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Life on the edge: early maritime cultures of the Pacific Coast of North America

Jon M. Erlandson[a,b,*], Madonna L. Moss[b], Matthew Des Lauriers[c]

[a] Museum of Natural and Cultural History, University of Oregon, Eugene, OR 97403-1224, USA
[b] Department of Anthropology, University of Oregon, Eugene, OR 97403-1218, USA
[c] Department of Anthropology, California State University, Northridge, CA 91330, USA

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ABSTRACT

A variety of evidence suggests that the Americas may have been colonized, at least in part, by maritime peoples moving around the North Pacific Rim near the end of the Pleistocene. Understanding the geography of late glacial and early postglacial landscapes and the antiquity of human societies along the Pacific Coast continues to be a challenge, however, due to geological dynamics associated with glaciation, tectonism, submergence of coastal lowland landscapes by rising postglacial seas, and coastal erosion. Nonetheless, archaeological research has pushed back the antiquity of human settlement along the Pacific Coast of North America to the terminal Pleistocene or early Holocene, providing important new data on the nature of the earliest coastal peoples in the Pacific Northwest, Alta California, and Baja California. In this paper, we summarize what is known about the earliest peoples of the Pacific Coast of North America and evaluate the current viability of the coastal migration theory via a Pacific Rim route. Archaeological evidence now shows that Palaeocoastal peoples occupied each major region of the Pacific Coast by at least 13,000–11,500 calendar years ago (cal BP) (13–11.5 ka), essentially contemporaneous with Clovis and Folsom peoples of the interior. Although it is too early to conclude that the initial human colonization of the Americas took place via a migration by maritime or coastal peoples, it seems increasingly likely that such a migration played a role in the early peopling of the Americas.

1. Introduction

Deep human histories—those written primarily from archaeological, anthropological, and geological evidence—have long been dominated by terrestrial narratives. For decades prevailing anthropological theory has proposed that widespread coastal adaptations and maritime lifeways only developed in the last 10,000 to 15,000 years (e.g., Washburn and Lancaster, 1968; Osborn, 1977; Yesner, 1980), as part of a larger reorganization of human economies associated with the "broad-spectrum" and agricultural revolutions. In a book about hominid migrations, for instance, Gamble (1994) listed ten major habitat types encountered by our ancestors as they spread around the world, none of which was coastal or aquatic. Regular reminders from geoscientists that sea level rise since the Last Glacial maximum (LGM) had submerged ancient coastlines and associated lowland landscapes—geographic changes that may have obscured or destroyed much of the evidence for earlier coastal settlement—were generally ignored and sporadic cases of marine or aquatic resource use by Pleistocene peoples (i.e., Garrod et al., 1928; Waechter, 1964; Volman, 1978) were dismissed as rare and largely irrelevant to prevailing paradigms.

Doubts about such paradigms have grown as archaeological evidence for earlier coastal settlement, aquatic resource use, and maritime migrations has emerged (Erlandson, 2001; Bailey, 2004; Erlandson and Fitzpatrick, 2006). This includes evidence for widespread coastal settlement in southern Africa during the Middle Stone Age (e.g., Klein, 1999; Parkington, 2004; Marean et al., 2007), Middle Palaeolithic peoples around the Mediterranean (e.g., Garrod et al., 1928; McBurney, 1967; Stiner, 1994; Barton et al., 1999), the settlement of Flores by *Homo erectus* (Morwood et al., 1998), and the maritime colonization of Australia, western Melanesia, and East Asian islands by anatomically modern humans (*Homo sapiens sapiens)* between about 50 and 35 ka (see Erlandson, 2001).

Reflecting the anthropological theory that dominated the 20th century, most archaeologists saw the initial colonization of the Americas as a strictly terrestrial enterprise, with small hunting bands trekking across the frozen plains of Beringia near the end of the Pleistocene and following an interior "ice-free corridor" southward into the heartland of North America. These Palaeoindians were seen primarily as big game hunters who settled the Pacific Coast only after large game animals were hunted out of interior areas, people migrated down river valleys to the western

* Corresponding author. Museum of Natural and Cultural History, University of Oregon, Eugene, OR 97403-1224, USA.
E-mail address: jerland@uoregon.edu (J.M. Erlandson).

