Conflicts in natural and cultural resource management: Archaeological site disturbances by seals and sea lions on California's Northern Channel Islands

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California's Channel Islands currently have around 150,000 breeding seals and sea lions (pinnipeds). Driven to near extinction by 20th-century exploitation, many pinniped populations have recovered dramatically under federal and state management and continue to expand in number and distribution. Some of these pinniped populations are damaging or destroying coastal archaeological sites as they establish new breeding and haul-out areas—places occupied between periods of foraging activity—on upland landforms. We use archaeological excavations from a prehistoric village on San Miguel Island to illustrate the adverse effects pinnipeds can have on archaeological sites. Estimates based on excavations at Otter Point suggest that in one year nearly 10,000 kg of shellfish remains, 840,000 animal bones, and 1700 formal artifacts were lost to erosion caused by the activities of seals and sea lions. Our study documents potential conflicts between natural and cultural resource management suggesting the need for collaborative efforts between archaeologists and biologists to balance the conservation of both resources.

Keywords: seals, sea lions, coastal erosion, archaeological conservation, Channel Islands

Introduction

Over the last twenty years, there has been growing interest in the history of aquatic adaptations, the antiquity of maritime voyaging, and human impacts on marine ecosystems (e.g., Erlandson 2001; Klein *et al.* 2004; Marean *et al.* 2007; Rick and Erlandson 2008). This interest intensified among New World Pacific Coast archaeologists after the confirmation of the antiquity of a pre-Clovis (>13,500 CAL B.P.) occupation at Monte Verde II in Chile (Dillehay 1997; Dillehay *et al.* 2008) and the increasing likelihood that the Americas were colonized, in part, by coastal migrants from the Old World (Dixon 1999, 2001; Erlandson 1994; Erlandson *et al.* 2007b; Fedje *et al.* 2004).

Despite this renewed attention to early coastal settlement in the Americas, Terminal Pleistocene sites along the Pacific Coast remain rare (Erlandson *et al.* 2008), an issue that has confounded archaeologists. Numerous studies on coastal archaeological sites dating throughout the Holocene suggest that, at least in part, a wide variety of natural and anthropogenic processes are damaging or destroying evidence for past human occupations along the coast. Among these processes are sea-level rise, tectonic activity, geologic instability, violent storms, wave, wind, and tidal action, modern development, offshore dredging, and sand mining (Bird 1992, 2009; Calliari *et al.* 1998; Daniel and Abkowitz 2005; Erlandson 2010; Fitzpatrick *et al.* 2006; Kellogg 1995; Oyegun 1990; Paw and Thia-Eng 1991; Rick *et al.* 2006). A 1971 U.S. Army Corps of Engineers report on the stability of our nation's coastlines determined that nearly one quarter of the 135,000 km of surveyed shoreline was "seriously eroding" (Komar and Holman 1986: 237). This is even more significant when one considers that 17% of the U.S. population lives along the coast, a figure that is expected to increase substantially over the next 25 years (Boesch *et al.* 2000). As human populations expand along already crowded coastlines, development pressure, anthropogenic alterations, and natural processes will continue to alter beach, shoreline, embayment, and near-shore environments.

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Less widely recognized are the potential effects of other animals that are expanding along our world's coastlines. In the last half century, many seals and sea lions (pinnipeds) have undergone massive population booms under governmental protection and are competing with humans and each other for haul-out and rookery space. Our findings indicate that these animals, in a very short time period, can have devastating effects on coastal archaeological sites.

Seals, Sea Lions, and Coastal Erosion

Sea mammals were sources of meat, blubber, oil, skins, and other raw materials for Native Americans along the Pacific Coast for millennia, and many species were driven nearly to extinction in the northeastern Pacific by commercial hunting during the 18th and 19th centuries A.D. before state and federal protection fostered dramatic recoveries in the last several decades. In California, populations of various cetaceans, sea otters (*Enhydra lutris*), and pinnipeds have greatly increased their numbers and ranges. The recovery of breeding populations of pinnipeds—California sea lions (*Zalophus californianus*), northern fur seals (*Callorhinus ursinus*), harbor seals (*Phoca vitulina*), and northern elephant seals (*Mirounga angustirostris*)—has been especially dramatic on the Channel Islands, other coastal islands, and along some mainland coasts (Carretta *et al.* 2007; DeLong and Melin 2002).

Although a major success story for marine mammal protection, archaeological and ecological data demonstrate that the abundance and distribution of pinniped species today are quite different from those of the last 10,000 years (Braje 2010; Braje and Rick 2011; Etnier 2007; Gifford-Gonzalez *et al.* 2005; Hildebrandt and Jones 2002; Rick *et al.* 2009b; Rick *et al.* 2011). An unfortunate outcome of pinniped recovery in California has been an exponential increase of disturbances by these animals to coastal archaeological sites. North America's Pacific Coast contains a remarkable history of human occupation spanning the Terminal Pleistocene and Holocene. In the Pacific Northwest and southern California, small hunter-gatherer-fisher populations evolved into large, sedentary, hierarchical societies living in closely spaced villages along the coast and inland river systems. Under federal protection, pinniped populations that were once suppressed by ancient human hunters, historic fur trading, or human presence have multiplied and spread to mainland and island haul-out locations, in some cases, atop the remnants of prehistoric village or camp sites (e.g., Walker *et al.* 2002).

