

“Good Water and Firewood”: The Island Oasis of Isla Cedros, Baja California, Mexico¹

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Abstract: Today, Isla Cedros is remote from major population centers of northwestern Mexico and the American Southwest, but before European contact and throughout the Colonial Period, it was a well-known location to both indigenous peoples and Europeans. Today, a local fishing cooperative shares the island with a massive Mitsubishi Corporation/Mexican government–owned salt-transshipment facility. Far from representing a cautionary tale of excessive development and environmental degradation, Isla Cedros is one of the few places on the globe where human harvesting of marine resources has not yet resulted in an ecological collapse. It is a place where paradoxes abound and allows an alternative view of human interaction with marine and insular ecosystems. Both short- and long-term environmental variation characterizes this ecologically transitional region, and the adaptability of both its human and nonhuman inhabitants presents insights into the possibility of a “commons” without tragedy. Issues of exclusive use rights, short-periodicity variation, localized effects on resources due to sea-level rise, and sustainable socioeconomic systems can be addressed in an examination of Isla Cedros, Huamalgua, the Island of Fogs. This island setting presents us with challenges to many underexamined assumptions. In essence, it refuses easy categorization, instead offering at least some alternative perspectives for future historical ecological research of broad relevance to coastal and island settings worldwide.

AT FIRST GLANCE, Isla Cedros (Figure 1) appears to embody the age-old concept of a desert island: dry, rocky, and geographically remote from modern population centers. Even the modern occupants, fishermen and salt-dock workers, refer to their home as “El Piedron” (“The Rock”). However, through a unique combination of a rich and robust ma-

rine ecology, surprisingly abundant sources of potable water, and an adequate base of terrestrial resources, Isla Cedros has been one of the most densely occupied areas of central Baja California for at least the last 2,000 years, if not longer. Occupation of the island extends back at least 12,000 calendar years (Des Lauriers 2006, 2008), and human populations on the island certainly experienced the full scope of Holocene climatic shifts, while never abandoning “the Rock.” For reasons linked to geography, demography, and ecology, the responses of those populations to such changes may have varied from those of communities occupying other portions of the Pacific coast of North America.

Drawing upon archaeology, historical documents, ethnography of contemporary local fishermen, and basic ecological data, a fascinating image emerges of this unique island and a complex ecological history, which both shaped and was shaped by the actions of its long sequence of occupants. Far from confirming standard notions about Baja Cali-

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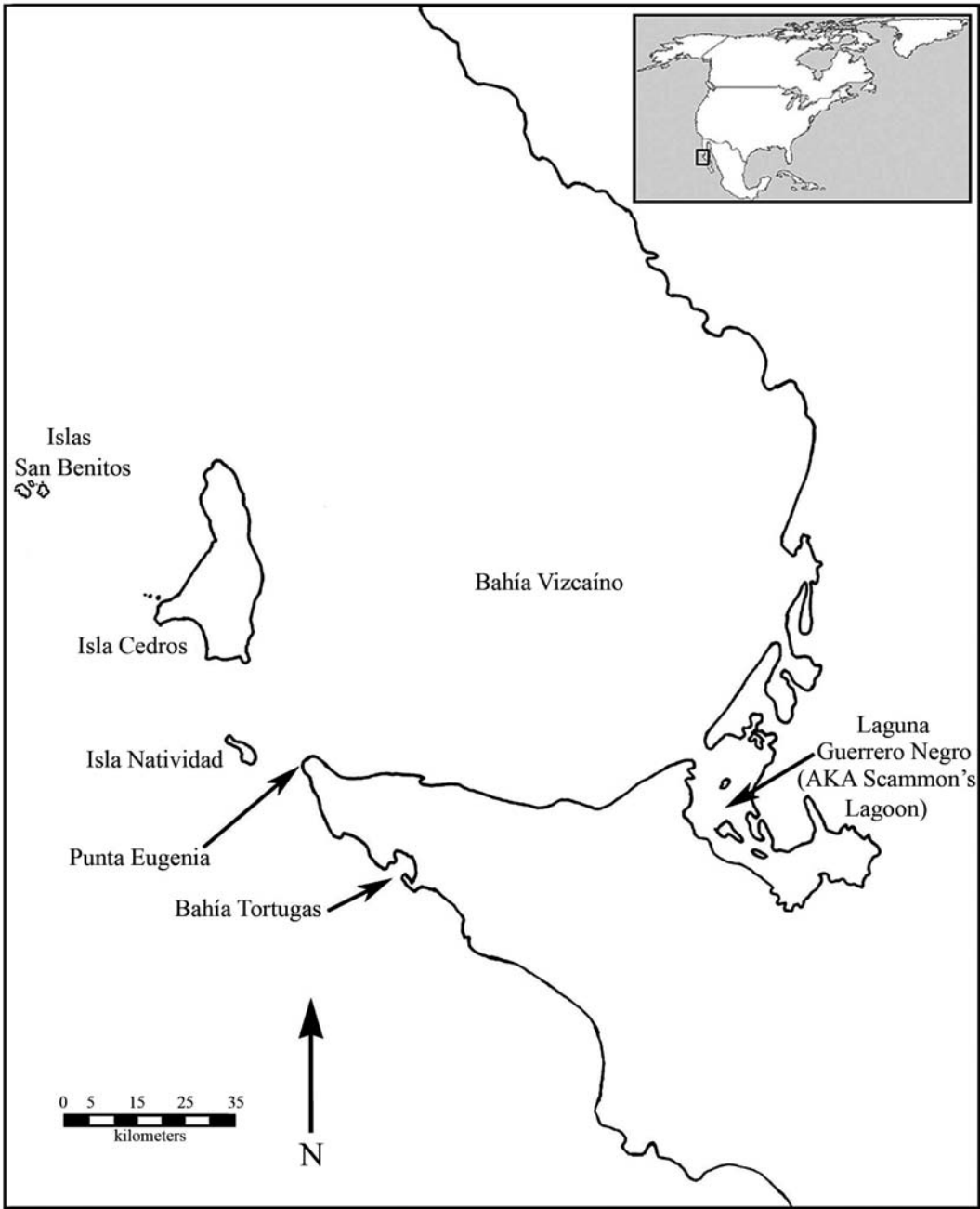


FIGURE 1. Isla Cedros in both regional and continental context.

ifornia, islands, or human impacts on littoral resources, Isla Cedros presents us with challenges to many underexamined assumptions. Among these are assumed negative consequences of human exploitation of natural resources and the presumption that the cumulative result of individually centered decision making is the best way to model patterns of human behavior in all societies for all time periods. The history and archaeology of Isla Cedros refuse easy categorization, instead offering at least one alternative perspective for future historical ecological research of broad relevance to coastal and island settings worldwide (Jackson et al. 2001, Steneck et al. 2002, Van der Leeuw and Redman 2002, Balée 2006, Rick 2007).