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edge of the continent, then gradually adapted to life by the sea. The maritime peoples who occupied much of the Pacific Coast when Europeans first explored the area were thought to have developed in just the last few thousand years. For the "Clovis First" model that dominated American archaeology until recently, the Pacific Coast was largely irrelevant to the peopling of the Americas, a marginal continental edge settled relatively late in the process of human expansion into this New World. Such views were bolstered by AMS ^{14}C dating of several purportedly "Pleistocene" human skeletons from coastal California—Del Mar, La Jolla, Laguna, Los Angeles, Angeles Mesa, and Sunnyvale—all of which were shown to be Holocene in age (e.g., Bada et al., 1984; Taylor et al., 1985; Stafford et al., 1987; Erlandson et al., 2007b).

For decades, an alternative "coastal migration theory" has proposed that early coastal or maritime peoples may have followed North Pacific shorelines from northeast Asia into the Americas. First fully articulated by Fladmark, 1979 (see also Dixon, 1993; Erlandson, 1994; Gruhn, 1994), the coastal migration theory was relatively marginal ground for American archaeologists until recently, even as geological evidence grew that a coastal route was geographically feasible as early as 16 ka (all dates given in this form are cal BP). Recent archaeological and geological research has transformed the coastal migration theory from marginal to mainstream. This scientific transformation has been fuelled by a variety of evidence, including: (1) growing knowledge of the presence of maritime peoples in eastern Asia before the LGM; (2) the increasing antiquity of human settlement and maritime activity along the Pacific Coast of the Americas (e.g., Erlandson et al., 1996; Keefer et al., 1998; Sandweiss et al., 1998; Johnson et al., 2002; Jones et al., 2002); (3) widespread (but not unanimous) scholarly acceptance of pre-Clovis occupations (>14 ka) at Monte Verde near Chile's Pacific Coast (see Dillehay, 1997; Meltzer, 1997); (4) geological evidence that the ice-free corridor was not open or suitable for human occupation until about 13 ka while the Northwest Coast of North America was habitable at least two millennia earlier (Mann and Hamilton, 1995; Mandryk et al., 2001; Clague et al., 2004).

These discoveries have not proven that coastal peoples were among the first to colonize the New World, but they have returned the Pacific Coast of North America to centre stage in debates about the peopling of the Americas. From Alaska to Baja California, this shift has rejuvenated and expanded the search for early Pacific Coast archaeological sites. Despite major geological obstacles—including sea level rise, coastal erosion, and landscape changes we discuss below—scholars have continued to push back the antiquity of coastal settlement in many areas, and to flesh out our understanding of early maritime peoples along the Pacific Coast. In this paper, we summarize the archaeological evidence for the antiquity and nature of early coastal settlement and maritime activity from Alaska to Baja California, focusing on recent research on Palaeocoastal sites securely dated to the Terminal Pleistocene and Early Holocene, between about 13 and 9 ka. First, we provide some environmental background to contextualize our study and examine some of the global, regional, and local processes that affect the preservation and visibility of archaeological sites in coastal settings.

2. Environmental context

Our study area along the Pacific Coast of North America, stretching for roughly 6000 km from the Gulf of Alaska to the southern tip of Baja California, encompasses almost 40 degrees of latitude and a remarkable amount of environmental variation (Fig. 1). Terrestrial environments along the Pacific Coast vary from tundra in the far north, to the dense temperate rain forests of the Pacific Northwest, to the arid desert landscapes of southern and Baja California. The geography of this vast coastal region is united, however, by its mountainous terrain, its location adjacent to the ameliorating influence of the vast Pacific Ocean, and the curvilinear nature of a coastline that has offered no significant physical barriers to migrations or information exchange by maritime peoples since shortly after the end of the Last Glacial.