Despite studies of the effects of other animals on the formation and preservation of archaeological materials (Erlandson 1984; Erlandson and Moss 2001; Stein 1983; Wood and Johnson 1978), little is known of the impacts of seals and sea lions on cultural deposits (Grenda 2006: 4). Rick and colleagues (2009a) recently highlighted the disturbances caused by seals and sea lions on California Channel Island sites, suggesting that such impacts were probably occurring elsewhere around the world where pinnipeds are abundant. We expand on their preliminary research by quantifying the loss of archaeological artifacts and ecofacts resulting from a rapidly expanding colony of California sea lions and elephant seals on the northwest coast of San Miguel Island. In a 12-month span, we documented the loss of cultural materials at the Otter Point site (CA-SMI-481) on San Miguel Island demonstrating the potential conflicts between natural and cultural resource management. While focused on a large Late and Middle Holocene site, this case study provides insight into how growing populations of seals and sea lions might affect shoreline archaeological deposits of any age, ancient to historic.

Environmental and Archaeological Background

The Northern Channel Islands are an extension of the mainland Santa Monica Mountains, forming an east-west trending line of islands along the Santa Barbara Channel (FIG. 1). The islands of Anacapa, Santa Cruz, Santa Rosa, and San Miguel are located between 20 and 98 km from the mainland coast and were never connected to a continental landmass during the Quaternary (Schoenherr *et al.* 1999). For the most part the islands have a Mediterranean climate, with mild, dry summers and cool, wet winters. San Miguel Island, the westernmost of the Northern Channel Islands, is the second smallest at about 37 sq km, with cool, foggy, and windy conditions year-round.

Unlike the adjacent mainland, the islands support limited terrestrial flora and fauna (Schoenherr *et al.* 1999). The largest endemic land mammals on the northern islands are the island fox (*Urocyon littoralis*), found on Santa Cruz, Santa Rosa, and San Miguel, and the island spotted skunk (*Spilogale gracilis*) found on Santa Cruz and Santa Rosa. After pygmy mammoths (*Mammuthus exilis*) became extinct at the end of the Pleistocene, the islands lacked the herbivores, carnivores, and most of the rodents found on the adjacent mainland. Marine resources are highly productive with large populations of finfishes, shellfish, seabirds, and marine mammals. Today, six species of seals and sea lions (California sea lions, northern fur seals, Guadalupe fur seals, harbor seals, elephant seals, and Steller sea lions [*Eumetopias jubatus*]) are found on the Northern Channel Islands, with the largest concentrations occurring on San Miguel. At the west end of the island, Pt. Bennett is home to one of the largest pinniped rookeries in the northeastern Pacific with over 150,000 animals hauling out annually (DeLong and Melin 2002).

San Miguel and the other Northern Channel Islands have been the focus of archaeological investigation for

