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ARCHAEOLOGY AND MARINE CONSERVATION

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> *If our population doubles to 12 billion and our coastal population triples in this century, it's not going to be enough to protect the oceans. We're going to have to manage and use them wisely, which means understanding them far better than we do today* [Helvarg 2001:10].

> *A fundamental aspect of ecosystem restoration is learning how to rediscover the past and bring it forward into the present—to determine what needs to be restored, why it was lost, and how best to make it live again* [Egan and Howell 2001:1].

Given the speed at which marine ecosystems are being degraded, it is increasingly important that we draw on our knowledge of ancient practices of both marine exploitation and management. Access to archaeological shell middens, which contain evidence of past subsistence patterns and the long history of human interaction with marine ecosystems, positions archaeologists to contribute important insights into successful management practices and the costs of mismanagement or overexploitation at great temporal depth. These deep historical perspectives are crucial to understanding the past, present, and future of marine environments. We describe ongoing work by University of Oregon archaeologists to develop deep historical data sets against which to measure the health of our marine ecosystems and to develop protocols for future conservation efforts.

State of the Oceans

The oceans, comprising 71 percent of the earth's surface, are the cradle of life, providing food, work, and play for billions of people. Yet, our burgeoning population and heavy reliance on the ocean's resources have created a crisis. Overfishing, coastal development, pollution, and coral bleaching have severely degraded marine ecosystems (Pew Oceans Commission 2003). Accordingly, ecological baselines provide essential reference points for ecologists, resource managers, and environmentalists, for such baselines measure ecosystem health, provide information against which to evaluate change, and help assess the elusive "natural" state (Jackson et al. 2001). By knowing the baseline for a degraded ecosystem, we can work to restore it. But if this baseline shifted before we had the chance to evaluate it, then we end up accepting a degraded state as normal or improved (Pauly et al. 1998). Though there are no "pristine" environments, our baselines should reflect environmental states before devastating human commercial and industrial impacts. Archaeological approaches can help to address this crisis.

A History of Exploitation

Between approximately 400 and 150 years ago, Euro-American explorers set in motion a "massive biological reorganization" of our continent's terrestrial and marine ecosystems (Helvarg 2001:10). These explorers and settlers caused catastrophic wildlife extinctions and deforestation on land, while marine ecosystems were severely altered with the commercial hunting of sea otters, fishes, pinnipeds, cetaceans, and sea birds (e.g., Scammon 1968). Sea otters, for example, once numbered up to one million in Pacific Coastal waters from Russia to Baja (Ogden 1941). Sea otters in California, however, were thought to have been eradicated by eighteenth- and nineteenth-century fur trappers, until 1939, when a remnant population was found along the Big Sur coast. Their subsequent protection, recovery, and geographic expansion in California coastal waters has generated considerable controversy and debate between commercial fishermen, environmentalists, and resource managers. Sea otters eat up to 25 percent of their body weight daily and pose fierce competition with fishermen for abalones, octopus, crab, sea urchin, and shellfish.

Recognizing the devastation from early commercial fisheries, scientists recorded the biological composition of terrestrial and marine environments, studying and recording species populations after they had already been corrupted or destroyed. It is this information that has served as a baseline to evaluate the health of marine ecosystems. Such a shallow temporal scale, however, spanning less than a century, makes it difficult to imagine the "natural" state. "Remediation and restoration" of marine ecosystems will be difficult without a deep historical perspective provided by paleoecological, archaeological, and historical data (Jackson et al. 2001:636). But if we can fix our baselines at a point before the devastating impacts of historical overfishing, we can begin to restore the oceans to a more "natural" state.

Historical Ecology and Interdisciplinary Solutions

Reexamination of both our notions of "pristine" marine ecosystems and the "shifting baselines" on which fisheries management are based is due, in part, to the work of archaeologists who have shown that humans have exploited marine environments for much longer than previously believed (Erlandson 2001). Archaeological evidence clearly demonstrates, for example, that marine hunting, fishing, and foraging began on the Channel Islands at least 12,000 years ago. Widespread, highly productive, and species-rich kelp forests played a key role in the development of maritime peoples along the Pacific Coast of North America, supporting some of the most complex and populous hunter-gatherer cultures ever known. Today, kelp forests continue to be an important economic, recreational, and aesthetic resource for California's coastal communities, providing three-dimensional gallery habitats that support a complex web of marine productivity and species diversity.