Compared to many regions of the world, the Pacific Coast of North America is tectonically active, with relatively high geographic relief and narrow continental shelves, and a stacking of resources from multiple marine, freshwater, and terrestrial ecosystems in proximity to the coastline itself (Erlandson and Moss, 1996, p. 278). Another common feature of Pacific Coast environments is the diversity and productivity of marine resources available to maritime peoples. Virtually the entire coast is characterized by significant marine upwelling, with nutrient-laden oceanic currents supporting highly productive marine food webs. North America's Pacific Coast also offers an essentially continuous mosaic of rocky intertidal, shallow rocky reef, kelp forest, sandy nearshore, and estuarine ecosystems, with a variety of habitats that support similar suites of resources. From Alaska to Baja California, these include (or once included): seals, sea lions, sea otters, and cetaceans; abalones, mussels, clams, sea urchins, and limpets; rockfish, sharks and rays, tunas, sardines, and other fish; seabirds, shorebirds, and waterfowl; and a variety of edible seaweeds. This wealth of marine resources, especially when combined with the plants and animals available in adjacent terrestrial and freshwater ecosystems, helped sustain the relatively dense aggregations of hunter-gatherers who lived along much of the Pacific Coast when Europeans first explored the area from the 16th to 18th centuries AD.

Despite broad similarities in coastal ecosystems along the western edge of North America, significant regional and temporal variation existed in the diversity, productivity, and accessibility of marine and terrestrial resources. In the marine realm, these differences result primarily from variability in coastal upwelling, water temperature, coastline type, freshwater or estuarine input, wave energy, tidal amplitude, and other factors. On land, biological and ecological differences are driven primarily by broader climatic factors, especially latitudinal variation in rainfall and temperature patterns. This environmental variation along the Pacific Coast—including the distribution or availability of freshwater, terrestrial and aquatic plants and animals, and key minerals—led to differences in human adaptations on a variety of scales. Since the end of the Last Glacial, changes in the geography, climate, and ecology of various areas along the Pacific Coast have also influenced the development and demography of human populations up and down the coast, as well as the preservation and visibility of the archaeological sites that early coastal peoples left behind.

3. Archaeological preservation and visibility in coastal environments

The notion that maritime societies developed only recently in human history—along the Pacific Coast and around the world—has its roots in anthropological interpretations of archaeological records strongly structured by the fact that global sea levels have risen an average of roughly 120 m (~400 feet) since the end of the LGM. In discussing the archaeological implications of this, Erlandson (2001) noted a strong global correlation between the antiquity of coastal settlement and the gradient of the adjacent continental shelf (see also Waselkov, 1987; Richardson, 1998). Coasts characterized by broad and shallow shelves have generally seen substantial lateral movement of the shoreline during the last 20 ka—sometimes on the order of hundreds of kilometres. Steep bathymetry limits lateral movement of the coast as sea level rises, however, so older coastal sites remain in proximity to modern coastlines) (see also Bailey and Flemming, 2008; Bicho and Haws, 2008). This geographic correlation helps explain the relatively great

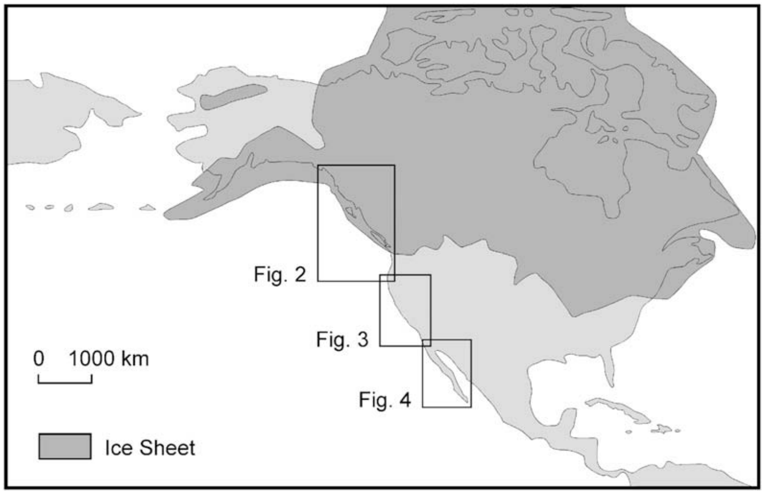

Fig. 1. Map depicting the study area along the Pacific Coast of North America and the approximate extent of the North American ice sheet at the glacial maximum, with insets indicating areas depicted in Figs. 2–4. Drawn by G.N. Bailey.

antiquity of shell middens and other coastal sites along much of the Pacific Coast of North America, especially compared to the Atlantic or Gulf coasts of North America, where the continental shelves of the trailing plate edge are much broader.