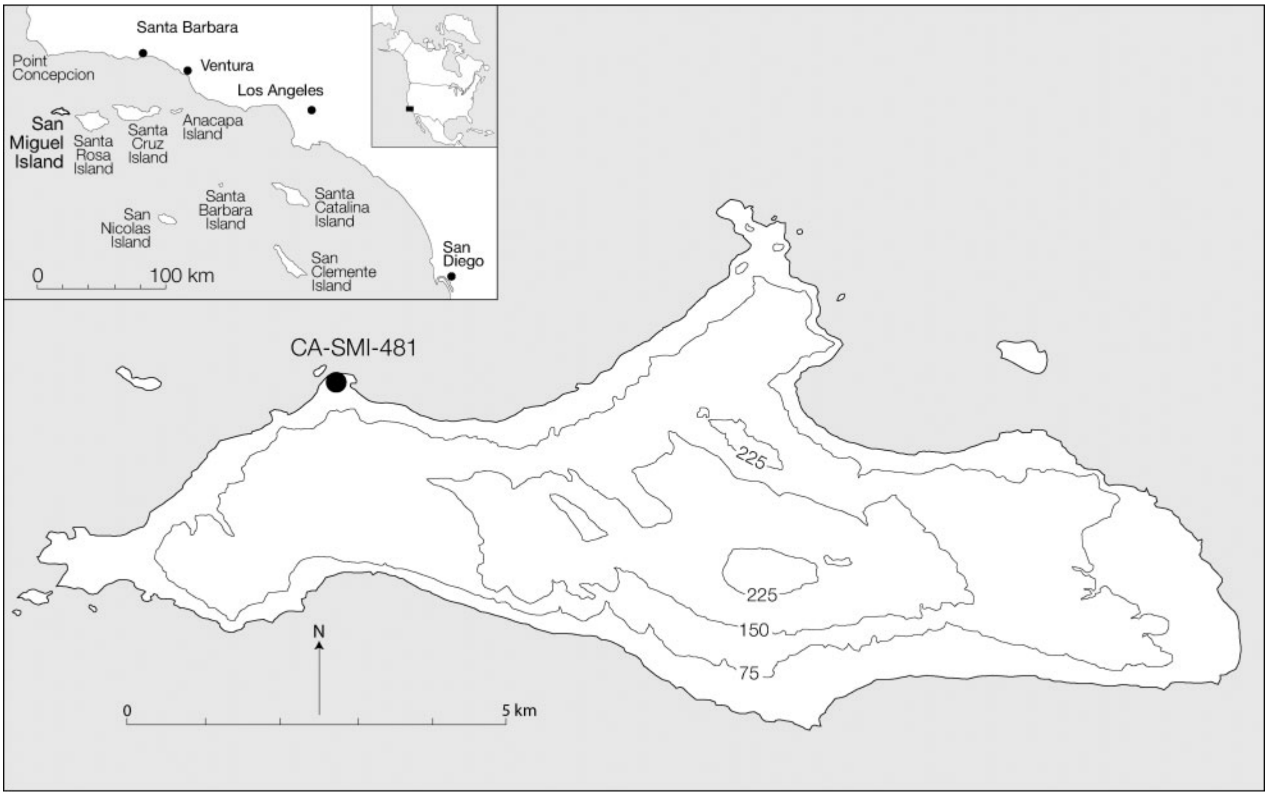

Figure 1 San Miguel Island and the location of Otter Point (CA-SMI-481) with inset showing the Santa Barbara Channel Islands and the southern California coast.

more than a century. The islands and the adjacent mainland were occupied historically by the Chumash, who lived in large villages and produced a variety of utilitarian, ornamental, and ritual objects. Scientific research over the last half-century indicates that the first island peoples arrived by boat at least 13,000 years ago (Erlandson *et al.* 2007a; Erlandson *et al.* 2008; Johnson *et al.* 2002). Human population densities gradually increased over the next several thousand years and were characterized by maritime hunter-gatherer-fisher populations who established permanently occupied village sites by at least 7500 years ago (Braje 2010; Erlandson 1994; Kennett 2005). After this time, the number of island archaeological sites and population densities generally increased and numerous large village sites were established along the coastlines of Santa Cruz, Santa Rosa, and San Miguel, especially during the Late Holocene (Arnold 2001; Braje 2010; Kennett 2005; Rick 2007; Winterhalder *et al.* 2010). At European contact in A.D. 1542, the Spanish described these island villages as being led by hereditary chiefs with subsistence economies focused on fishing, sea mammal hunting, and shellfish collecting (Gamble 2008).

Archaeology of Otter Point

The remnants of a large Late Holocene village are located at Otter Point on northwestern San Miguel Island. Otter Point contains one of the largest archaeological sites (CA-SMI-481) on San Miguel, in a massive dune complex with at least 10 discrete archaeological components spanning about 7300 years (FIG. 2). The site extends for nearly a kilometer along the shore and includes a series of shell midden deposits in a 30-m-high dune, several smaller dunes capped by shell middens, a 2-m-deep shell deposit exposed in the sea cliff, and material on the tip of Otter Point. The site covers an area of roughly 600 × 420 m, including dense deposits of eroding shell midden (Rick 2007).

While early antiquarians and other relic hunters likely collected from the Otter Point midden, the first scientific excavations at the site were conducted in the last decade. Erlandson and colleagues (2005) excavated a test unit in a small rock shelter (Otter Cave) with deposits dating to 6500 years ago. Vellanoweth and colleagues (2006) collected samples from a dense 6000-year-old "red abalone" midden near the base of the large dune face. Finally, Rick (2007) excavated a test unit at the top of the large dune from deposits dated to about 1200 years ago, collected a bulk sample from a roughly 500-year-old deposit on the eastern site boundary, and performed extensive surface collection of faunal remains and artifacts. Most of the archaeological components at CA-SMI-481 have now been dated, but the majority of the site remains unexcavated and is being lost to coastal, dune, and animal-induced erosion.

Less than a decade ago, Otter Harbor was occupied primarily by harbor seals, elephant seals, and non-breeding, subadult male California sea lions largely restricted to beaches on either side of Otter Point. In 2001, as crowding along prime beaches to the