ISLAND OASIS: GEOGRAPHIC AND HISTORICAL FACTORS

After the precontact period of indigenous history, Spanish explorers (Mathes 1968, Montané-Martí 1995), missionaries (Des Lauriers and García-Des Lauriers 2006), American and Russo-Aleut sea-mammal hunters (Ogden 1941), pirates, California miners (Veatch 1869), Chinese and German-Japanese fishing operations (McVicar 1964) all visited and exploited the island's resources over the last 500 years. It is from the maps of Sebastian Vizcaíno, who was sent at the dawn of the seventeenth century to chart the coast of the Californias by the viceroy of New Spain, that the title of this article is drawn. The handwritten comment "Good Water and Firewood" is noted for at least seven locations around the coast of Isla Cedros, and accompanying documents remark on the abundance and ease of access to both resources for mariners (Mathes 1968). Correspondence by the Jesuit Sigismundo Taraval (Des Lauriers and García-Des Lauriers 2006) dating to 1732 indicates a strong community orientation of native society on Isla Cedros, with some leadership roles and ritual specialists but relatively few hierarchical tiers of status visible to European observers. The rapid, violent, and collective opposition to attempted landings by Spanish explorers

(Wagner 1929, Montané-Martí 1995) is one of the most consistent items mentioned in the accounts, and such descriptions clearly indicate a level of organized response by the indigenous communities. During the sixteenth through the nineteenth centuries, the use of Isla Cedros as a base for sea-mammal hunters (Ogden 1941), Chinese and Japanese fishermen (McVicar 1964), and other apocryphal stories of pirates and galleon crews is well documented and a fascinating story of the roots and processes of globalization in the eastern Pacific. But why was such a rugged and seemingly inhospitable island such a nexus of indigenous and colonial activity? The answer is simple—water. Quite the opposite of Coleridge's dilemma, Isla Cedros represents an anomalous hydrological situation, and it was this factor in the historical ecology of the island that enabled so many of the other systems to emerge and processes to unfold.

In the arid terrain of central Baja California, water is perhaps the most critical resource, and the one in shortest supply. Isla Cedros is a geographic paradox. The adjacent mainland coast has the fewest potable water sources along the Pacific coast of the Baja California Peninsula, but Isla Cedros itself is well provided with numerous springs, seeps, and tanks (Figure 2). The modern port town for the local fishing cooperative (Pescadores Nacionales de Abulon), which houses around 1,200 residents, receives all of its water from one major spring located high on the slopes of Monte Cedros, the 1,330 m high peak in the center of the island. This abundance in the midst of scarcity was a critical factor throughout the indigenous history of Isla Cedros, continued right through the historic period, with Manila galleons, otter hunters, miners, and travelers taking advantage of the island's abundant water. For the earliest indigenous colonizing groups, the presence of reliable water may have made Cedros an ideal location to stage further exploration and would undoubtedly have resulted in the island being a "known location" from a very early date (Mathes 1968, Montané-Martí 1995). Spanish (and other European) mariners may



FIGURE 2. "Vizcaíno's Spring," located on the east coast of the island.

have preferred the water source a few kilometers north of the modern town due to the proximity of deep anchorages and the sheltering effect of the imposing bulk of Monte Cedros, which blocks virtually all northwesterly winds. However, their preferences were conditioned by the nature of their vessels and the fact that Isla Cedros was simply a point en route to or from their port cities farther south along the Mexican Pacific coast (Mathes 1968).

The nonagricultural native populations of Isla Cedros did not have the same water requirements as horticultural groups, since drinking water was the only need that could not be fulfilled by the surrounding ocean. Seawater can be (and indeed often still is) used in cooking and cleaning, even by locals today, and its capacity to fulfill certain needs should not be ignored for temperate-climate maritime peoples. Indeed, although the statement that water is available in “nearly every ravine” (Veatch 1869:144) is something of an overstatement, it is certainly true that on Isla Cedros it would require very careful planning to be more than about 2 km from a reliable source of potable water. The earliest documented inhabitants of the island, arriving sometime before 12,000 cal B.P. (Des Lauriers 2005, 2006, 2008), seem to have made their camps as close as possible to major water sources, despite the fact that these would have been 3–4 km from the ocean at the time. Modern coastline is still about 2 km from these sites, which underscores the small amount of land that Isla Cedros has lost to sea-level rise. These Early sites display little evidence of later occupation, which seems to have shifted toward the coast, though typically centered around the mouths of arroyos containing springs or other water sources at no great distance updrainage (Des Lauriers 2005). Suffice it to say that the surprising availability of water (Veatch 1869, Mathes 1968, Venegas 1979 [1739], Montané-Martí 1995) noted by successive generations of European explorers and missionaries was and continues to be one of the most salient factors underlying the ecological and demographic distinctiveness of Isla Cedros.

Themes of Discussion

It is my intention to energize the dialogue about the nature of human relationships with their natural environment, with each other, and with that unusual convergence of geography, ecology, and society that creates not only the literal, but the conceptual “island.” In this effort, some of the larger assumptions about human-environmental interaction, including the notion that individualistic models of decision making are broadly applicable in non-Western, premodern contexts, will be set aside in favor of a perspective that sees collective organization of economic activity as being an equally plausible way to model ancient human behavior. The ideas will be introduced before discussing the modern Isla Cedros context and its social and ecological characteristics that (it is argued) allow us to derive analogies relevant and applicable to the past of the island and beyond. A few of the archaeological problems encountered on Isla Cedros are discussed in detail, and they are viewed through the lens of the theoretical approaches and modern analogies enumerated earlier. Overall, conceptual engagements between sustainability, broad-spectrum patterns, and the advantages of collectively held exclusive use rights for long-term economic and ecological stability form the underlying threads of the discussion. It is hoped that these points will be taken in the spirit of discourse and lead to further dialogues about these issues, which are absolutely central to a fuller understanding and appreciation of insular and maritime societies.

ISLAND SOCIETIES: SUSTAINABILITY, FLEXIBILITY, AND RESILIENCE

No system that depends on the “best of times” can be sustained over the long term. Much more resilient are systems that will carry a group through the “hard times” as well. An environment that presents a rich resource profile in general, but where the specific proportions of those resources can frequently vary within a short time frame, will require technologies with broad applicability and a flexible exploitation strategy

with a rapid response time. In addition, the exploitation of a broad range of resources on a sustained basis allows for critical reserves of knowledge to be maintained, along with up-to-date information about locations, density, and accessibility. If the amplitude of shifts in the proportional abundance of economically valuable resources is sufficiently great and occurs with subgenerational frequency (see Ingold 2000), then the active maintenance of “sustained broad spectrum exploitation” can be seen as contingency planning (e.g., Binford 1977, 1978) rather than simply the reactive response suggested by some applications of diet breadth modeling (MacArthur and Pianka 1966).