Ecological study of California kelp forests demonstrates that a variety of factors influence their extent, structure, and health. Aside from physical factors (El Niño/La Niña cycles, storm intensity, etc.), several animals play important roles in the ecology of California kelp forests. These include sea otters, sheephead, sea urchins, lobster, and several other economically important species that depend heavily on the productivity of kelp beds. Beginning in the late 1700s, European and American commercial interests severely disrupted California coastal ecosystems and heavily impacted many marine species. Sea otters, several pinnipeds, and cetaceans were hunted to local extinction, for instance, and sea urchins, abalones, lobster, sheephead, and other species were heavily overfished. This commercial overexploitation altered key ecological relationships in California kelp forests and other marine communities and created tensions between conservation biologists, the fishing industry, and resource managers. Collaborative interdisciplinary efforts are the key to mediating this debate and to understanding the long-term relationships between humans and kelp forest communities. We need detailed case studies, however, to develop effective management protocols and to guide us along the way.

Case Study: The Northern Channel Islands, California

For the last 12,000 years, the Northern Channel Islands and the Santa Barbara Channel area (Figure 1) have been home to the Chumash and their ancestors, some of the most complex maritime hunter-gatherers in the world (see Kennett 2005). Unfortunately, most Chumash sites along the mainland coast have been devastated by development, bioturbation, agriculture, looting, historic construction, and other processes. These disturbances inhibit our ability to reconstruct past environments, interpret ancient lifeways, and understand human impacts on ancient ecosystems. The Channel Islands, in contrast, have been largely unaffected by development, plowing, and burrowing animals, and hundreds of archaeological sites—with well-preserved stratigraphy, faunal remains, and artifacts—have remained largely intact (Figure 2).