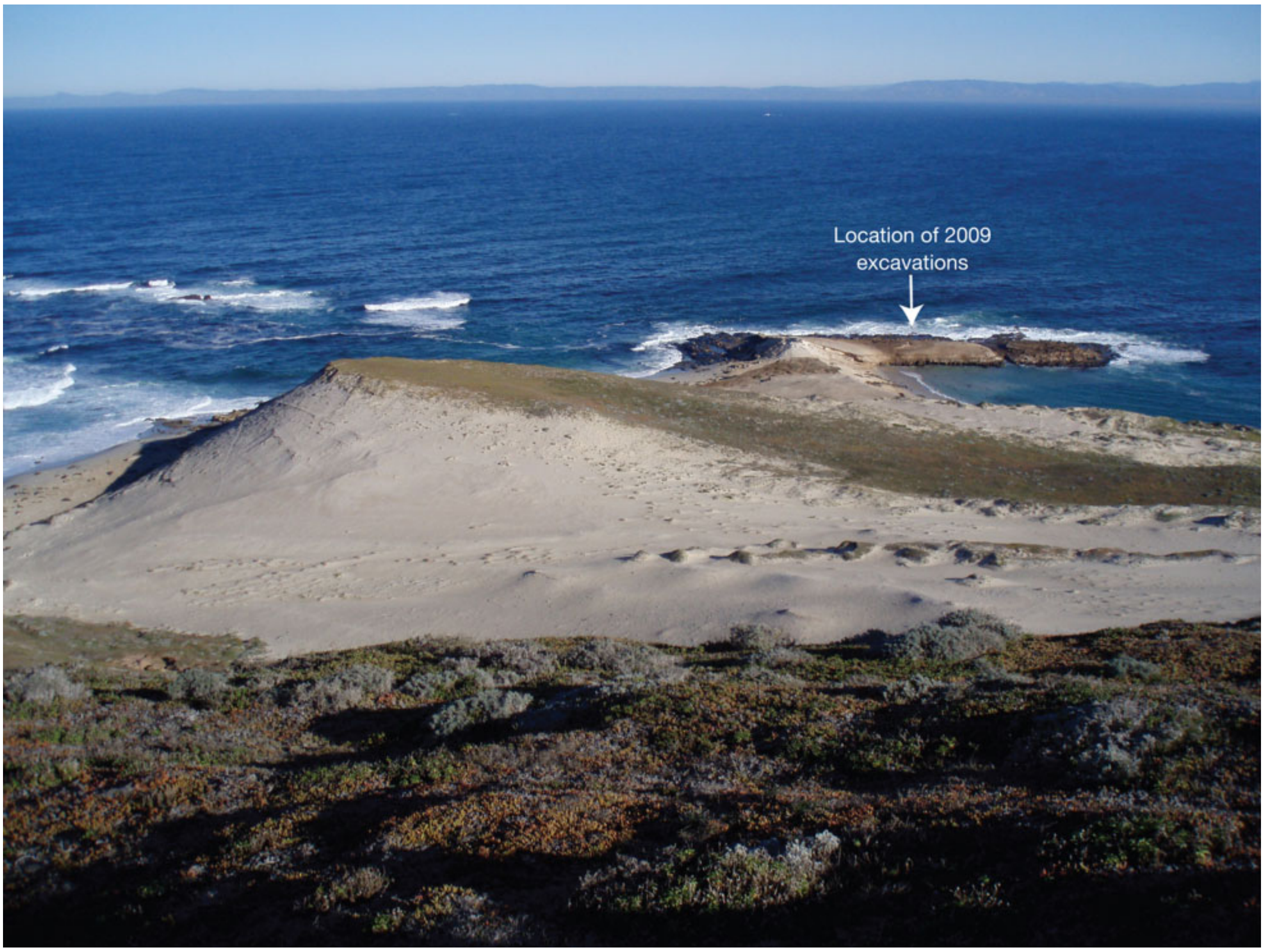

Figure 2 Otter Harbor area showing the location of the 30-m-high dune with shell midden dating between ca. 7300 and 150 CAL B.P. (locations have not been labeled to protect against looting) and the location of our 2009 excavation area at Otter Point. Photo by T. Braje, January 2009.

west pushed populations further to the east, the first sea lion pups were born at Otter Harbor. As the numbers of sea lions increased, animals expanded off the beaches and onto the rocky point, an area that was once capped by thick deposits of shell midden. Today, approximately 2500 California sea lion pups are born along Otter Point and Otter Harbor annually and the dramatic intensification of pinniped terrestrial activity has devastated archaeological deposits (Rick *et al.* 2009a). These animals move from the beaches and rocky point to the sea and back every day causing rapid damage to the archaeological site deposits. Northern elephant seals also use Otter Point as a rookery and haul-out location and crawl onto the point from a sandy beach to the west. In January 2008, a ridge connecting the tip and base of Otter Point and capped by a 6200-year-old shell midden was intact. By January 2009, a combination of pinniped activity and undercutting by wind caused the natural bridge to collapse before the midden deposits could be sampled (FIG. 3).

Methods

For the last decade, we have regularly monitored CA-SMI-481 and worked to recover material and date archaeological components threatened by erosion. During a monitoring visit in January 2008, we documented significant erosion of archaeological deposits on the tip of Otter Point, including the exposure of a large sandstone mortar that was not visible the year before. In January 2009, we returned to CA-SMI-481 to collect data from the archaeological deposits before they were completely destroyed. We mapped the area, collected radiocarbon samples, and excavated a 1×2 m unit and a 25×25 cm column sample from intact remnant deposits. Small column samples are excellent for the recovery and analysis of shellfish and fish bone remains, while the larger excavation unit targeted less evenly distributed artifacts and ecofacts such as stone, bone, shell tools, and sea mammal bone. Our excavations were limited by access to the site because of pinniped breeding and haul-out activities as well as by funding limitations.