Despite the relatively steep bathymetry of much of the Pacific Coast, many coastal areas have experienced lateral shoreline movements of tens of kilometres over the last 15 ka. Sea level rise and marine erosion have undoubtedly submerged or destroyed many early sites, and very few areas are likely to retain evidence of Pleistocene coastal occupations along modern shorelines. The entire south coast of Beringia has been submerged, for instance, from near the base of the Kamchatka Peninsula to Bristol Bay. This vast gap in the archaeological record, precisely where the earliest evidence of a coastal migration into the Americas theoretically should be located, will be exceedingly difficult to fill because the appropriate shorelines are now located in deep water, far from land, in the Bering Sea where wave energies are exceedingly high.

Once portrayed as a harsh and relatively unproductive area for human habitation (e.g., Hopkins et al., 1982), recent research suggests that the south coast of Beringia may have been "geomorphically complex during the late glacial, with hundreds of islands located just off a coast riddled with bays and inlets" (Brigham-Grette et al., 2004, p. 59). During the summer months, such convoluted coastlines—when combined with the low gradient of the Beringian platform—may have offered broad expanses of productive intertidal and nearshore habitats for early maritime peoples to hunt, forage, and gather in. Even covered with sea ice much of the year, the south coast of Beringia would have provided rich habitat for seals, walrus, and a variety of other marine organisms. Erlandson et al. (2007a) have argued that much of Beringia's south coast may have supported productive kelp forests after the end of the LGM.

Recent study of deep-sea sediment cores from the far northwestern Pacific suggest that three periods of warmer sea surface temperatures occurred after the end of the LGM (ca 18.2–17.2 ka, 16.8–16.3 ka, and 16.2–14.7 ka), events that may have reduced seasonal sea ice cover, increased human access to intertidal and nearshore habitats, and facilitated the migration of maritime peoples around the North Pacific (Sarnthein et al., 2006). Along the margins of the northeast Pacific, outer coast areas from the Alaska Peninsula to Puget Sound appear to have been largely deglaciated by about 15–16 ka and supported a relatively diverse and productive array of marine and terrestrial resources, including bears and other mammals (see Heaton and Grady, 1993; Mann and Hamilton, 1995; Ward et al., 2003).

Up and down the Pacific Coast, regional variation in geography, tectonics, and glacial history have had a powerful influence on the differential preservation and visibility of early archaeological sites. Some of these taphonomic issues are discussed in the summaries of the archaeology of each region that follow, but general patterns are worth noting here. From south central Alaska to Puget Sound, for instance, regional glacial history has had a major effect on coastal landscapes and the archaeological record since the LGM, with isostatic and eustatic adjustments contributing to change in shoreline location and the conformation of coastal landscapes. From Vancouver Island to the northern California Coast, the unique tectonic history of the Cascadia Subduction Zone—where large subduction earthquakes every few centuries have caused widespread subsidence and erosion—has also shaped the geomorphological and archaeological records. South of Cape Mendocino, much of the Alta and Baja California Coast is affected by tectonic uplift, but sea level rise and coastal erosion since the end of the LGM have been the dominant geological forces shaping coastal landscapes and the archaeological record.

Given the difficulties posed by the Pacific Coast's history of glaciation, sea level rise, marine erosion, and landscape change, recent research has focused on finding early archaeological sites in settings where evidence of coastal or maritime occupations might be expected. These strategies include study of: (1) offshore islands where boats were required for human colonization; (2) coastlines with very narrow continental shelves; (3) northern shorelines uplifted by isostatic rebound after deglaciation; (4) caves or stone sources that provided shelter or raw materials valued by early coastal peoples; (5) springs that attracted humans away from now submerged shorelines in arid landscapes; (6) the margins of estuaries that formed inland extensions of the sea as global sea levels were rapidly rising; and (7) the vast underwater landscapes submerged by rising seas.

