor surface. Trampling on the floors during occupation pulverized midden shell into small fragments. Thin lenses of fine gray ash were also apparent on the floors, reflecting hearth deposits in or near the houses. In some places, these floors also revealed hard, cemented layers of calcium carbonate a few millimeters thick (Fiore 1998). The compact floor surfaces appear to have trapped calcium carbonates leached from midden shells. An experienced eye could reliably identify floors on the basis of these characteristics. One of these structures produced a radiocarbon date of 2,623 to 2,428 cal BC (table 4-1, Beta-100566), contemporaneous with the Middle Holocene houses at the Nursery site. Two other house floors at Eel Point yielded dates of 4,451 to 4,316 cal BC (Beta-100564, table 4-1; Fiore 1998:30) and 3,939 to 3,781 cal B.C. (Beta-100565; table 4-1; Fiore 1998:31).

These Middle Holocene structures may not be the oldest residential structures at Eel Point. The basal cultural stratum at Eel Point, as we saw in chapter 4, contained a tool kit capable of constructing sophisticated watercraft. These tools were recovered from a living surface that dates between about 6,000 to 7,000 cal BC, if not earlier. An intriguing aspect of this cultural stratum is possible evidence of residential activities. For example, two hearths surrounded by large deposits of burned mussel (*Mytilus californianus*) shell and ash were found in this area (Cassidy et al. 2004). Associated artifacts included six mussel shell disc beads. A mussel shell disc bead recovered near these hearths produced a radiocarbon date of 6,567 to 6,428 cal BC (Beta-95897; table 4-1).

Shell and charcoal samples from one hearth were dated 6,496 to 6,287 cal BC and 6,235 to 5,836 cal BC, respectively (Beta-95899 and Beta-95898; table 4-1). Ground and chipped stone tools, debitage (waste flakes from chipped stone tool production), and an assortment of dietary animal bones were recovered from the hearths and the associated burned shell deposits. Metate (milling slab) fragments, manos (hand-held milling stones), and utilized stone flakes hint at the processing of a variety of food resources. Faunal elements (complete bones or fragments) were mixed with this material, including bones of fish, sea mammals, and birds (Cassidy et al. 2004; Garlinghouse 2000).

While this material points to domestic activities, Eel Point's Early Holocene stratum has not yet been excavated sufficiently to reveal a clear picture of possible houses or other types of residential construction. This complicates the study of large cultural features such as houses. As alluded to earlier, house structures can require the excavation of many tens of cubic meters of overlying cultural deposits—no small undertaking. House Pit 2 of the Nursery site, described earlier, is a comparatively rare instance that resulted from a concerted effort to expose a complete floor. In many instances, archaeologists are able to expose only a small portion of such structures.

Despite these limitations, the well-defined Early Holocene cultural features found at Eel Point suggest an intensity of domestic activity that may be consistent with some degree of residential permanence. The tool assemblage described in chapter 4, linked to the possible construction of boats, reinforces the impression that Eel Point's basal cultural stratum contained a substantial Early Holocene residential complex. This hypothesis is worth pursuing in future research.

House Form and Construction

Based on the evidence in hand, houses on San Clemente Island reflect similarities of form and construction across the whole prehistoric time period. The initial stage of house construction consisted of excavating shallow, saucer-shaped pits. Ranging from about 0.5 to 1.0 m in depth and 4.0 to 5.0 m in diameter, these pits formed the house floor. In instances where these pits were dug into undisturbed sediments, such as the Middle Holocene structures at the Nursery site, the resulting floor was extremely compact. In many instances, house pits were excavated into existing midden deposits, resulting in a less compact floor of crushed shell and other midden constituents.

The next construction step involved erecting a conical or dome-shaped roof over the floor-pit. Wood and whale bone appear to have been the most suitable materials for this purpose. Oaks or other aboreal species found in the major canyons (see chapter 2) might have provided suitable roof members, but driftwood was perhaps a better source of large pieces of wood. As we saw earlier, whale bone was also used for this purpose. In fact, the natural curvature of whale ribs likely provided an ideal roof configuration. Set at intervals around the periphery of the floor and curving inward toward the center of the structure, the resulting dome-shaped roof would have provided a maximum of usable space inside the dwelling. A post hole at the periphery of House Pit 2 at the Nursery site contained the stub of a whale rib, attesting to this style of construction (Salls et al. 1993). The resulting roof structure likely would have required one or more supporting posts near the center of the floor, but these apparently were not set into post holes excavated for this purpose. A variety of materials could have been used for roofing material. Grasses or shrubs available on the island may have provided suitable thatching. Animal skins are another logical roofing material, including the skins of sea lions; sea lions were an important food source throughout prehistory (see chapter 8).

Based on ethnohistoric information, Cook and Heizer (1965) found that, on average, the occupants of California Indian dwellings required 20 ft^2 of floor space per person. The modal diameter of house floors on San Clemente Island appears to be about 5 m, yielding a floor surface of about 19.6 m^2, or 211.2 ft^2. Applying Cook and Heizer's figure, a dwelling of this size may have housed 10 to 11 people. While estimates of this kind are no doubt subject to a considerable margin of error, it seems clear that the typical San Clemente Island house could easily have sheltered a nuclear family (parents and offspring), if not larger groups.

As we saw above, archaeological evidence attests to various kinds of domestic activity within and around houses, including food preparation, storage, and the production and use of various kinds of tools. Hearths appear to have been relatively informal, with fires built either in shallow pits or on the ground surface. Hearths of this type have been found within and around houses. Storage pits, rarely exceeding a meter in width and depth, have been found on floors and around the outside periphery of houses (Salls et al. 1993). Extensive "toss zones" of midden are also in evidence around house pits. The lifespan of the typical San Clemente Island house is difficult to estimate. The available evidence suggests, however, that houses were likely abandoned when the efforts required to maintain their structural integrity exceeded the labor required to rebuild them. It appears that houses could have been occupied for at least several years before such rebuilding. As noted earlier, house pits were often filled with refuse after abandonment.

Selective Advantages of Sedentism

Salls et al. (1993) concluded that sedentism was established on San Clemente Island by the Middle Holocene, based on the age of the Nursery site houses. Evidence from Eel Point's basal cultural deposits may warrant pushing this estimate back to the Early Holocene. Part of the evidence in support of this conclusion was the substantial amount of labor that must have been required to build the Nursery site houses. In addition to excavating the house pit, it would have been necessary to collect and transport fairly large amounts of building materials, including the whale bones used in roof construction. Excavating post holes, setting roof beams, and covering the roof with grass, animal skins, or other materials would have added to the labor costs.

Based on these labor investments, the Nursery site's occupants apparently intended to make intensive use of their houses. If not permanently occupied, these must have been used for extended periods of time. Another line of evidence pointing in this direction are extensive midden deposits at the Nursery site, including the refuse thrown into abandoned house pits. While these deposits have not been precisely quantified, it is clear that they represent thousands of cubic meters. Brief occupation seems unlikely to have produced such deposits. The association of a Middle Holocene cemetery with the Nursery site also points to a substantial degree of residential permanence (Potter 2004).

The same arguments may apply to the Eel Point houses. To date, none of the house floors at Eel Point have produced the large amounts of whale bone found in the Nursery site house pits. However, this material may have been valuable enough to warrant recycling, with bones often moved from one house to another as structures were abandoned and rebuilt. Based on the evidence from the Nursery site and Eel Point, and contrary to traditional models of California coastal prehistory, a considerable degree of residential sedentism, focused on relatively substantial houses, appears to have characterized life on San Clemente Island across most of the Holocene.

While this chapter is not dedicated to an extensive discussion of the causes of residential sedentism, it may be helpful to offer some tentative hypotheses. In recent years, a number of theorists have argued in favor of researching the selective advantages of cultural behavior. As we describe in chapter 8, efforts along these lines have focused on understanding the selective advantages of cultural practices, where "selective advantages" means improved survival through optimization of access to vital resources. Following such models, it may be helpful to frame hypotheses about the emergence of residential sedentism in terms of its energetic cost/benefits.

One might imagine that San Clemente Island's ancient inhabitants faced few serious environmental stresses, excepting the island's aridity. As noted in chapter 2, the island rarely experiences great extremes of temperature. While temperatures on the island can climb to near 100 degrees F for short periods, freezing conditions occur rarely, if ever. Yet, the absence of great temperature extremes may create a deceptively benign impression of the stresses the island can place on its human inhabitants. The island frequently experiences windy conditions. Wind speeds of between 20 to 50 miles per hour are not unusual; sometimes persisting for days. Given constant exposure, even temperatures as high as 55 to 65 degrees F, combined with persistent wind and/or foggy conditions, can impose a significant amount of thermal stress. The difficulty is not that these conditions are immediately life threatening, but rather they drain away calories that need to be replaced by foraging. Put another way, calories that can be conserved by creating a favorable microclimate inside a domestic structure are, effectively, units of energy that do not need to be replaced by additional foraging. If this residential strategy conferred greater rates of survival and reproduction, its selective advantages would work in favor of its retention as a cultural practice.

Testing this hypothesis represents a considerable challenge. However, it is interesting to note that some of the most substantial structures yet found, such as those at the Nursery site, appear to have emerged during the Middle Holocene. Archaeologists, drawing on paleoenvironmental data, have long theorized that some of the warmest conditions of the Holocene occurred during the Altithermal, or Middle Holocene warm period. Researchers estimate that California may have experienced relatively warm and dry conditions between about 4,000 and 6,000 years ago (Kennett et al. 2007; West et al. 2007). Paradoxically, such conditions may have made conditions on San Clemente Island cooler than at present, owing to the persistent marine layer that forms over the off-shore waters of southern California during periods of elevated atmospheric temperatures (see chapter 2). Future research on the island might reveal a relationship between labor investments in house construction and Holocene atmospheric and marine temperature trends.

Pálsson (1991) points out that, based on comparative ethnographic surveys, groups exploiting aquatic environments with boats tend to create central-place settlements. Pálsson argues that this is the most efficient way to exploit aquatic environments, given the relatively high efficiency of travel and bulk transport afforded by watercraft. Given the early advent of watercraft on San Clemente Island, it may not be surprising that relatively permanently occupied settlements appeared on San Clemente Island, including constructed houses. Here, it is interesting to note that neither the Nursery site nor Eel Point afforded immediate coastal access. The Nursery site is about 2.0 km from the ocean. While the Eel Point site is today only about 300 m from the sea, it was over 1 km from the shoreline when it was first occupied between 8,000 and 9,000 years ago (Cassidy et al. 2004). These facts suggest that factors other than access to boat launching areas influenced the placement of major settlements.

Here, we should not forget that San Clemente Island's houses were also the homes of the dolphin hunters described in the previous chapter. As we saw in chapter 5, sea mammal hunting afforded a productive economic base. This factor, too, may have been important in allowing residential permanence. With a reliable supply of food from the sea, selection of residential loci may have factored into other considerations, such as proximity to water supplies and use of landforms that offered protection from winds.

Based on the evidence above, residential sedentism appeared on San Clemente Island at closer to the beginning of the Holocene than the end. These data may suggest a causal link between maritime foraging, including watercraft, and residential sedentism, a possibility that remains to be fully explored by archaeologists. In light of these data, the Late Holocene coastal villages of southern California clearly represent an important aspect of their time and place, including their role in emergent social complexity, but it no longer appears that these were a new and novel development in the way suggested by progressive-evolutionist schemes.

7

Beads and the Great Basin Connection

L. Mark Raab and William J. Howard

James Deetz's *In Small Things Forgotten* (1977) captures one of archaeology's signal strengths: Small things, long lost and forgotten, can sometimes spark surprising insights into much larger historical and cultural patterns. Deetz was referring to small household items owned by America's European colonists, but his point is no less relevant to objects coveted by prehistoric peoples across vast stretches of North America.

When we began our work on San Clemente Island, we did not envision that shell beads, small things forgotten almost five thousand years ago, would set us on an investigative trail that would eventually link San Clemente Island to a sphere of cultural interaction spanning much of Western North America. Yet beads recovered from one of the Middle Holocene pit houses described in the previous chapter launched just such an effort. In this chapter, we describe how this trail illuminates far more extensive cultural ties between coastal southern California and the arid American West than many previously imagined.

Shell beads of Pacific Coast marine species, found deep in the interior of North America, are clear evidence of contacts between coastal and interior groups, reaching far back in time. This evidence suggests that coastal groups were far less isolated from the prehistoric cultural landscapes of the interior of North America than the "coastlines last" model of prehistory recognized (chapter 1). It appears that this interaction began much earlier than once suspected. Manufacture of marine shell beads spans the Holocene in coastal Southern California, from which they were traded to interior regions, including the Great Basin, beginning in the Early Holocene (Hughes and Milliken 2007). Erlandson et al. (2005) report *Olivella biplicata* (purple olive) shell beads from Orange County, California, with radiocarbon dates between about 7,500 and 5,800 cal BC. Fitzgerald et al. (2005) show that similar beads reached interior locations ranging from 250 to 365 km from the coast, beginning as early as 10,300 to 10,000 calibrated years before present. These studies add to an extensive archaeological literature, showing that beads from coastal California were part of ancient trade connections and perhaps other kinds of cultural networks, linking archaeological sites of the Pacific Coast, the Great Basin, the American Southwest, and even more distant regions (Bennyhoff and Heizer 1958; Bennyhoff and Hughes 1987; Hughes and Milliken 2007). Even so, archaeological pattern recognition remains difficult. The nature of the exchange networks involved in the movement of these beads and the specific cultural groups linked by them often remains obscure.

The Southern Channel Islands, including San Clemente, enter this ambiguous picture as a happy irony. Owing to these islands' relative remoteness and distinctively maritime cultural patterns, one might imagine them among the least promising places to search for insights into the patterns described above. Instead, these islands bring distinct advantages to the search for ancient cultural networks. As we have seen in previous chapters, the high degree of preservation and chronological resolution that characterizes San Clemente Island's archaeological deposits is of great advantage in archaeological pattern recognition. One such pattern points to an important Middle Holocene cultural interaction sphere extending more than 1,000 km from the Southern Channel Islands to the northern Great Basin, made archaeologically visible by the distribution of distinctive marine shell beads.

The OGR Corridor

As discussed in the previous chapter, *Olivella* grooved rectangle (OGR) beads were discarded in House Pit 3 of the Nursery site, San Clemente Island, between 2,695 to 2,905 cal BC. This discovery caught our attention because previous excavations at the Little Harbor site (CA-SCAI-17) on Santa Catalina Island had also yielded OGR beads from cultural deposits dated to this time interval (Raab et al. 1995a). An interesting pattern was emerging. Did these beads indicate cultural links between San Clemente and Santa Catalina Islands? This seemed plausible, given that these islands were logically linked by sea travel, with Santa Catalina Island an intermediate destination for sea travelers headed to San Clemente Island from the mainland. But were these beads part of even larger Middle Holocene cultural patterns?

Two features of OGR beads suggested that they might be particularly useful markers of Middle Holocene trade and cultural interaction. First, OGR beads are readily identifiable and not easily confused for any other bead type. Bennyhoff and Hughes (1987:141–42) assign OGR beads to their Classes N1 and N2, defined as "Rectanguloid to oval bead with ground edges and an elongate perforation formed by a central groove transverse to the long axis of the shell." Virtually all other marine shell beads from prehistoric coastal California are perforated by drilling or punching, a perforation technique that is qualitatively distinct from the grooving found in OGR beads (figure 7-1).

Second, previous research suggested that OGRs might have interesting cultural correlates. King (1990:111) noted that, "On the basis of present information, it appears that beads with grooved holes were used at the end of the Early period or at the beginning of the Middle period mainly in areas where the historical native people spoke Uto-Aztecan languages." As we saw in chapter 2, the Southern Channel Islands, including San Clemente, were occupied by the Gabrielino Indians at the time of European contact. Significantly, the Island Gabrielino were representatives of the Takic branch of the Uto-Aztecan super-family of languages dispersed over much of the western United States and Mexico. King's observation, linking the OGR beads to this linguistic community, suggested that the Southern Channel Islands might have been part of much larger cultural patterns.

While these circumstances posed intriguing questions, we needed more data on the temporal and spatial distribution of OGR beads. Additional investigation revealed relatively recent

Figure 7-1. Olivella *grooved rectangle beads from San Clemente and Santa Catalina islands.*

discoveries of OGR beads, as well as specimens cataloged for decades. Fortunately, a number of these beads have been radiocarbon dated in recent years. With regard to the latter, we note the difficulty of calibrating radiocarbon dates found in archaeological reports and publications, owing to the highly variable information about how these were processed by various dating laboratories. Consequently, we present such dates as they appear in the literature—i.e., in radiocarbon years before present (RYBP). Bearing this caveat in mind, we believe this protocol is nonetheless adequate for identification of major temporal trends.

OGR specimens have been reported for decades from locations spanning coastal southern California, interior southern California, and the Great Basin. Mainland coastal locations include sites CA-ORA-368 (Bolsa Chica Mesa, Orange County) and CA-SBA-119 (Rincon, Santa Barbara County; Bennyhoff and Hughes 1987:142). Interior sites include CA-LAN-43 (Encino Village, Los Angeles County), CA-LAN-361 (Vasquez Rocks, Los Angeles County; King 1990:111) and CA-KER-824 (Kern County; Bennyhoff and Hughes 1987:139). Sites in the Carson Sink region of Western Nevada represent a conspicuous cluster of OGR specimens, including Lovelock Cave and Kramer Cave (Bennyhoff and Heizer 1958:69), and Hidden Cave, Stillwater Marsh, and Shinners Site F (Bennyhoff and Hughes 1987: 141–42). Radiocarbon dates on several of these Great Basin specimens range between 4,400 and 5,400 RYBP (Vellanoweth 2001).

More recent discoveries augment this pattern. Vellanoweth (1995, 2001), for example, reported OGR beads from the Bird Blind site (CA-SNI-161), San Nicolas Island, where specimens yielded ages between about 4,200 and 4,800 RYBP. Jenkins and Erlandson (1997) demonstrated the existence of OGR beads at the DJ Ranch site in the Fort Rock Valley of central Oregon. These specimens, the most distant from the southern California coast recorded to date, are close to the younger end of the temporal range of OGR beads, with an age of about 4,150 RYBP (Jenkins and Erlandson 1997). This discovery added a dramatically greater spatial dimension to the OGR distributional pattern:

> As suggested by Howard and Raab (1993) and others, the distribution of OGR beads along the southern California coast and

> their presence in Middle Holocene sites in the western and northern Great Basin may support the existence of an early cultural interaction sphere, possibly linking Uto-Aztecan peoples of the southern California coast and the western Great Basin. Remarkably, more OGR beads have now been found at the DJ Ranch site in central Oregon, up to 1,200 km from their probable point of origin on the southern Channel Islands, than have been found in the heavily studied Santa Barbara Channel region immediately to the north of the proposed cultural interaction sphere. (Jenkins and Erlandson 1997:301)

Three OGR beads from archaeological sites in Kern County, California (southern end of the San Joaquin Valley), conform to the patterns described above. Jackson et al. (1998:143) reported a date of 5,080 ± 40 RYBP on one of the beads (site CA-KER-3166/H), and dates of 4,740 ± 60 and 4,840 ± 100 RYBP from freshwater mussel shells in a stratum containing two other OGRs (site CA-KER-5404). This location is also consistent with previous discoveries of OGR beads at the southern periphery of the San Joaquin Valley (Buena Vista Lake, CA-KER-824; see Raab and Howard 2000).

Based on the available evidence, then, OGR beads can be traced from the Southern Channel Islands (San Clemente, San Nicolas, and Santa Catalina) to the adjacent mainland coast, to archaeological sites in the Los Angeles Basin and the southern periphery of the San Joaquin Valley, to a cluster of sites in western Nevada, and finally to central Oregon. Throughout this range, OGR beads date to between about 2,100 and 3,000 cal BC, a relatively narrow temporal horizon. We note, once again, that to date no OGR specimens have been reported outside these relatively discrete spatial and temporal parameters. For descriptive purposes, the authors have called this pattern the "OGR corridor" (Howard and Raab 1993; Raab and Howard 2000). Based on this pattern, Howard and Raab (1993) proposed that OGR beads might mark a discrete Middle Holocene sphere of trade and interaction that included the Southern Channel Islands and portions of the adjacent mainland; a sphere that remarkably excluded the Northern Channel Islands only about 80 km distant. Based on King's (1990:111) observation, it was also hypothesized that OGR beads may have been traded within a sphere mediated by Uto-Aztecan linguistic affiliations.

Expanding the Search Pattern

If the OGR corridor was a pathway of cultural interaction, it may be productive to look for additional patterns of trade or exchange beyond the OGR beads themselves. Possibly among these patterns are enigmatic fired clay “figurines” or “effigies,” identified in prehistoric cultural deposits in the Southern Channel Islands and adjacent mainland archaeological sites for decades (Porcasi 1998). Despite the fact that these are among the oldest ceramic artifacts in the New World, it is not surprising perhaps that they remain obscure, since ceramic traditions play only a marginal role in southern California coastal prehistory. Ceramic vessels are thought to have appeared on the coast only a few centuries before European contact, and these rare specimens, typically represented by a handful of potsherds, are attributed to trade with the Colorado River region of eastern California or to local copies of such wares (Moratto 1984). Yet fired clay artifacts, albeit non-vessel forms, appeared far earlier in coastal southern California, and at least some of these objects may be linked to the interaction sphere marked by OGR beads.

Porcasi (1998) offers a summary of research on Middle Holocene ceramic artifacts from the Channel Islands and mainland. Although these artifacts have been referred to as figurines or effigies, Porcasi (1998) describes them as “craft objects,” eschewing any attempt to impose functional or ideological interpretations. These objects reflect a wide range of relatively amorphous forms, although there can be no doubt that they were intentionally fabricated. Porcasi (1998:272), for instance, describes three specimens from the Little Harbor site, Santa Catalina Island, with the observation that, “All three are rounded, knob-like forms with tapering stems, projecting flanges, and various surface decorations, such as incised lines, perforations, or pigmentation.” All of the craft items examined to date were made from un-tempered, coarsely textured clays ranging in color from reddish-brown to gray to black.

Ceramic objects are reported from several Channel Islands and mainland archaeological sites. Unfortunately, the age and contextual associations of many of these discoveries remain in doubt.

Individual objects are reported from Santa Cruz, San Nicolas, and San Clemente islands (Porcasi 1998). Owing to the small number of these objects, doubts about their age, and a lack of contextual information, it is difficult to draw firm conclusions. We emphasize, however, that at least 31 fired clay objects can be securely associated with the cultural strata that yielded the OGR beads at Little Harbor (Porcasi 1998; Raab et al. 1995a).

Three mainland cases also appear to link ceramic objects with OGR beads. These include Vasquez Rocks (CA-LAN-361), the Irvine site (CA-ORA-64), and Encino Village (CA-LAN-43). The Irvine site is particularly interesting in this connection. Excavations at this from 1994 to 1996 yielded more than 100 fired clay artifacts (Macko 1998). Forty-two radiocarbon dates bracket the age of the site's cultural deposits between about 4,300 to 9,000 RYBP, indicating that at least some of these objects could well be contemporaneous with the OGR beads and the ceramic craft objects found at Little Harbor.

As Porcasi (1998) shows, the time-space distribution of fired clay objects in Southern California is not a perfect overlap with localities that have produced OGR beads. There is also a hint that ceramic objects may pre-date OGR beads (Porcasi 1998). However, it seems reasonably clear that a ceramic craft industry was associated with OGR beads in some locations, suggesting that these clay objects (whose cultural significance remains unknown) help to define at least a peri-coastal segment of the OGR corridor. Future research might well address the question of whether early ceramics industries can be associated with OGR beads elsewhere along the OGR corridor.

Coastal California and the Great Basin

The Great Basin geographic province forms essentially an inverted isosceles triangle, whose western leg is formed by the great Sierra Nevada mountain chain. The tip of the triangle dips below the Sierra Nevada, where it merges with the Mojave Desert of southern California. Moving westward from the Mojave, through the Transverse Ranges, skirting the southern end of the Central Valley, a scant 65 km separates the arid lands of southern California from the sea, and about 100 km from the Southern Channel Islands. This route marks by far the closest proximity of the Great Basin to the Pacific coast. "A glance at a physical map of the area reveals that there is only one good pass out of the desert toward the coastal area, and this probably acted as a funnel through which the small groups of migrants moved and spread out" (Bright and Bright 1976:202). This is the route marked by the OGR corridor.

Archaeologists have theorized for decades, of course, about possible cultural connections between California and the Great Basin—connections made plausible by the geography described above. Linguistic patterns are perhaps the most obvious of these. The continuity of languages spoken by native peoples of the Great Basin and southern California, including the Southern Channel Islands (chapter 3), was recorded by pioneering California archaeologists and anthropologists (Golla 2007; Moratto 1984). The linguistic data clearly point to cultural ties between the Great Basin and maritime Southern California, but did such connections go beyond language to include other cultural traits? The time depth and spatial patterning of the OGR corridor suggest a wide range of possible cultural influences, in our view, between the arid lands of the Great Basin and maritime California. Below, we consider some of these possible links, beginning with linguistic data.

Linguistic Connections

At the time of European contact, the Great Basin's native peoples were largely speakers of Numic languages, a sub-set of the Uto-Aztecan (Utaztekan) super-family of Native American languages. Linguistic evidence suggests that these Numic speakers, through a series of migrations, displaced resident groups who spoke other languages (Golla 2007; Madsen and Rhode 1994). While Numic speakers moved eastward and northward deeper into the Great Basin from a linguistic hearth located in southeastern California, the Takic branch of the Uto-Aztecan linguistic group is thought to have expanded westward across southern California (Golla 2007:74–75), forming the celebrated "Shoshonean Wedge."