The samples were excavated from deposits on the south-central portion of the rocky tip and demonstrated good preservation, except for the upper 10 cm that was coated in sea lion excrement and heavily disturbed by their activities. We were unable to recover intact samples from the Middle Holocene deposits and the western site area so our excavations and analysis were limited to the eastern site area and the Late Holocene

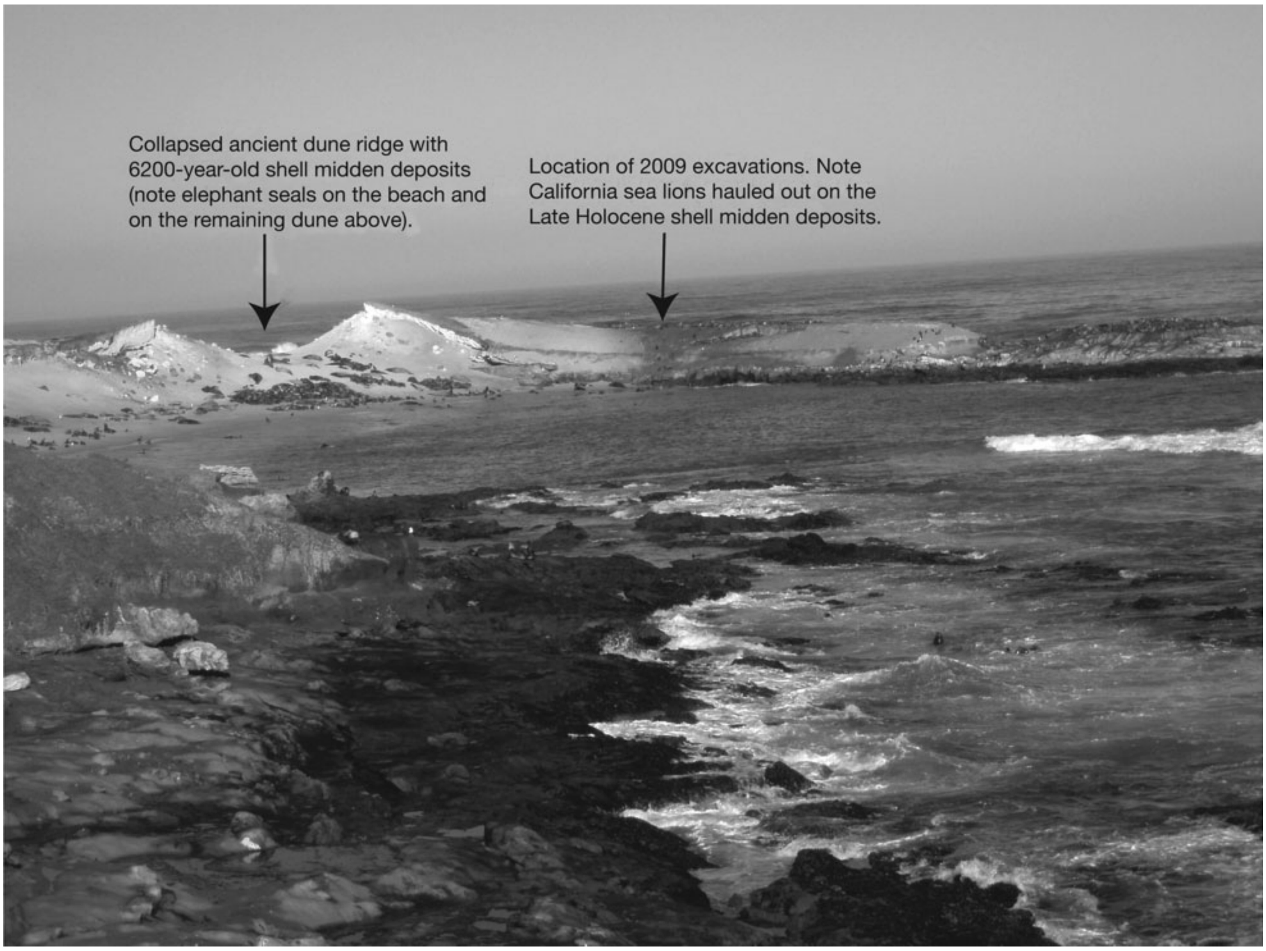

Figure 3 Otter Harbor area showing the locations where California sea lions haul-out on Middle and Late Holocene shell midden at Otter Point and the collapsed dune ridge caused by northern elephant seals. Photo by T. Braje, January 2009.

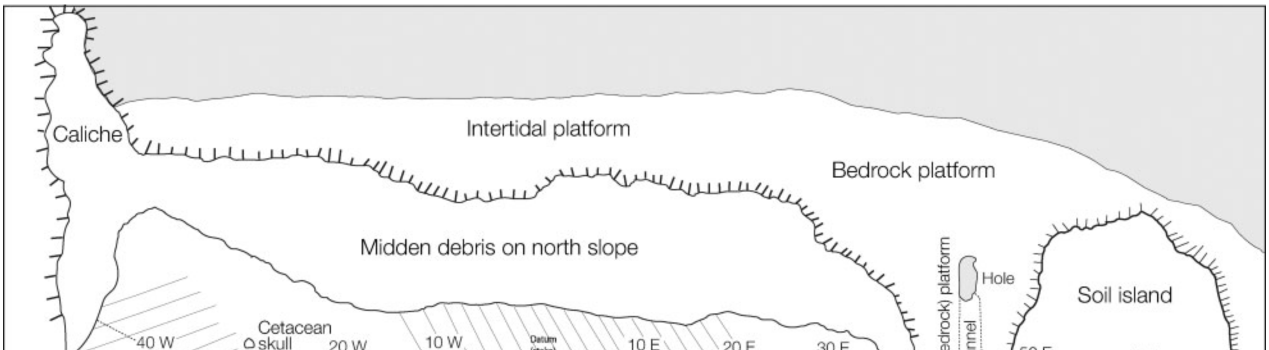

Figure 4 Site map of the north end of CA-SMI-481, the location of Unit 1, and various shell midden features. Drafted by J. Erlandson, January 2009.

deposits (FIG. 4). We used buckets of known volume, excavating 35 L of material from the column sample (25 × 25 cm wide and 56 cm deep) and 1228 L from a 1 × 2 m wide test unit 56–60 cm deep.