4. The Northwest Coast

In the thickly forested landscapes that characterize most of the Northwest Coast of North America, the search for early coastal sites (Fig. 2, Table 1) is especially complicated due to regional and local variations in the history of glaciation, isostatic and tectonic movements, sea level changes, and marine erosion. As acidic soils also tend to form under the coniferous forests of the Pacific

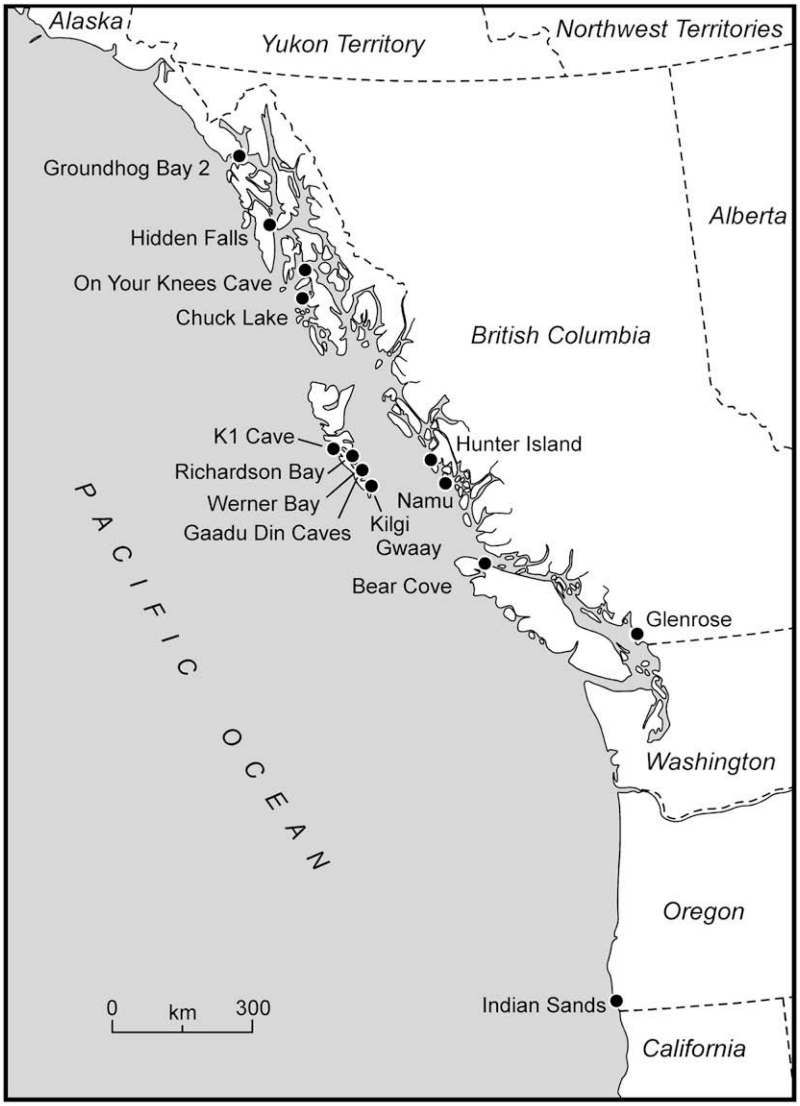

Fig. 2. Map of the Pacific Northwest showing the location of Palaeocoastal sites. See Table 1 for site details. Redrawn by G.N. Bailey from an original by M. Moss and Jacob Bartruff.

Northwest, the preservation of shell and other faunal remains found in many early Pacific Coast sites is relatively rare. From northern California to southern British Columbia, where the effects of glaciation and isostatic adjustments are less pronounced, a long history of massive and episodic subsidence earthquakes (and associated marine erosion) within the Cascadia Subduction Zone may have destroyed most early coastal sites (Erlandson et al., 1998). Further north, however, especially along the convoluted and protected coastlines of southeast Alaska and northern British Columbia, a number of recent discoveries hint at the presence of an ancient maritime tradition that spans more than 10 ka.