Early in the twentieth century, Kroeber and other linguists recognized three principal linguistic stocks in southern California: Hokan (including several Chumashan dialects), Uto-Aztecan

(Takic), and Yuman. The evidence suggested that Uto-Aztecan speakers, namely representatives of the Takic branch, entered southern California from the Great Basin, pushing resident Hokan speakers to the north and south, finally reaching the coast and Southern Channel Islands, forming the so-called Shoshonean Wedge (Golla 2007:74). But when did the Numic and Takic expansion occur, and can it be recognized archaeologically? After more than 70 years of research, debate continues over this question, with widely divergent views held by experts on the timing, pattern, and causes of the Numic/Takic expansion (Golla 2007; Moratto 1984). As O'Connell and Elston (1999:263) note, the topic of Numic expansion shows little sign of fading away in Great Basin anthropology: "Interest in the possible late prehistoric spread of Numic speakers has recently threatened to swamp discussion of any other regional problem." At the risk of contributing to what some might perceive as topical overkill, another dimension of the problem may be worth considering.

The OGR corridor traces the western margins of the Numic linguistic area and passes directly through the Takic "wedge" in southern California (Golla 2007:74). This pattern raises obvious questions: Does the OGR corridor mark the western margin of the Uto-Aztecan linguistic province, with which it overlaps, marking the spread of this linguistic community into California during the Middle Holocene? On this question, answers are divided among specialists.

One school of thought has the expansion of Uto-Aztecan languages occurring late in the Holocene. In a recent synthesis of California linguistic prehistory, Golla (2007) argues that the Takic subfamily of the Uto-Aztecan stock probably entered southern California relatively recently, perhaps within the last one to two millennia. This view is supported by other researchers, who conclude that Uto-Aztecan speakers did not occupy their historical ranges until the Late Holocene—perhaps no earlier than 1,000 to 1,500 years ago (Rhode and Madsen 1994; Young and Bettinger 1992).

A related issue is whether archaeological data can help to resolve the timing of Uto-Aztecan expansion. Some are dubious that reconstruction of prehistoric linguistic provinces is possible on the basis of archaeological data, in view of the fact that language is not synonymous with culture—certainly not with the material cultural traits typically observable in the archaeological record. There may be other approaches, however. Rhode and Madsen (1994:219) offer this view, born of the battles among Great Basin specialists to define ancient linguistic and ethnic provinces:

> It seems unreasonable (and largely un-testable) that units defined by archaeologists must be isomorphic with linguistic, "ethnic," or even "ethnolinguistic" groups, as defined by linguists, ethnologists, or Numic peoples themselves. But just because an archaeological unit is not an "ethnic" unit (however "ethnic" is defined) doesn't mean that archaeological units are any less valid for tracing human population movements. Archaeological units are an independent means of classifying humans, or, more accurately, the tangible remnants of past human behavior. Using the archaeological record to document patterns of past behavior, including population movements, seems more productive than trying to demonstrate that certain artifacts must be "Numic."

The same can be said perhaps of attempts to define "Takic prehistory" in southern California and the Channel Islands. While archaeological research may eventually help to resolve elusive ethnic or linguistic patterns, it may be productive to model culture contact and interaction between maritime southern California and the Great Basin, utilizing the OGR corridor as a template for pattern recognition. Given the length of the OGR corridor (about 1,200 km) and the apparent time frame of its existence (ca. 2,100 to 3,000 cal BC), it seems likely that beads and other artifacts traversed this region gradually through a series of "down the line" exchanges (Hughes and Milliken 2007). Highly portable artifacts, such as beads, eventually spread the length of the corridor, while other kinds of artifacts may have been more restricted in their distribution. Future research will tell. Whatever the relative diffusion of artifact classes, however, the corridor's discrete temporal-spatial dimensions imply that exchange took place preferentially. It appears that trade partners along the corridor shared some framework for interaction. If this was so, what factors would logically mediate such connections? We suggest that several possible cultural linkages existed between the California coast and the arid stretches of the Great Basin.

Beyond the Desert Culture

Archaeologists today generally reject the oversimplifications promoted by the Desert Culture concept of the 1950s and 1960s. While this construct was a milestone in North American arid-lands archaeology, its emphasis on monolithic, relatively unchanging technological and social adaptations to the arid lands of the American West has given way to recognition of considerable cultural variability across time and space among desert-adapted groups (Beck 1999a). Even so, archaeologists have long hypothesized that paleoenvironmental conditions in the Great Basin and Mojave Desert launched population migrations into southern California—populations that brought with them "desert culture" technoeconomic adaptations. Plant resources and plant-processing tools, such as seeds and stone milling equipment, and the hunting of small terrestrial game have long been viewed as hallmarks of this influence.

Paleoclimatic stress is also a staple of traditional scenarios. Repeated incursions of desert peoples into Southern California have been attributed to episodic deterioration of climatic conditions in the arid interior of western North America (Kennett et al. 2007; Moratto 1984; West et al. 2007). Desiccation at the end of the Pleistocene, Altithermal warming and drying during the Middle Holocene, and Late Holocene droughts have all been linked to such dynamics. For instance, Kennett et al. (2007), using climate proxies derived from deep-sea cores, argue that between 6,300 and 4,800 cal years BP, the western Great Basin and southern California were severely dry. In general agreement with the model presented here, Kennett et al. (2007) cite archaeological, linguistic, and genetic data in support of a population movement from the Great Basin to the southern California coast during the Middle Holocene. As valuable as these insight are, however, they do not exhaust the possible forces underlying inter-regional culture contact and interaction.

Demographic Flux

While paleoclimatic stresses cannot be ignored, contemporary models of Great Basin prehistory suggest a more complicated set of forces underlying culture change, including population movements (Beck 1999a). Bettinger and Baumhoff (1982), for example, argued that major Late Holocene population migrations and/or replacements occurred in the Great Basin as Numic "processors" out-competed pre-Numic "travelers" for vital resources. Based on a computer simulation of the Numic expansion, Young and Bettinger (1992) estimated that waves of population replacement led by Numic foragers could have swept across the whole of the Great Basin in six centuries or less. While this model posits a Late Holocene time frame, one of its larger implications is the idea that far-reaching and comparatively rapid demographic changes can be set in motion quite apart from environmental stresses—in this instance, selection on the relative efficiency of alternative foraging modes.

As Beck (1999b) points out, optimal foraging or other kinds of selectionist models have probably become the dominant theoretical viewpoint in Great Basin archaeology. In general, these models argue that changes in foraging efficiency, driven by a combination of technological, environmental, and social-organization factors, were capable of causing widespread demographic shifts (Kelly 1999; Zeanah and Simms 1999). Our purpose here is not to decide the merits of these models, but simply to point out that contemporary theorists envision large-scale demographic shifts in the Great Basin and Mojave Desert regions, including migrations and population replacements (Beck 1999b; O'Connell and Elston 1999). These scenarios are far more dynamic than traditional models, which envision a fundamentally homogeneous and conservative set of desert adaptations that resisted rapid change, except perhaps under the impact of extreme climatic stresses. Today, archaeologists recognize a variety of cultural and environmental forces that were likely a source of recurrent, large-scale demographic flux involving California and the arid lands of the interior Far West.

Desert Fishers

Heizer (1956) was one of the first investigators to challenge the Desert Culture, arguing that this concept was unduly influenced by Julian Steward's ethnographic studies of the central and eastern Great Basin—research that stressed seasonal exploitation of terrestrial plant and animal resources by small groups of highly mobile foragers. Heizer and others correctly emphasized that Steward's model was accurate as far as it went, but this model obscured quite different modes of settlement and subsistence in other regions of the Great Basin. Moving westward from the center of the Great Basin, the landscape drops in elevation to form a series of low basins and "sinks" along the eastern margins of the Sierra Nevadas. From central Oregon southward to the Mojave Desert of southern California, this zone contained numerous Ice Age lakes and streams (Madsen 1999). Remnant streams, lakes, and marshes dotted the western Great Basin well into the Holocene, with some of these persisting to the present day. Belying the impression that Great Basin aboriginal adaptations were shaped exclusively by aridity, archaeological evidence from the western Great Basin indicates sometimes extensive use of fish, shellfish, waterfowl, and other aquatic resources (Janetski and Madsen 1990; Zeanah and Simms 1999).

In contrast to notions of high mobility among Great Basin foragers, lacustrine habitats of the western Great Basin reveal substantial semi-subterranean houses and related food storage facilities dating at least as early as the Middle Holocene (Janetski and Madsen 1990). It was these discoveries, among others, that prompted investigators to question Desert Culture stereotypes. Debate continues (Beck 1999a; Kelly 1999) about whether these lacustrine settlement-subsistence dynamics should be characterized as sedentary ("limno-sedentary") or as part of more seasonally mobile adaptations ("limno-mobile"). We do not propose to settle this controversy, but certain patterns may be worth noting in the context of culture contact and interaction between maritime southern California and the Great Basin.

Striking, for example, is the association of OGR beads with cultural adaptations that can be classified broadly as aquatic. Not only this, but parallels are discernable in patterns of archaeological research related to the use of aquatic resources. In chapters 1 and 4, it was pointed out that early coastal researchers in California drastically underestimated the contributions of fish and other marine resources to the prehistoric diet, owing to inadequate archaeological excavation techniques. In a parallel development, Greenspan (1990:208) observes that: "Experiments designed to quantify the amounts and categories of bone through different screen mesh sizes in Great Basin sites have been conducted by various researchers. . . . Not surprisingly, this work has shown that smaller screen sizes significantly increase the rate of recovery of fish remains from Great Basin sites."

Greenspan's (1990) analysis shows that fish were a significant subsistence resource for peoples who lived around the lakes, rivers, and marshes of the western Great Basin, the region bisected by the OGR corridor.

One can also observe some basic technological similarities related to fishing that span the length of the OGR corridor. Tuohy (1990), for instance, argues that nets, compound hooks, fish spears, and bone gorges ("bipoints") were used by fishers of the western Great Basin at least as early as 9,000 years BP. Some of the barbs and gorges illustrated by Tuohy (1990:133–35) are strikingly similar to specimens that were used in the Channel Islands.

The Human Dimension

Transport of beads and other objects may reflect "down the line" trade rather than the movement of people. Models of interaction between the Great Basin and California coast, such as the "Shoshonean Wedge," imply the movement of people, however. Accordingly, researchers have long been interested in the question of whether population movements can be detected in human remains. The search for evidence of the arrival of human populations in the Channel Islands focuses primarily on human skeletal traits, particularly cranial morphology. The study of cranial morphometrics has ignited "Skull Wars" (Thomas 2001) over the question of what measuring skulls can tell us about human ancestry. Just the same, some scholars argue that such information does reflect underlying genetic differences between human populations—differences that may be valuable in reconstructing population movements. Kerr and Hawley (2000) and Titus (1987), for example, suggest that new genetic populations may have arrived on San Nicolas and San Clemente Islands, respectively, possibly displacing earlier inhabitants. Kerr and Hawley (2000:551) sketch out this scenario for San Nicolas, one of the southern Channel Islands:

> These sites with mixed metric data may represent periods of time in which there was contemporaneous occupation by Hokan and

> Takic [language] groups either as peaceful co-habitants, or during a period of hostile transition. Future research on evidence of violent behavior may reveal how peaceful the interactions of these groups truly were. Alternatively, multiple populations may have intermittently occupied the island.

Given scenarios of this kind, it is important to understand the implications of combining disparate data from linguistics, archaeology, and biology. While it is not the intention of the present discussion to launch "Bead Wars," it is important to correct certain misconceptions about the significance of the OGR bead research to migrationist models of Channel Islands culture change. Kerr and Hawley (2000:547) say that, "Howard and Raab (1993) infer a population replacement on the Southern Channel Islands from evidence of an 'interaction sphere' based on the distribution and dating of Olivella grooved rectangle beads." A similar position is attributed to Vellanoweth (1995, 2001), based on research on OGR beads from San Nicolas Island (Kerr and Hawley 2000:547). However, this is not precisely what Howard and Raab suggested.

Speaking for Howard and Raab (1993), we postulated a possible interaction sphere marked by the OGR beads, among other artifact indicators. We did not conclude that this sphere was proof of population replacement or human migration, only that it might be a marker of connections between maritime southern California and the Great Basin. These connections logically include migrations, but also include transmission of artifacts and cultural traits from one population to another, perhaps mediated by some combination of language, geographic proximity, and shared techno-economic adaptations. The notion that the Channel Islands and portions of southern California experienced a population replacement is based fundamentally on the Shoshonean Wedge hypothesis, which is a linguistic construct. Since language travels with people, it seems reasonable to suppose that the appearance of a linguistic community implies a demographic shift. Raab and Howard (2000) argued that the OGR beads may mark the distribution of Uto-Aztecan speakers, including the Takic (Cupan) speakers found on San Clemente Island at the time of European contact (see chapter 2). Even if we accept this conjecture as valid, however, a host of other questions remains.

The demographic significance of the Southern Channel Islands human skeletal evidence remains murky, owing to difficulties with chronology, small samples of skeletal material, and the possibility that the observed osteological traits could reflect endemic genetic variation, rather than population replacement:

> At present, the metric and non-metric data are not in full agreement as to the presence of two distinct genetic populations on San Nicolas Island. The non-metric data demonstrate inter-island genetic differences, and an Early-Late Period dichotomy for select traits. Metric cranial information does suggest a change in cranial type from Early to Late periods, although some variability in these data makes it impossible to determine the exact timing of this replacement. Further, there is currently no statistically significant correlation between the metric and non-metric data that would lend additional support to the hypothesis of prehistoric population change on San Nicolas Island. (Kerr and Hawley 2000:552)

Did Southern California receive one or more decisive waves of population movement, or was the region affected incrementally over longer time frames? In fact, we do not currently know if demographic flux in the southern islands during the Middle Holocene is necessarily implied by the distribution of OGR beads or other kinds of data. The assumption that the OGR beads point to Takic speakers easily sets in motion a sequence of inferences: The beads mark a Takic presence, which means that a population replacement likely took place, which suggests that variation in cranial traits is attributable to demographic change. Care must be taken here to avoid conflating linguistic, archaeological, and biological data.

We believe the polarized approaches outlined above suggest the value of models aimed at understanding variation in maritime cultural adaptations, including processes that led to both directional cultural changes *in situ* and more punctuated responses to stimuli external to the coastal zone. Patterns of culture contact and interaction related to what we have defined as the OGR corridor should perhaps be taken into account in developing such models.

Marine-Terrestrial Adaptive Continuum

Despite the cautions outlined above, several points emerge from the overview presented in the chapter. At more than 1,000 km in length, the OGR corridor suggests that the Southern Channel Islands and adjacent portions of the mainland were linked to a sphere of interaction that spanned a much larger region than many might have supposed. Although prehistoric cultural developments in the Channel Islands, particularly technoeconomic trends, were clearly shaped by local insular conditions, these developments were not completely insulated from potential cultural interactions with a large expanse of western North America.

Groups along the OGR corridor possessed a broad range of adaptive capabilities. These included not only mobile exploitation of arid terrestrial environments, as conventional thinking leads us to expect, but also substantial residential sedentism and utilization of aquatic resources. The presence of substantial houses on San Clemente Island (chapter 6) and in lacustrine settings of the Great Basin may suggest that sedentism is a widespread trait of groups dependent on aquatic resources. If so, this pattern poses considerable irony in light of traditional models of California prehistory. As we noted in earlier chapters of this book, theorists imagined for decades that desert-adapted émigrés arrived on the California coast, unable or unwilling to consume fish, shellfish, and other marine foods owing to their terrestrial cultural orientations, including "desert adapted" modes of hunting and gathering. From this perspective, the Channel Islands were long viewed as some of the least likely places to bear any sort of cultural connections to the arid lands of the Great Basin.

Yet the OGR bead data paint quite a different set of possibilities. At least as early as the Middle Holocene, the Southern Channel Islands appear to have been part of an exchange network populated by fishers and aquatic foragers inhabiting, of all places, the desert interior of the American West. At the very least, this Great Basin connection shatters simplistic stereotypes of foragers locked rigidly into either terrestrial or maritime modes.

This connection is not surprising perhaps in light of what researchers have learned about hunter-gatherer cultural adaptations in recent decades. Hunter-gatherers are capable of great adaptive flexibility, rather than being locked for centuries or millennia into fixed adaptations (Kelly 1995), as models of progressive cultural development have often portrayed them. Based on adaptive capabilities of this kind, combined with the evidence outlined above, we should perhaps view the OGR corridor not simply as a transport vector for goods such as beads, but also as an adaptive gradient between terrestrial and aquatic modes of foraging during the Middle Holocene. If so, the high-resolution archaeological records available from San Clemente and other Channel Islands may prove to be of crucial importance in rethinking the role of maritime cultural adaptations in the development of forager cultural adaptation across a vast expanse of prehistoric North America.

IV

LATE HOLOCENE

8

Tragedy of the Commons

L. Mark Raab

Archaeologists have long envisioned California's prehistoric peoples as the heirs of paradise, and nowhere more so than along its fabled coastlines. This scenario fit comfortably within a centuries-old mythic tradition of bountiful seas, teeming wildlife, and perpetually benign climate (Raab and Jones 2004). For many, the story of California prehistory was essentially about how hunter-gatherer ingenuity progressively tapped a larger and larger share of this natural abundance (Chartkoff and Chartkoff 1984). This theme was central to conventional theories of coastal prehistory. As we saw in previous chapters, the first humans to arrive on California's coastlines were thought to have arrived as terrestrial foragers. Over time, these groups added seafaring and maritime hunting, fishing, and collecting to their inventory of cultural accomplishments. The end result, by most accounts, was a Late Holocene cultural climax made possible by sea travel and by combining terrestrial and marine subsistence modes into coastal economies of unprecedented productivity. At the terminus of this trajectory of maritime cultural evolution, as we saw in earlier chapters, were the Chumash, Gabrielino, and other native groups observed by the first European coastal explorers (Chartkoff and Chartkoff 1984; Gamble 2008; Gamble and Russell 2002).

To be certain, California's native maritime societies evidence many genuine cultural accomplishments worthy of study and admiration. However, to view these societies as the best of all possible worlds, in the fashion of Voltaire's Dr. Pangloss, creates an unrealistic narrative about prehistoric culture change. The realism of any such narrative suffers from ignoring the possibility of maladaptive cultural behaviors or the role of other stressful forces, such as climate flux, in promoting culture change (see chapter 9). In this chapter, we focus on cultural behavior and marine ecosystems, the nexus of supposed maritime adaptive success in traditional models of coastal prehistory.

Garrett Hardin's influential essay (1968) *The Tragedy of the Commons* offers useful insight into the dynamics behind these patterns. Hardin used the example of village grazing lands, or commons, of fourteenth-century England to illustrate how the economic productivity of any environment, regardless of time and geography, can be compromised by certain patterns of human exploitation. Hardin notes that unrestricted access to the commons encouraged villagers to maximize personal consumption ahead of possible rivals, resulting in a "scramble competition" that caused significant resource depression. Contrary to romantic primitivism, research increasingly shows that forager societies enjoy no exception from their own tragedies of the commons (Alvard 1993; Kay and Simmons 2002; Kelly 1995; Lentz 2000; Raab and Jones 2004). Could this be so in ancient coastal California, imagined for centuries as a near earthly paradise?

Over the last two decades, human predation in ancient coastal environments of California has emerged as an important area of research. In assessing the role of humans in depressing prehistoric seal and sea lion populations (pinnipeds), for example, Jones and Hildebrandt (1995) have explicitly likened the coastlines of Pacific North America to a commons for maritime hunters. Subsequent studies have revealed a number of instances in which depression of targeted resources appears to be correlated with human harvesting pressures (Basgall 1987; Broughton 1994a, 1994b; Broughton and O'Connell 1999; Hildebrandt and Jones 2004; Jones and Hildebrandt 1995; Porcasi et al. 2004; Raab 1996). Important to the study of culture change, dynamics of this kind appear to have played a significant role in shaping economic and technological innovations. In this chapter, we examine similar trends on San Clemente Island and the implications of these for larger trends in coastal prehistory. Patterns of fishing, shellfish collecting, and sea mammal hunting changed significantly over a period of more than 9,000 years on San Clemente Island. These records, currently some of the most detailed available from the California coast, well illustrate the island's utility as a natural laboratory for the study of maritime culture change that we noted in chapter 1.

Models of Maritime Economic Change

Researchers generally agree that patterns of maritime foraging have changed over time, but ideas differ about when and why various combinations of marine mammals, shell fish, fish, and other foods were added to the diet since humans colonized coastal southern California near the end of the last Ice Age. As we saw earlier in this volume (chapters 1, 4, and 5), theorists have attributed these patterns to various causes, including changing cultural food preferences or taboos and functionalist arguments that emphasize progressive improvements in maritime economy. As noted above, the latter explanation reigned for decades as the dominant model of maritime prehistory.

This theoretical landscape is shifting, however. Based on concepts derived from the field of evolutionary ecology, some contemporary archaeologists argue that hunter-gatherer behavior can be understood in terms of Darwinian selective pressures—namely, the cost effectiveness of the search for food or other vital resources under a given set of cultural and environmental constraints (Bettinger 1991a; Broughton and O'Connell 1999; Jones and Hildebrandt 1995; Kelly 1995; Porcasi et al. 2004; Raab 1996; Winterhalder and Smith 1981). Critical differences between the neo-Darwinian program and the traditional progressive-evolutionary approach come into focus in answering this question: What determines the abundance of food resources for foragers?

As we have already seen, progressive evolutionists begin with an assumption of "natural abundance"—i.e., a largely stable biosphere stocked with a wide range of food species, both terrestrial and marine. According to conventional thinking, the range of food items that could be acquired depended primarily on having the appropriate technologies or other kinds of knowledge. By gradually acquiring a wider range of technologies and knowledge, more items were added to the menu—particularly marine food species. By the Late Holocene, the resulting economies are frequently described as "fully developed," meaning that coastal foragers had presumably achieved a more diverse and ample food supply than during, say, the Middle or Early Holocene.

Evolutionary ecologists take a different approach to assessing subsistence abundance, rejecting the notion that change in forager economies necessarily reflects trends toward larger or more diverse food supplies, regardless of the relative abundance of particular food resources in the natural environment. This approach argues that the payoffs of particular foraging patterns (activities related to finding, processing, and consuming food or other vital commodities) must be assessed in terms of their relative time or energy costs. The degree to which the payoffs exceed the costs can be described as foraging efficiency. Only through assessing foraging efficiency can we have a realistic idea which economic strategies yield greater returns (in calories, protein, or other essential resources) than possible alternatives, and thus have some notion of whether the survivorship of humans and their cultural arrangements can be understood in terms of selective processes arising from foraging efficiency (Bettinger 1991a; Broughton and O'Connell 1999; Kelly 1995; Smith and Winterhalder 1992).

This frame of analysis poses questions seldom considered by traditional accounts of coastal prehistory: If maritime foragers selectively targeted the most productive food resources, could this have resulted in resource depression? Did new technoeconomic strategies arise to cope with such scarcity? Studies of foraging efficiency hypothesize that the timing and direction of culture change can be understood more accurately by archaeologists in relation to the selection pressures outlined above, not in terms of cultural-evolutionary stages that are assumed to represent increasingly greater levels of economic productivity. As we shall see next, San Clemente Island is an excellent venue for testing this hypothesis.

Maritime Economic Change

In chapters 4 and 5, we examined aspects of the prehistoric maritime economy of San Clemente Island, including seafaring and dolphin hunting at the Eel Point archaeological site. In this chapter, we expand our discussion of maritime foraging to consider other important activities, such as fishing, shell fish collecting, and other types of sea mammal hunting. Here, we try to understand whether changes in these activities are consistent with the expectations of optimal foraging models. We emphasize that information presented in this chapter summarizes a wide range of data in publications and academic theses and dissertations on San Clemente Island's diverse, well-preserved archaeo-faunal assemblages (Andrews 2000; Garlinghouse 2000; Porcasi et al. 2004; Raab 1992; Raab et al. 1994; Cassidy et al. 2004). These data point to interesting patterns of maritime foraging.

Fishing

Fishing is one of the most extensively investigated aspects of prehistoric coastal economy in southern California. A number of studies provide data on the economic, ecological, and technological aspects of the region's marine fisheries (Colten and Arnold 1998; Davenport et al. 1993; Erlandson 1994; Landberg 1965, 1975; Raab et al. 1995b; Rick 2007; Salls 1988). One of the most significant areas of agreement among these studies is that fishing dramatically intensified during the late Holocene. Depending upon the locality in question, this trend began between about 1,000 and 4,000 years ago (Glassow 1980; Rick et al. 2005; Salls 1988; Tartaglia 1976).