Both archaeological and historical data from Isla Cedros, combined with broadly comparative ethnographic examples from other insular/maritime contexts, suggest that one viable model to explain such sustainability (despite intensive harvesting in both ancient and modern systems) is the holding of exclusive use rights vested in communities rather than individuals. As highlighted by Berkes et al. (1989:91), the sustainability of common-property resource exploitation depends upon the recognition of the “divergence between individual and collective rationality.” The modern cooperative system employed by the lobster and abalone fishermen of Isla Cedros since 1943 (McVicar 1964) may be a productive analogy for modeling the indigenous resource-harvesting practices, because it is likely that both were/are conducted by communities acting in concert rather than simply being the cumulative effect of individual decision making. The distinction is most notably present in the definition of communal property provided by Feeny et al. (1990:4; see also Berkes et al. 1989:92), who stated that, “[u]nder communal property, the resource is held by an identifiable community of interdependent users” who can “exclude outsiders while regulating use by members of the local community.” This concept runs counter to models that depend upon the assumption that exploitation decisions are made by individuals unrestricted by traditional self-regulation or by exclusionary use rights and the circumscribed territo-

ries that accompany such. The “tragedy of the commons” (Hardin 1968) is only an inevitability when the cultural or political context is such that the exploitation of a resource is conducted by individuals behaving as individual actors rather than as members of a community (McCay 1978, 1980, 1981). Given the nature of marine resources and the frequent necessity of collaboration between multiple individuals (especially true with regard to lobster and abalone fishing), in practice, the collectivity begins at the level of a boat crew, and metaphors derived from such are common in contemporary discussions.

THE MODERN COMMUNITY ON ISLA CEDROS

The inhabitants of the modern fishing community have no known direct cultural or biological ties to the indigenous population of the island, which was tragically eradicated by 1732 due to a combination of disease and removal to mainland Jesuit missions (Aschmann 1959, Venegas 1979 [1739]). Despite this discontinuity, their knowledge about the marine ecology surrounding the island is based upon at least four generations of permanent occupation by fishermen and divers. Given the strong similarities between modern and indigenous communities in terms of resources exploited, the identical landscape, and the ecological and social factors common to many fishing societies, analogies are here derived from both conversations and direct experience with several locally born and raised fishermen.

Ethnographic Methods

The most important informants were Catarino Martinez, his cousin Catano Martinez Burguez, and Victor Molina (Figure 3), though quite a few other local people have provided important insights, including Arnulfo, Ivan, “El Patón,” Mario, Timoteo, Angela, José, and others. The methods used most frequently were unstructured interviews largely driven by the topics volunteered by local fishermen to avoid obtaining only data about preconceived topics. This was fortunate, because some of the insights obtained



FIGURE 3. Principal informants for ethnographic data discussed herein. *Top left*: Catarino Martinez (1928–2004); *top right*: logo of the Pescadores Nacionales de Abulon, the Isla Cedros fishing cooperative; *bottom left*: Catano and Angela Martinez Burguez shown with a *vigilancia* boat of the local fishing cooperative (photo, 2006); *bottom right*: Victor Molina and crew hauling in catch from set nets in the Bahía Sur of Isla Cedros (photo, 2005).

would not have been included in any previously prepared formal interview. In addition, I went fishing with Catarino Martinez on three occasions during which topics identified during earlier conversations were pursued further. Until his passing in 2004, Catarino Martinez was considered the single most experienced and knowledgeable diver on the island and was responsible for training many

of the younger generations of divers currently working on the island. Victor Molina was kind enough to take me on four trips to both place and recover anchored gill nets targeting elasmobranch species such as angel shark (*Squatina* sp.) and guitarfish (*Rhinobatis productus*). At least eight additional trips, each with different fishermen, have also been carried out in the last 4 years. Catano Martinez

Burguez and his wife Angela have provided over 7 years of conversations over dinner and coffee, as well as innumerable contacts with other long-time residents of the island.

Modern Adaptations on Isla Cedros

The modern fishing cooperative (Pescadores Nacionales de Abulon) possesses the exclusive use rights to all lobster and abalone in the littoral and nearshore zone around the island and several small islets to the west (McVicar 1964). In addition to the cooperative, there are also several independent fishermen who focus their exploitation on net fishing, largely to supply fish to off-island buyers. The fishermen share the island with a large, jointly owned Mitsubishi–Mexican government salt-transshipment facility (Figure 4), though its impact on the fishery is not well studied.

The marine ecology of Isla Cedros appears to be remarkably resilient, having weathered the same El Niño events and broad-effect perturbations as the Alta California coast. This resiliency represents one point of difference between the northern and southern portions of the Californian marine biogeographic zone, which runs from Point Conception in the north to Punta Eugenia in the south. As numerous scholars have observed, “The Santa Barbara Channel area is susceptible to El Niño/La Niña cycles, intensive droughts, and other climatic perturbations” (Rick et al. 2008:79). The plant and animal communities of Isla Cedros differ in their ecological response to these large-scale variations, because in contrast to the depleted situation in the southern Alta California portion of the “Bight,” in the waters of central Baja California, there remain strong, commercially



FIGURE 4. A view of the southeastern corner of Isla Cedros, showing part of the Mitsubishi/Mexican government-owned salt-transshipment facility (ESSA).

exploited populations of a variety of marine shellfish and crustaceans, including *Haliotis* and *Panulirus* (abalone and spiny lobster, respectively), as well as a range of elasmobranch and bony fishes. The pinnipeds, cetaceans, and seabirds are not currently exploited but also thrive in the robust marine environment around the island, supported by waters enriched by both the California Current and pronounced upwelling (Dawson 1952). Localized upwelling and complicated current patterns creating dramatic thermoclines sustain the cool-water communities thriving around Isla Cedros (Dawson 1952, Pondella et al. 2005), so the ecological stability of the area is not exclusively dependent on the strength of the California Current. In fact, during the 1997–1998 El Niño, the upwelling in the area continued without dramatic decrease in intensity (Pondella et al. 2005:188). In addition, the location of Isla Cedros in a transitional zone means that year-to-year variation in surface sea temperature is to be expected, and local faunal and floral communities have developed distributional structures and behaviors that provide some enhancement of thermal tolerances (Dawson 1952). Fish species that prefer colder temperatures, for example, do not migrate out of the region when warmer water currents make uncommon inroads into the area but instead simply migrate down the water column, taking advantage of the complex thermocline system, which is created by the interaction of upwelling, localized current systems and the larger California Current (Dawson 1952, Pondella et al. 2005). A high diversity of species, combined with a highly productive overall environment has created a remarkably robust marine ecology.