All excavated sediments were screened in the field through 1/16-in mesh and the residuals were returned to Humboldt State University for analysis. In the laboratory, residuals were washed and screened over 1/8-in mesh to facilitate sorting and sampling. The 1/8-in fraction was completely sorted, with all artifacts cataloged and all shell identified to the lowest possible taxonomic level. All bone was identified to general categories of bird, fish, land mammal, marine mammal, or unidentifiable bone. The 1/16-in fraction, which made up a relatively small portion of the well-preserved assemblage, was rough sorted for artifacts and other diagnostic material.

Results

Four radiocarbon dates from Unit 1 suggest that the tip of Otter Point was occupied during the Late Holocene between 1495 and 880 years ago (TABLE 1), a period referred to by many Santa Barbara Channel archaeologists as the late Middle Period (Arnold 2001; Gamble 2008; Rick 2007). The oldest three dates overlap at the 1σ age range, but the youngest date comes from the bottom of the unit and the midpoints of all the radiocarbon dates show a pattern

Table 1 Radiocarbon dates from Unit 1, located at the rocky tip at the north end of CA-SMI-481.

Provenience	Material	Lab no.	Conventional ^{14}C age	Age range (CAL B.P., 1σ)	Age range (CAL B.P., 2σ)
U1, 0–2 cm	*M. californianus*	OS-74087	2060 ± 30	1420–1310	1495–1285
U1, 15 cm	*H. rufescens*	OS-74088	2030 ± 35	1390–1290	1480–1260
U1, 30 cm	*M. californianus*	OS-74089	1960 ± 30	1330–1250	1380–1185
U1, 48 cm	*M. californianus*	OS-74116	1650 ± 30	1020–920	1095–880

Note: Calibrated in CALIB 6.0 program using a local reservoir correction of 225 ± 35 years (Stuiver and Reimer 1993, 1999).

Table 2 Shellfish and animal bone remains from Column Sample 1 by weight and MNI along with estimated loss due to sea mammal activity from January 2008 to January 2009.

Faunal type	Total wt. (g)	Total MNI	Estimated loss by wt. (g)[1]	Estimated loss by MNI	Total NISP	Estimated loss by NISP
SHELL						
Abalone						
Haliotis cracherodii/black abalone	350.5	21	525,750	31,500	–	–
Haliotis rufescens/red abalone	62.4	50	93,600	75,000	–	–
Haliotis spp./abalone unid.	2.3	–	3450	–	–	–
Barnacle						
Balanus spp./acorn barnacle	186.7	–	280,050	–	–	–
Pollicipes polymerus/gooseneck barnacle	83.6	–	125,400	–	–	–
Chiton						
Chiton unid.	53.5	11	80,250	16,500	–	–
Crab						
Cancer spp.	9.9	7	14,850	10,500	–	–
Gastropods misc.						
Olivella biplicata/purple olive	0.1	1	150	1500	–	–
Gastropods unid.	0.9	9	1350	13,500	–	–
Limpets and slipper shells						
Crepidula spp./slipper shell	2.0	16	3000	24,000	–	–
Fissurella volcano/volcano limpet	0.9	1	1350	1500	–	–
Lottia gigantea/owl limpet	252.9	51	379,350	76,500	–	–
Limpet unid.	46.7	116	70,050	174,000	–	–
Mussel						
Mytilus californianus/California mussel	4595.7	738	6,893,550	1,107,000	–	–
Septifer bifurcatus/platform mussel	25.3	61	37,950	91,500	–	–
Turban shell						
Tegula brunnea/brown top	74.3	7	111,450	10,500	–	–
Tegula funebralis/black top	273.8	54	410,700	81,000	–	–
Serpulorbis squamigerus/scaled worm shell						
Strongylocentrotus spp./sea urchin	494.9	99	742,350	148,500	–	–
Shell nacre unid.	26.4	–	39,600	–	–	–
Shell unid.	48.6	–	72,900	–	–	–
Shell total	6591.4	1242	9,887,100	1,863,000	–	–
BONE						
Bird bone	8.7	–	13,050	–	9	13,500
Fish bone	123.2	–	184,800	–	472	708,000
Land mammal	2.7	–	4050	–	1	1500
Sea mammal	176.3	–	264,450	–	52	78,000
Bone unid.	1.6	–	2400	–	23	34,500
Bone total	312.5	–	468,750	–	557	835,500

[1]Estimates based on the analysis of a 35 L column sample and a loss of 52,500 L of archaeological material in a 12-month span.

of decreasing age from the surface to the base of the unit. It may be that our unit was excavated into a house berm or the backdirt of an ancient pit feature, though no house floor or distinct pits were identified. This may account for the stratigraphic reversals in the radiocarbon sequence, but because of heavy disturbance from pinniped activity it is impossible to draw a definitive conclusion.