A similar trend can be seen in table 8-1, where we can compare the relative abundance of fish bones to pinniped remains in Eel Point's dated cultural strata. The chronological sequence encompassed by these strata was examined previously in chapter 4. Here, our goal is to assess the general importance of fishing in relation to marine mammal hunting across time. In this way, we can obtain an estimate of the relative importance of the major components of the vertebrate diet. Of course, such an estimate is subject to certain limitations. The data in table 8-1 reflect challenges endemic to research on coastal midden (food refuse) deposits. Occupied over many millennia, habitation of Eel Point produced considerable spatial and temporal variability in the site's midden deposits. The result is variation in the size of bone samples and chronological gaps in the data. An example of the latter can be seen in table 8-1,

Table 8-1. Marine Mammal and Fish Bone Frequency per Cubic Meter from 28 Dated (cal BC/AD) Strata, CA-SCLI-43 (from Procasi et al. 2004:80)

Unit (Stratum)	*Date*	Phoca vitulina	Arctocephalus townsendi	Zalophus californianus	Mirounga angustirostris	*Unidentified pinniped*	***Total pinniped***	Enhydra lutris	*Unidentified Cetacean*	*Mammal*	*NISP/m³*	*Fish (g/m³)*
24.5/77E (3)	AD 1400	0.0	0.0	6.9	0.0	41.4	**48.3**	117.2	0.0	537.9	703.5	5508.0
2N/35E (3)	AD 1020	3.1	0.0	0.0	0.0	9.4	**12.5**	18.8	6.3	90.6	128.0	1021.5
C (2B)	AD 660	0.0	0.0	0.0	0.0	4.3	**4.3**	4.3	0.0	144.7	153.2	316.5
28,29N/16E (2)	AD 570	5.0	0.0	5.0	0.0	105.0	**115.0**	70.0	0.0	135.0	440.0	672.6
C (3C)	AD 420	0.0	0.0	0.0	0.0	25.5	**25.5**	25.5	6.4	165.6	222.9	827.3
24.5S/77E (8)	AD 240	0.0	0.0	0.0	0.0	4.5	**4.5**	0.0	0.0	80.0	84.4	2342.0
2N/35E (4)	AD 120	0.0	0.0	7.4	0.0	7.4	**14.8**	31.8	3.2	77.3	126.9	718.0
2N/35E (5)	AD 5	0.0	19.4	0.0	0.0	70.9	**90.3**	64.5	25.8	290.3	470.7	1568.0
2N/35E (6)	2 BC	0.0	10.0	3.3	0.0	53.3	**66.6**	16.7	6.7	280.0	380.0	1596.7
B (5A)	320 BC	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	36.0	36.0	842.1
2N/35E (7)	620 BC	0.0	0.0	0.5	1.4	0.9	**2.8**	7.6	0.5	35.7	45.7	825.0
A (5A)	720 BC	0.0	0.0	0.0	0.0	2.1	**2.1**	0.0	27.1	291.7	320.8	193.4
2N/35E (8)	1270 BC	2.4	2.4	0.0	0.0	16.9	**21.7**	21.7	2.4	19.3	65.1	1257.0
2N/35E (9)	1520 BC	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	2.6	4.5	88.9
2N/35E (10)	1560 BC	0.0	0.0	0.0	0.0	25.0	**25.0**	0.0	25.0	335.0	385.0	442.6
B (6)	1740 BC	0.0	67.5	35.0	2.5	272.5	**377.5**	35.0	103.0	515.0	1030.0	1666.0
B (6A)	2250 BC	0.0	0.0	0.0	0.0	94.1	**94.1**	0.0	106.0	211.8	447.1	2184.0
D-G Profile[a]	2480 BC	4.3	0.0	1.4	0.0	27.2	**32.9**	37.1	38.6	800.0	900.6	1125.9
B (6B)	2490 BC	0.0	6.1	6.1	0.0	15.2	**27.4**	6.1	24.2	178.8	236.4	228.0
B (7B)	2610 BC	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	50.0	10.0	60.0	35.0
28,29N/16E (4A)	3640 BC	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	10.0	90.0	100.0	1815.0
B (10)	3650 BC	0.8	0.0	0.0	0.0	0.0	**0.8**	0.0	0.0	0.0	0.8	6.2
28,29N/16E (4B)	3770 BC	0.0	0.0	0.3	0.0	13.3	**13.6**	0.0	96.7	325.0	440.0	703.5
C (6)	3970 BC	0.0	0.0	0.0	0.0	4.0	**4.0**	2.0	128.0	58.0	192.0	165.0
A (6)	6160 BC	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	5.8	28.9	34.8	5.7
2N/35E (11)	6380 BC	1.6	0.0	1.6	0.0	9.7	**12.9**	0.0	3.2	30.7	46.8	93.5
28,29N/16E (6)	6435 BC	0.0	0.0	0.0	0.0	90.0	**90.0**	5.0	15.0	790.0	900.0	109.9
C (9C)	7040 BC	0.0	0.0	0.0	0.0	28.6	**28.6**	0.0	0.0	0.0	28.6	0.0

[a] Profile of house floor, averaged across contiguous excavation units.

reflected in a hiatus of dated cultural strata between 6,160 to 3,970 cal BC. As noted by Porcasi et al. (2004), it is not currently known whether this gap reflects archaeological sampling error (possible, given Eel Point's extensive cultural deposits) or an actual gap in site occupation. Moreover, the present discussion is not an attempt to convert the bone data to estimates of food yield. Estimates of this kind can yield useful information, but they take us beyond the scope of the present discussion (see, for example, Erlandson 1994; Garlinghouse 2000).

Despite such challenges, it is possible to gain a picture of the relative importance of fishing and sea mammal hunting across the Holocene by averaging the frequency of bones by time periods. In table 8-1, we can compare the weight of fish bone by dated strata (g/m^3) with counts of sea mammal bones (total pinnipeds/m^3). Table 8-1 breaks these data down into three periods: Early Holocene (7,040 to 6,160 cal BC), Middle Holocene (3,970 to 3,640 cal BC) and Late Holocene (2,610 cal BC to cal AD 1,400). We should note that large differences in the size of the fish and sea mammal bone samples are problematic to graph as raw frequencies. If we average these frequencies for each time period and plot them on a logarithmic scale, however, we can see the pattern of co-variation shown in figure 8-1.

The most interesting pattern revealed by figure 8-1 is the almost mirror image difference between fishing and sea mammal hunting patterns across the Holocene. We take up sea mammal hunting in more detail below, but suffice it to say that sea mammal procurement shows considerable variability across the Holocene, including an apparent drop in productivity during the Middle Holocene. In sharp contrast, fishing increases dramatically across the Holocene, rising rapidly during the Middle Holocene and climbing to even higher levels during the Late Holocene (Raab et al. 1995b).

A study by Garlinghouse (2000), who analyzed archaeo-faunal remains from Eel Point, including 20-cm^2 column samples from all major excavation loci, including fish, sea mammal, bird, and other vertebrate bones numbering in the hundreds of thousands, points to the same conclusion as figure 8-1:

> The trend in the growing importance of fish relative to the general category of mammalian, noted in the Middle Holocene

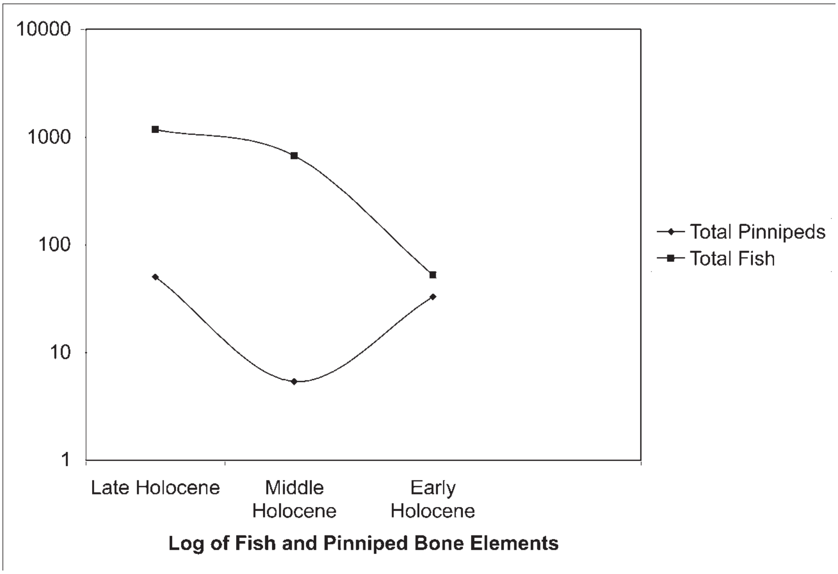


Figure 8-1. Logarithmic plot of fish and sea mammal bone at Eel Point across the Holocene.

> component . . . continues in the Late Holocene. In fact, when the broad classes of fish, bird, and mammal are converted to meat weight estimates, fishes dominate . . . fishes account for 80% of the estimated meat weight. This is an increase of nearly 45% from the Middle Holocene. This fishing is in line with the broad trend observed in prehistoric southern California middens, where fishes frequently account for the majority of bone. (Garlinghouse 2000:153)

Shellfish Collecting

Thousands of shell-bearing middens that dot the California coast are testimony to the importance of shellfish in the prehistoric diet (Colten and Arnold 1998; Erlandson 1991b, 1994; Erlandson et al. 2008; Jones and Richman 1995; Rick et al. 2005). Several factors enhance the value of shellfish. Minimal skills and gear are needed to collect many species. Members of the community who might not be suitable for more demanding types of foraging (young and old, for example) can often collect shellfish. While comparatively low in calories, it may have been the protein yield of shellfish that made mussels, abalones, clams, and many other species worth harvesting (Erlandson 1994). This protein can be valuable in combination with other food resources, such as seeds or other vegetal sources of calories.

Two studies from San Clemente Island afford insights into prehistoric patterns of shellfish consumption. Raab (1992) studied three of the "*Tegula* middens" that dot the marine terraces of San Clemente Island (see chapter 2). Thousands of these relatively compact archaeological sites (< 15 m diameter × 30 cm depth) exist on the island's west shore. Ranging in age from about 3,000 RYBP to historic contact, these sites appear to reflect episodes of shellfish collecting that unfolded over a period of days or weeks (Raab 1992; Raab et al. 2002; see also chapter 10, this volume).

These middens are overwhelmingly made up of two types of shellfish. The largest of these are black abalones (*Haliotis cracherodii*), an intertidal gastropod that was collected from the rocky shoreline of the island. The second shellfish constituent is the small *Tegula sp.* (black turban snail), which also inhabits the rock intertidal zone. While the larger abalones were comparatively abundant in the basal strata of the middens, *Tegula* clearly dominated the upper strata (Raab 1992). Recorded in these deposits was a recurrent cycle in which shellfish collectors initially targeted the larger abalones but soon shifted to collection of *Tegula* as the meat yield of abalones declined. Average abalone size was also constrained, as contrasted to the maximum size of black abalones recorded in habitats lacking human predation, suggesting considerable harvest pressure (Raab 1992).

What about shellfish collecting patterns over the longer term? The study by Garlinghouse (2000) noted earlier reinforces the conclusion that shellfish stocks were vulnerable to human harvesting pressure. Garlinghouse discovered two striking changes in patterns of shellfish consumption over the span of Eel Point's occupation. One of these patterns was heavy reliance on California mussels (*Mytilus californianus*) during the Early Holocene (Garlinghouse 2000:206). For reasons that currently are not clear, but perhaps involve changes in the marine environment, mussels effectively dropped out of the diet at Eel Point about 6,000 years ago. A second pattern, principally involving consumption of abalones (*Haliotis sp.*) and *Tegula*, dominated the shellfish diet from this point in time until abandonment of the site:

> The Middle Holocene levels are dominated by the exploitation of *Haliotis*. In terms of dietary yield, it is the most important shellfish, surpassing the others by significant percentages. These species continue to play the most important role in terms of dietary yield during the Late Holocene. However, *Tegula* steadily increases in importance over the Holocene, becoming especially important resources during the latter period of the Middle Holocene (ca. 3,446 BP) and the Late Holocene. Indeed, in terms of dietary yield, it surpasses *Mytilus* in relative importance; but it never competes with *Haliotis* by this same measurement. (Garlinghouse 2000:206–207)

Sea Mammal Hunting

Prehistoric sea mammal hunting on the southern California coast involved a wide range of species, including sea otters (*Enhydra lutris*), small cetaceans (dolphins and porpoises; see chapter 5), and the pinnipeds noted earlier. Clearly, this spectrum of species encompassed a variety of hunting tactics and economic benefits (Colten and Arnold 1998; Hildebrandt and Jones, 1992; Glassow 1980; Rick et al. 2005). Our attention is focused here on the pinnipeds and sea otters. In terms of nutritional yield, there can be little doubt of the importance of sea mammals. The calorie-rich blubber of these animals was extremely important, particularly as combined with generally low-fat food items such as fish and shellfish. Seals, sea lions, and dolphins would have represented extremely attractive prey items, with body weights easily exceeding 100 kg. Parenthetically, it should be noted that, while whale bone appears as a minor component of the mammalian faunal assemblage on San Clemente Island, beached carcasses were the source of this material. No evidence from extant cultural traditions or the archaeological record suggests that the ancient peoples of the southern California Bight were whale hunters (unlike some maritime foragers of Alaska and the Northwest Coast).

Sea mammals are among the most intensively investigated food resources at the Eel Point archaeological site, including studies by Garlinghouse (2000), Porcasi and Fujita (2000), and Porcasi et al. (2004). These studies reveal interesting trans-Holocene trends. Returning to figure 8-1, for example, we can see the relative abundance of sea mammal bone specimens (NISP/m^3) across the Holocene. Once again, as compared to the clearly rising trend line for fishing, sea mammal hunting appears to have varied within more constrained limits. Even so, we can detect major shifts in sea mammal hunting patterns across time.

One of the most robust of these trends was a general decline in the contribution of pinnipeds to the diet across time, with a significant increase in sea otter hunting during the Late Holocene (Garlinghouse 2000; Porcasi 1995; Porcasi et al. 2004). Summarizing the dietary contributions of pinnipeds on San Clemente Island, Garlinghouse (2000:194) found the following:

> No doubt islanders derived a considerable amount of meat from these large, blubbery animals, perhaps considering them primary prey species. Nonetheless, there is evidence of considerable temporal variability in the importance of these animals through prehistory on the island. During the Early Holocene, for example, they account for over 80% of the assemblage . . . , during the Middle Holocene their percentages are 70% . . . ; and during the Late Holocene they constitute 45% of the assemblage. . . . These figures suggest that the relative percentages of pinnipeds follow a generally linearly declining trend over the Holocene occupation of the island. They contribute less and less to the overall diet. In fact, during the Late Holocene, sea otters compete with pinnipeds in relative importance.

Overall, then, sea mammals appear to have been an important part of the diet—perhaps the top-ranked food species in terms of calorie yield. Islanders were never able, however, to intensify sea mammal hunting or shell fish collecting in the fashion that is evident for fishing.

Foraging Efficiency and Maritime Economic Change

How do we explain the patterns outlined above? Based on the available evidence, patterns of maritime economic change on San

Clemente Island do not appear to be the result of random historical trends, inscrutable cultural preferences, or Panglossian progress. These trends are more explicable in terms of basic changes in foraging efficiency. If we first consider consumption of sea mammals, researchers are in general agreement that pinnipeds declined in availability as the Holocene progressed, only to be replaced by intensified fishing and sea otter hunting (Garlinghouse 2000; Porcasi et al. 2004). Parallel trends have been documented in the Northern Channel Islands (Colten and Arnold 1998).

These results have important implications for the model of prehistoric sea mammal hunting proposed by Hildebrandt and Jones (1992). This model weighs into a debate about the timing and causes of the distribution of pinniped populations on the North American Pacific coast. During the historical era, pinniped populations were largely restricted to remote off-shore rocks and islands. All agree that the vulnerability of seals and sea lions to terrestrial predators played a role in this pattern.

Two of the most important pinniped hunting targets, the Guadalupe fur seal (*Arctocephalus townsendi*) and the California sea lion (*Zalophus californianus*), give birth at rookeries on the Channel Islands during the summer (Hildebrandt and Jones 1992). Elephant seals (*Mirounga angustirostris*), on the other hand, spend a few winter months at rookeries giving birth. These animals are highly vulnerable to attacks by terrestrial predators during these periods. Human hunters, prehistoric and modern, can quickly decimate the females and juveniles that principally compose these breeding colonies with nothing more elaborate than clubs. If frequently attacked, however, pinnipeds will abandon their breeding grounds for more remote locations. While Lyman (1991) argues that pinnipeds were not driven from rookeries on the mainland coast of North America until historic times, other investigators conclude that this shift most likely occurred far earlier. Hildebrandt and Jones (1992:361) make the following case:

> Simply stated, we argue that the depletion of seal and sea lion populations and their restriction to offshore rookeries and haulouts is an anthropogenic phenomenon not restricted to the historical era. Rather, the process of extirpation . . . is one that began with the initial prehistoric settlement of coastal environments. We

> derive these conclusions from seal and sea lion population ecology, optimization theory, and dated faunal assemblages from the California and Oregon coasts. In combination, these data suggest a process of human overexploitation which has affected the character of hunter-gatherer intensification within this region.

The early advent of pinniped hunting on San Clemente Island and the general decline in the availability of these animals across the Holocene are consistent with the scenario proposed by Hildebrandt and Jones. Moreover, Porcasi et al. (2004:83) show that more than 90 percent of the adult pinniped bones at Eel Point were of females, with juveniles representing more than 40 percent of all pinniped bones. These figures leave little doubt that shore-based breeding colonies were the targets of choice by human hunters during all time periods. The ready availability of large amounts of meat, fat, and hide was no doubt extremely attractive to human hunters from very early times onward. This resource was not limitless, however. The type of hunting would have tended to drive away breeding colonies, while the selective targeting of females and juveniles would have killed the breeding stock required to replenish hunting losses. Porcasi et al. (2004:83) describe the probable long-term consequences of pinniped resource depression:

> As other classes of prey became increasingly scarce relative to the survival needs of the human population, the one resource susceptible to technological intensification was fish (Hildebrandt and Jones 1992). Whether or not they were hunted to near extinction, pinnipeds (especially the terrestrial breeders) have natural population ceilings . . . that limit the potential for humans to exploit them intensively. Greater reliance on fishing is consistent with increased use of watercraft and, in concert with greater exploitation of sea otters, indicates that optimal foraging strategies gave way to less efficient ones during the course of the Holocene.

Turning to shellfish consumption, much the same dynamic appears to have been at work on San Clemente Island. As noted earlier, Garlinghouse's (2000) research shows that small turban snails (*Tegula sp.*) replaced much larger abalones during the late Holocene. Abalones are comparatively slow-growing animals that would have disappeared quickly as a result of intensive harvesting

(Raab 1992). As abalone stocks declined, small species such as *Tegula* were added to the diet.

The California Bight (arc of the coast from Point Conception to the Mexican border) supports some of the most productive marine fisheries in the world, an area in which nearly 1,000 fish species are routinely cataloged (Allen 1985). The fish species potentially available offered greater opportunities for resource intensification (sustained harvest) than less numerous, more slowly reproducing and more slowly growing species such as abalones, seals, and sea lions. Viewed in this light, the widely recognized pattern of fishing intensification on the southern California coast during the Late Holocene, including San Clemente Island, is better understood perhaps as a move compelled by depression of alternative food resources, such as pinnipeds and abalones, than an advanced stage of maritime cultural evolution.

The Selective Advantages of Invention

The foraging efficiency trends noted above may help us to understand a wider range of technological and economic innovations. A good example is the appearance of circular shell fishhooks. By Late Holocene times, single-piece circular fishhooks fabricated from abalone, mussel, and other marine shells were widely used across coastal southern California (Strudwick 1986; Vance 2000). These hooks were added to the types of fishing gear previously used, including bone gorges or “bi-points,” nets, traps, and spears (Strudwick 1986). McKenzie (2007), in a productive application of experimental archaeology, found that circular hooks are considerably more effective than bone gorges. At Eel Point, the earliest shell hooks were recovered from cultural strata ranging in age from 736 to 482 cal BC and 1065–794 cal BC (Raab et al. 1994, 1995b).

While the exact reasons for adoption of shell hooks remain open to debate (Rick et al. 2002; Salls 1988, 1989; Strudwick 1986), we can say they appeared on San Clemente Island during a period of crucial economic change—namely, when fishing began to intensify (figure 8-1) in the face of the declining productivity of shellfish and pinniped stocks. This correlation suggests that shell fishhooks helped in some fashion to “ramp-up” fishing. On the other hand, these data do not point to a random act of invention or simply the result of a rationally recognized opportunity to "improve" the economy. If it were the latter, why didn't the islanders decide to improve their fishing economy earlier? Instead, the Eel Point data suggest that technological innovations such as shell fishhooks take hold in environments where they enjoy a selective advantage in terms of alternative foraging strategies.

Human Welfare

Declining foraging efficiency has significant implications for human welfare. The inverse relationship between foraging efficiency and cultural crises in coastal southern California noted by Broughton and O'Connell (1999) is striking; dropping foraging efficiency (Raab 1996) correlates with rising rates of interpersonal violence and health crises (Lambert 1993). The fishhooks mentioned earlier, along with other fishing gear, are a good example of the increasing labor costs associated with resource intensification. While larger amounts of fish could be produced, this increase could only be achieved by investing labor in a more diverse array of gear and in visiting a wider range of marine habitats, some of which required the use of boats. Similarly, a shift toward a shellfish diet dominated by *Tegula* appears to have required these small gastropods to be boiled for consumption, imposing a substantial labor cost in the collection of cooking fuel and the manufacture of cooking containers (Raab 1992). These patterns are consistent with the scenario described by Broughton and O'Connell (1999), in which people had to work harder to obtain adequate provisions.

Tragedy of the Commons

Given some currently popular impressions of human prehistory, a focus on foraging efficiency may seem surprising. Many people imagine that over-exploitation of natural resources is a relatively recent problem in human history, associated primarily with modern industrial or agrarian societies. Hunter-gatherers, in sharp contrast, frequently are viewed as environmentally benign, restrained from over-harvesting plants and animals by a deep reverence for nature or, less idealistically, simply too small in numbers and too technologically limited to have much impact on the natural environment. Raab and Jones (2004) argue that such beliefs have taken particularly deep root in California. Despite these popular stereotypes, we should note once again the evidence of foragers, modern and prehistoric, as powerful agents of environmental change, including environmental alterations that are not necessarily benign (Kay and Simmons 2002; Krech 2000; Lentz 2000; Raab and Jones 2004; Rick and Erlandson 2008).

Still, not all researchers subscribe to theories of resource optimization. Colten and Arnold (1998) describe a sequence of prehistoric subsistence change on Santa Cruz Island, the largest of the Northern Channel Islands. Their data demonstrate subsistence shifts that closely parallel those seen on San Clemente Island, including a long-term decline in the productivity of pinniped hunting, coupled with a dramatic upswing in Late Holocene fishing. However, Colten and Arnold (1998) reject the notion that this pattern can be attributed to optimal foraging dynamics, arguing instead that this pattern reflects the inventiveness and flexibility of the islands' population in developing new food resources. Arguments of this kind imply that optimal foraging models oversimplify the behavior of human foragers, particularly with regard to "bigger is better" arguments about prey items.

Optimal foraging models are sometimes perceived as predicting that human predators will eschew small food items such as shellfish or fish in favor of larger prey such as pinnipeds. Arguments of this kind misstate optimal foraging theories, however. These theories do not categorically predict that predators will ignore any food item in preference to another, including small items in favor of large prey. Rather, these models predict that human foragers will add items to their diet in a fashion that optimizes acquisition of essential nutrients, given the cost-effectiveness of the available resource choices. In the context of the Channel Islands, the diet breadth has always included a range of prey and prey sizes, leading to a wide range of possible foraging strategies.

In effect, Colten and Arnold (1998) advance traditional theories of progressive economic development, which identify "invention," technological "improvement," and like phenomena as sources of culture change. But why do these improvements occur when and where they do? While optimal foraging models by no means rule out human creativity and invention—these are parts of the human adaptive phenotype—these models suggest that subsistence innovations are not inscrutable or random events but rather are highly correlated with changes in resource productivity.

On San Clemente Island, it appears that resource productivity was conditioned by over-exploitation of the island's marine "commons." Porcasi et al. (2004:85) point out dynamics that likely worked against resource conservation by ancient coastal dwellers, including San Clemente Island:

> As the pursuit of highly ranked marine mammals began early and continued intermittently through the Holocene, gradual reduction in the population was almost inevitable, particularly in light of an apparent focus on females and juveniles. . . . Any human population exploiting pinnipeds with relatively crude technology would have, of necessity, focused on large groups of females and young. Self interest and conservation were mutually exclusive objectives in this instance, and there seems little justification for denying the inevitability of nonconservative behavior under such circumstances. Even if the inhabitants of San Clemente Island attempted a measure of management-oriented selectivity in their exploitation of migratory herds, it would have been to no avail. Previous studies (Hildebrandt and Jones 1992) show that these animals were pursued at every location where they hauled out on land. The same animals that gave birth on San Clemente Island and avoided pursuit there were subsequently hunted by other Native peoples on other islands or the mainland.

Does San Clemente Island contribute anything significant to a larger picture of prehistory? Some might wonder if a comparatively small, remote island is likely to reflect the sorts of cultural-environmental connections that characterized much larger areas, particularly the mainland California coast. Islands, owing to their limited resources, can be particularly prone to environmental disaster (Kirch and Hunt 1997). Easter Island is a classic case, where Polynesian colonists deforested the island and hunted various animal species to extinction, eventually suffering warfare, depopulation, and other calamities as a result.

Despite the possibility of "Easter Island scenarios," islands can also offer distinct research advantages. The relatively high-resolution cultural-environmental information offered by San Clemente Island reinforces important patterns seen in other regions of California. Like various studies of foraging efficiency in prehistoric California cited earlier, the San Clemente Island data indicate that ancient humans were significant agents of environmental change from very early times. Moreover, human-induced changes in resource availability appear to have been important in shaping robust patterns of culture change, including the adoption of new technologies and new economic patterns. Moreover, these changes likely had significant impacts on human welfare, including increasing labor demands, dietary quality, and susceptibility to disease.

Finally, this chapter was not intended to denigrate the ancient human populations of coastal California. As Porcasi et al. (2004) suggest, these groups were merely doing what contemporary populations would probably do under similar circumstances: favoring survival over the uncertain benefits of conservation. Through studies of foraging efficiency, we obtain a more realistic and more authentically human understanding of the cultural-environmental history.

9

Medieval Climatic Crisis

Andrew Yatsko and L. Mark Raab

Using the recently developed technique of dendrochronology (tree-ring dating), archaeologists working in the American Southwest during the 1920s announced that devastating medieval-era droughts played a role in the abandonment of the region's prehistoric pueblos (Jones et al. 1999). While archaeologists conceded the plausibility of such catastrophes in the arid American Southwest, few believed that coastal California was ever plagued by similar problems. Indeed, the idea of a timeless, exceptionally benign climatic province is one of the California's most closely held mythic traditions (Jones et al. 1999; Raab and Jones 2004).