This aquatic abundance is contrasted with an extremely arid terrestrial ecology, one that, despite ample potable water and abundant xerophytic plant communities (agave, jojoba, opuntia, juniper, etc.), is incapable of supporting subsistence agriculture. The town on the southeastern corner of the island has sometimes gone years without registering measurable precipitation. The native plant communities are largely sustained by the

dense marine fog that contributed to the native appellation of the island as Huamalgua, recorded by the Jesuit Taraval (Venegas 1979 [1739]) and meaning “Island of the Fogs” (Des Lauriers and García–Des Lauriers 2006).

The principal points derived from my ethnographic work on Isla Cedros include, first, how some events and short-term environmental variation can have a disproportionate effect on the archaeological record; second, how some social practices can have an impact on resource exploitation patterns; third, how contingency planning and flexibility allow for avoidance of crises; fourth, how the anticipation of short-term events can be more important than “normal” conditions for shaping the exploitation practices of some fishing societies; and finally, how, despite the cultural and biological discontinuity between the modern and indigenous populations, similar patterns of resource exploitation reoccur due to a combination of geography and the basic nature of human exploitation of marine resources.

Basic Principles of the Modern Cedros Strategy

It is notable that many of the fishing communities of the Pacific coast of Baja California organized on the cooperative model remain economically viable long after the collapse of the Alta California fisheries. One distinct possibility, and one that is asserted by the Cedros Island Coop members, is that the system of geographically defined and exclusive use rights protects the resources from overexploitation (a term they understand and use without being prompted). They feel that if the harvesting were not controlled by a single, locally based entity (such as the cooperative), management would not be possible. This restriction may allow fishing communities to avoid a supposedly inevitable “tragedy of the commons” (contra Hardin 1968, sensu McCay 1978, 1980; Feeny et al. 1990). It is interesting to note that Late Period archaeological settlement patterns (Des Lauriers 2005) and Jesuit documents (Des Lauriers and García–Des Lauriers 2006) seem to indi-

cate the presence of territorial clans on Isla Cedros. It may be this spacing that allows for each residential group to monitor and manage the resources within its allocated and/or defended territory. This “defense” today is carried out by the cooperative itself, which employs *Vigilancia* units to patrol the island’s most productive areas by land and by boat, especially during low tides.

Another relevant factor is the effect that transportation has on the location of settlements. With the introduction of outboard motors, the number of separate fishing camps decreased and nucleation increased as more and more powerful motors became available. It would not be surprising if comparable improvements by indigenous peoples in watercraft cargo capacity, speed, and reliability likewise resulted in increased nucleation of actual habitation sites.

In addition to the benefits of collective decision making within a zone of exclusive use rights and avoiding the tragedy of the commons, in the last 10 years the modern cooperative (PNA) has also actively begun expanding the range of products that they ship to market. This is despite reasonably sustained harvests of both lobster and abalone during the same time period. Part of the stated purpose involves their own anticipation of periodic fluctuations in both the natural productivity and market value of each of their two principal resources and their need to buffer the economic impact on community members by engaging in a diversified marine economy. It is striking that this “expansion of diet breadth” appears to be occurring without the assumed prerequisite depletion of more highly ranked resources. The added stability afforded by such practice potentially allows the cooperative to maintain exploitation of the lobster and abalone at sustainable levels, even if price fluctuations would usually prompt increased harvesting. The economic buffering provided by supplementary harvests of sea cucumber, sea urchin, sea snail (*Litbopoma undosa*), and scale fish helps mitigate potential shortfalls. The parallels between such modern practice on Isla Cedros and the early indications of a precontact indigenous broad-spectrum economy should not be dis-

missed as coincidental, because such practices are paralleled by other fishing cooperatives elsewhere on the globe (McCay 1981). It is entirely plausible that, over time, similar solutions to human ecological dilemmas can be developed repeatedly in the same geographic space by local people making decisions that affect their lives. As such, the local (or traditional) ecological knowledge (Sillitoe 1998, but see Palmer and Wadley 2007) possessed by the people of Isla Cedros can illuminate not only contemporary issues but also assist in understanding the long, historical relationship between the peoples of this island and the world around them.

Examples of These Principles in Action: Casting a Wide Net

One of my informants, Victor Molina, provided an interesting perspective on short-term shifts in ocean temperature. He mostly fishes by means of set nets made from nylon cordage or monofilament, but there are a variety of other methods at his disposal. When asked about the water conditions in July of 2005, he commented that the warm-water current from the south that usually makes an appearance sometime during the summer, bringing with it different species of fish, including sardines and yellowtail, had not arrived. When asked how this had affected his fishing, he replied that it had forced them to fall back on fishing for angel shark and guitarfish, which do not command the high price of yellowtail but are abundant and fairly predictable as to their location and density.

In all of my conversations with Victor Molina, one of the most salient points he made was that it was not change in and of itself that was problematic—one can adjust strategy, techniques, targeting, etc., to counterbalance any specific change, as long as there is something, anything, to harvest. What is particularly troubling to Victor is “true” unpredictability—where the normal associations of season, geography, and animal behavior fail to cohere. Erratic (rather than simply variable) weather patterns, unexpected oscillations in resource abundance, and

changes in species behavior can cause a greater disruption to the productivity of his fishing than even an El Niño year. Victor claims that when warm water does come to Cedros, it does not disrupt his fishing so much as change the species being taken. Because Victor's father was among the first of the early twentieth century colonists to found the current community on the island in the 1920s, Victor has at his disposal over 75 years of cumulative ecological knowledge about the waters surrounding Isla Cedros. As such, he is well prepared for any ecologically relevant variation that has occurred repeatedly during that time span (see Ingold 2000). Only unprecedented events, or those with extremely long periodicity, would require the innovation of completely new responses. It seems that with relatively minor adjustments of technique and geographic targeting (all of which are part of preconceived contingency plans) the same technology and labor organization can produce the same effective result. A difficulty in extending such modern analogies back in time is the observation that the archaeological signature of such variation from year to year may result in an "average" assemblage rather than one that actually reflects the distinct pattern produced in any given year (Jochim 1991).

Wave-lashed Shores

One of the most dramatic events described by local fishermen was the *Chubasco*, or hurricane, of 1972 (Hurricane Joanne, 5–8 October 1972). When the storm hit the island, it brought torrential rains that caused large amounts of sediment to be dumped at the mouths of the many arroyos that cut through the steep topography of the island. Usually these arroyo mouths are some of the more productive abalone beds, due to the favorable substrate conditions and many boulders and rocks suitable for attachment of both abalone and mussels. The sediment outwash resulted in the virtual extirpation of these beds and had a major impact on the kelp forests near the arroyo mouths, which are very near the shore due to the steep bathymetry of the island. Many abalone, some still barely alive,

washed up on the beach for nearly 2 weeks after the storm. For 2 to 3 years the kelp forest was seriously damaged and only began to recover after about 4 years. In addition, the arroyos filled with sediment and buried several springs used by the seasonal fishing camps for washing and other purposes. Ten to 15 years passed before the affected areas returned to "normal" and were as productive as before. That storm (and the damage it caused) served as a catalyst for the abandonment of some of the west-coast fishing camps that were already declining in importance as increasingly powerful outboard motors further reduced the need for base camps so remote from the town site (Figure 5). Such alterations of settlement pattern could also be expected in other instances of innovation and change in watercraft design and capabilities (Arnold 1995, Ames 2002, Gamble 2002, Des Lauriers 2005).