Equally dense archaeological deposits once covered the entire point, an area at least 120 m long and 40 m wide (FIG. 4). A conservative estimate, based on observations in January 2008 and 2009 with a loss of 15 cm of midden material over the densest Late Holocene deposits measuring 35 m east-west and 10 m north-south, suggests that a minimum of 52.5 cu m (52,500 L) of archaeological material was lost in just 12 months, with pinniped activities the direct cause of the erosion of anthropogenic soils.

Tables 2 and 3 provide the weights (g) and minimum number of individuals (MNI) for shellfish, and weights (g) and number of identified specimens (NISP) for bone recovered from Column Sample 1. Our sample includes over 6.5 kg of shellfish representing at least 1242 individuals, and 312.5 g and 557 individual animal bones. Over 98% of the shell was identified to at least a general taxon, with most identified to the species level. The shellfish assemblage included at least 17 different shellfish taxa. Over 96% of the animal bone assemblage, by count, was identified to a general faunal category. Based on these data, we estimated the loss during the past year of material by weight, MNI, and NISP due to sea lion activity. A conservative estimate suggests that nearly 9900 kg of marine shell representing over 1.8 million individuals, and nearly 470 kg of animal bone and 835,500 individual bones were lost to erosion caused by pinnipeds.

Similar calculations were done for shell, bone, and stone tools recovered from the 1×2 m unit and column sample (TABLE 3). Excavations produced a total of 41 formal shell, bone, and stone tools, including projectile points and point fragments, shell beads and dishes, and bone points and awls (FIG. 5). These data suggest that at least 1700 formal artifacts were lost in just one year.

Since the small islet immediately east of our study area was capped with shell midden just a few years ago, as was the Middle Holocene midden immediately to the west, the loss of artifacts, faunal remains, and other cultural materials from pinniped activity in the northern portion of Otter Point in the last few years is much larger than the estimates presented. Elephant seals are also damaging areas along the northwestern and western margins of CA-SMI-481, impacting deposits that range in age from 7200 to 6000 years ago. During a brief 2009 assessment of these areas, we observed numerous artifacts and at least two human burials disturbed by pinniped activities.

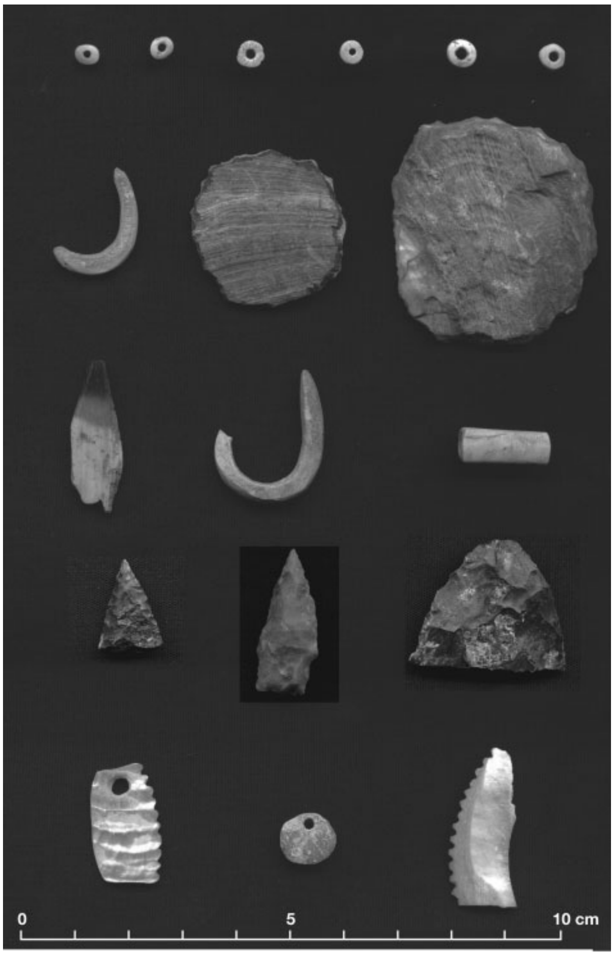

Figure 5 A sample of the formal shell, stone, and bone artifacts recovered from excavations at CA-SMI-481 during our 2009 field season. Top row: *Olivella* shell beads. Second row (left to right): Abalone single-piece shell fishhook fragment, black abalone fishhook blank, red abalone fishhook blank. Third row (left to right): Bone point fragment, bone single-piece fishhook, bone bead. Fourth row (left to right): Chert projectile point fragment, chert arrow point, chert knife point fragment. Fifth row: Abalone ornaments.

Table 3 Formal shell, stone, and bone artifacts recovered from Unit 1 and Column Sample 1 by weight and count along with estimated loss due to marine mammal activity from January 2008 to January 2009.

Artifact type	Total wt. (g)	Total count	Estimated loss by wt. (g)[1]	Estimated loss by count
Shell artifact	429.3	24	17,845.0	998
Bone artifact	9.4	6	390.7	249
Stone artifact	62.2	11	2585.5	457
Total	500.9	41	20,821.2	1704

[1]Estimates based on the analysis of a 35 L column sample and a 1228 L test unit and a loss of 52,500 L of archaeological material in a 12-month span.