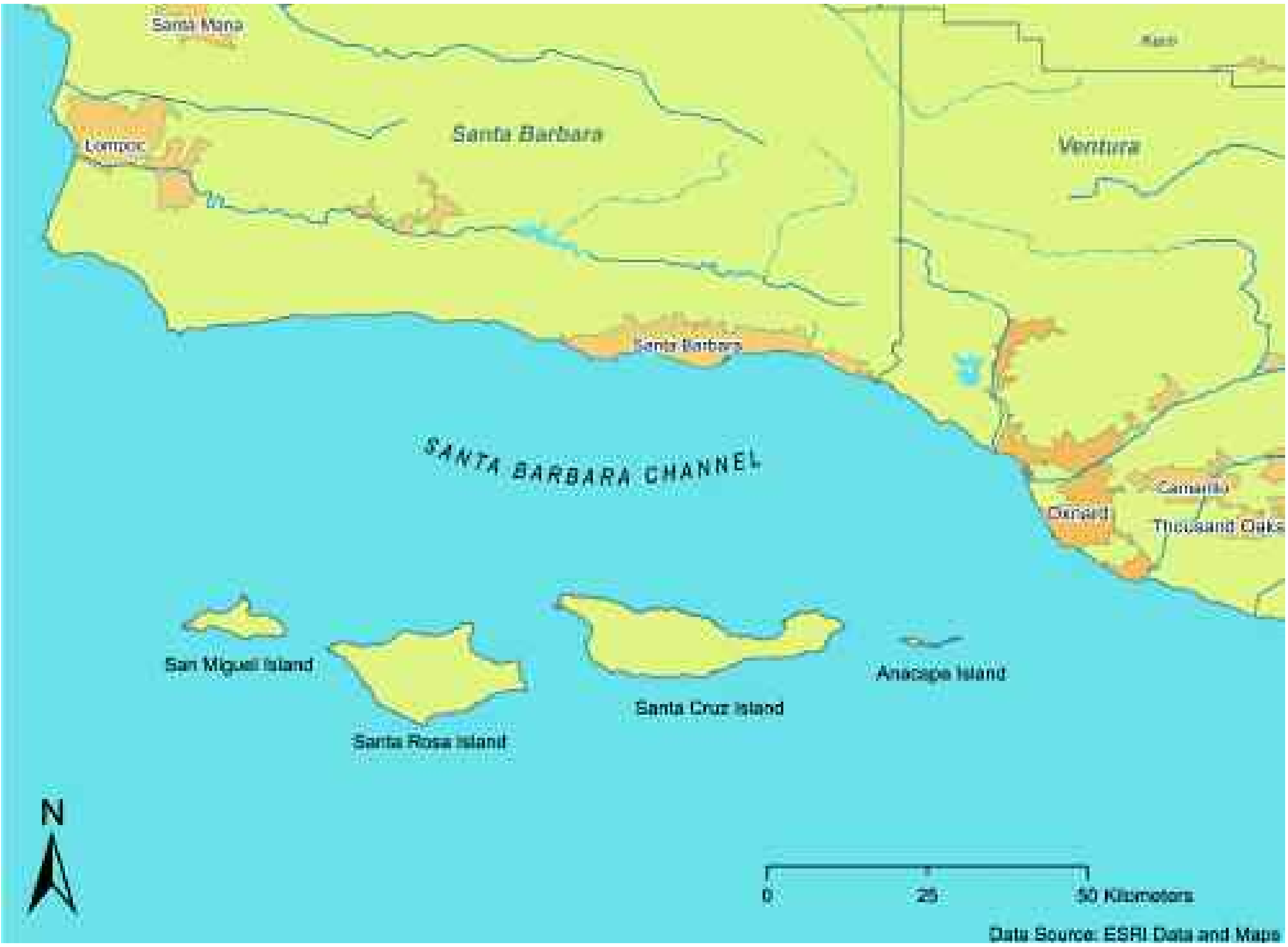

Figure 1: Map of the southern California Bight and the Northern Channel Islands (by Jacob Bartruff).

Together, the Northern Channel Islands of Santa Cruz, Santa Rosa, San Miguel, and Anacapa constitute most of Channel Islands National Park. Despite over a century of archaeological explorations, just a small percentage of archaeological sites within the park have been excavated or dated. These sites offer impeccable high-resolution data, including the well-preserved remains of marine mammals, fish, shellfish, and sea birds, as well as land animals (island fox, dogs, spotted skunk, etc.). The long record and pristine nature of Channel Island sites is unmatched in California and in virtually any coastal region in the world.

Dayton and Tegner (1984:471) hypothesized that Native Americans played an important role in marine ecology along the California Coast. They proposed that Native sea otter hunting released shellfish populations from predation, increasing productivity of important shellfish fisheries. Preliminary support for this idea has been found on San Miguel Island, where Erlandson and his colleagues (2005) have documented Native American hunting of sea otters from at least 9,500 years ago to early historic times. This hunting helped maintain productive shellfish and fish populations throughout the Holocene, as evidenced by hundreds of large middens containing enormous quantities of abalones and other large shellfish not normally found in coastal waters where otters are abundant. As Native populations grew over the millennia, marine fishing intensified (Kennett 2005). By about 3,000 to 4,000 years ago, heavy fishing may have impacted some local populations of sheephead, which help to control urchin populations in island waters. We are now studying several San Miguel and Santa Rosa middens dated to the last 3,500 years, where some strata are dominated by sea urchin—possible evidence that Native hunting and fishing helped create localized and short-lived urchin barrens. In contrast to the devastation of the historic Euro-American era, however, Native peoples harvested the same species of marine mammals, fish, and shellfish relatively continuously for 10,000 years. By documenting the technological and behavioral adaptations of the Chumash and their ancestors over the millennia, we hope to learn (1) how they affected marine ecosystems of the Channel Islands, (2) what adjustments they made to sustain their large populations in a fragile island environment, and (3) how modern resource managers can more effectively conserve and restore the natural and cultural resources of America's national parks, manage commercial fisheries, and preserve the quantity and quality of our oceans' resources.