Increased rainfall following long-term drought or rare storms on particularly arid coastlines can actually be extremely disruptive to localized littoral ecology, as well as corresponding human settlement patterns (Moseley et al. 1992). No El Niño–Southern Oscillation event is necessarily required, simply a single powerful storm or a period of high-amplitude variation in rainfall (Waylen and Caviedes 1986). Once again, efforts to mitigate for erratic conditions are the most taxing on food collectors, who cannot inherently increase productivity simply by expending more labor but absolutely must be successful in predicting location, abundance, and timing of resources to be harvested, particularly in maritime settings. For the pre-contact inhabitants of Isla Cedros, the most ironic dimension of this phenomenon would have been that although the arroyo mouths are the ideal locations for acquiring water, traveling into the interior, and launching watercraft, they are also the exact locations that would present the most unpredictable, highest-amplitude variation in shellfish bed productivity. Areas away from these usually "optimal" locales would not have been as strongly affected and would present lower-amplitude variation in productivity, making them technically more "reliable."



FIGURE 5. A portion of the cooperative town on Isla Cedros and two of the standard *lanchas* with outboard motors used in virtually every type of fishing or circumisland transport.

THE ARCHAEOLOGICAL PATTERNS
OF ISLA CEDROS THROUGH THE FILTER
OF MODERN ANALOGY

As noted earlier, the archaeological record of Isla Cedros spans at least the last 12,000 calendar years, with over 70 recorded sites; excavation data are currently available for seven of these (Des Lauriers 2005). Among the remarkable discoveries include several sites dating to the Terminal Pleistocene and Early Holocene (Des Lauriers 2006, 2008); large, multiple Late Period village sites with hundreds of house features; and highly specialized maritime resource harvesting technology, including both bilaterally barbed harpoons (Figure 6) and single-piece shell fishhooks (Des Lauriers 2005). One consis-

tency in the archaeological data relevant to the current discussion is the surprising breadth of species recovered from all time periods for which excavation data are available (Des Lauriers 2005, 2006). Beginning in the Early Holocene and continuing up until the abandonment of the island, the exploitation of marine resources seems to have been very broad based, taking advantage not only of a variety of species but also a wide range of littoral and nearshore environments. It is unlikely that the earliest documented inhabitants of the island had achieved sufficient population densities to reach the point of diminishing returns required in many diet breadth models as the catalyst for diet breadth expansion (e.g., Broughton 1997). To occupy Isla Cedros in the first place, these

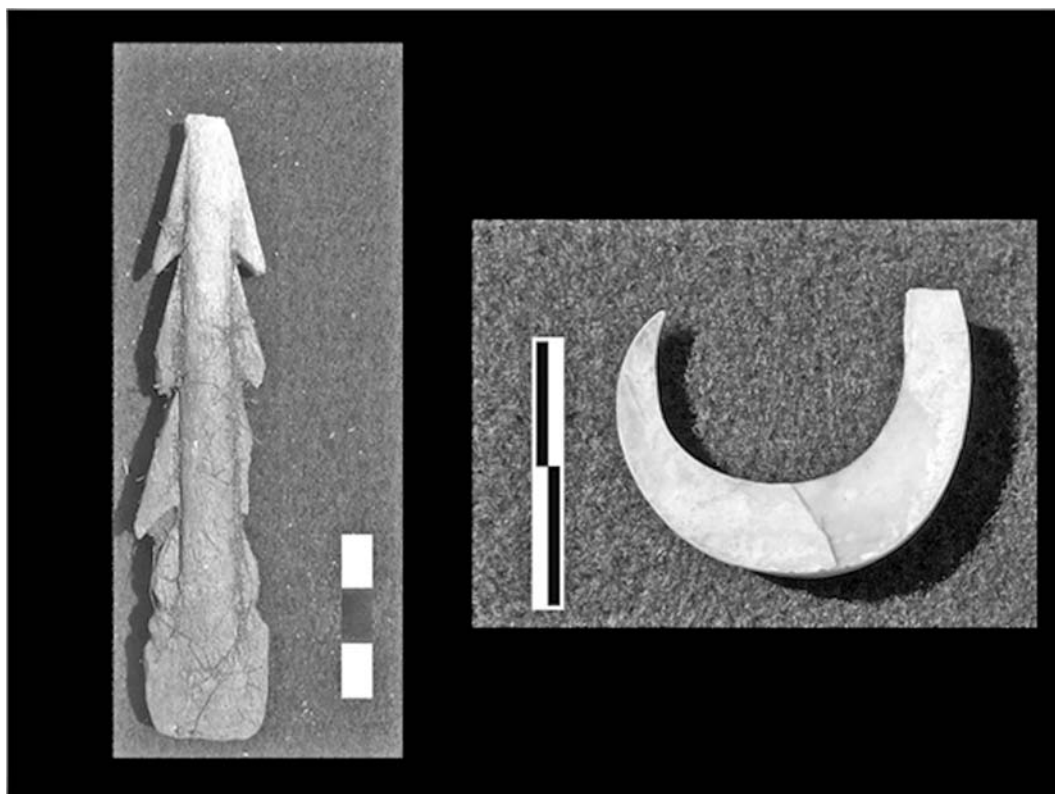


FIGURE 6. Bilaterally barbed whalebone harpoon point (PAIC-45) (*left*), and a single-piece abalone shell fishhook (PAIC-32c) (*right*). Scale bars in centimeters.

“colonization phase” occupants would have had to be fairly familiar with the challenges and opportunities presented by coastal contexts. Given the instability of coastal ecosystems during the Terminal Pleistocene–Early Holocene, the parent population for the initial colonists of Isla Cedros would most likely have been economically flexible, broadly focused opportunists. As such, the “importation” of a broad pattern of exploitation developed by colonizing populations before island settlement may have more explanatory value than models that would require the assumption of *in situ* and *de novo* development of human–environmental relationships.