Nowhere does this tradition, and its effects on theorizing about California's ancient peoples, have deeper roots than coastal southern California. Native groups, such as the Gabrielino and Chumash discussed in chapter 3, have been portrayed for decades as beneficiaries of a natural environment teeming with wild foods and blessed by benign climate. A. L. Kroeber (1925:551), luminary California anthropologist, articulated this theme early in the twentieth century: "Marine life along the Chumash shores is exceptionally rich, the climate far famed, and every condition favored the unusual concentration of population among a people living directly upon nature."

This assessment was not confined to the Chumash. In a pamphlet entitled "Indians of Southern California," prepared for visitors to the Southwest Museum in Los Angeles, archaeologist

Edwin Walker (n.d.:2) offered this scenario of pre-European Indian life among the Gabrielino Indian neighbors of the Chumash:

> Until the whites arrived there probably had been almost no organized warfare for hundreds of years in most of Southern California, where there were no war drums, no war chiefs, no well-defined tribal organization. In fact, "tribe" meant so little to these Indians that they could give the whites no definite idea of it. . . . Many of these Indians belonged to the great Shoshonean family, who had penetrated the country unknown centuries ago, doubtless as conquerors; but once having secured a foothold, they seem to have settled down to enjoy in peace the climate and abundant food supply.

This treatise does not include a date of publication, but based on its bibliography, Walker's account was issued to museum visitors at least as late as the 1950s. Many archaeologists today would dismiss Walker's characterization of California Indian life as not only patronizing but also over-idealized in its assumption that ancient California was a natural Utopia (Raab and Jones 2004).

Modern research on California's ancient marine and terrestrial environments points to a decidedly non-Utopian past. The excellent summary of California's post-Pleistocene climatic trends by West et al. (2007) reveals considerable swings in temperature and moisture. Several studies, including proxies of marine temperature and terrestrial temperature/moisture trends, have identified the period from about AD 450 to 1300 as a period of relatively high climatic instability for coastal southern California. Paleoenvironmental indicators—including deep sea cores, tree rings, ancient lake sediments, and pollen records—suggest that Western North America, including coastal California, experienced recurrent droughts of "epic" magnitude between about AD 800 and 1300 (Jones et al. 1999; Kennett and Kennett 2000; Raab and Larson 1997; Stine 1994). This time period, referred to as the Medieval Climatic Anomaly (MCA) by climate scientists, is thought to have been marked by bouts of aridity more severe and persistent than any recorded in historical times. Whereas the longest North American meteorological drought of the twentieth century (Depression-era Dust Bowl) lasted for about eight years, California droughts of the

MCA appear to have persisted for decades, perhaps even more than a century (Stine 1994). Jones et al. (1999) point out that during the MCA, California's Indian populations, owing to their comparatively high population density and reliance on stored foods (e.g., acorns), were probably as vulnerable to drought-driven crises as the Puebloan farmers of the American Southwest.

These findings challenge the traditional model of California maritime prehistory examined previously (chapters 1, 3, 4). This model envisioned the centuries immediately prior to European contact as a time of unprecedented economic productivity, when groups such as the Chumash were able to tap "fully" the productivity of marine and terrestrial environments through critical technological and social-organizational innovations such as ocean-going boats and elite-brokered regional trade (see chapter 10). This model was predicated, at least implicitly, on the Chumash natural environment touted by Kroeber—i.e., a stable and benign biosphere offering consistently high levels of natural food production. The principal challenge facing southern California coastal groups, it seemed, was unlocking this natural bounty through progressively more productive cultural and technological arrangements. In Kroeber's time, an age that lacked detailed paleo-environmental data, such reconstructions were understandable.

Today, paleoenvironmental and archaeological data reveal a far more stressful coastal environment than once believed. Drought-driven scarcity of vital resources such as water and food appears to have been an important factor in bringing about "punctuated" patterns of culture change in coastal southern California during the MCA. Some of the most pronounced of these patterns have emerged in the last two decades from Channel Islands archaeological research. This is not surprising perhaps, in that these islands represent relatively small catchments for the capture and storage of water. As we saw in chapter 2, San Clemente Island's geology is poorly suited to the formation of aquifers. This, combined with the island's relatively low annual rainfall (average $<$ 10 inches), made finding sufficient drinking water a key survival challenge for native San Clemente Islanders. Other Channel Islands are better watered, but all of them are highly sensitive to downturns in precipitation (Lambert and Walker 1991). The same can also be said for any terrestrial food resources.

Several studies link drought-induced stresses to dramatic patterns of culture change in the Chumash area, including island and mainland localities. Arnold (see chapter 10) noted intensified production of shell beads on San Cruz and other Northern Channel Islands during the MCA, which she links to efforts to buffer the effects of drought via elite-brokered trade with the mainland. Kennett and Kennett (2000), drawing proxies of marine and atmospheric climate flux, argued that the MCA was a period of relatively high climatic instability in coastal southern California, marked by intensified warfare, new trade alliances, and altered settlement patterns. Lambert (1993) and Lambert and Walker (1991), based on the study of human skeletal populations, documented heightened warfare in the Chumash area during the MCA, as well as declining levels of health. Jones et al. (1999) and Raab and Larson (1997) correlated episodes of medieval-era drought with multi-faceted patterns of culture change, arguing that Late Holocene coastal populations were at high levels of vulnerability to climate flux, owing to their relatively low levels of foraging efficiency.

Hypothesis and Research Design

This chapter summarizes a study by one of the authors (Yatsko 2000a, 2003) designed to test the hypothesis that human settlement of San Clemente Island during the MCA was significantly affected by drought conditions. San Clemente Island is a nearly ideal locality for testing such a theory. As mentioned above, the island receives relatively little rainfall—less than 10 inches per year on average (chapter 2). Moreover, the island's relatively small landmass and impermeable volcanic bedrock make for poor natural water storage. Under the best of conditions, the prehistoric inhabitants of this desert island would have found drinking water limited. Periods of extended drought would have made insular life precarious, indeed. These factors suggest that settlement of San Clemente Island should be a sensitive archaeological barometer of climatic stress.

The major hypothesis pursued by this research is that periods of severe regional drought caused measurable shifts in settlement on San Clemente Island. This hypothesis follows from the assumption that drinking water would have become increasingly scarce during intervals of prolonged drought. Moreover, since the availability of surface water on the island today can be correlated with certain geologic/soils conditions, it seems reasonable to expect that settlement clustered around such areas during the most severe periods of drought or, for purposes of this research, those between about AD 1100 and 1300. This is the period that the most pronounced effects of drought appear in the archaeological investigations summarized above.

Testing this hypothesis requires two types of data. First, we need relatively detailed information about the age of settlements in order to determine how many of these date to the MCA. Second, we need information on the spatial patterning of settlements in relation to sources of water. The objective is to determine if there was a spatial and chronological convergence of settlement on locations that likely offered water during the MCA. In evaluating this hypothesis, we are fortunate in having a relatively large and detailed pool of archaeological information to draw upon, a subject that we turn to next.

Island Chronology and Paleodemography

Radiocarbon dating affords the best means of assigning ages to the artifacts, cultural features, stratigraphic levels, and intervals of cultural change found on San Clemente Island. Advances in radiocarbon dating of sites and site components have improved the resolution of San Clemente Island's prehistoric chronology, facilitating the investigation of a range of research topics (Porcasi et al. 2004; Raab et al. 1994; Yatsko 2000a). The number of San Clemente Island radiocarbon dates increased rapidly after the mid-1980s. From just twenty dates in 1983, the list expanded to nearly 100 by 1992 (Breschini et al. 1996; Raab et al. 1994; Raab et al. 1995b). At the time of this writing, the number of radiocarbon dates from San Clemente Island stands at more than 265 [information on file, Navy Region Southwest Cultural Resources Management Program (CRMP), San Diego]. While it is always desirable to have more dates, this figure affords a level of chronological resolution in reconstructing prehistoric settlement patterns on San Clemente Island that is better than many areas of comparable size in North America.

A probabilistic site survey (PSS) of San Clemente Island, conducted during 1991–1992 by the author and others, was of particular importance in developing the chronological and settlement pattern data reported in this chapter. Below, we take a more detailed look at how this survey was designed. Here, it suffices to note that sample survey quadrats (sampling squares), each one-quarter-km^2, were statistically selected for intensive examination (figure 9-1). These quadrats made up 15 percent of the island's surface, yielding a sample of archaeological sites that were then test excavated and radiocarbon dated. Radiocarbon dates produced by this survey

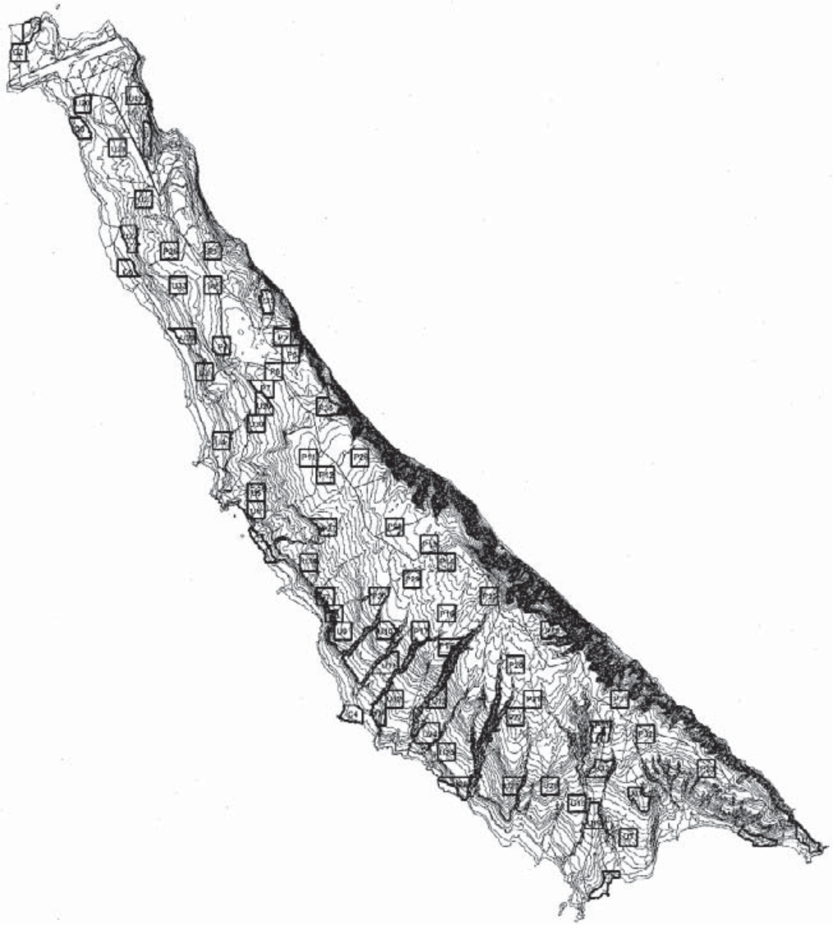


Figure 9-1. Sample quadrats of San Clemente Island Probabilistic Site Survey.

proved particularly valuable in understanding the island's settlement chronology (Yatsko 2000a; Yatsko and Raab 1991).

California researchers have suggested that radiocarbon dates, like those from the PSS, while not free of possible interpretive biases, are perhaps the best proxy measure of paleodemographic trends (Breschini et al. 1996; Glassow et al. 1988). All other things equal, one might logically expect that as a prehistoric human population expanded or contracted in size, it created a correspondingly larger or smaller number of discrete archaeological sites or cultural strata. Assuming a regional sampling of radiocarbon dates reasonably reflects this variation, it should be possible to perceive general population trends in the form of shifting date frequencies. A difficulty with this approach, of course, is that seldom are all other things equal. Possible sources of error include biased selection of sites for dating, small samples of dates for many time periods, variable preservation of datable materials across time, and settlement dynamics that result in greater or lesser numbers of sites regardless of the actual magnitude of a prehistoric population.

All of these difficulties acknowledged, the PSS helps to eliminate a good deal of potential bias. The excavated samples for dating represent essentially all site types and terrain settings identified on the island (Yatsko 2000a; see also chapter 2, this volume). These dates can be assigned to a total of 57 separate cultural components or strata. In defining these cultural components, care was taken to avoid the problem of "double counting"—i.e., counting only a single date from each discrete provenience, if more than one date of the same statistical age was available. Figure 9-2 plots 57 dates from the PSS against a similarly controlled 93 dates from an island-wide sample (IWS) collected by different researchers over a number of years. The IWS dates are drawn from a variety of sources, including Breschini et al. (1996), Raab et al. (1994), Erlandson et al. (1998), Gallegos (1994), and radiocarbon laboratory reports on file at the CSU Northridge Center for Public Archaeology and the Navy Region Southwest CRMP. The samples presented in figure 9-2 excluded dates from pre-1990 studies on San Clemente Island. Unfortunately, many of these pre-1990 dates lack sufficient documentation to assess their reliability.

The frequency distribution of dates from the PSS and the IWS are strikingly similar in the post-5,000 RYBP (radiocarbon years

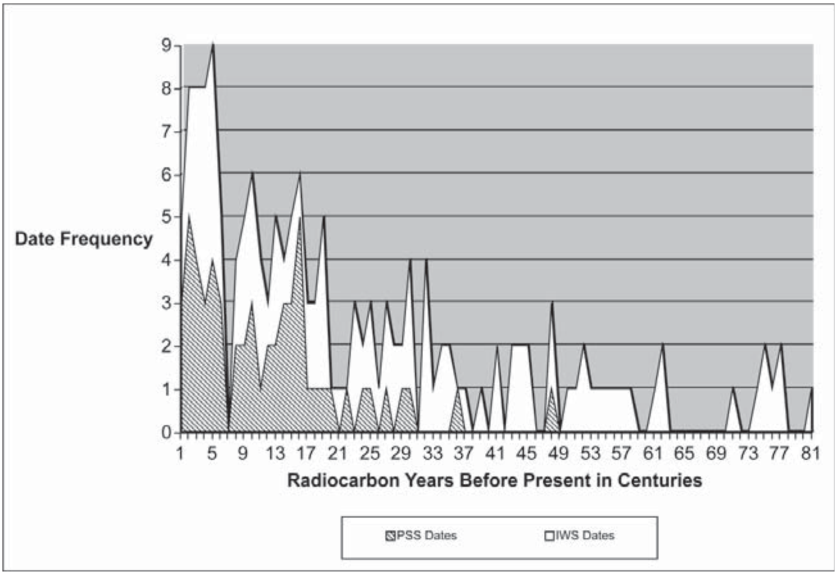


Figure 9-2. Frequency of radiocarbon dates by Probabilistic Site Survey (PSS) and Island-Wide Sample (IWS).

before present) time range. That the PSS sample does not include dates earlier than 5,000 RYBP should probably not be viewed as a defect. Dates in the IWS earlier than 5,000 RYBP come almost entirely from the Eel Point archaeological site (figure 4-1). Based on the results of the PSS, Eel Point appears to have an exceptionally long history of occupation, perhaps serving as one of the island's most intensively occupied localities for many millennia. This would explain the site's impressive volume of cultural deposits, which are discussed in chapters 4, 5, 6, and 8.

More important to the current discussion are the consistently high frequencies of dates in the PSS and IWS after about 2,000 RYBP, both punctuated by a dramatic and synchronous drop to zero or near zero at around 800 RYBP. This pattern suggests the possible collapse of an otherwise growing human population on San Clemente Island in the centuries preceding the MCA. Eel Point's cultural deposits may reinforce this conclusion. If Eel Point was one of the most intensively occupied settlements on the island over time, as it appears to be, it is interesting to note that most of the site's shell-bearing midden deposits accumulated after about 3,500 RYBP (chapter 4). This pattern is consistent with a generally growing island population during the Late Holocene, reflected as well in the PSS dates. Despite the methodological challenges noted above, the island's radiocarbon chronology appears to offer a robust signal of population decline during the MCA. The next step was to determine how this decline might be reflected in settlement patterning.

Modeling Settlement

This work followed Thomas's (1974) suggestion that the collection of prehistoric settlement data should address three criteria in order to be anthropologically relevant. First, it is not enough to generalize from an individual site or localized group of sites. Rather, all ecological aspects potentially influencing site location must be delineated for the region sampled. Second, because capricious sampling techniques affect interpretation of the relative importance of site categories, the data collection process should be as unbiased as possible. Finally, to the extent possible, the sampling design must provide useful negative evidence to show not only where specific activities took place, but also where they did not.

To obtain a statistically valid island-wide sample, the PSS followed the recommendations of Thomas (1975) and others (Judge et al. 1975; Read 1975; Schiffer et al. 1978) for probabilistic sampling. Among the more efficient approaches to such sampling, these researchers suggest systematic or stratified random transect survey (Judge et al. 1975; Read 1975). However, experience with San Clemente Island's rugged topography indicated that transect sampling was likely to be of little use. Instead, quadrats, distributed in a statistically random fashion and stratified on the basis of the terrain types described in chapter 2, were selected as the most productive sampling scheme (Yatsko 1991).

Island terrains provided a logical basis for stratifying this sample (see chapter 2), given an already extensive body of knowledge about variation in site density and site characteristics in various terrains (chapter 2). For instance, while the Eastern Escarpment and Major Canyons terrains (chapter 2) are known to contain isolated archaeological loci (e.g., occupied rock shelters), their steep, dissected topography does not provide survey conditions comparable to the island's dominant terraced topography. Like the Eastern Escarpment and Major Canyons, the Sand Dunes terrain was also excluded from survey because the archaeological deposits in this area reflect extensive wind deflation. Instead, the PSS survey concentrated on the terrains demonstrably containing the bulk of the island's archaeological sites: the Coastal Terrace, the Upland Marine Terraces, and the Plateau. The resulting sample quadrats accounted for a total of 15 percent of the island's surface, drawn from the approximately 79 percent of the island encompassed by the Coastal Terrace, Upland Marine Terraces, and Plateau terrains. To select individual sample units, each terrain stratum was overlain with a 500-meter-square (25 ha) grid oriented on the Universal Transverse Mercator (UTM) system. Grid squares within each terrain stratum were numbered sequentially, with a table of random numbers used to select the sample quadrats (figure 9-1).

The PSS documented 1,143 sites within the sample quadrats (Yatsko and Raab 1997). A stratified random sample of 33 sites was selected from these quadrats for test excavation and radiocarbon dating, contributing to the chronological pattern shown in figure 9-2. Development of a sampling approach for a more detailed understanding of possible temporal and spatial correlations between site locations and island water sources required examination of the three principal terrain strata sampled by the PSS. Essentially, the PSS indicated the presence of site clusters at the upland heads and coastal mouths of the major canyons, where natural "rock tanks" are sources of held surface water (Yatsko and Raab 1997). Similarly, the PSS and other contiguous surveys showed site clusters in association with fossil dunes over the northern portion of the island (Yatsko 2000a). These eolian deposits currently show no evidence of semi-permanent water sources (e.g., springs or seeps). The working assumption was that these fossil dunes held small, perched aquifers that produced perennial or seasonal springs at their margin, where they contacted relatively impermeable underlying volcanic bedrock. Differentiating terrains according to these two potential water sources, surface-held runoff vs. groundwater, provided a basis for stratifying a new sampling design.

Experience suggested that the 25-ha quadrats used in the PSS were not large enough to adequately represent hydrology-correlated patterning, especially in areas of the Plateau known to have low site density. Therefore, it was decided to sample larger, contiguous areas of each hydrologic stratum. To maintain comparability with the PSS, the three principal sampling terrains (Coastal Terrace, Upland Marine Terraces, and Plateau) were targeted as sampling strata. However, comparability also required that the survey areas be proportional in size to the three strata. This would have required very large sampling areas, and consequently a commitment of effort beyond the study's practical limits. Compromises had to be made. To establish reasonable limits on the overall sample size, a choice was made to restrict the investigation to upland drainage catchments along the Plateau's crest and drainage channels, as these flow across the Coastal Terrace.

This excluded the intervening Upland Marine Terraces terrain from the survey sample. This reduced fieldwork by almost half. It also reflected the fact that where drainage catchments coalesce on the Plateau, their dissection of the terrain is relatively shallow and water is readily accessible. However, as these same water courses drain off the Plateau across the Upland Marine Terraces terrain, they rapidly become steeply incised into the terraces, making them less accessible. Accessibility to water improves again as these drainages open onto the Coastal Terrace. Consequently, it was assumed that Plateau and Coastal Terrace terrains both afforded greater access to water than the Upland Marine Terraces.

On the Plateau terrain, two contrasting areas were judgmentally selected, including one each from eolian (wind-deposited sediments, such as dunes) and bedrock terrains (Yatsko 2000a). These are respectively referred to as the Old Airfield (OAF) Study Area and the Middle Ranch-Box (MRB) Study Area. The 400 ha (988 acre) OAF Study Area covers the larger portion of a mid-Pleistocene fossil dune deposit overlying the island's north-central Plateau. The MRB Study Area covers a 3.95 km^2 (395 ha/975-acre) portion of Plateau bedrock terrain encompassing the upper Norton Canyon drainage between upper Middle Ranch Canyon to the northwest and the head of Box Canyon to the southeast (Yatsko 2000a). This area of the island Plateau, with its topography carved into andesitic and dacitic bedrock, contains no Pleistocene eolian deposits.

The two study areas from the smaller Coastal Terrace terrain were correspondingly selected, based on the hydrologic characteristics of the Plateau terrain that fed the channels crossing it (Yatsko 2000a). Drainages crossing the 110 ha (272 acre) Shell-Abalone (SA) Study Area are situated in eolian terrain on the very northern Plateau. Those draining across the 102 ha (252 acre) Mail Point (MP) Study Area have their sources on the bedrock areas of the Plateau, just north of the MRB Study Area. The topography and soil in both Coastal Terrace study areas are similar, representing the island's youngest emergent marine terrace terrain and geology.

While selection of these areas involved compromise, insofar as sampling was concerned, the resulting sample did afford a good cross-section of settings likely to have had surface water during prehistory. Surface survey, auger testing, and small-scale excavation were used to establish typological and chronological control of 33 archaeological sites selected to supplement the results of the PSS. A charcoal sample was selected from each of these sites for radiocarbon dating, allowing these sites to be compared to the chronological patterns developed by the PSS work, and to assess their age in relation to the MCA.

Results and Conclusions

The data collected by this study support the hypothesis that substantial shifts in settlement took place on San Clemente Island during the MCA. One of these shifts is the apparent decline in island population during this interval, as noted earlier (AD 1100–1300). This is visible archaeologically in the dramatic decline in the frequency of sites dating to this period (figure 9-2). During what otherwise appears to be an upward trend of population increase during the Late Holocene, the frequency of sites dated to about AD 1150 plunges dramatically downward. Once again, this appears to be a robust trend reflected in both the PSS and IWS dates.

As regards settlement patterning, one of the most interesting findings of this study points to occupation of areas of high hydrologic potential during the MCA. One of these was an apparent residential focus in the Shell-Abalone (SA) Study Area, a locality on the island's western Coastal Terrace (chapter 2). Site testing in the SA Study Area produced dates correlated with the MCA. These are site CA-SCLI-259, a buried and eroded shell-bearing midden, dated at around 970 to 1190 cal AD, and site CA-SCLI-244, a partially buried and intact carbonaceous midden, dated at around 1030 to 1220 cal AD (Yatsko 2000a).

The first of these sites was a remnant deposit in a streambed. The second of these sites was also buried within an alluvial deposit in the channel of a narrow arroyo. Both of these sites reflect deposition in alluvial deposits, and subsequent cutting or erosion by higher energy flows. This pattern hints at interesting precipitation/erosion trends during and after the MCA.

The SA sites are drainages fed from an upslope fossil dune field in the Plateau terrain (Yatsko 2000a). This drainage concentrates significant quantities of water from this upland area, carrying it across the Coastal Terrace. That the sites mentioned above were originally buried in streambeds and later excavated by arroyo down-cutting suggests that the hydrologic regime at the time of occupation (MCA) may have had relatively less volume and erosive power than subsequently. This may imply a period of occupation with lower-than-present rates of precipitation and arroyo cutting. The subsequent erosion of the streambed deposits may have resulted from increases in runoff due to historic overgrazing of the upland tributary terrain.

The alluvial dynamics observed in the SA Study Area have interesting implications for future research. Having initially assumed that San Clemente Island's topography was created primarily by erosional processes, with little potential for buried cultural deposits, it seemed reasonable to conclude that most site loci would be visible at the surface. However, the present research suggests otherwise. It is now apparent that the island's terraces have substantially more potential for alluvial transport and redeposition than earlier assumed. This is especially true on the lower Marine Terraces of the island's west shore (chapter 2). Survey work undertaken to augment the PSS identified a minimum of eight midden deposits buried in the banks of streams (Yatsko 2000a). Some of these middens are buried as much as 1.5 in/3.8 cm below the present terrace surface. These deposits appear to have been buried relatively quickly, and as a result they have good integrity and a high charcoal and artifact content. It may be hypothesized that other buried sites dating to the MCA may be found in alluvial contexts on the Marine Terraces, where they may reflect water availability due to the area's hydrologic discharge from upland eolian deposits.

These findings have wider research implications for studying prehistoric human population dynamics in the Late Holocene for the Channel Islands as a whole. While researchers have concluded that substantial settlement reconfigurations occurred on the Northern Channel Islands during the MCA (Arnold 1992; Peterson 1994; Kennett and Kennett 2000; Lambert and Walker 1991), until this study there was little comparable evidence from the Southern Channel Islands. The San Clemente Island data now suggest that substantial settlement realignments were occurring on the island during the same time interval as the northern islands. Considering the cultural, social, and economic relationships that existed prehistorically among the Southern Channel Islands (chapter 3), it seems likely that settlement changes apparent on San Clemente Island have counterparts on the other Southern Channel Islands, including Santa Catalina Island and San Nicolas Island. Even small-scale site-dating studies on these other islands would go a long way toward addressing broader regional research questions focused on the MCA.