Discussion and Conclusions

Our mapping, excavation, and analysis of archaeological materials from Otter Point demonstrate the catastrophic loss of cultural materials that can result from pinniped activities. The site is subject to a variety of coastal erosion processes that continually displace archaeological materials, and sea level rise will play an even greater role in coastline degradation in the future (Erlandson 2008). These issues are widespread and "[i]sland and coastal archaeologists cannot afford to stand idle as the long and diverse history of maritime cultures around the world is lost to sea level rise and accelerating erosion" (Erlandson 2008: 169). Government agencies, resource managers, and archaeologists must deal with the unintended consequences of marine management plans. The growing populations of California sea lions, northern elephant seals, harbor seals, and northern fur seals, for example, are creating competition for prime beaches and pushing some pinniped colonies into upland areas where important archaeological sites exist. San Miguel Island contains over 700 recorded archaeological sites that are protected as part of a federal archaeological district, creating a conflict between the protection of biological and cultural resources.

From southern California to the Pacific Northwest, many of the largest and densest archaeological sites on the Pacific Coast of North America are located along productive rocky shores and protected harbors. Ancient hunter-gatherer-fisher populations aggregated in large coastal towns and villages, often driving sea mammal communities to offshore rocks and isolated coastlines. As many seal and sea lion populations have rebounded under government protection, some have established rookeries and haul-out locations on archaeological sites with devastating consequences (Grenda 2006; Rick *et al.* 2009a). This includes some mainland locations (e.g., Point Año Nuevo; Hildebrandt and Jones 2002) where pinnipeds were probably excluded not just by ancient human hunters, but also by brown bears, mountain lions, and other large terrestrial predators.

Site monitoring and archaeological excavations at Otter Point exhibit how destructive pinniped activity can be on cultural resources. When they haul-out, molt, or breed atop archaeological sites, the sheer weight of these animals often compacts, crushes, or destabilizes archaeological material. To help regulate their body temperature and limit sun exposure, some pinniped species—including the massive elephant seal—dig into sandy soils or sediments, shoveling the material across their bodies, further disturbing cultural resources. Movement across undercut dune bridges or wave-cut faces can result in their complete collapse, a process we recorded at Otter Point and noted by Maxwell and colleagues (2006: 145–148) at Vizcaino Point on San Nicolas Island, California. The excretions of live animals and rotting carcasses of dead animals also alter the soil chemistry of archaeological sites. These processes are occurring at many other sites on San Miguel Island, including several Early Holocene sites near Pt. Bennett, sites on San Nicolas and Santa Rosa islands, sites near Point Año Nuevo in central California (Mark Hylkema, personal communication 2011), and other places around the world where pinnipeds haul-out and breed in prime locations once occupied by ancient coastal people.

On San Miguel's south-central coast, for example, where sea mammal activity is limited compared to other locations on the island, the first systematic archaeological survey in the late 1970s documented substantial shell middens, village sites, and human burials at Crook Point. During recent site assessments, evidence for substantial site deposits could not be relocated. Some of these deposits appear to have been damaged or destroyed by subadult elephant seals who regularly haul-out along the shallow coastal plain, sometimes traveling several hundred meters inland. The effects of pinnipeds can often exacerbate or be augmented by the impacts of marine and wind erosion (Rick *et al.* 2006).

With seal and sea lion populations growing around the world, threats to archaeological sites are on the rise globally. This will create tensions between protecting marine mammal populations and preserving archaeological resources. Constructing barriers that restrict movement off of beaches is one possible solution, but might have adverse effects on pinniped breeding and terrestrial behavior. The construction of temporary fencing around archaeological sites has been ineffective in diverting large seals and sea lions and more costly, permanent constructions such as sea walls can have undesirable environmental and aesthetic consequences (Mark Hylkema, personal communication 2011). Culling of marine mammal populations would be highly controversial and is not a viable solution because of protective legislation. Instead, we believe a joint effort by biologists, resource managers, archaeologists, and government agencies is necessary to address the deleterious effects of pinnipeds on cultural resources. This transdisciplinary effort should seek to balance the preservation of pinniped populations and the nonrenewable archaeological sites threatened by their activities. Increased and prioritized funding for radiocarbon dating and salvage excavation of threatened archaeological sites are important steps towards mitigating the damages by pinnipeds. Since cultural resource budgets are often limited, one solution might be to allocate funding in the budgets of biological and conservation programs in agencies such as the National Park Service and National Oceanic and Atmospheric Administration (NOAA).

Our work at Otter Point has been restricted to relatively small samples by both limited cultural resource budgets within Channel Islands National Park (CINP) and by the conservation ethic within the National Park system that restricts excavations at many sites. Since the National Park Service and NOAA are both federal agencies, archaeologists and cultural resource managers might argue that the protection and management of sea mammal populations, especially in regards to their haul-out territories, fall under *Federal Undertakings* in Section 106 (Advisory Council on Historic Preservation 2011). This may compel federal agencies to allocate additional funding to mitigate the impacts of sea mammals on cultural resources.

Twentieth-century federal legislation and funding were established in response to the collapse of global marine mammal communities, a crisis created by human overexploitation. We need to frame the loss of cultural resources to coastal erosion, climate change and sea level rise, development, and marine mammal impacts in the same light. Many archaeological sites are being lost at an alarming rate, often before archaeologists have a chance to properly document them. If we fail to act, we risk losing some of the most important pieces to the story of human history.

Acknowledgments

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