Sites with evidence for long-term occupation during the last 2,500 years are consistently located on high ground near the mouths of arroyos and are often bounded on

two if not three sides by steep arroyo walls and beach cliffs. Among these sites are nine that contain at least 40 house features (four of these contain over 100). These sites are not evenly spread across the island but are centered around rich, rocky intertidal areas with excellent landing coves and available water (see earlier). In addition, the space between these sites displays an interesting pattern, with contemporary, peripheral sites decreasing in frequency with distance from a residential “village” (Figure 7). At some point intermediate between two such centers, site density reaches a low level before increasing once again with proximity to the next “village.” Although a great deal more research is required, such a pattern could possibly be explained by the holding of exclusive territories by clan-based communities, as is sug-



FIGURE 7. One of the larger house features at the site of Punta Montero, located on the southern bay of Isla Cedros. This feature is part of a cluster of approximately 30 houses, each ranging in size from 8 to 13 m in diameter.

gested by both the eyewitness accounts (i.e., Des Lauriers and García–Des Lauriers 2006) and cross-cultural comparisons. The potential ecological significance of such a community-based holding of resource rights is of great interest, and future research will help to establish the details of such a system.

Evidence of Short-term Environmental Impacts versus Human Predation Pressure

Not all the archaeological signatures observed on Isla Cedros are on such a grand scale. During archaeological survey of the island, a number of small, single-event dumps of Pismo clam (*Tivela stultorum*) shell were recorded as part of a larger shellmidden complex on the west coast. What was notable about these deposits was the uniformly small

size of the single species of mollusk represented. All the shells measured between 3.5 and 5 cm in maximum width (in the case of this bivalve, “width” is taken to be roughly parallel to the growth lines). Other deposits consisting of up to 90% pismo clam had already been identified nearby, in which no such restriction in size was apparent. With the history in California archaeology of models of human-induced size reduction in shellfish, one possibility considered was the overexploitation of this particular resource. Another possibility was some climatic event or change in littoral substrate resulting in a cycle of recolonization by *Tivela*, with the early phases of reestablishment being characterized by a uniformly small size in the population.

All of these suggestions were discussed

with local fishermen Catarino Martinez, Catano Martinez Burguez, Victor Molina, and other informants. None of my suggestions found support among these knowledgeable and experienced islanders. Their assertion was that it was very clear that these particular deposits were remnants of storm events. By independently corroborated accounts, we were told that when a particularly strong storm passes the west coast of the island, it causes the surf to become strong enough to dislodge the smaller *Tivela*, leaving the larger individuals in place. These smaller clams are washed up on the beach and easily collected after the storm.

Here we have an example of a strong archaeological signature that may represent a single storm event, which may or may not have had any long-term impact on the remainder of the resource base. The archaeological visibility of this event may misleadingly exaggerate its usual importance in prehistoric exploitation patterns and/or representation of the demographic structure of the *Tivela* population in the immediate environs. The sudden “inclusion” of small clams in the diet has little to do with the absence of larger individuals or, indeed, other species and is simply the opportunistic exploitation of a momentarily abundant resource. That being said, the knowledge of this phenomenon and the ability to predict the outcome of a storm would have been critical for native peoples to have taken advantage of this “windfall.” This is especially true, because unlike other plant or arthropod resources that fall into the windfall category, beached shellfish, even bivalves, have a very definite window of edibility, after which they will be spoiled and dangerous to eat.

Sea Turtles and Sea Grass: Environmental Change, Not Overpredation

On Isla Cedros, one of the most important of the nonpiscine vertebrate fauna recovered from the Terminal Pleistocene–Early Holocene deposits of the PAIC-44 (Cerro Pedregoso) site (Des Lauriers 2006) is sea turtle (some elements cf. *Carretta carretta* or loggerhead sea turtle, Thomas Wake, pers. comm.,

2005). Excavations of later sites have thus far failed to produce any such remains, though a wide range of sea mammal and large fish remains indicate the continued use of technological systems capable of capturing turtles. Thus far, no clear evidence of turtle egg collection has been identified for any time period of Isla Cedros, though continued investigations could potentially expand the importance of this taxon.

It is interesting that a similar early focus on sea turtles, followed by a sharp and persistent decline in the archaeological abundance of their remains, is found farther south along the Pacific coast of the Mexican state of Guerrero, based upon work conducted in the Acapulco area by Kennett et al. (2008). Although there is not room here to fully explore the comparison, the parallels in chronology and Early Holocene subsistence patterns along the Pacific coast of Mexico are potentially revealing. Sea turtles are common today in and around the lagoons of Guerrero Negro (which lie along the mainland coast inside Bahía Vizcaíno) and are occasionally seen in the waters around Isla Cedros.

One potential explanation for the early and abrupt falloff in evidence for sea turtle use, possibly favored by those researchers who assume an overall negative ecological impact resulting from human harvesting, would be that the early occupants of the island seriously depressed the sea turtle population below a level meriting exploitation. This explanation is not parsimonious for the simple reason that sea turtle remains have not been identified from any of the sites that date to the subsequent 8,000 years of island occupation. The migratory nature of such aquatic reptiles would allow for local extirpation for a span of time, but eventually they would likely return and become reincorporated into the diet. An examination of the bathymetry surrounding Isla Cedros provides a more likely scenario, which attributes the disappearance of sea turtles from the resource base not to human action but to eustatic sea-level rise. During the Pleistocene–Holocene transition, the space between Isla Cedros and the mainland at Punta Eugenia was covered by a mixture of tidal lagoons and a shallow, rockier shelf

(Des Lauriers 2006, 2008). Given the depth requirements of *Zostera marina* meadows, the sea turtle's favored habitat, as sea level continued to rise and the depth of this shallow shelf increased, the meadows would have contracted in their areal extent. By the time sea level reached its high stand sometime around 6,000 years ago (Inman 1983), the depth of most of the shelves in the nearshore waters around Isla Cedros would have exceeded the depth tolerances of *Zostera*, which are usually between 2 and 5 m (Meling-López and Ibarra-Obando 1999), with the deepest recorded population observed at a depth of 13 m, off the south coast of Ireland (Cullinane et al. 1985). As such, it is possible to attribute the decline of the Isla Cedros turtle population not to human predation but to habitat destruction resulting from sea-level rise. This is an issue of some modern relevance, given the current crisis of global warming and its effects on many nearshore ecological systems.

Dwarf Mule Deer as Evidence of Sustainable Strategies?

The apparent resilience of the ecology of Isla Cedros may be at least partly due to the decisions made by its occupants. Sea otters (*Enhydra lutris*) were once so common in the waters around the island that they attracted the attention of both Russian and American otter hunters as late as 1845 (Ogden 1941). The historic exploitation of these animals was so "efficient" that they have not been seen on or around the island for at least the last 40 years. The point is that despite ample evidence for the indigenous exploitation of not only sea otters but a range of pinnipeds and dolphins, it was not until the arrival of Russo-Aleut and Euroamerican hunters (Ogden 1941), serving a global market, that such species were either locally extirpated or depleted in numbers.