It is difficult to interpret the chronological scale of settlement and demographic trends reflected in these data. Questions remain about the synchronicity of settlement and wet and dry periods during the MCA. Larson and Michaelsen (1989), for example, reconstruct two periods of favorable precipitation, based on tree-ring studies from southern California. The precipitation regime between about AD 800 and AD 1000 is described as a sustained high-interval of precipitation, unmatched in the entire 1600-year reconstruction by Larson and Michaelsen (1989:22). Another 70-year period of normal rainfall is reconstructed for about AD 1030 to 1100. These data parallel trends identified by Stine (1994), Kennett and Kennett (2000), and Jones et al. (1999), identifying the medieval era as one of climatic instability in southern California. Even with the relatively narrow radiocarbon counting error probabilities used in this study, however, error ranges overlap periods of moist conditions and periods of drought, making it difficult to link some dated sites with one of these climatic periods over another.

While the available evidence suggests that population levels retreated dramatically during the MCA, it appears that the island continued to support a small human population during at least some of this period. On the other hand, given that radiocarbon dates often reflect a statistical margin of error of at least one century, it is possible that San Clemente Island could have been depopulated for shorter periods—years or decades—without being reflected in radiocarbon-based proxies of population size. Whether continuous or discontinuous, survival on San Clemente Island during the MCA appears to have encouraged a pattern of residential settlement positioned to take advantage of the availability of surface water. Without additional data, it is not possible to say whether the sites corresponding with medieval-era droughts represent a persistent occupation by a small island population or periodic reoccupation of the island during shorter, more favorable climatic intervals within the MCA.

There appears to be little doubt that San Clemente Island experienced dramatic demographic and settlement-pattern shifts during the MCA, events synchronous with rapid culture change in the Chumash area, including the Northern Channel Islands. The cultural outcomes of stresses induced by the MCA were by no means identical in these areas, however—a topic that we take up in chapter 10. Even so, this research demonstrates how archaeological records from San Clemente Island and the other Channel Islands can chronicle prehistoric human population responses to large-scale paleoclimatic shifts. This is one area where these islands deliver on their potential as natural laboratories for the study of cultural and environmental change.

At present, it is difficult to make island-by-island comparisons of demographic trends during the MCA across the Channel Islands. However, research on the impact of the MCA on insular and mainland California continues. San Nicolas Island, as we discussed in chapter 3, is the most seaward of the Southern Channel Islands, and also one of the most systematically surveyed by archaeologists (Martz 2005). Martz (2005) concludes that the population of San Nicolas Island declined between AD 1100 and 1200, synchronous with the pattern described above. San Nicolas Island's sedimentary geology supports relatively abundant surface water, as compared to San Clemente Island (Reinman 1964, 1984). A population decline on San Nicolas Island during the MCA, in the island's relatively well-watered environment, may also be a testament to the disruptive effective of Late Holocene climate change.

On a larger scale, Jones and Schwitalla (2008) offer evidence of pervasive changes in settlement patterning, regional trade networks, patterns of health and violence, and other cultural patterns during the MCA. These data suggest that some responses to medieval drought, such as declining health and interpersonal violence, are more regionally variable than researchers previously documented. Moreover, the onset of aridity and the decline of resources dependent on water may have been more gradual than previously modeled. Based on work in the Northern Channel Islands, Kennett (2005), for example, argues that moisture was probably declining after about AD 400, rather than precipitously after around AD 800. Just the same, the patterns identified by Jones and Schwitalla (2008) broaden the pattern of data indicating important changes across California during the MCA.

The results of this study add to our portrait of the Late Holocene along the southern California coast as a time period marked by stresses of sufficient magnitude to alter cultural arrangements. Contrary to traditional models of coastal prehistory, which have often portrayed the proto-historic era as one in which coastal peoples achieved unprecedented levels of economic abundance and subsistence security (Gamble 2005), the Late Holocene appears to have been a time of significant crises, including damaging droughts. We examine some of the implications of these findings for modeling maritime prehistory in chapter 12.

10

In the Shadow of Chiefdoms

L. Mark Raab

While nineteenth-century Euro-American adventurers and relic hunters were discovering the Channel Islands' Native American archaeological sites (chapter 3), some of the first archaeologists in Europe were digging into their own past (Trigger 1989). What the European excavators found startled Victorian observers: If one went deep enough into the past, all humans, including Europeans, had once lived Stone Age lives, similar perhaps to the hunter-gatherer societies encountered by European explorers and colonists. Thus was discovered a universal but almost entirely unknown human *prehistory* that antedated even the oldest civilizations.

This discovery quickly took its place alongside Charles Darwin's new ideas about evolution. The result was to extend the concept of evolutionary change from the biological realm to the cultural, for it was plain that in the prehistoric past "simple" hunter-gatherers (the term "foragers" is preferred by many today) were in some places transformed into the more "complex" social orders in which virtually all of humankind lives today. Creation of the new discipline of archaeology was a response to these revelations (Fagan 2005), posing a question that has animated archaeologists ever since: What are the origins of social complexity? This is one of the questions taken up by the distinctively *anthropological* archaeology that took root in the United States, dedicated to understanding the cultural development of humankind, not merely of particular peoples or world regions (Trigger 1989). It is also a question that would eventually transform the California Channel Islands into an important natural laboratory for testing theories of social evolution.

After a century of Channel Islands archaeology (chapter 3), most researchers agree that two island groups, the Chumash and Gabrielino Indians, should be counted among the most socioeconomically complex foraging societies in the world (Arnold 2001a; Erlandson et al. 2008; Kennett 2005). The Chumash Indians of the Northern Channel Islands are the most extensively researched group, but the Gabrielino Indians of the Southern Channel Islands are often credited with forms of social complexity similar to those of their Chumash neighbors (Gamble and Arnold 2003; Gamble and Russell 2002; McCawley 1996). Most importantly, both groups are thought to have given rise to chiefdoms in the millennium or two preceding European contact (Arnold 2001b; Gamble 2008; Gamble and Russell 2002; Munns and Arnold 2002). In the traditional model of California coastal prehistory we examined in chapter 1, Chumash and Gabrielino chiefdoms have long been viewed as emblematic of a Late Holocene maritime cultural climax. Debate continues about the dynamics behind these developments, involving divergent theoretical viewpoints and diverse archaeological and ethnohistoric data (see Jones and Klar 2007:312–13 for a useful summary). There is no doubt, however, that Chumash chiefdoms have emerged in recent decades as a topic of particular interest to archaeologists seeking to understand emergent social complexity.

But to what extent do models of Chumash social complexity hold throughout the Channel Islands region? This question is interesting when we consider that early theorists of California coastal prehistory lumped the Chumash of the Northern Channel Islands and the Gabrielino Indians of the Southern Channel Islands under the rubric of the “Canaliño” (people of the California Channel, Rogers 1929), based on the fact that both groups possessed similar seagoing canoes and insular economies heavily dependent on marine foraging. More recent discussions characterize both the Gabrielino and Chumash as chiefdoms, as noted earlier, possessing largely similar socioeconomic characteristics (Gamble 2008; McCawley 1996). Based on these discussions, should we expect to find largely similar developmental trajectories toward social complexity in the northern and southern islands, a scant 80 to 150 km distant from each other? If the Channel Islands offer themselves as a natural archaeological laboratory, as we argued in chapter 1, this is a question that seems well suited to comparative analysis.

It is instructive to compare San Clemente Island with three scenarios that have been advanced to explain the emergence of Chumash chiefdoms: development of a political economy and economic redistribution; elite control of seafaring; and the effects of climatic stress on violence and social hierarchy.

Political Economy and Economic Redistribution

Some theorists attribute the ascent of Chumash chiefs to the wealth and social power they derived from managing sumptuary and subsistence economies. As Bettinger (1991a:5) notes, this line of theorizing typically attributes cultural change to innovations in which, "Cultures are portrayed as populations that collectively solve adaptive problems through novel, and often complex, social, technical, political and religious means." In this case, the problem that is said to have been solved was replacing smaller subsistence economies attuned to local ecological conditions with a more productive regional economy based on redistribution of goods and services. The resulting "political economy" becomes a complexity-generating system, in that it tends to create a class of system managers or exploiters—depending on theoretical viewpoint—whose wealth and power sets them apart from commoners.

In one of the first explicit formulations of such a system, fiestas, gift giving, mortuary ceremonies, and a monetized economy based on shell beads were cited by King (1976) as components of an elite-brokered "inter-village exchange system":

> The operation of the inter-village exchange system seems to have been essentially an expression of the profit motive on the individual level, and the operation of the law of supply and demand. Effects of the system were to produce a common resource base for a large area at the expense of much work. . . . By randomizing the effects of environmental variability with frequent interaction, the Chumash were able to use more of their resources; the degree of their interaction was a result of the high variability in the resources of the area. Their frequent

> use of money [shell beads] allowed them to average their many resources efficiently. (King 1976:317)

Some theorists argued there was much to redistribute. Bean and Lawton (1976) speculated, for example, that acorns were abundant in California, offering a nutritious, readily storable staple—effectively the equivalent of agriculture. Against this view, Basgall (1987) and Wohlgemuth (1996) contended that the cost-effectiveness of acorn consumption is relatively low as compared to many alternative resources, and this may explain why acorns were not incorporated into the diet of some native Californians until relatively late in the Holocene. The medieval-era climatic crises described in the previous chapter also cast doubt on the notion that California was a fail-safe cornucopia for the state's ancient peoples. Even so, the notion of ancient California as a natural paradise for hunter-gatherers, launched by Kroeber and other early anthropologists (chapter 9), has proven to be one of the theories of California prehistory most resistant to change (Raab and Jones 2004). A corollary of this theory is the assumption that ancient California sustained consistently high levels of natural food production, thus offering an opportunity for elites to acquire power by taking charge of the redistribution of these resources (Arnold 2001a; Gamble 2008; Gamble and Russell 2003).

Publication of *The Origins of a Pacific Coast Chiefdom: The Chumash of the Channel Islands* by Arnold (2001a) was a major contribution to southern California coastal archaeology, arguing that the Northern Channel Islands were an essential component of emergent social complexity in the region. This and previous works laid out an innovative, multi-faceted model of the origins of Chumash chiefdoms. Arnold (1992) proposed that between about AD 1100 and 1300, a combination of environmental stresses, including drought and sea-temperature flux, resulted in food shortages in the Channel Islands (see chapter 9). Chiefs were able to exploit this crisis, it was thought, through control of trade networks involved in the exchange of Channel Islands craft commodities (marine shell beads) for mainland foodstuffs such as acorns.

Further developing this model, Arnold (2001b) proposed that the appearance of the Chumash ocean-going canoe sometime after about AD 500 (*Tomolo*, see chapters 3 and 4) supplied the choke-point that allowed chiefs to take control of the entire insular economy (Arnold 2001b). Coercive social relations, based on elite control of the means of economic production, gives this model a distinctly neo-Marxist character, in contrast to the benign functionalist tenor of King's model. A notable component of Arnold's (2001b) model, as discussed in chapter 4, was the argument that *Tomolos* were not only critical to elite power but also the first fully seaworthy boats to appear in the Chumash area.

Despite their differences about whether social power among the Chumash was coercive or consensual, the King and Arnold models are in agreement that goods such as marine shell beads and ornaments and food stuffs were being transported across the Chumash area in appreciable quantities, including the Northern Channel Islands. A logical implication of these models is that Late Holocene Chumash populations should have been the beneficiaries of rising subsistence abundance, owing to regional redistributive (political) economies. Put another way, these models imply that localized subsistence economies should have given way to increasing food abundance and diversity, as local production regimes were supplemented with non-local food stuffs.

How do such predictions fare on San Clemente Island? As we saw in chapters 5 and 8, relatively detailed analyses have been conducted on San Clemente Island subsistence patterns over time. Here, it might be useful to see how these data conform to the expectations of redistributive economic models.

Tegula Middens

In chapter 2, it was noted that the marine terraces along the west shore of San Clemente Island contain thousands of small archaeological sites (typically < 15 m diameter and < 1.0 m depth). These sites are characterized by large amounts of crushed shell from the small turban snail (*Tegula sp.*) collected in the island's intertidal zone (Raab 1992). In fact, these "Tegula middens" are the single most abundant archaeological site type on the island. Contrasts between Tegula middens and larger, more deeply stratified archaeological sites such as Eel Point are striking. As we saw in chapters 4, 5, and 8, Eel Point contains a wide range of cultural features (hearths, occupation surfaces, house floors, and burials), refuse deposits rich in faunal remains of many kinds, and a wide spectrum of bone, shell, and stone artifacts. Based on the density and diversity of cultural materials, Eel Point is reasonably viewed as a large and comparatively permanent residential base (chapters 4, 5, 6, and 8). Rarely more than 600 m^2 in extent, shallow Tegula middens typically contain few discrete cultural features and a limited range of artifacts and faunal remains (Raab 1992). These characteristics suggest loci of much shorter use duration and relatively limited activities.

Data presented in reports and previously published discussions allow us to gauge the relative intensity of fishing and shellfish collecting in the Tegula middens and at Eel Point. To date, only three Tegula middens on San Clemente Island (CA-SCLI-1318, -1319 and -1325), located about 4 km north of Eel Point, have been studied in enough detail to compare to the more intensively studied Eel Point site. Based on radiocarbon dating, Tegula middens appear to be a largely Late Holocene phenomenon (Raab 1992). Site CA-SCLI-1318 produced dates of cal AD 865 and 1655; site CA-SCLI-1319 yielded dates of cal 346 BC and AD 1660. From one to four 1 m^2 excavation units were placed in these sites (Raab 1992). Although radiocarbon dates were not obtained for site CA-SCLI-1325, the character of its shell-bearing deposits and the presence of circular shell fishhooks leave little doubt about its identity as a Late Holocene Tegula midden. At Eel Point, a sample of faunal data from three cultural strata of a 1×2 m excavation unit (2N/35E; Garlinghouse 2000; Raab et al. 1995b) can be compared with strata in the Tegula middens. The temporal overlap of the cultural strata that may be compared between the Tegula middens and Eel Point is not precise, but it seems clear that Eel Point and many of the Tegula middens were contemporaneous aspects of Late Holocene San Clemente Island's settlement-subsistence patterns.

In table 10-1, we can see that fish bone density in the three Tegula middens varies from a low of 0.001 to a high of 0.620 kg/m^3, with an average density of 0.153 kg/m^3 for all strata. Density of Tegula shell in these strata range from a low of 2.90 to a high of 67.10 kg/m^3, averaging 30.54 kg/m^3. As these data suggest, some strata consist almost entirely of crushed Tegula shell. In the three comparable strata from Eel Point, we find a quite different pattern with regard to the relative contributions of Tegula and fish to the diet. At Eel Point, Table 10-1 shows that Tegula range from a low of 1.46 to a high of 2.85 kg/m^3, with an average of 2.03 kg/m^3 for all three strata. However, in these same Eel Point strata, fish bones account for 0.71 to 1.42 kg/m^3, with an average of 1.13 kg/m^3. Another way to look at the differences between Eel Point and the three Tegula middens is the Tegula/fish ratio. In Table 10-1, this ratio varies from a low of 81:1 to a high of 902:1 in the Tegula middens. At Eel Point, this ratio ranges from 1:1 to 4:1.

Table 10-1. Tegula Shell and Fish Bone, kg/m^3, in Tegula Middens and Contemporaneous Eel Point Cultural Strata

Site Excavation Unit/ Cultural Strata	*Tegula*	*Fish Bone*	*Tegula/Fish Bone Ratio*
SCLI-1318:[1]			
0–10 cm	3.52	0.001	352:1
10–20 cm	6.42	0.015	428:1
20–30 cm	3.95	0.008	494:1
SCLI-1319:			
0–10 cm	7.15	0.016	447:1
10–20 cm	43.33	0.048	902:1
20–30 cm	67.10	0.240	280:1
30–40 cm	32.21	0.173	186:1
SCLI-1325:			
0–10 cm	18.64	0.229	81:1
10–20 cm	65.33	0.620	105:1
20–30 cm	66.75	0.380	176:1
30–40 cm	50.85	0.171	297:1
40–50 cm	28.85	0.078	370:1
50–60 cm	2.90	0.009	322:1
SCLI-43 (Eel Point)			
Unit 2N/35E:			
Stratum 5/6	1.46	1.42	1:1
Stratum 7	2.85	0.71	4:1
Stratum 8	1.79	1.26	1.4:1

[1] Data from Raab 1992

These data suggest that at Eel Point fish played a proportionally larger role in the diet than Tegula.

Is it possible that the differences between Eel Point and the Tegula middens merely reflect depositional scale? In other words, could it be that more of everything was deposited at Eel Point simply because that site sustained a larger population than any of the Tegula middens; leaving open the possibility that the relative importance of fishing and shellfish collecting was proportionally comparable at all sites? The ratios of Tegula to fish bone that we saw above argue against this possibility. Fish appear to have made a considerably larger contribution to the meals consumed at Eel Point than at the Tegula middens (Garlinghouse 1995, 2000; Raab et al. 1995b). Much the same pattern exists for the sea mammal consumption discussed in chapter 8 .

Another trend with regard to Tegula consumption is worth noting. As we saw in chapter 8, the consumption of small shellfish, particularly Tegula, expanded dramatically in the Late Holocene (Garlinghouse 2000). This pattern presents an interesting contrast with the Tegula middens, however. During the Late Holocene, even though shellfish collecting at Eel Point increasingly focused on Tegula, these small gastropods were a comparatively small component of the meals consumed at Eel Point. Although these data are limited, they hint at inter-site differences in subsistence behavior too pronounced to be dismissed as sampling error. The foraging pattern involved in the small Tegula middens primarily involved shellfish collecting and consumption, while at Eel Point there appears to have been greater emphasis on fishing and sea mammal hunting. These give the appearance of a bifurcated Late Holocene settlement-subsistence pattern. Fish and sea mammals appear to have been major staples at large, relatively permanent residential bases such as Eel Point, whereas many small, temporarily occupied satellite loci such as the Tegula middens subsisted largely on small shellfish. These patterns are difficult to square with the redistributive economy hypothesized for the Chumash area. Instead, San Clemente Island's Late Holocene settlement-subsistence patterns are better understood perhaps in relation to the resource intensification trends we examined in chapter 8, and new divisions of labor brought about by intensification across much of prehistoric California.

Intensification and Division of Labor

Researchers increasingly believe that gender-based divisions of labor probably changed over the Holocene, with the patterns observed among historical California Indian groups having arisen during the Late Holocene. Bettinger (1991), Walker and Erlandson (1986), Jones (1996), and McGuire and Hildebrandt (1994) argue that labor demands imposed by new foraging practices should be viewed as a logical cause of the widely documented, gender-based division of labor that existed in aboriginal California. In general, males fished and hunted larger game animals; females hunted smaller game and collected a wide range of plant foods (Willoughby 1963). Increasing expenditures of labor on gathering and processing small, dispersed food items; rising labor demands in the face of resource over-exploitation; and increased expenditures of effort on production and maintenance of a widening array of specialized tools and weapons all argue for an increasingly complex division of labor:

> The increased importance of fish and the adoption of more labor intensive shellfish exploitation strategies are consistent with the emergence of a processing specialization among women concurrent with increasing intensity in fishing and hunting by males. This appropriation of tasks approximates the division of labor observed at contact in native California. (Jones 1996:245)

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

The increasing importance of fishing and some aspects of sea mammal hunting (sea otters, for instance; see chapter 8) may help account for the comparatively dense concentration of fish and sea mammal remains at Eel Point, particularly if these activities involved frequent use of watercraft. The range of species found in the Eel Point fish assemblage suggests that a good deal of fishing was conducted in kelp beds, likely with the aid of boats (Raab et al. 1995b; Salls 1988). Pálsson (1991), in a world-wide ethnographic survey, shows that intensive fishing is strongly correlated with coastal sedentism because a centralized base of operations makes for efficient deployment of watercraft. Manufacture, maintenance, and storage of an increasingly diverse array of fishing and hunting gear are also managed effectively at a major base of operations. Processing of fish catches is also a logical activity at sites of this kind. Salls (1988:375) found large numbers of fish skull and tail bones and correspondingly small numbers of mid-body vertebrae in certain parts of the Eel Point site. Also noting copious quantities of ash and a general absence of bone charring, Salls (1988:375) argued that parts of the site were used to smoke or dry fish.

Eel Point's presence as a base for fishing and hunting does not explain the existence of the Tegula middens. Some of the intensification trends reflected at Eel Point may offer insights into this problem, however. A logical implication of declining foraging efficiency is a need for more frequent and wide-ranging foraging trips. Men and women are capable of equally high levels of stamina in pursuit of such a subsistence strategy, but young children are not (Kelly 1995:261–70). In many societies, foraging patterns allow children and their caregivers, often including the children's mothers and adults of both sexes, to be included in the food quest (Kelly 1995).

Because foraging trips take these collectors more than a few kilometers from a residential base, a need arises for locations where the group can rest and prepare meals. These sites have many of the qualities that Meehan (1982) documents for "dinner time camps" of Northern Australia. They offer an expedient facility for the preparation of meals by adults and their dependent children, while they are foraging for shellfish. Intensive foraging for both terrestrial and marine resources seems a logical source for the thousands of Tegula middens that dot San Clemente Island's landscape. Collecting of abalones and Tegula, and only a comparatively small amount of fishing, appear to have provisioned these camps.

A logical explanation of these patterns was an attempt to extract nutrients from a suite of resources that required increasingly labor-intensive, technologically diversified, and spatially extensive modes of foraging. If so, these patterns diverge from models of elite-brokered subsistence redistribution in two important ways. First, increases in gender-based divisions of labor accompany progressive loss of foraging efficiency (caloric/nutrient return per unit of time/effort expended; see chapter 8), not the increased economic abundance postulated by redistributive models. Second, foraging efficiency and division-of-labor trends on San Clemente Island appear to have been driven by locally available resources, not resources imported from distant locations. Also notably lacking on San Clemente Island is an export commodity comparable to the well-documented shell bead production on Northern Channel Islands such as Santa Cruz (Arnold 2001a; Kennett 2005; King 1990; Rick et al. 2005:209–10). On San Clemente Island at least, resource intensification trends and the available local subsistence resources may have far more to say about Late Holocene economies than the managerial skill of chiefs. Models that describe San Clemente Island's native population, the Island Gabrielino (see chapter 3), as redistributive chiefdoms in the same vein as their Chumash neighbors are called into serious questions by these findings.

Were the Island Chumash themselves a good example of redistributive subsistence economics? Studies of stable carbon and nitrogen isotopes (^{13}C, ^{15}N) found in prehistoric human skeletons offer useful insights into dietary regimes. In the Chumash area, including the Northern Channel Islands, Walker and DeNiro (1986) show that subsistence patterns, such as the relative contributions of marine and terrestrial food resources to the diet, can be gauged through the study of stable isotopes derived from human bone. These data probably should be regarded as suggestive rather than definitive, owing to the comparatively limited scope of this type of research to date. Even so, one of the most interesting aspects of this research is the finding that in the Chumash region, foraging location is strongly correlated with carbon-nitrogen ratios—more so than with than any other variable, including time period. Walker and DeNiro (1986) found that, across all time periods, the Channel Islands, mainland coast, and mainland interior regions display relatively discrete clusters of isotopic values. Interestingly, the Channel Islands' skeletal population has such a strong marine isotopic signal that the closest comparison of the diet of islanders is with seals and sea lions. These data provide scant evidence that mainland foods, such as carbohydrates derived from seeds or acorns, were an appreciable component of island diets. According to Lambert and Walker (1991:965), the stable isotope data point to an important conclusion about redistributive economies: "during the Late Period, the redistribution of food was insufficient to equalize local differences in resource availability."

Bio-archaeological evidence moves beyond reconstructions of prehistoric Chumash economy based on inferences from ethnohistoric sources to look at the people who actually lived through the events in question. Based on such evidence, it is far from clear that Chumash chiefs were able to redistribute significant amounts of food, and thus buffer the effects of climate stress. Instead, if San Clemente Island's Late Holocene settlement patterns are indicative, Channel Islanders may have responded to Late Holocene climatic stresses on the basis of localized adjustments to settlement patterning, foraging strategies, and inter-group relations, including trade and warfare.

Elite Control of Seafaring

As discussed in chapter 4, a number of theorists assign watercraft a central role in creating Chumash chiefdoms. Indeed, by some accounts the advent of effective seagoing watercraft is the *sine qua non* of chiefdoms. The logic of this position envisions different chiefly motivations but the same end result. For functionalists, the appearance of the Chumash *Tomolo* provides a plausible means by which chiefs could have transported large amounts of goods, including food, between mainland coastal communities and the Channel Islands, thus enticing commoners to submit to their authority (King 1976, 1990; Gamble 2002). For neo-Marxists, enticement had nothing much to do with it; instead, chiefs are envisioned effectively as a property-owning class, taking self-aggrandizing control of a vital means of production, namely the canoes that made redistribution of valuable commodities possible (Arnold 2001b). Either way, the advent of the *Tomolo* is viewed as a critical step in the rise of chiefdoms.