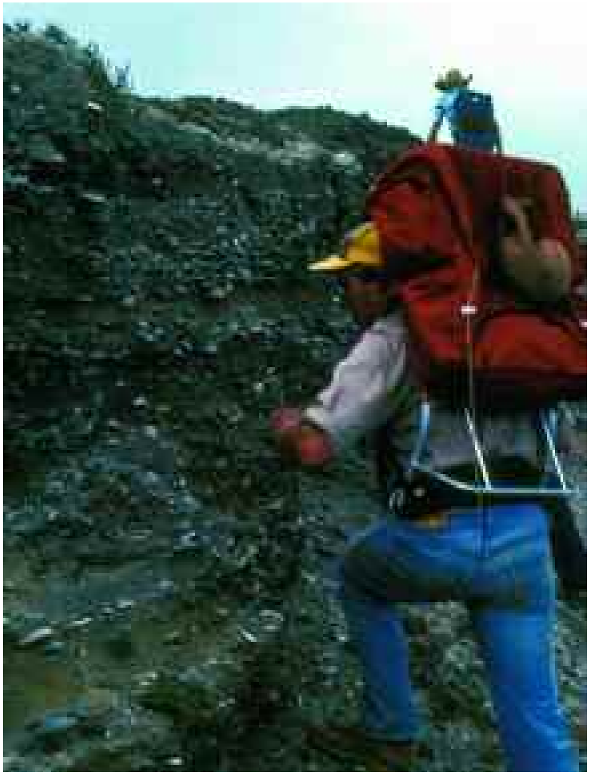

Figure 2: Erlandson inspecting shell midden exposure at CA-SMI-525.

We are employing several methodological approaches to help conserve these cultural data sets and to study the historical ecology of the Northern Channel Islands:

> (1) Intensive radiocarbon (^{14}C) dating to reconstruct settlement and subsistence patterns and identify threatened sites that span the Holocene.
>
> (2) Surface collection, mapping, excavation, and analysis of threatened sites to reconstruct local marine and terrestrial environments through time; identify changes in human technology, demography, and subsistence over the last 9,000–10,000 years; and document human impacts on local ecosystems (Figures 3 and 4).
>
> (3) Oxygen and carbon isotopic analysis of marine shells, paleoecological records of sea surface temperature, kelp forest extent, marine productivity, and sea-level change to account for environmental fluctuations.
>
> (4) Detailed analysis of faunal constituents and measurement of relative sizes to elucidate changes in prey species and size through the Holocene.

In documenting a series of trans-Holocene ecological records of near-shore marine ecosystems, we are exploring some of the ecological relationships first proposed by Dayton and Tegner (1984) 20 years ago. In the process, we are collecting a variety of ecological and archaeological data that will help archaeologists, marine ecologists, and resource managers better understand the nature of intertidal, kelp forest, and other near-shore ecosystems prior to European contact.

This picture is complicated by environmental fluctuations that affect marine and terrestrial ecosystems outside the domain of human agency. To manage this complex picture, oxygen isotope studies will help to differentiate climatic from human-driven marine and terrestrial changes. In addition, Kennett and Kennett (2000) have developed a high-resolution sea-surface temperature curve for the Santa Barbara Channel region that can help to identify changes in kelp forest and intertidal species composition due to sea temperature oscillations.

Without doubt, the Chumash had an effect on Channel Islands' marine and terrestrial environments.

As their populations increased, technologies became more sophisticated, and subsistence practices intensified during the Holocene; they altered the environment in significant ways. But, when compared to the devastation of historical practices, they employed relatively sustainable and low-impact strategies. If we can better understand their conservation practices, we may be able to better design management practices today.

Conclusions

The crisis of the oceans and our marine fisheries calls into question how long these resources will last in the face of growing global populations and continuing environmental degradation. The state of modern ecosystems is the result of complex and continuous interactions between organisms and humans. Applying historical perspectives and the interdisciplinary work of ecologists, biologists, historians, archaeologists, and other scientists, we can identify the "shifting baselines" we need to address this crisis. Archaeologists can play a key role in reconstructing past ecosystems and understanding the sustainable practices of past human societies. By studying past human impacts, we gain a better understanding of what the future might hold and develop more effective protocols for present conservation efforts.