In another parallel example, there exists on the island a small population of an endemic subspecies of mule deer (*Odocoileus hemionus cerrosensis*), which has undergone an evolutionary shift toward smaller size and are considered to be "pygmy" (Pérez-Gil Salcido

1981, Mellink 1993). Although remains of these creatures are absent from the earliest deposits on the island (~9,000–12,000 cal B.P.), they have been recovered at low but detectable levels in most of the deposits dating after 2,500 years ago (Des Lauriers 2005). It would be unprecedented for a large ungulate to have been transported to an island by precontact native peoples in the Americas, and focused research into the origins of the Cedros Island mule deer is necessary to clarify this point. If such intentional "seeding" of the island was carried out by native Cedros Islanders, it would not be the only such case in the region, because in the nearby Sea of Cortez, at least two species of iguanids were intentionally translocated between islands by the native Seri for the express purpose of providing alternative food sources for fishermen stranded on small rocky islets, as well as for use by established populations on larger islands (Nabhan 2002). What is notable is that the extermination of such small breeding populations, occupying such small land areas, with no potential for immigration, is eminently feasible, even for native peoples, as has been demonstrated in other island contexts (e.g., Kirch 1997, Anderson 2002, 2008, Steadman 2006). The "failure" of the native Cedros Islanders to eradicate these deer is something that must be explained in one of two ways: either (1) the richness of the marine environment was such that deer were nutritionally superfluous and thus exploited at a low level, principally for their antlers and bones (used in the production of pressure flakers and harpoons), or (2) some level of proscriptive restraint was practiced by native Cedros Islanders.

Other instances of nearly exclusive maritime resource foci within early "colonization-phase" assemblages are seen in insular contexts as geographically disparate as the West Indies (Steadman and Stokes 2002), the Pacific coast of South America (Reitz et al. 2008), and the Aleutian Island chain (Corbett et al. 2008). In the latter instance, the impoverished terrestrial fauna of an Arctic archipelago left few alternatives, but in the cases of Early Holocene Pacific South America and the Caribbean, the intensive exploitation of

marine fauna appears to have been actively preferred over terrestrial prey options of known availability. However, Anderson (2008) highlighted in his work on changing subsistence patterns in southern Polynesia that not all new human arrivals have such nominal impacts on the terrestrial fauna, as the Moa extinction clearly demonstrates (Anderson 2002). Nor are all new arrivals empty-handed, and even early voyagers in the circum New Guinea Archipelago appear to have intentionally translocated and released at least a handful of small terrestrial mammals between islands (White 2004).

One case with some similarities to that of the Cedros Island mule deer can be found in the case of Bennett's wallaby in southwestern Tasmania, which was consistently a major prey species in the region during the Pleistocene and does not appear to have been either depressed or locally eradicated during a long span of time as a dietary staple. Allen (1997:28) stated that, "The point here is that such survival of species may also imply the presence of deliberate hunting strategies (of whatever kind) on the part of their human predators." Although the relative size of Tasmania and Cedros are markedly different, the much longer length of human occupation in Tasmania compensates somewhat for this distinction.

One somewhat mysterious instance of a small island population of large artiodactyls is that of the now-extinct (Wigen 2005) caribou of Haida Gwaii (aka the Queen Charlotte Islands). This enigmatic population of caribou allegedly played a very small role in local native subsistence and ecological ideology but survived until at least the first decades of the twentieth century (Sheldon 1912). The scientific characterization of this population was as a species that had undergone some degree of insular dwarfism (see Van Valen 1973); however archaeological caribou remains from Haida Gwaii dating between 6,000 and 1,500 radiocarbon years B.P. display no indication of statistically significant variation from adult size ranges within mainland populations (Wigen 2005). How such a small population managed to survive on such a relatively small group of islands while re-

maining outside the mainstream of indigenous resource-harvesting knowledge is still perplexing. These caribou were clearly a relict Terminal Pleistocene population and yet are the oldest known remains from an archaeological context date at least 4,000 years after the earliest known human occupations of the coast (Erlandson et al. 2008). Wigen (2005) pointed out that because dwarfism seems to postdate the documented exploitation by humans, it is possible that human predation was a contributing factor toward selection within the population toward a smaller body size range. Why such pressure would be completely lifted before demographic population collapse is unclear from available evidence, but the entire scenario has fascinating implications for the situation of the Cedros Island mule deer.

When did the population of mule deer on Isla Cedros begin to consistently display smaller body size? Does this postdate evidence for human exploitation? Although the pygmy mammoth of the Channel Islands of Alta California (Agenbroad 2001) were clearly diminished in size before human arrival on the northern Channel Islands, do the trends toward dwarfism work at such varied scales of initial body size, and how can human predation impact such general biogeographic patterns? Both issues are unresolved but present excellent avenues for future research. In addition, the survival of these cervids to the modern day would also allow for DNA studies within the existing population. Regardless of the human ecological involvement in their evolutionary trajectory, the Cedros Island deer share 10 millennia of cohabitation on this dry, rocky island with human populations. Although on Isla Cedros itself their remains are only archaeologically documented for sites dating to the last 2,000 years, the importance of the mainland populations of this relatively large grazing animal to human populations may extend much farther back in time given the major role it plays in the shared regional ideological systems and subsistence patterns of central Baja California (Crosby 1997, Hyland 1997, Gutierrez and Hyland 2002).

Modern anecdotal evidence suggests that

ecological variation alone cannot explain the exploitation or lack thereof of insular artiodactyls. Instead, human ecological and social configurations will dictate, to a large extent, the intensity with which such animals are pursued and how much harvesting pressure will be exerted on the population. To wit, at some point in the historic period, goats were released on Isla Cedros, and, as is typical of other populations of goats introduced to eastern Pacific islands, they reproduced in large numbers (Mellink 1993). In addition, when the mines operated by the San Francisco Mining Company at the north end of the island were abandoned during the Mexican Revolution, a number of burros were left behind and went feral. On California islands farther north, including Guadalupe (Mexico) and San Clemente (U.S.), the burgeoning goat populations precipitated ecological disasters. This has not occurred on Isla Cedros for the simple reason that the Mexican fishermen, who have occupied the island since 1922, found them to be an excellent source of red meat. Such a variation from the monotony of abalone, lobster, and yellowtail is still highly prized today. Today, however, there are no remaining herds of goats, and only a small group of female burros remains, which the local people worry may soon disappear due to continued hunting and a non-reproductive population structure—assuming the local people are correct in saying that all the remaining individuals are female.