While scenarios of this kind may seem plausible when viewed solely within the context of the Chumash area, they ignore obvious questions posed by the larger context of Channel Islands prehistory. If large amounts of food from the mainland, particularly carbohydrate sources relatively scarce in insular settings, reached the Northern Channel Islands during the Late Holocene, after the advent of effective seafaring, why do the isotope data mentioned earlier fail to reflect such a trend? As we have seen elsewhere in this book (chapter 4), most authorities argue that Channel Islands chiefdoms were a Late Holocene development (Arnold 2001b; Gamble and Russell 2002; Glassow et al. 2007). San Clemente Island offers credible evidence of seafaring and sophisticated watercraft reaching back in time at least nine millennia (chapter 4). If the appearance of seagoing boats was a critical technological stimulus to emergence of chiefdoms, why is there no evidence of chiefdoms during the Middle or Early Holocene? Boats may well have been important to Chumash chiefs, but the argument that "fully developed" seafaring appeared for the first time in the Channel Islands during the Late Holocene, and thereby served as a critical new pathway to social power, is increasingly at odds with the history of seafaring in the region.

Climatic Stress, Violence, and Social Hierarchy

Debate continues about whether climatic stress played a significant role in altering Late Holocene cultural patterns of coastal southern California. Gamble (2005), for example, discounts such a possibility, arguing that groups such as Chumash and Gabrielino were able to buffer the effects of climate change through mechanisms like food storage and regional trade systems managed by chiefs. Several studies have, however, painted a more complicated picture of "punctuated" culture change coincident with periods of intense, persistent droughts associated with the Medieval Climatic Anomaly (MCA) (Arnold 1992; Fagan 2003; Jones et al. 1999; Kennett and Kennett 2000; Raab and Larson 1997). As noted earlier, Arnold (1992) was one of the first investigators to identify such droughts as the cause of a subsistence crisis in the Northern Channel Islands, necessitating larger imports of food to the islands from the mainland, thus elevating the importance of boats and the power of the chiefs who controlled them. While such trade implies at least a measure of control over the effects of drought, others emphasize that drought-driven scarcity appears to be a likely source of conflict (Kennett and Kennett 2000; Raab and Larson 1997).

San Clemente Island did not escape the effects of Late Holocene climate deterioration. As we saw in chapter 9, a major change in settlement patterning occurred on San Clemente Island between about AD 800 and 1300, consistent with increasing aridity. These data suggest that upland portions of the island, geologically unsuited to holding water, contained few sites during this interval, while the number of sites increased in locations near major water-holding canyons. Overall, it appears that San Clemente Island was sparsely populated or perhaps periodically depopulated during the MCA. How does this record compare with the Chumash area during the same time period?

It may be a mistake to assume that all coastal or insular groups responded alike to Late Holocene climatic pressures. On San Clemente Island, for example, there is little evidence for certain of the cultural reactions documented in the Northern Channel Islands. Kennett and Kennett (2000) found that warfare intensified in the Chumash area during periods of medieval-era drought, echoing similar findings by Lambert (1993) and Lambert and Walker (1991). Lambert (1993) also documents a significant deterioration in human health during this period in insular and mainland Chumash populations (Jones and Schwitalla 2008).

The Late Holocene Southern Channel Islands appear to have largely escaped the patterns of interpersonal violence that characterize their insular neighbors to the north. Admittedly this phenomenon is difficult to assess, since bio-archaeological data are far more limited from the Southern Channel Islands than from the Santa Barbara Channel area. Some of the best data come from the Nursery site (SCLI-1215) on San Clemente Island, where a Late Holocene cemetery has been partially excavated and analyzed. Salls (1988:388–90) reports a date of 1,490 ± 30 years (UCLA-2592) on a bone sample from one of the Nursery site burials. Potter (1998) describes 22 burials from this cemetery population, all of which appear to be contemporaneous, based on mortuary patterns and degree of preservation. Potter (1998:14) found that:

> Longer life expectancy and better general health for Late Holocene populations contrasts with that of the northern Channel Islands. In the southern Channel Islands, it appears that health was poor for the Middle Holocene samples and remarkably good for the Late Holocene sample. Also contrasting with the northern Channel Islands data is the temporal decrease of violence, as indicated by the lack of injuries present from interpersonal violence, in the Late Holocene sample.

To date, investigations in the Southern Channel Islands (Kerr and Hawley 2002; Potter 1998, 2004; Titus 1987) have failed to find skeletal evidence of interpersonal violence comparable to the Late Holocene populations of the Northern Channel Islands and adjacent mainland coast (Kennett and Kennett 2000; Lambert 1993). Wounds attributable to the bow and arrow—a new and more lethal form of combat that appeared during the Late Holocene—are conspicuously absent in the Southern Channel Islands skeletal populations studied to date. On San Clemente Island, small triangular stone arrow points are rare, while these are relatively common in Late Holocene archaeological contexts of the Santa Barbara Channel region (Glassow 1996).

As LeBlanc (1999) and Keeley (1997) document, ancient warfare was a potent source of culture change. Many of the dynamics linked to emergent social complexity, including violent conflict and inter-community cooperation, can be seen as logical responses to a need for community defense, leadership in warfare, and diplomacy between warring communities. Dynamics of this kind, more perhaps than redistributive economies or control of watercraft, are sources of social hierarchy.

If climatic stresses were responsible for deteriorating health, high rates of interpersonal violence, and a more complex social hierarchy in the Northern Channel Islands, what has not been explained to date is why such dynamics appear to be absent on San Clemente Island and perhaps throughout the southern islands as a whole. Perhaps this problem requires recognition that groups may employ a range of strategies for responding to stressful environmental and cultural conditions (Kennett 2005; Kennett and Kennett 2000). These may range from attempts to gain exclusive control over productive resources, sometimes employing violence, to cooperative modes of behavior involving trade and reciprocity.

Future research could profitably examine the cultural and environmental factors that promote differing responses across time and space. Instead of a monolithic march of chiefdoms toward social complexity, Late Holocene coastal southern California probably contained a variable mix of both adaptive modes.

In the Shadow of Chiefdoms

The brief examples given here do not adequately probe the cultural trends that distinguished the Northern from the Southern Channel Islands during the Late Holocene. However, it is evident that considerable variability existed between the two island groups with regard to social complexity (Rick et al. 2005:212–13). Where the clearest archaeological evidence of complexity can be seen in coastal southern California (e.g., status hierarchy in mortuary populations, settlement aggregation, and trade in non-food items) these traits were part of a distinctive cultural pattern that emerged in the Late Holocene Santa Barbara Channel area (Arnold 2001a; Kennett 2005). As noted above, increased territoriality and violent competition were fundamental components of this pattern (Jones et al. 1999; Jones and Schwitalla 2008; Kennett and Kennett 2000; Lambert and Walker 1991).

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

Much of the adjacent mainland coast appears to reflect a pattern similar to the Southern Channel Islands. If so, one of the crucial tasks before researchers interested in emergent social complexity is explaining why the distinctive constellation of enhanced territoriality, high rates of interpersonal violence, depressed health, and intensive trade in manufactured goods seen in the Chumash region failed to become universal, despite the fact that Late Holocene climatic and resource intensification stresses seem to have been pervasive.

Jones and Klar (2007:314) emphasize the increasingly diverse panorama of prehistoric social complexity that has emerged in California during the last two to three decades: "As with so many other aspects of California prehistory, emergent complexity defies explanation via any single theoretical perspective. Some regions conform with the expectations of linear cultural evolution, whereas in others, devolution, decentralization, and deintensification seem to have occurred late in time."

Expanding research on southern California's coastal peoples has contributed strongly to this picture. Where Chumash chiefdoms once tended to overshadow thinking about social complexity, a broadening base of research, including the discoveries presented in this volume, exposes a high degree of Late Holocene cultural variability across the Channel Islands and the southern California mainland coast. The nature and causes of maritime social complexity across this region, including the Chumash area, remain far from completely understood. It seems increasingly apparent, however, that Chumash chiefdoms were part of a diverse mosaic of maritime social complexity, rather than an evolutionary or developmental stage toward which all southern California coastal groups were trending.

11

Vectors of Death and Native Messiahs

L. Mark Raab

Previous chapters of this book mark a journey through time of at least nine millennia, a chronicle that would not be complete without considering prehistory's poignant end on San Clemente Island. As generations of schoolchildren have learned, soldiers and priests representing the Spanish colonial empire arrived in California in the late 1700s to establish a chain of missions stretching from San Diego to San Francisco Bay. The resulting calamities for California's indigenous peoples, including the introduction of devastating new diseases and various forms of cultural oppression, are well known. The end of the prehistoric era in California is conventionally, but not altogether accurately, attributed to this period of colonization.

In his Pulitzer Prize–winning *Guns, Germs, and Steel*, Jared Diamond (1997) describes the global mosaic of culture change, often disastrous, that was wrought by European exploration and colonization from the fifteenth through the eighteenth centuries. Societies around the globe were transformed by European diseases, technologies, and institutions. As one of the first points of contact between native North America and European explorers, San Clemente Island offers an archaeological record that shows an exceptionally detailed picture of the effects of these powerful agents of culture change.

As noted in chapters 3 and 4, Juan Rodríguez Cabrillo and his sailors arrived on the Southern California coast in 1542, a scant 44 years after Columbus's world-changing voyage, thus including the Channel Islands among the earliest points of contact between Native Americans and Europeans in the New World. This was not followed, as many seem to suppose, by immediate Spanish colonization. It was not until construction of Mission San Diego in 1769 that the first European settlers claimed California. The 227-year reprieve between initial European contact and settlement was by no means uneventful, however. Southern California Indians almost certainly had indirect contacts with Europeans through interactions with the native populations of Baja California and the American Southwest, where Spanish colonization was well under way during the 1600s (Reff 1991). California continued to be visited by European and Mexican sailors traversing the trans-Pacific Spanish trade routes between East Asia and Western Mexico. These early voyages undoubtedly resulted in Indians coming aboard Spanish ships, sailors going ashore to visit Indian coastal communities, and the conveyance of European-made goods to Indian trade partners (Erlandson and Bartoy 1995; Preston 2004). As we shall see below, these exchanges almost certainly yielded lethal biological consequences for California Indians.

Our understanding of how native Californian groups coped with European influences during this twilight of prehistory remains murky, owing to the paucity of both historical accounts and archaeological data from this era. However, intriguing patterns from this time period are beginning to come into focus. In this chapter, we examine the attempts of San Clemente Islanders and other Indian groups to preserve their cultural autonomy through a social movement based in part on new ideas and material items of European origin.

Religions of the Oppressed

Anthropologists have long known that contact between cultures can spark "revitalization" movements. A classic Native American example is the nineteenth-century Ghost Dance, a movement inspired by Wavoka (Jack Wilson), a Paiute Indian shaman. The message of Wavoka, who was seen as a messianic figure, appealed to Native American groups threatened by expanding Euro-American settlement and punitive military campaigns. By the close of the nineteenth century, the Ghost Dance movement had spread to Indian groups across much of the western United States and Canada (Kehoe 2006). Like other revitalization movements, the Ghost Dance attracted groups facing catastrophic culture change at the hands of a more populous and technoeconomically powerful society. Through rituals designed to promote social solidarity among the oppressed and to obtain the protection of supernatural forces, the Ghost Dance offered to bring back the old ways of life and fend off powerful enemies.

Native American revitalization movements also took hold in California. Chartkoff and Chartkoff (1984:241) describe four major religious movements that emerged among California Indians during late prehistoric or early historic times:

> Four great regional patterns or traditional systems of religious movements arose in California during the [late prehistoric period]: the World Renewal movement in northwestern California, the Kuksu Cult of the Sacramento Valley and North Coast Ranges, the Chingichngish movement of coastal southern California, and the Toloache Cult, which was widespread in the region south of the Delta. Though the details of the movements varied considerably, they also shared certain features: their ceremonies were conducted by religious societies that existed within communities; membership was usually restricted to those adult males who passed initiation tests; and shamans played important roles in these societies.

Bean and Vane (1978) suggest that the *Chingichngish* movement of southern California was among the "crisis cults" that sprang up in California and other parts of North America in response to disruptions brought about by contact with Europeans. This movement may have had connections to the native "*toloache* religious system," involving the use of an intoxicant made from the *Datura* plant ("loco weed") during the initiation of adolescents into adulthood:

> A second variation on the toloache religious system was the Chingichngish religion, which may have developed from conditions arising from European contact, perhaps a "crisis cult" developed in reaction to European diseases that were decimating Gabrielino and Luiseño groups prior to 1776. Others have theorized that this branch of the toloache religion developed as

> a result of contact with Christian deserters or castaways, since many of its central features are reminiscent of Christian themes. (Bean and Vane 1978:669)

Until recently, most of our information about the Chingichngish religion was recorded by mission clerics. One of the most detailed of these accounts was authored by Fray Gerónimo Boscana, recording his observations of Indian life in a manuscript that was not translated until many years after his death. Boscana's manuscript, commonly referred to as Chingichngish, was published in 1846 in an English-language translation. A modern edition of Chingichngish appeared in 1933, edited by P. T. Hanna and annotated by J. P. Harrington, the latter a well-known California ethnographer (Harrington 1933). Kroeber (1925:636), in his landmark of California anthropology, *The Handbook of the Indians of California*, describes Boscana's manuscript as "easily the most intensive and best written account of the customs and religion of any group of California Indians in the mission days."

Stationed at San Juan Capistrano Mission from 1812 to 1826, Boscana wrote an account based primarily on his missionary work among Juaneño and Gabrielino Indian neophytes; the latter drawn from the Gabrielino Indian communities described in chapter 3, likely including individuals from the Southern Channel Islands (Johnson 1988). The principal importance of this work for Native American religion is a description of the rituals and beliefs associated with the Chingichngish religion, elements of which were widespread among native peoples in southern California during the early historic era (Kroeber 1925). A complete description of the rituals and beliefs associated with the Chingichngish religion goes beyond our scope, but Bean and Vane (1978:669) offer this summary:

> The religion is traditionally supposed to have diffused from Pubunga (near Long Beach) in Gabrielino territory where a shamanlike hero named Chingichngish taught a new body of beliefs that became syncretized with preexisting beliefs and practices. He was assimilated into Luiseño religious literature as creator of the Luiseño and their laws and rituals, after he had transformed the people created by *wiyot*, the earlier creator, into spirits. He provided a more explicitly moral normative order than had hitherto prevailed and enforced his order by creating a new class of

> spirits, the "avengers" (rattlesnake, spider, tarantula, bear, sting ray, raven), who were assigned to watch that people obeyed his laws and to punish wrongdoers.

The Chingichngish religion, then, appears to be an amalgam of pre-European shamanistic practices and elements of Christian theology (Bean and Vane 1976; Kroeber 1925). The latter appears to be reflected in both the messianic role of Chingichngish and notions of divine moral oversight. This moralistic tone represents a distinct departure from the shamanistic religions that characterized most of Native California, where shamanism was concerned largely with matters such as witchcraft, healing, divination, and the rites of passage associated with birth, puberty, and death. Notably, Chingichngish religion included communal ceremonies in which animal sacrifices were made, particularly raptors (birds of prey) such as eagles or hawks. According to Boscana's account, after being killed during a dance performed by a shaman, the bird's body was ritually buried. These sacrifices were envisioned as messengers between humans and the creator deities.

In all, ethnohistorical evidence points to the Gabrielino Indians, perhaps along with their Luiseño Indian neighbors, as likely originators of the Chingichngish movement (Kroeber 1925). However, a number of questions remain: Did the Chingichngish movement come about in the missions or from earlier contacts with Europeans? What kinds of crises were provoked by European contact? Did the movement arise in a mainland setting, or could it have appeared first in insular Gabrielino communities? Discoveries on San Clemente Island may help us to answer these questions.

Archaeological Correlates of Chingichngish

San Clemente Island archaeological sites provide a possible window on the origins of Chingichngish ceremonialism:

Big Dog Cave

The first overland exploration of California by Europeans departed from Mexico in 1769 under the leadership of Don Gaspar de Portolá. In an effort to supply the expedition upon their arrival in San Diego, the Spanish Viceroy José de Galvéz dispatched two ships. One of these, the *San Antonio*, carried Fray Juan Vizcaíno, who kept a diary of the expedition's daily progress. The *San Antonio* miscalculated its position, however, and made its first California landfall on the Channel Islands rather than the mainland coast. This accident brought members of the expedition to San Clemente Island when, on March 15, the *San Antonio* sighted the southern end of the island. Rounding a point with a "hummock rising from the sea" (likely China Point), Vizcaíno observed Indians with cooking fires along the beach (Pyramid Cove). The *San Antonio* remained at the island until March 21, during which time several contacts with the aboriginal population were made. Wooden plank canoes containing two to four islanders paddled out to trade with the passengers of the *San Antonio* (Vizcaíno 1959:7–19).

This contact on the south shore of San Clemente Island would have brought Europeans very near Big Dog Cave (Woodward 1941), the archaeological site described in chapter 3. Whether inhabitants of the cave made contact with Europeans in 1769 is unknown. However, it is clear that the cave's Indian inhabitants had contact with the Spanish missions constructed in the years following the Portolá expedition. An expedition from the Natural History Museum of Los Angeles County camped in the same area 170 years after Vizcaíno's visit to San Clemente Island. The archaeologists of this expedition visited several of the possible Indian settlements described by Vizcaíno.

Among these sites was Big Dog Cave (CA-SCLI-119), named after the burial of a dog wrapped in otter skin, excavated by Arthur Woodward and his team from the Natural History Museum (Ehringer 2003; Woodward 1941). Although the cave yielded an excellent collection of Indian and European artifacts (currently housed at the museum), other artifacts were apparently taken by relic hunters before Woodward's arrival—a not-uncommon fate of Channel Islands archaeological sites (see chapter 3). The Big Dog Cave archaeological material offers impressive testimony of the interaction between the Indians of San Clemente Island and the Spanish missions. Saturated by salt spray from the nearby ocean, the cave's sediments offered a rich array of perishable materials preserved by the cave's saline environment (Salls 1990).

The presence of loom-woven cloth and a buried domestic chicken, both items of European origin, places the occupation of the cave within the mission era (1769–1834). The cave also yielded canoe plank fragments, basket fragments, and cordage. Several wrapped bundles were found—one containing the "big dog" burial that inspired the cave's name. Bundle wrapping consisted of a variety of materials, including fiber netting, sea grass, sea otter fur, and cloth of mission origin (Ehringer 2003; Woodward 1941:284).

Woodward's work established Big Dog Cave as a remarkably well-preserved window into contact between native San Clemente Islanders and the early Spanish colonists of California. It seemed to most observers that Big Dog Cave recorded the activities of mission runaways—Indians who fled to relatively remote San Clemente Island to continue a more traditional way of life beyond the control of Europeans. What Woodward could not have known at the time, Big Dog Cave was part of a pattern that antedates the missions and one that suggests a more active role for insular locations like San Clemente Island in the origins of the Chingichngish religion.

Lemon Tank

The true scope of San Clemente Island's connection to the Chingichngish religion came into focus during the 1980s. Archaeologists from UCLA excavated a series of archaeological sites on the island's central plateau (see chapter 3), where they found pits containing mission-era objects of European manufacture, including a religious medal. In the vein of Big Dog Cave, Rechtman (1985) linked these finds to Indian refugees from the mainland caching their valuables.

To better define this interesting cultural pattern, Andrew Yatsko and Mark Raab undertook investigation of the Lemon Tank archaeological site (CA-SCLI-1524) in 1988 and 1989, as discussed in chapter 3. Lemon Tank's location and surface artifacts suggested similarities to the sites investigated by UCLA researchers. These excavations pointed to a more complex set of events than previously recognized.

Thirty-eight 1 m^2 and six 0.5 m^2 pits were excavated at Lemon Tank, for a total excavated volume of about 15 m^3. This volume represents an estimated 5 to 10 percent of the archaeological

Table 11-1. Radiocarbon Dates from the Lemon Tank Archaeological Site (CA-SCLI-1524)

Lab Number	*Provenience*	*^{14}C Age*[1]	*Material*	*Calibrated Years AD*[2]
Beta-39151	9S/15E, 30–40 cm	370 ± 50	charcoal	1452–1522
Beta-39152	15E/0N, 40–50 cm	1140 ± 90	charcoal	803–986
Beta-39153	9S/16E, 30–40 cm	300 ± 60	seeds	1511–1601

[1] Radiocarbon years before present, uncorrected for fractionation.
[2] Dendrocalibrated age, 1-s range.

deposits located within the site's core area. Artifacts from the site, including glass beads, a fragment of a wheel-made ceramic vessel, a ceramic pipe stem fragment, and metal fragments, point to early contacts with Europeans (Hale 1995). This assessment is born out by three radiocarbon dates from Lemon Tank, shown in table 11-1. These dates mark a temporal span ranging from the prehistoric era (AD 780 to 793 and AD 1452 to 1522) into the period of initial European exploration of coastal southern California (AD 1511–1601; Cabrillo contact in AD 1542), but all antedate the founding of the California missions (AD 1769).

A total of 136 cultural features were defined at Lemon Tank. A detailed analysis of the Lemon Tank features by Hale (1995) shows patterns remarkably consistent with descriptions of Chingichngish ceremonialism by Boscana. Hale's (1995) findings convey the richly detailed evidence of ceremonialism that emerged from the Lemon Tank site. Ritual burials of raptors are a good example (see figure 11-1):

> The distribution of the eight bird burials . . . shows six of them within the central structure area (features 23, 116, 118, 129, 132 and 141), one outside of it (feature 93), and one (feature 63) along the central structure wall in the burned personal property fire area in unit 9S/14E. All of the birds are immature individuals. All were buried vertically, head down, except for features 93 and 118, which were head up. . . . Five are red-tail hawks (*Buteo jamaicensis*), two are peregrine falcons (*Falco peregrinus*) and one is a raven (*Corvus corvax*). One red-tail hawk, feature 23, and the raven, feature 93, were capped with pinniped [seal-sea lion] scapulae. Features 116 and 132 were capped with rocks. (Hale 1995:21)

Figure 11-1. Raptor burial from Lemon Tank Archaeological Site (CA-SCLI-1524).

Hale's research documents equally striking sacrificial burials of canids (dogs and foxes; figure 11-2):

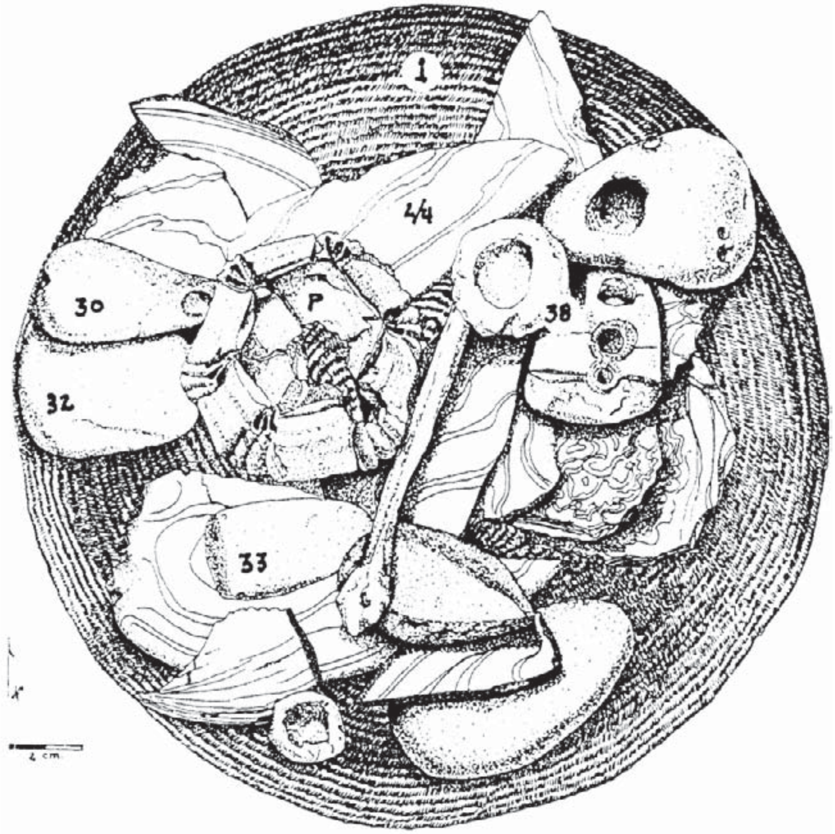
> The distribution of the canid burials . . . suggests at least two forms of canid sacrifice. The six fox burials (features 6, 48, 96, 109, 125 and 140) and two of the dog burials (features 5 and 124) were outside the central structure area. All of these were juvenile animals, six to eight weeks old, except for feature 125, an adult Channel Island fox (*Urocyon littoralis*) and feature 5, an adult dog (*Canis familiaris*). All of the juvenile animals were buried near fire sites, vertically, either head up or head down . . ., except for feature 124, which was extended and feature 48, parts of a disarticulated juvenile fox among a collection of personal property items. Both of these features were near a burned personal property feature, 138. Feature 124 probably represents a fox burial disturbed by burning activity. The dog in feature 124 did not appear to have been buried at all and may have died in the fire, or at some later time. Feature 125, the adult fox, was partially disarticulated and buried adjacent to the burned personal property feature 131, in unit 7S/17E. (Hale 1995:23)

In yet another revealing discovery, Hale (1995:21–22) describes a feature of particular symbolic importance:

> Feature 120 . . ., adjacent to the stone bowl feature 41 near the center of the central structure area, contained an assemblage of shell, stone and bone objects arrayed on the basket-tray. The array consisted of thirteen tear-drop shaped Haliotis sp. cutouts spread over the basket surface with three clusters of mineral objects ranged around a central, large barnacle (*Coronula diadema*). The mineral objects consist of three flat, ovoid sandstone pieces and a sandstone object with a barnacle hole etched deeply into it, three shaped steatite pieces and two small cup-shaped pieces of chalk. A bone awl, made from the fibula of a California sea lion (*Zalophus californianus*) lay adjacent to the barnacle with its point oriented toward magnetic north. The entire assemblage had been liberally dusted with powdered red ocher.