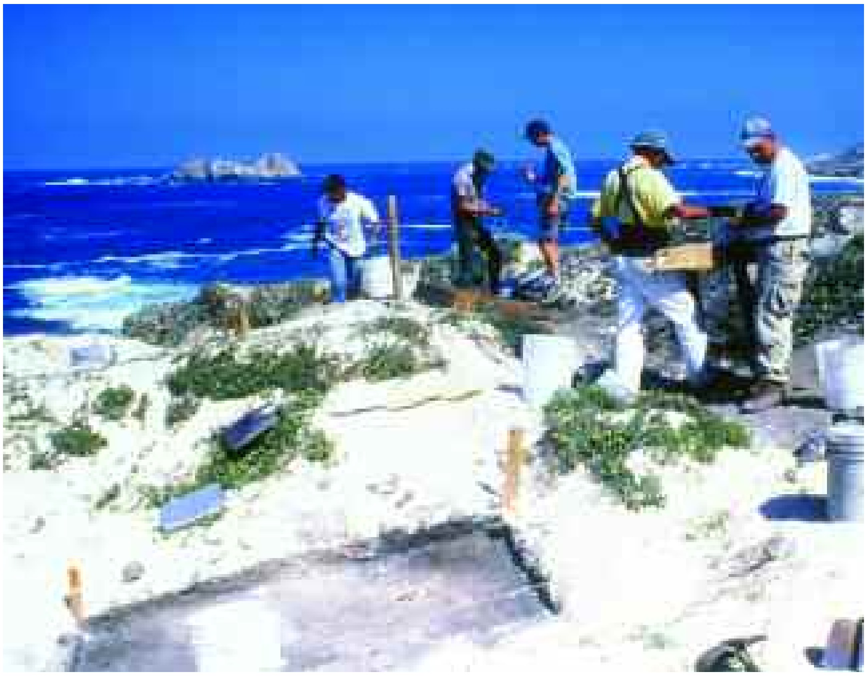

Figure 3: Excavations at Point Bennett, San Miguel Island.

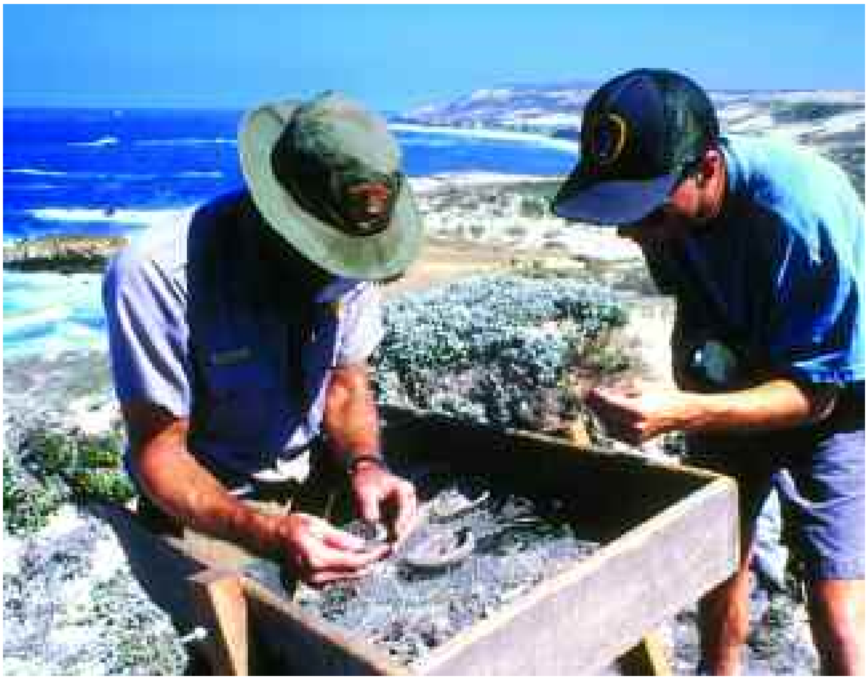

Figure 4: Excavations in cooperation with Channel Islands National Park officials at CA-SMI-528.

Acknowledgments

Our research is supported by Channel Islands National Park, the Marine Conservation Biology Institute (MCBI), and the University of Oregon. We thank Ann Huston, Kelly Minas, Bob DeLong (NMFS), and Ian Williams for their time and support.

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