This dramatic suppression of potentially damaging introduced grazers has continued despite the fact that 10 goats were intentionally let loose on the island in 1990. Within a few days, their numbers were noticeably reduced (Mellink 1993:66). By 2000, no goats were observed, nor have there been any reports of such during the 8 years of fieldwork I have conducted on the island (2000–2008). If a modern population, which spends little time in the exploitation of terrestrial resources, can so effectively cleanse an island of such notoriously “weedy” species (Crosby 1986:28, 173), then an indigenous population, given 10,000 years, could have easily eliminated native species such as the pygmy mule deer. Again, their failure to do so indicates

a relationship between the native people and their resource base that was more complex (sensu Carlson and Keegan 2004) than many simple models that emphasize caloric “efficiency” would suggest (e.g., Broughton 1997, Broughton and O’Connell 1999, Broughton and Bayham 2003).

TERRESTRIAL FOOTPRINTS OF INSULAR POPULATIONS

Although much of this article and related literature on insular hunting and gathering populations focuses on the central role of marine resources, often the most noticeable impacts are those within the terrestrial ecosystems of these bounded spaces. Isla Cedros is not and probably was not an exception to this rule. The modern landscape within walking distance of the towns is largely bare of large woody bushes, which have been harvested for over 70 years for building material and fuel. This concentric denudation of the arid Baja California landscape around particularly dense settlements has been noted by other scholars before (Aschmann 1959), but the limited geography of an island makes such a process even more dramatic and problematic for inhabitants of such places.

One of the most important carbohydrate staples for the indigenous population of Isla Cedros was *Agave shawii*. This relative of the “century plants” found throughout ornamental gardens in the warmer portions of North America contains a “heart” where sugars are stored during the growth phase of the plant to supply the necessary energy to send up a massive, flower-bearing stalk during the reproductive phase (Gentry 1978). Harvested at the correct time, this “heart” can be roasted and eaten, and is both sugary and very palatable. The coastal agave (*A. shawii*) (Figure 8) endemic to Isla Cedros is a species particularly high in both water and sugar content, being described by eighteenth-century Jesuit missionaries to the peninsula as “particularly juicy” and as being a major staple—the “daily bread” of the islanders as it were (Des Lauriers and García-Des Lauriers 2006). Given the size of some of the Late Period communities inferred from the archaeological



FIGURE 8. *Agave shawii* on Isla Cedros.

record (Des Lauriers 2005), such a dependence upon this slow-growing plant would undoubtedly have led to a certain level of localized depletion surrounding the larger settlements. Aschmann (1959) described the

depletion on the mainland stretching for great distances around the Jesuit missions where native populations were concentrated at higher densities than when under the pre-contact settlement regime. In point of fact,

many of the largest archaeological clusters of house features, interpreted as indigenous "villages," are surrounded by some of the most barren ground on the island, whereas areas farther away, at the same elevation, on the same geological substrate, and receiving the same amount of fog and/or precipitation are home to robust xerophytic floral communities. Palynological evidence may not provide the level of resolution necessary to detect such localized landscape modification, but macrobotanical studies have confirmed the intensive use of *Agave* at least as far back as 2,200 years ago and probably much earlier.

Although the potential for serious degradation of the terrestrial ecology is apparent, given the current denuded state of the hillsides in the vicinity of the two modern town sites on the island it is unclear to what level indigenous populations created long-term, islandwide changes in the floral communities. It is possible that their experience with moderating the exploitation of fairly sessile marine resources such as abalone and mussels provided them with strategies for sustainable harvesting. It is also possible that the numerous village sites represent sequential occupations, with village relocation being at least partly conditioned by the local "deforestation" of the *Agave* community and the increased transport costs that would necessarily have involved foot traffic over very rugged terrain. The *Agave* often form part of commensal communities of plants, with new shoots sprouting under the protecting leaves of older, more established plants. In addition, given the fog-dependent flora, the drip lines of many plants serve as the main nurseries for new shoots. This ecological system is not entirely dissimilar to that operating in the "lomas" of coastal Peru, where fog condensation supported substantial stands of vegetation, which have suffered catastrophic degradation over the last few centuries (Weir and Dering 1986). On Isla Cedros, the selective removal of *Agave* from such a system could have long-lasting but very localized effects on the landscape. This issue is a subject of future research, but it should already be clear that despite some rather sustainable practices, even the indigenous population of

Isla Cedros had an ecological footprint and was not without a notable effect on the insular ecology.

CONCLUSIONS

The continued sustainability of the Isla Cedros fishery is an example that varies markedly from many models that see the trans-Holocene relationship between human groups and the environment along the Pacific coast of North America as an inevitable prelude to collapse. Although the modern community, as noted earlier, is not descended from the precontact indigenous population, both societies seem to have developed strategies for exploiting their rich resource base that did not lead to pronounced depletion of the marine ecosystem. Nor, it seems, would Isla Cedros be alone in this long-term maintenance of a sustainable pattern, because Bernstein (2006) observed similarly (though not identical) consistent patterns in subsistence and technology along the Atlantic coast of southern New England. Although the details of socioeconomic organization for the indigenous communities remain under investigation, the currently available archaeological data from Isla Cedros fail to provide indications of climate-induced resource collapse or depletion-driven changes in harvesting patterns as has been theorized for other regions of the Pacific coast of California (Salls 1992, Broughton 1997, Kennett 2005, and others). It seems unlikely that 100% of this variability can be attributed to a higher degree of ecological resiliency and is at least partly due to differences in the ways that the Cedros Islanders organized their labor and structured their interaction with the natural environment.

Change, either short or long term, and driven by either natural or human processes, results in the development of coping mechanisms, technological innovations, and the acquisition of information. All of these become part of the cumulative "fund of knowledge" (see Vélez-Ibáñez and Greenberg 1992) possessed by the group that successfully weathers the difficult times. This can be drawn upon in the future to make more effective decisions

about how to deal with similar situations or, indeed, how to avoid some in the first place. It is knowledge of this kind that Cedros Island fishermen and cooperative members continually refer to both in their conversations and in planning their exploitation of marine resources. Nor do we need to romanticize the situation by forcing these people to don the heavy mantle of “conservationists.” Instead, we need only realize that for both the modern fishermen of the island and their indigenous predecessors, the marine resource base formed, and forms, the foundation of their entire livelihood. If resource depression becomes acute enough, the only paths that remain open are out-migration or pronounced poverty (Cruz-Torres 2001).

Thus it is the cumulative body of knowledge transmitted from elders to apprentices (Ohmagari and Berkes 1997) that makes a difference, especially when a population relies on the metaphorically Protean ocean for its livelihood. Reconstructing this dynamic knowledge base from the archaeological record can be difficult, but its effects can be seen whenever innovative populations manage to survive major climate change, develop novel social systems, or devise new technologies. All of these have been argued for based on the archaeological record of many different regions, and all could be interpreted as prime examples of why the “ever-changing” sea drives maritime peoples to be some of the most dynamic and innovative among human societies.

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those who knew him. He is remembered fondly both by residents of Isla Cedros and by me. This work is dedicated in his memory.

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