The barnacle mentioned above, *Coronula diadema*, grows only on the bodies of whales, usually the humpback (*Megaphera novaeangliae*). The obvious care with which feature 120 was prepared led Hale (1995:55–56) to interpret this feature as a *Tukmul* basket-tray of considerable ceremonial significance in initiation ceremonies (figure 11-3).

Figure 11-2. Dog burial from Lemon Tank Archaeological Site (CA-SCLI-1524).



1. Milky Way
2. Night (or sky)
3. Our spirit or soul
P. Pit in center
30. Sea
32. Hill or *hulwul* plant
33. Boil, abscess
38. Four avenging animals

Figure 11-3. Artist's reconstruction of Tukmul *basket-tray (from Hale 1995:56).*

Based on the elaborate rituals reflected at Lemon Tank, this site contains perhaps the most extensive and best-preserved archaeological evidence of Chingichngish ceremonialism documented to date. The raptor burials are particularly evocative of the ceremonies described by Boscana, where birds of prey were ritually killed and placed in offertory pits. On the other hand, the canids (dogs and foxes) appear to reflect types of sacrificial animal burials that are not reflected in historic accounts such as Boscana's.

These data suggest that Chingichngish ceremonialism may have had more diverse elements than were captured by historical accounts. This is not surprising, perhaps, if one assumes that Chingichngish ceremonialism occurred outside the gaze of European observers and was associated with some degree of regional or temporal variation. If so, the San Clemente Island archaeological record offers valuable insight into the ritual components of Chingichngish.

Return to Big Dog Cave

The Lemon Tank discoveries cast a fresh light on the artifacts discovered at Big Dog Cave and other island sites. Given the expanded view of Chingichngish ceremonialism reflected at Lemon Tank, the finds reported by Rechtman (1985) may actually have been offertory pits, rather than simply caches of personal property left behind by Indian refugees escaping from mainland European oppressors. A recent reanalysis of the contents of Big Dog Cave by Erhringer (2003) suggests a previously unsuspected connection between Big Dog Cave and the Chingichngish religion. When the burial of chickens, dogs, and various artifacts first came to light at Big Dog Cave, there was no archaeological "search image" for recognizing Chingichngish ceremonialism. In light of the patterns at Lemon Tank, however, the chicken burials at Big Dog Cave may well parallel the raptors and other birds (ravens, for example) buried at Lemon Tank. The ritual burial of dogs at both sites suggests another parallel (Ehringer 2003). Moreover, the burial of mission-era cloth, the wooden canoe effigy, wheat seeds, and other objects at Big Dog Cave (Coleman and Wise 1994) also has parallels in the features at Lemon Tank in the form of basketry, cordage, steatite (soapstone) effigies, fishhooks, and a seed cache containing the deciduous teeth of children (Eisentraut 1990).

Based on the Lemon Tank radiocarbon dates, it appears that an elaborate complex of Chingichngish ceremonialism was present on San Clemente Island during the 1600s—the interval between initial European contact (1542) and construction of the missions (1769). Assuming a ritual continuity between Lemon Tank and Big Dog Cave, the latter is explicable perhaps as a mission-era expression of evolving Chingichngish ceremonialism, where items of mission origin, including chickens and cloth, were added to offertory items of native origin (dogs, foxes, raptors, etc.). If so, San Clemente Island may indeed have served as a center of Chingichngish ritual, away from the control of colonial authorities.

Chingichngish as a Crisis Religion

When the ship *San Antonio* dropped anchor off San Clemente Island in 1769, it was preceded by other European landfalls in coastal southern California by more than two centuries. Based on what we know of other world regions, such voyages were powerful agents of culture change in native communities. One of the most catastrophic of these influences was, of course, the introduction of devastating new maladies into native populations, such as smallpox, measles, malaria, venereal diseases, and other scourges. Could such a thing have happened in premission California?

This question is difficult to answer, given the devastation inflicted by epidemic disease. Based on historical evidence (Dobyns 1983; Preston 2004; Ramenovsky 1987; Reff 1991), European diseases often spread so quickly and with such lethality among susceptible Native American populations that many of the dead were never buried. Among small island populations, these effects would have been especially devastating. Even the survival of those not felled directly by disease would have been rendered desperate, owing to the destruction of the labor force engaged in food production, and the disruption of vital trade networks.

The likelihood that such "virgin soil epidemics" erupted from premission contacts seems nearly certain. Erlandson and Bartoy (1995) and Preston (2004), for example, document *known* contacts between ships and coastal groups between 1542 and 1769. However, since the California coast was on a regularly traveled route of Spanish galleons returning to Mexico from the Orient, as noted earlier, it seems quite likely that the coast was visited by Europeans on many occasions that escaped record.

What we know with certainty is that devastating disease epidemics were ignited in virtually every corner of the New World following even intermittent contact with Europeans. In what Ramenovsky (1987) aptly refers to as “vectors of death,” European diseases often raced through native populations tens or even hundreds of kilometers distant from points of initial infection (Diamond 1997; Dobyns 1983; Reff 1991). Based on the information compiled by Erlandson and Bartoy (1995), it seems highly probable that at least regional epidemics followed the visits of European ships to the Channel Islands and other coastal localities from the earliest dates of contact onward.

Aside from disease, the psychological dislocations of European contact were likely substantial. The sudden appearance of powerful strangers on the coast must have provoked considerable alarm among groups little equipped to resist European influences. Introduction of trade goods such as glass beads and metal tools (which were unknown prior to European contact) would also have begun to supplant native economies, perhaps further destabilizing social relations.

Given that the Channel Islands were among the earliest points of contact between Europeans and Native Americans in North America, it may not be surprising that a Chingichngish crisis region, combining exotic and native ideological and material elements, sprang up early, perhaps even first, in insular California. If so, the Chingichngish movement that sprang up on San Clemente, and perhaps other Channel Islands, appears to have survived long enough to be recorded by clerics such as Boscana. If this scenario is correct, San Clemente Island offers a glimpse into this “ground zero” from which some of the earliest collisions of European and Indian societies rippled outward across California and far beyond. Chingichngish was a portent of crises to come, as Native American cultural autonomy retreated under the advance of Euro-American civilization. If the nineteenth-century Ghost Dance marked one of the last of these crises, Chingichngish may have been among the first. Born of tragedy and ruin, Chingichngish effectively signaled the twilight of prehistory on San Clemente Island.

V

TOWARD A NEW PARADIGM OF MARITIME PREHISTORY

12

Perspectives from an Island Laboratory

L. Mark Raab, Jim Cassidy, Andrew Yatsko,
and William J. Howard

We conclude our study of San Clemente Island by returning to an observation made at the outset of this book: Once an obscure province of adventurers and relic collectors, California's Channel Islands have emerged in recent decades as one of archaeology's finest natural laboratories. These islands lend themselves to "natural experiments" from which all historical sciences draw their analytical power. In archaeology, as in geology, paleontology, biology, and other disciplines, such experiments seek to evaluate rival explanatory models through the comparative method. Accounting for patterns of archaeological data under contrasting temporal and/or spatial conditions is the operational basis of this approach. In these match-ups, one model is not preferred over another because it is perfect but rather because it accounts for patterns of data better than its competitors.

Employed by archaeologists around the world, this approach is scarcely unique to the present study. Nor can any single location or methodological or theoretical viewpoint adequately reconstruct something as manifestly complex as southern California's maritime prehistory. Just the same, we believe the data presented in this book offer an informative vantage point. These data span at least nine millennia, offering insights into the diverse maritime cultural patterns we examined earlier: seafaring origins (chapter 4), maritime subsistence (chapters 5 and 8), residential sedentism (chapter 6), trade and cultural interaction (chapter 7), paleoenvironmental change (chapter 9), social complexity (chapter 10), and culture contact (chapter 11). What lessons can we draw from these data about the origins and development of southern California's prehistoric maritime societies?

Modeling Maritime Prehistory

California Archaeology (Michael Moratto) and *The Archaeology of California* (Joseph and Kerry Chartkoff) both appeared in 1984. These works synthesized decades of archaeological, ethnographic, and linguistic research, achieving two of the most comprehensive overviews of California archaeology in print (Moratto and Chartkoff 2007). We agree with Jones and Klar (2007) that the contrasting models of California prehistory offered by these works are a logical starting point for any synthetic treatment of the state's prehistory. The divergent models of maritime cultural development advanced by the 1984 volumes are a case in point. The progressive-evolutionary logic of the Chartkoff and Chartkoff (1984) model stands in sharp contrast to the more cultural-ecological and historically "contingent" dynamics behind Moratto's formulation (1984).

Progressive Cultural Evolution

"As California's native population grew over the last 12,000 to 13,000 years, people gradually became more sedentary, increased their participation in trade, and became more sociopolitically complex" (Jones and Klar 2007:299). This succinct summary of the Chartkoff and Chartkoff (1984) model captures its grounding in the idea of progressive cultural evolution—i.e., cultural complexity is the end state of incremental, trans-Holocene increases in technoeconomic and social-organizational sophistication. This notion of cultural progress has, of course, been one of the most familiar branches of anthropological and archaeological theory since the nineteenth century (Bettinger 1991a; Trigger 1989). Understandably, theories of this kind flourished in a time when archaeologists' stock of data about coastal prehistory was at best rudimentary (chapter 1).

To quickly reprise this line of thinking, theorists assumed that Paleo-Indians, terrestrial hunters of big game who migrated into North America from Eastern Siberia near the end of the last Ice Age, were the ancestral cultural stock of all native New World peoples, with the exception of certain late-arriving Arctic groups (chapter 1). Paleo-Indians or their immediate successors appeared to be the first humans to reach the California littoral, from which point it took millennia of trial and error for these hunters to develop a taste for marine foods and the technological capabilities to acquire them. This *in situ* evolution, according to the Chartkoff and Chartkoff model (1984), yielded true maritime societies near the end of the Holocene.

It was generally supposed that the Channel Islands could not be colonized until the development of effective boats and intensively maritime economies, events set at no more than two to five millennia before European contact. Once these were in place, however, intensive sea mammal hunting and off-shore fishing catalyzed economic growth capable of sustaining residential sedentism and political economies directed by powerful chiefs (see chapters 4, 6, and 10). The Gabrielino and Chumash chiefdoms that greeted the first European explorers were thus the climax of a sequence of terrestrial-to-maritime cultural transformation reaching back in time to the arrival of California's first coastal populations. Given this developmental sequence, it seemed logical to suppose that maritime prehistory could be "reverse engineered" by seeking the cultural traits of historic coastal groups in the archaeological record.

California Paleo-Coastal Tradition

Moratto's (1984) model "integrated historic linguistic analysis with paleoenvironmental information to develop a masterful, highly plausible prehistory in which climate flux was seen as an important agent of cultural change" (Jones and Klar 2007:299). This was a more eclectic stance than the Chartkoff and Chartkoff (1984) scheme, emphasizing the importance of population migrations, replacements, culture contact, and climatic forces in bringing about sometimes abrupt and discontinuous patterns of culture change. Moratto's formulation envisioned prehistoric culture change in

California as a complex mosaic with many causes, rather than a product of the broadly transformative stages posited by progressive-evolutionism. The intrusion of Great Basin Uto-Aztecan speakers into California and the Southern Channel Islands, discussed in chapters 3 and 7, is one such example of these dynamics.

One of the most important contributions of Moratto's model was postulation of a California Paleo-Coastal Tradition, discussed in chapter 1. This hypothesis was a decisive break with traditional models of California maritime prehistory. Whereas Chartkoff and Chartkoff (1984) argued that true maritime cultural adaptations were a Late Holocene development, Moratto (1984:104–13) pointed to emerging evidence of maritime foraging in California during the Early Holocene, perhaps even as early as the terminal Pleistocene.

Assessing the Maritime Record

These contrasting models represent paradigmatic differences in our understanding of California coastal prehistory. Key features of Moratto's model (1984), including the Paleo-Coastal hypothesis and multi-causal, non-linear patterns of culture change, stand in sharp contrast, once again, to the more linear, transformative stages of cultural evolution envisioned by Chartkoff and Chartkoff (1984). These rival models offer the basis of a useful "crucial experiment," inasmuch as the timing and character of maritime cultural developments envisioned by each are quite different, even mutually exclusive. Which of these models best comports with the available evidence? We turn next to the San Clemente Island data for some possible answers.

Origins of Seafaring

The advent of seafaring is clearly central to maritime cultural origins. In chapter 4, we saw that San Clemente Island's mariners were constructing seaworthy watercraft by 7000 BC, and likely much earlier. Data from the Eel Point archaeological site suggest Early Holocene boat-building technological capabilities comparable to the historic Island Gabrielino and Chumash Indians (chapters 3 and 4). Eel Point brings early seafaring into relatively sharp archaeological resolution, but it is hardly an isolated case. Archaeological deposits and human skeletal remains in the Northern Channel Islands, dating between 8,000 and 11,000 years BC, are explicable only on the basis of watercraft (Rick 2007; Rick and Erlandson 2008; Rick et al. 2005). These data point to sea travel on the southern California coast by the time of the Pleistocene/Holocene transition. As we saw in discussions of the Eel Point and Nursery sites (chapters 4, 5, 6, and 8), substantial refuse deposits and cultural features found in Early and Middle Holocene cultural strata attest to a relatively intensive occupation, consistent with substantial residential groups. Moreover, studies of the aboriginal settlement of other insular settings, notably Polynesia, make it clear that long-term colonization of small islands can only be sustained through contact with larger populations (Diamond 1997; Kirch 2000). It seems clear that sea travel was essential to long-term colonization of the California Channel Islands.

These findings directly challenge a key tenet of the progressive-evolutionary model of maritime prehistory. As discussed in chapter 4, some theorists argue that the "fully developed" Chumash Indian plank canoe (*Tomolo*) appeared only after about AD 500, making substantial transport of people and goods to the Channel Islands possible for the first time. The advent of such boats, according to this model, ushered in a host of new and revolutionary socioeconomic arrangements, particularly monopolistic control of watercraft by chiefs (Arnold 2001b; Munns and Arnold 2002). Thus ended, according to this model, an earlier "littoral phase" of watercraft use, during which the Chumash were restricted to waters near the mainland coast by boats too primitive to venture into the open sea. To our knowledge, there is no archaeological evidence of a primitive littoral phase in coastal southern California, if we mean a time during which coastal populations were restricted to near-shore mainland waters by a lack of seagoing boats. Such a phase is difficult to reconcile with the long history of Channel Islands settlement outlined above.

It seems probable that seaborne passages to the Channel Islands have always demanded sophisticated watercraft and seafaring skills. As an archaeologist and skilled mariner with first-hand experience of the seas surrounding the Channel Islands, Fagan (2004) convincingly argues this point. Accordingly, it may be useful to broaden the study of seafaring origins from an emphasis on ethnographic case studies to research comparing maritime technological capabilities, like the example presented in chapter 4.

In contrast to the progressive-evolutionist scenario, which tends to view Native Californian seafaring as an exclusively *in situ* development, Moratto's (1984) model leaves room for alternative hypotheses. Sea travel in Eurasia extends hundreds of thousands of years into the past (Erlandson 2004; Rick and Erlandson 2008), opening the possibility of early Pacific North American seafaring traditions with origins far from coastal California, a point that we will return to. At the other end of the prehistoric era, Jones and Klar (2005) hypothesize that Polynesian sailors may have reached the southern California coast sometime after AD 800, introducing a new type of seagoing canoe, along with its Polynesian linguistic referents, to the Chumash. In support of this provocative hypothesis, Jones and Klar (2005) point to the timing of the *Tomolo*'s appearance, similar technological attributes of Polynesian and Chumash canoes, as well as shared linguistic patterns and fishing technologies. In our view, this hypothesis, too, has a useful place in the debate about California seafaring origins.

Evidence of early seafaring in the Channel Islands weighs decisively in favor of Moratto's Paleo-Coastal hypothesis. The possibility of multiple seafaring traditions is also compatible with the hypothesis that migration and intrusion of peoples and/or ideas shaped not only prehistoric California's complex cultural landscapes but seascapes as well.

Maritime Subsistence

When evidence of early coastal occupation began to materialize in California, critics suggested that these occupations might not represent "real" maritime cultural adaptations but rather terrestrial foragers who occasionally added marine resources to their diet. Such quibbles were, of course, encouraged by the progressive-evolutionist model, which had argued for decades that exploitation of marine resources came late to California. But what do we mean by "real" maritime subsistence adaptations? For many researchers, this question was given suitable operational definition by Yesner (1980:728), who argued that any group obtaining at least 50 percent of its calories or protein from marine sources can be described as maritime adapted. Accepting this definition, data from the Channel Islands (chapters 4, 5, and 8) and mainland coastal California reveal widespread maritime foraging by the beginning of the Holocene, if not Late Pleistocene times (Rick et al. 2005; Erlandson et al. 2008).

But why were the Channel Islands settled at all? Judging from the data we saw in chapters 4, 5, and 8, these islands appear to have been competitive with mainland subsistence regimes from the earliest times onward—notably including the hunting of sea mammals such as seals, sea lions, sea otters, and dolphins. Dolphins, as we saw in chapter 5, emerge as a fascinating aspect of maritime hunting, a development unanticipated by theorists who imagined marine resources categorically inferior to terrestrial alternatives. San Clemente Island's dolphin hunters underscore the capacity of the archaeological record to surprise us with new insights into ancient human adaptability.

The progressive-evolutionary model, as we saw earlier, argues that marine fishing, hunting, and shellfish collecting were part of an incremental, trans-Holocene trajectory of resource intensification that yielded a Late Holocene culture climax of unrivaled economic productivity (see chapter 1). On San Clemente Island, the evidence presented in chapter 8 points to a more complex pattern of prehistoric technoeconomic change. Along with a growing body of archaeological data from other regions of California, the San Clemente Island findings suggest that changes in foraging efficiency played a large role in shaping the make-up of maritime economies across the Holocene. Overall, these data implicate depression of more cost-effective resources such as sea mammals (seals and sea lions) and shellfish (mussels and abalones) in the intensification of Late Holocene fishing (chapters 4 and 8). These dynamics appear to have been instrumental in technological innovation. The appearance of circular shell fishhooks by the third millennium BC, described in chapter 8, marks the beginning of rapid intensification of fishing on San Clemente Island, a trend mirrored widely across coastal southern California (Rick et al. 2005).

We do not want to overstate the San Clemente Island subsistence data. During the last decade, researchers have demonstrated complex subsistence patterns across California during the last 13,000 years or so (for a good summary, see Jones and Klar 2007:305–7). Across this span of time, some areas appear to reflect patterns consistent with the expectations of optimal foraging models, but debate continues about whether cultural factors also helped to shape local economic patterns (McGuire and Hildebrandt 2005).

Not in dispute, however, is the significant role played by coastal resources in early California economies, as compared to the expectations of the progressive-evolutionary model of California prehistory. As noted earlier, reliance on marine resources is evident in mainland as well as Channel Island settings, where the former combined marine species with terrestrial resources from the Early Holocene onward (Erlandson 1994; Erlandson et al. 2008; Jones 1991; Jones et al. 2002; Porcasi 2007). These findings reveal Late Holocene coastal groups such as the Gabrielino and Chumash as variant maritime cultural adaptations, fascinating and informative to be certain, but not wholly new innovations.

Despite the evident complexity that characterizes California maritime subsistence economies across the Holocene, the putative late advent of all such economies, a core element of the progressive-evolutionary model, now seems definitively outmoded. Conversely, early maritime foraging adaptations posited by the Paleo-Coastal Tradition are now beyond doubt.

Residential Sedentism

Along with seafaring and intensive maritime economies, residential sedentism has long been identified with a Late Holocene maritime cultural climax in southern California, as noted in chapter 6. Yet, the hearths, storage pits, occupation floors, and tools that we saw at Eel Point indicate considerable residential permanence on San Clemente Island from the start of human occupation, beginning at least nine millennia ago (chapters 4 and 6). By about 5,000 years ago, we saw that a community of pit houses, featuring whale bone roof structures and other substantial construction features, existed on San Clemente Island at the Nursery archaeological site (chapter 6).

These examples of residential sedentism do not fit a model of progressive cultural development. The notion that village sedentism emerged for the first time during the Late Holocene, under the influence of a particular set of technoeconomic practices, is too simplistic. As explored in chapters 4, 5, and 8, we find sedentism on San Clemente Island associated with a relatively heavy emphasis on large sea mammal hunting during the Early and Middle Holocene, but also with the hunting of small sea mammals (otters) and intensive fishing during the Late Holocene. Historic Gabrielino and Chumash Indian villages noted by early European explorers (chapter 3) appear to have been some of the largest sedentary communities but, once again, not the first appearance of residential permanence in maritime California.

Based on this evidence, we need to seek more discerning explanations of maritime residential patterns than those proposed by theories of progressive cultural evolution. As we point out in chapter 6, the structure and productivity of maritime subsistence regimes, particularly supported by the use of watercraft, may be more telling correlates of coastal sedentism than time period or geographic region.

Trade and Cultural Interaction

The progressive-evolutionary model posits elite-controlled trade networks as an essential mechanism behind the rise of social complexity in coastal California, as we discussed in chapter 10. Marine shell beads, for example, began to be produced in astonishing quantities in the Northern Channel Islands during the Late Holocene and traded widely across California and beyond (Arnold 2001a; Hughes and Milliken 2007; King 1994; Rick et al. 2005).

It would be a mistake, however, to conclude that expansive trade systems did not exist earlier in coastal southern California or that these were not as “fully developed.” Marine shell beads have long been recognized as informative markers of ancient trade and interaction (Hughes and Milliken 2007), but these scarcely fit a single template. As discussed in chapter 7, California shell beads, approximately 10,000 years old, have been found more than 300 km from the coast (Fitzgerald et al. 2005). Hughes and Milliken (2007) argue that the most intensive trade in shell beads between coastal California and the Great Basin may have occurred during the Early to Middle Holocene.

San Clemente Island points to early Channel Islands participation in shell bead trade networks. A mussel shell (*Mytilus sp.*) disk bead, found on the floor of one of the Eel Point residential loci mentioned above, yielded a radiocarbon date of 6,567 to 6,428 cal BC (chapter 7). This is not the only evidence of Channel Islands links to expansive trade and interaction networks. San Clemente Island was connected to one of the largest Middle Holocene cultural interaction spheres in western North America, as indicated by the intriguing distribution of various types of artifacts, including the distinctive *Olivella* grooved rectangle (OGR) beads.

In chapter 7, we showed that 5,000 years ago an "OGR Corridor" made its way from the Southern Channel Islands to the western fringes of the Great Basin, reaching as far as central Oregon. Ten beads of this type were recovered from refuse deposited in the San Clemente Island pit houses mentioned above, dated between 2,600 and 2,900 cal BC (chapter 7). Debate continues about the cultural significance of the OGR Corridor, but it underscores the potential importance of cultural interactions arising far from coastal California in bringing about maritime culture change.

Little noticed by many California coastal researchers, the Great Basin hosted interesting "limno-sedentary" aquatic adaptations during the Middle Holocene, including areas traversed by the OGR Corridor. Some of these groups constructed substantial pit houses on the shores of remnant Pleistocene lakes and utilized an extensive array of fishing gear, some of which (e.g., fishhooks) closely resembles fishing equipment found on the California coast (chapter 7).

In Moratto's model (1984), coastal southern California and the Great Basin are prime examples of regions linked by population migrations or intrusions. The linguistic dimensions of this linkage have long been debated, of course, under the rubric of the "Shoshonean Wedge," shorthand for the intrusion of Uto-Aztecan speakers from the Great Basin across southern California, including the Southern Channel Islands (chapters 3 and 7). While the timing of one or more such migrations continues to be debated (chapter 7), and coastal-Great Basin cultural linkages are currently far from clear, it seems reasonable to note that aquatic adaptations were more widespread across Western North America than the progressive-evolutionary model suggests (Kennett et al. 2007).

Is it possible that groups reaching the California coast from the Great Basin not only brought new languages, but were already well adapted to aquatic subsistence regimes, including techno-economic traits useful in southern California's marine environments? We do not currently have answers to this question, but it seems one worth asking if we wish to expand our models of maritime prehistory. Future research might take a closer look at the continuum of aquatic adaptations that existed across the western Great Basin and coastal California.

Paleoenvironmental Change

Early California archaeologists rarely considered environmental change as a significant contributor to prehistoric culture change, particularly in coastal California (chapter 9). Moratto's (1984) model broke with this tradition, as we have already seen, by contrasting regional patterns of culture change with Holocene climate trends. Since the publication of Moratto's model, studies have identified the arid American West, including California, as prone to recurrent Holocene droughts capable of provoking population migrations and *in situ* cultural changes (Kennett et al. 2007; West et al. 2007). The Medieval Climatic Anomaly (MCA), from about AD 800 to 1350, appears to be an interval marked by widespread cultural reactions to meteorological drought (Jones et al. 1999; Jones and Schwitalla 2008).

Debate continues, however, about the effects of Late Holocene aridity on culture change. Arnold (1992) was one of the first investigators to propose that medieval-era droughts played a role in the rise of Chumash chiefdoms. The necessity of provisioning island communities with mainland foodstuffs during periods of drought, according to this line of thought, would have increased the power of chiefs, who controlled the redistributive networks and boats on which such trade was dependent (chapter 10). The large quantities of marine shell beads produced on the Northern Channel Islands during this period were cited as probable payment for food (Arnold 1992).

Others pointed out that interpersonal violence and health crises intensified during the MCA (Raab and Larson 1997). Kennett and Kennett (2000) identified marine and atmospheric climatic trends associated with the MCA in coastal southern California, emphasizing the role of both competitive and cooperative cultural strategies in coping with the pressures of climate change (see also Kennett 2005).

These arguments have not persuaded everyone. Bettinger (1991b) and Basgall (1999) cited population growth and resource intensification trends as more likely causes of Late Holocene culture change than climate flux. Gamble (2005, 2008) has recently entered this debate, arguing that redistributive chiefdoms and other cultural innovations among the Chumash and Gabrielino were able to buffer successfully the effects of drought. This argument echoes the familiar progressive-evolutionist idea of a highly productive coastal climax economy. In this instance, elite-brokered food storage and redistribution is thought to have ameliorated any localized scarcity induced by drought.

We saw evidence that San Clemente Island, too, was influenced by medieval-era droughts (chapter 9). However, unlike the Northern Channel Islands, there is no evidence that such droughts encouraged higher levels of social complexity, trade, or warfare (see discussion of social complexity below). Instead, the San Clemente Island data suggest that population levels declined during the medieval-era droughts, while the island's remaining settlements became more tightly tethered to surviving water sources.

Based on these findings, it does not appear that Late Holocene climate change had consistent cultural effects throughout the Channel Islands, including patterns of human health, social complexity, trade, and warfare (chapter 10). This situation appears to mirror the variability of responses to Holocene climate change across prehistoric California summarized by Jones and Klar (2007:303–5) and Jones and Schwitalla (2008).

There is little doubt that coastal groups mobilized a variety of cultural strategies to cope with climatic stresses (Jones et al. 1999; Jones and Schwitalla 2008; Kennett 2005). Nevertheless, as we saw in chapter 10, analysis of dietary markers from prehistoric human skeletons contradicts the proposition that significant amounts of food were being redistributed between the Channel Islands and the mainland during the MCA or any other period. Health crises and increased warfare during the MCA implicate resource scarcity, not abundance, as drivers of culture change (Jones and Schwitalla 2008). Droughts seem likely, as well, to have depressed production of terrestrial food resources amenable to storage and redistribution, such as acorns and seeds (Jones et al. 1999).

On balance, we suggest the available data are consistent with Moratto's model, which identified increased warming and aridity after AD 400 as a consequential factor in, "population movements, changes in settlement patterns, economic adjustments, disruption of exchange systems, and other cultural changes." Even before this period, Middle Holocene climatic stresses appear to be correlated with population movements from the Great Basin into southern California (Kennett et al. 2007), as discussed in chapter 7. In our view, the cultural-environmental dynamics of Moratto's model are a better fit with long-term patterns of culture change than models predicated on progressive-evolutionary mechanisms.

Social Complexity

Another important claim of the progressive-evolutionary model, as we have already seen, is that social complexity emerged from a Late Holocene maritime culture climax. The Chumash chiefdoms discussed in chapters 3, 4, and 10 are the preeminent source of evidence in support of this argument (Arnold 2001a; Gamble 2008). To what extent, however, is the Chumash case a general template for maritime social complexity across coastal southern California? Contrary to the implications of the progressive-evolutionary model, there is scant evidence that social complexity existed to the same degree or arose in the same manner across maritime southern California (Erlandson and Jones 2002; Jones and Klar 2007; Rick et al. 2005).

Let us return for a moment to the claim that seaworthy watercraft (*Tomolo*) helped to trigger the rise of Chumash chiefdoms. As we saw above, Channel Islands seafaring may have begun during the Late Pleistocene but was certainly widespread in the Channel Islands, including San Clemente, by 7000 BC. Accepting the conclusion of many researchers (chapter 10), let us also suppose that Chumash chiefdoms appeared sometime between one and two millennia ago. By this reckoning, Chumash chiefdoms appeared seven to ten thousand years after sea travel. This raises an obvious question: If the appearance of seagoing boats ushered in chiefs, why did it take so long for chiefdoms to appear? Any answer to this question goes beyond the current discussion, but it appears that no single technoeconomic innovation, even one as important as seaworthy boats, can explain the rise of social complexity.

Another question: Why did Chumash-style chiefdoms fail to appear, even when seaworthy canoes were at hand? We saw earlier that Spanish mariners recorded the *Ti'at*, the Island Gabrielino equivalent of the seagoing Chumash canoe (*Tomolo*), in 1602 on Santa Catalina Island and in 1769 on San Clemente Island (chapter 3). Yet these and subsequent accounts offer no evidence for the existence of chiefdoms comparable to those attributed to the Northern Channel Islands. As described in chapter 10, scant evidence exists on San Clemente or the other southern islands for social complexity in the vein of the Chumash. Once again, it appears that social complexity in insular California hinged on more than access to boats (Rick et al. 2005).

Although reconstructions of the precontact Gabrielino have been modeled for decades on a Chumash template (Bean and Smith 1978; Gamble and Russell 2002; McCawley 1996), Southern Channel Islands archaeology reveals little of the political economy commonly attributed to the Island Chumash. If we look, for example, at the production of steatite (soapstone) vessels and effigies on Santa Catalina Island, there is little evidence that this underwent standardization of production comparable to the intensive shell bead production in the Northern Channel Islands (Williams and Rosenthal 1993).

The Southern California mainland coast presents additional challenges to the universality of the Chumash model of social complexity. During the time that the Chumash area was achieving a cultural climax marked by high degrees of social complexity, some archaeologists envision a virtual anti-climax at the southern end of the California Bight, owing to Late Holocene silting of the large coastal lagoons of San Diego and Orange counties (Byrd and Raab 2007). While some degree of social ranking may have existed among coastal groups in this region, archaeological evidence suggests little of the mortuary ceremonialism, craft specialization, and settlement pattern dynamics thought to signal complexity in the Chumash area (Glassow et al. 2007; Byrd and Raab 2007).

Why do these areas appear to be so different, if they were being influenced by many of the same transformative, progressive-evolutionary forces? We suggest that the available evidence points to patterns of cultural variability more consistent with the multi-causal, mosaic-like dynamics of the Moratto model (1984) than with the linear, progressive forces advanced by the Chartkoff and Chartkoff (1984) scheme. If so, there may be no one-size-fits-all template of social complexity for the native maritime societies of the California Bight.

Culture Contact

For centuries, California's Channel Islands remained one of the most remote and mysterious archaeological domains in North America. While twentieth-century archaeology was rising as a professional scientific discipline, the Channel Islands ostensibly had little to contribute to emerging models of California and North American culture history. This impression stemmed in part from the fact that the islands' native inhabitants, the Island Chumash and Gabrielino, had been forced to abandon their islands by the time professional anthropologists and archaeologists were on the scene (chapter 3). This does not mean, however, that this period of early contact between native islanders and Euro-Americans is beyond the scope of productive research. In recent decades, considerable scholarly interest has developed in the topic of early Euro-American settlement of North America, particularly in the effects of European-introduced diseases, technology, and ideologies, as we saw in chapter 11.

San Clemente Island's Lemon Tank, Big Dog Cave, and other archaeological sites reveal an extraordinary ceremonial complex linked to the rise of the Native Californian Chingichngish religion. These data point to the existence of this "crisis religion" on San Clemente Island during the seventeenth century, a time during which Spanish ships were visiting the Channel Islands but before Euro-American colonization of California. Introducing the catastrophic effects of exotic diseases, technologies, and ideologies to native Channel Islanders, these contacts were among the first in the New World to provoke Native American cultural intensification movements, later episodes of which would play out across North America for centuries to come. Effectively bringing Channel Islands prehistory and native islanders' cultural autonomy to an end, this collision of Native American and Euro-American worlds is a poignant example of how historical contingency can sometimes play a powerful role in shaping culture change.

Paradigm Shift

In our view, the match-up of models above suggests what is already apparent to many archaeologists. The traditional paradigm of maritime prehistory that we outlined in the first chapter of this book, let's call it "coastlines last," is an increasingly poor fit with archaeological facts. It seems apparent that we need new models of how North America's coastlines were settled, and how coastal groups contributed to the continent's oldest cultural traditions. As we noted in chapter 1, after decades of dominantly terra-centric research, this is perhaps North America's greatest remaining archaeological frontier. For the authors of this book, research on San Clemente Island's extraordinary archaeological record has catalyzed some observations that may be useful in the search for new paradigms of maritime prehistory:

Standing Maritime Prehistory on Its Head

The results examined above overturn the traditional paradigm of maritime prehistory. As Rick et al. (2005) note in an excellent summary of Channel Islands archaeology, maritime cultural traits once thought to have arisen only within the last millennia or two now manifestly have origins far deeper in time. As we saw earlier in this book, many of the traits that were once thought to mark "climax" coastal cultures of the Late Holocene were extant on the southern California coast at or near the beginning of the Holocene, including intensive maritime economies, residential sedentism, and far-reaching trade patterns. The early appearance of seaworthy watercraft, requisite to settlement of the Channel Islands during the Late Pleistocene or Early Holocene, is one of the most dramatic divergences from the traditional model.

The emergence of maritime cultural complexity, heavily influenced by research on the historic Chumash, now appears to have been a more regionally variable phenomenon than progressive-evolutionary models suggest. The largely intra-cultural dynamics ("cultural progress") that the traditional model credits as the main agent of culture change must now cede a place to what we have referred to as historical contingency—events such as population migrations and intrusions, climate change, opening of cultural interaction spheres, culture contact, and more. In all, the available evidence heavily favors Moratto's (1984) model of California prehistory. This evidence reinforces many of the observations made by Jones and Klar (2007) about the complex nature of prehistoric culture change in California, including its littoral zones. None of these views deny the possibility of accurately modeling California prehistory, but the time has passed in which it can be explained in terms of over-arching, progressive-evolutionary stages.

These findings implicate the need for new tactics in studying maritime prehistory. As we saw in various parts of this book, ethnohistory casts a long shadow over coastal southern California. Some measure of this influence can be seen in the bibliography by Holmes and Johnson (1998), for example, where the Chumash region is revealed as one of the most extensively researched and reported in all of California, if not North America. Efforts to model maritime prehistory have gravitated strongly toward this body of information as we saw, for instance, in the case of seafaring. Theorists have also relied heavily on interpretations of ethnohistoric data to bolster reconstructions of prehistoric Chumash chiefdoms and social complexity in Late Holocene coastal southern California (Arnold 2001a, Gamble 2008).

We emphasize again, as we have done throughout this book, that southern California's native coastal societies are extraordinary examples of human ingenuity and adaptability. Long-standing ethnohistoric and archaeological interest in these societies is well justified. When archaeological data on southern California coastal prehistory were comparatively scanty, and the coastlines-last model reigned, models based primarily on interpretations of ethnohistoric data were understandable. It now seems clear, however, that we cannot simply project the cultural traits of Late Holocene coastal groups deeper and deeper into the past, if we hope to gain realistic understanding of prehistoric maritime cultural developments known to span the Holocene.

Ethnohistoric data remain valuable, of course, but it is increasingly possible to compare hypotheses of ethnohistoric derivation with archaeological and other bio-physical data. Indeed, some of the most surprising and informative insights into coastal prehistory of recent decades have come from the realization that the cultural arrangements of Early and Middle Holocene coastal groups are not necessarily understood accurately in terms of analogies with Late Holocene societies.

New World Cultural Origins

The last two decades have seen increasing debate about New World cultural origins. This debate would be more productive, perhaps, if it were reframed to include advances in coastal archaeology. Consider the "Clovis-first" controversy—the long-standing debate about whether Clovis Paleo-Indians were the first human settlers of North America (chapter 1). Much of this debate has centered on the question of temporal priority for obvious reasons. Yet, the gravitational pull of the dating question has proven so great that, when confronted with alternative scenarios of New World settlement, many archaeologists simply want to know, "Is it earlier than Clovis?" This question tends to obscure an equally important one: Which groups were the New World's *ancestral* cultural traditions?

The question of temporal priority has an over-riding significance only if one accepts a traditional theoretical bias about the peopling of the Americas. Since the discovery of the Clovis culture, archaeologists have generally theorized that most of North America's cultural branches stemmed from Paleo-Indian cultural roots (exceptions are groups that arrived in the Arctic relatively late in prehistory, such as the Inuit peoples). In this familiar scenario, integral to the Clovis-first model, Paleo-Indian big-game hunters crossed the Bering Land Bridge during the late Pleistocene, perhaps traversing an ice-free corridor southward between Canadian ice sheets, arriving in the central United States between about 10,900 and 11,500 radiocarbon years ago (Anderson and Faught 1998; Fiedel 1999), then dispersing rapidly to colonize North and South America.

This model envisioned prehistoric North America settled from the inside out. Like Doppler radar, cultural development radiated across time and space from a Clovis bull's-eye near the continent's center. This model was not intended to explain what happened on the littoral margins of North America, but it was adapted to such a purpose. The progressive-evolutionary model of maritime prehistory, as we saw in previous chapters, begins with Paleo-Indians arriving on the coastlines of California, where, after millennia of experiments with coastal living, their descendants morphed into the first true maritime foragers. This scenario made coastal groups not only the most distant from their Ice Age ancestors in time, but also the most technoeconomically divergent from Paleo-Indian-inspired terrestrial hunting patterns. But what if Clovis Paleo-Indians were not the sole ancestral population of North America or the only group to colonize the Pacific North American littoral?

Adaptive Mosaics of Pacific North America

Artifact assemblages, including numerous projectile points, have been excavated from stratified cultural deposits across North America, reaching back in time to the Pleistocene-Holocene transition. In Eastern North America, these studies reveal wide-spread patterns in which Paleo-Indian fluted-point traditions gave way to Early Archaic projectile point types (e.g., Dalton and variants; see Fagan 2007:142–68 for a summary). This pattern is graphically apparent in plots of the frequency of Paleo-Indian projectile points across the United States, as shown by Anderson and Faught (1998; see also Paleoindian Data Base of the Americas (PIDBA): http://pidba.utk.edu/main.htm). While subject to potential sampling problems, this database nevertheless offers a fascinating, continental-scale picture of the Paleo-Indian occupation of North America. The PIDBA makes it clear that fluted points are most common in the woodlands of Eastern North America, are found in lower frequencies across the

Great Plains, and reach their lowest frequencies on the Pacific Coast. As Erlandson (1994), Moratto (1984), and Rondeau et al. (2007) document, fluted projectile points are known from coastal California but, compared to other regions of North America, at almost vanishingly low frequencies. Moreover, the chronological placement and faunal associations of fluted points in California remain far from clear (Rondeau et al. 2007).

It is by no means clear, as compared to eastern North America, that Paleo-Indian traditions were the inspiration for early coastal technoeconomic patterns. As Dixon notes (1999), Pacific Coastal archaeological sites dating to about 8000 to 6000 BC contain a variety of stone tool types, variously mixing bifacial projectile points, microlithic flake tools, and cobble-and-flake technologies. A direct, ancestor-descendent technological relationship is not clearly evident between Clovis-era stone tool technologies and the broader range of non-fluted tools seen in early coastal sites. Across much of far-western North American, stemmed and foliate point technologies appear to overlap fluted projectile points in time (Bryan 1980; Davis and Schweger 2004; Davis et al. 2004).

What explains the relatively low frequency of fluted points on the Pacific Coast and the conspicuous absence of following technological traditions similar to those found in other regions of North America? One might argue that such patterns do not invalidate Paleo-Indian cultural ancestry, but rather reflect the variability of Paleo-Indian-derived cultural adaptations across the continent. One logical possibility is that Paleo-Indians quickly transformed themselves into maritime foragers after reaching Pacific North America. The seagoing Paleo-Indian hypothesis has two advantages. It preserves the assumption of a universal Paleo-Indian cultural ancestry and, in light of Late Pleistocene/Early Holocene seafaring and other early maritime cultural traits, it offers a more realistic model perhaps than the traditional coastlines-last scenario.

Based on current evidence, the possibility that Paleo-Indian terrestrial hunters gave rise to the first maritime cultures of Pacific North America cannot be ruled out (Dixon 1999; Erlandson 1994). From our perspective, this explanation seems increasingly unlikely. Such an explanation does not explain, for example, why the technoeconomic patterns of Pacific North America diverge from those seen over much of the rest of the continent. Unlike the clear and widespread transition from Paleo-Indian to Archaic technoeconomic traditions noted above, early Holocene technoeconomic patterns along the Pacific Coast reveal a complex mosaic of traditions, including a sometimes bewildering mix of bifacial and non-bifacial stone tools (Dixon 1999; Erlandson and Moss 1996; Fagan 2007).

We suggest that these differences may reflect quite different adaptive patterns and technological ancestry in Paleo-Indian and Paleo-Coastal North America. The Early Holocene technoeconomic patterns found across the eastern two-thirds of North America are explicable perhaps in terms of continental bio-geographic zones, where subsistence resources exerted a strong influence on bifacial technologies suitable for hunting in these environments. The Pacific littoral, by contrast, presents greatly different patterns of environmental variability than the continental interior (Erlandson et al. 2007b).

On the Pacific coast, "The juxtaposition of mountains and the sea tends to 'stack' numerous ecological zones within a narrow area and allows access to a variety of marine and terrestrial resources" (Erlandson and Moss 1996:278). These habitats included off-shore islands, bays, beaches, coastal forests and mountains, large rivers, and their tributary streams. From north to south, the Pacific littoral varies from temperate rain forests to semi-arid Mediterranean environments to the dry tropics of the Baja California Peninsula. Early coastal dwellers confronted a diverse mosaic of resources, including terrestrial mammals, seeds, and other vegetal foods of mainland coastlines; anadromous fishes; many species of shellfish; marine mammals and fishes of kelp forests; and the diverse marine resources of off-shore islands (Jones 1991). This suggests the utility of flexible, technoeconomically diverse responses to coastal environmental variability.

In California, seeds and stone milling equipment were combined with shellfish to obtain a beneficial mix of carbohydrates and protein that were part of the Early Holocene coastal diet (Erlandson 1994; Erlandson et al. 2008; Jones et al. 2002). Early coastal populations of the Pacific Northwest also exploited marine and terrestrial resources. Stable isotopes reveal a diet rich in marine foods at On Your Knees Cave in southeastern Alaska dating to around 7500 BC (Dixon 2002). A variety of marine and terrestrial faunas was available to coastal foragers of the Pacific Northwest during the Pleistocene to Holocene transition (Fedje et al. 2004). The array of bifacial projectile points, microlithic tools, core-and-flake technologies, grinding equipment, and other objects that were used by these groups (Dixon 1999) may be characteristic of Paleo-Coastal traditions, rather than the broadly recognizable stylistic and technological traditions that followed the Paleo-Indians in other areas of North America.

The California Channel Islands form an important part of this Paleo-Coastal mosaic. As we saw on San Clemente Island, sea mammal hunting appeared at least as early as 7000 BC, without benefit of bifacial stone tools. As Rondeau et al. (2007) point out, the microblade tools found in the earliest levels of the Eel Point archaeological site on San Clemente Island hint at technological origins in maritime eastern Asia, not the bifacial stone tool technologies of Paleo-Indian derivation (chapters 4 and 5). Speaking of this tool assemblage, Moratto and Chartkoff (2007:3) are correct in observing, "One of the remarkable things about this complex is that microblades are anything but typical of California; they are patently exotic." These are a conspicuous example of the heterogeneity posited by Moratto's model (1984).

The ability of early coastal dwellers to colonize these diverse settings cannot be divorced from a critically important mode of travel and transportation unavailable to most inhabitants of the continental interior: seafaring. In chapter 4, once again, we show that San Clemente Islanders possessed technological capabilities sufficient to construct sophisticated, seagoing watercraft by about 7,000 cal BC. This does not reflect the true antiquity of seafaring in the Channel Islands, however, given terminal Pleistocene occupation of the Northern Channel Islands between 9,500 and 11,000 cal BC (Rick et al. 2005:177–80). These data make it likely that sea travel was widespread in Pacific North America during the Pleistocene to Holocene transition. If so, boats not only allowed rapid colonization of the Pacific Littoral, they brought into reach the diverse range of resources described above.

Erlandson et al. (2007b) have recently proposed the "Kelp Highway" hypothesis. With the waning of the Pleistocene, kelp forests proliferated in littoral zones from northeastern Asia to

South America. Kelp forests, discussed in chapter 2, rival the biotic productivity of some of the most food-rich terrestrial ecosystems. Archaeologists have emphasized the high levels of animal biomass available to Paleo-Indian hunters as an important factor in the spread of humans across terrestrial North America. A Kelp Highway, traveled by boat-borne maritime foragers of the Pacific Rim, is an equally compelling vector for early settlement of North America (Erlandson et al 2007b). Colonization of the Channel Islands would have been well within the reach of groups equipped to exploit this environment. The early mariners of San Clemente Island, examined in chapters 4 and 5, may be a glimpse into this adaptive pattern.

Exploitation of such environments requires reappraisal of the cultural sophistication of maritime foragers. The "biface bias" that we noted in chapter 4 has long equated bifacial stone tools and large terrestrial mammalian prey, beginning with Paleo-Indians and fluted projectile points, as markers of hunter-gatherer cultural advancement. If sophisticated terrestrial hunting weapons were the signal technological legacy of the Paleo-Indians, boats were the signature technology of Paleo-Coastal foragers. Based the technological aptitudes of San Clemente Island's early mariners (chapter 4), and considering the challenges confronting their watercraft and seafaring skills, seagoing boats may have been the most complex, technologically sophisticated devices constructed in ancient North America.

DNA Evidence

The New World's earliest settlers left behind genetic patterns as distinctive as the distribution of their artifacts and settlements. Johnson and Lorenz (2006), for example, collected 126 mitochondrial DNA (mtDNA) samples from contemporary California Indians, whose maternal lineages can be traced back to original eighteenth- and nineteenth-century sociolinguistic groups on the basis of mission records and other sources. This research shows that a distinctive Haplogroup D sequence occurs in four Chumash Indian lineages of southern California, representing a rare subgroup occurring primarily among populations arrayed along the

Pacific Coast of North and South America. Regarding this subgroup, Johnson and Lorenz (2006:53) comment that:

> A sequence identical to that occurring among the Chumash was recently discovered by Kemp from an mtDNA sample obtained from a human tooth from an early Holocene burial excavated by James Dixon in *On Your Knees Cave* (Dixon 1999:117–19). This finding supports the identification of this haplotype as being another founding lineage for the Americas. Other closely related lineages have now been identified among Mexican populations, the Mapuche Indians of southern Chile, and prehistoric peoples of Tierra del Fuego among others.

DNA evidence seems likely to play an increasingly important role in illuminating possible early coastal migrations into North America, a point echoed by Eshleman and Smith (2007). These data, too, offer a challenge to the Clovis bull's-eye.

Paleo-Coastal and Paleo-Indian: Ancestral Cultural Taxons

The exact temporal range of the Clovis culture continues to be debated. The time frame for the Clovis culture is conventionally set to about 11,500 and 10,900 radiocarbon years before present; Waters and Stafford (2007) argue that the age range of Clovis, based on selected, high-precision radiocarbon dates, should be narrowed to 11,050 to 10,800 radiocarbon years before present. Waters and Stafford (2007) suggest provocatively that Clovis technology may have originated and spread across North America in as little as 200 calendar years. This possibility, along with a closing temporal gap between Clovis and non-Clovis cultures, suggests to Waters and Stafford (2007) that humans already occupied North America when the Clovis culture appeared. We cannot resolve this complex debate here, but we agree that the exclusive ancestral status once assigned to the Clovis culture is increasingly open to question.

As earlier generations of archaeologists pondered alternatives to a land-based entry of the New World, scant evidence pointed to the sea:

> The alternative, of course, is a coastal water route. To such there also are objections, the main one being that use of a coastal or open-sea entry route would require some kind of open-water voyaging capabilities earlier by thousands of years than most archaeologists believe they existed. And, since to posit the coastal route requires more unproved but interlocking assumptions than the overland route requires, the coastal alternate has attracted no great following. (Jennings 1983:29)

Much has changed in our understanding of coastal prehistory since Jennings penned this assessment. The earliest radiocarbon dates from the Channel Islands greatly narrow, if not close, the temporal gap between the Clovis culture and earliest maritime settlement of Pacific North America (Rick et al. 2005). As Rick et al. (2005:187) conclude, "These discoveries have contributed to the emergence of the coastal migration theory as a viable option for explaining the initial entrance of humans into the Americas." If we add terminal Pleistocene seafaring, discontinuities between Paleo-Coastal and Paleo-Indian technoeconomic patterns and DNA evidence of early coastal genetic lineages to the picture, the coastal migration hypothesis becomes even more compelling.

Perhaps the time has come to expand models of New World cultural origins to include two great ancestral cultural taxons: Paleo-Coastal and Paleo-Indian. Instead of seeing these populations merely as competitors for the honor of being first, we need to understand how both contributed to the earliest patterns of North American settlement and subsequent continental cultural diversification.

Recognition that Ice Age hunters trekked into the continental heartland from Asia, for all its manifest import to North American prehistory, does not exhaust the mechanisms by which humans colonized ever larger segments of the Earth. Once again, terra-centric archaeologists tend to ignore the role of seafaring in the colonization of Eurasia, beginning perhaps 150,000 years ago, tracing some of the most important human migrations in global history (Erlandson et al. 2008).

The archaeological data from localities such as San Clemente Island, and many other waypoints in Pacific North America, may point to another epic maritime migration. Once established on the continent's coastlines, again judging from San Clemente Island's long and varied record of maritime cultural adaptations, these colonists gave rise to distinctive, albeit diverse, coastal traditions spanning the Holocene. As we enter the twenty-first century, archaeologists seem increasingly receptive to paradigm change in modeling New World cultural origins. California's maritime cultural record has clear relevance to any such deliberations. We suggest the time has come to include Paleo-Coastal colonists and their cultural descendants, long overlooked by a land-locked North American archaeology, among the continent's ancestral peoples.

Finally, in helping to create this expanded panorama of New World prehistory, there is a fitting irony in the role played by San Clemente Island and its Channel Islands neighbors. Looked upon for centuries as some of the most remote and reluctantly occupied cultural outposts of ancient North America, the continent's prehistory is coming into focus in new and uniquely informative ways from its southern California insular margin.

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