4.1. Northern Northwest Coast

In Southeast Alaska, the earliest coastal sites include Early Holocene occupations at Ground Hog Bay 2, Hidden Falls, and Chuck Lake 2 (Ackerman et al., 1979; Davis, 1989; Erlandson and Moss, 1996; Moss, 1998, 2004). At these sites early maritime activities are attested to by the settlement of islands, the presence of obsidian artefacts from the Suemez Island source located on the outer coast, and the dearth of terrestrial alternatives. At Chuck Lake on the karstic Heceta Island, a roughly 8.8 ka shell midden and microblade component provides direct faunal evidence of intertidal foraging, fishing, and sea mammal hunting, including a unilaterally barbed bone point (Ackerman et al., 1985; Okada et al., 1989, 1992). Human skeletal remains and artefacts were found by palaeontologists at On Your Knees Cave (49-PET-408) on Prince of Wales Island in 1996. Later archaeological excavations at the site documented the presence of microblade technology in a well-defined occupation dating to about 9.3 ka, and a possible bifacial industry that may be a millennium older (Fedje et al., 2004). The younger component produced faunal remains from a variety of marine animals and isotopic study of the human bone revealed a strong marine signature, confirming the maritime nature of early human settlement in the Alexander Archipelago. Ancient DNA extracted from a human bone sample allowed genetic comparison to modern and ancient DNA sequences from Native Americans, revealing a link to Pacific Coast populations in North and South America (Kemp et al., 2007).

In northern British Columbia, Canadian scientists have combined detailed reconstruction of ancient coastal landscapes with archaeological studies to document an impressive array of early coastal sites dated between about 11.5 and 9 ka. Underwater work documented the presence of a submerged coastal landscape

Table 1
Paleocoastal sites (~9000 cal BP or older) of the Northwest Coast (ordered north to south)

Site name	General location	^{14}C age (cal BP)	Site description or contents	Primary references
Groundhog Bay 2	Chilkat Peninsula, Glacier Bay, AK	9200 cal BP	Lithic site on raised beach	Ackerman et al., 1979
Hidden Falls (49-SIT-119)	Baranof Island, AK	~9000 cal BP	Lithic site on elevated landform	Davis, 1989
On Your Knees Cave (49-PET-408)	Prince of Wales Island, AK	11,200 cal BP ~9200 cal BP	Multicomponent occupation in karst cave; younger component with micro-blades and human remains	Dixon et al., 1997
Chuck Lake 1	Heceta Island, AK	~8800 cal BP	Shell midden with fish remains, barbed bone harpoon point	Ackerman et al., 1985; Okada et al., 1989, 1992
Richardson Island	Richardson Island, SE Haida Gwaii	9590–8490 cal BP	Intertidal and raised beach components	Fedje et al., 2005c, pp. 204–211
K1 Cave	Moresby Island, Haida Gwaii	10,950–10,400 BP ~12,500 cal BP	Projectile point bases possibly associated with bear bones	Fedje and Mathewes, 2005, p. 149
Werner Bay stone tool	Juan Perez Sound, Haida Gwaii	~10,000 BP	Basalt flake recovered from ~50 m below sea level on drowned fluvial terrace	Fedje et al., 2005a, pp. 178–180
Gaadu Din Cave	Huxley Island, Haida Gwaii	10,500–10,000 BP ~12,000 cal BP	Projectile points and flakes associated with bear bones	Fedje and Mathewes, 2005, p. 149
Gaadu Din Cave 2	Huxley Island, Haida Gwaii	11,030 cal BP	Projectile point 5 m away from dated charcoal, with additional flakes below	Fedje et al. 2008
Kilgii Gwaay Wet Site	Ellen Island, Haida Gwaii	9450–9400 BP ~11,000 cal BP	Intertidal wet site with 4000 stone tools, abundant organic remains	Fedje et al., 2005b, pp. 187–203
ElTa-18	Hunter Island, central B.C. Coast	9940 BP ~11,500 cal BP	Shell midden ~4 m asl	Cannon, 2000, p. 72
Namu	Fitz Hugh Sound, central B.C. Coast	11,100 cal BP	Shell midden ~4 m asl	Carlson, 1996; Cannon, 2000
Bear Cove	NE Vancouver Island, B.C.	9000–5000 cal BP	Lithic site with faunal remains	Carlson, 1979, 2003
Glenrose	Lower Fraser River, B.C.	~8500 BP ~9500 cal BP	Shell midden	Matson, 1976
Indian Sands (35CU67C)	Curry County, Oregon	~8500–8400 cal BP	Deflated shell midden associated with numerous flaked cobble tools	Moss and Erlandson, 1998; Davis, 2006a

off Haida Gwaii (Queen Charlotte Islands) flooded by rapidly rising seas about 10 ka. Here Josenhans et al. (1997) identified ancient river channels, a delta, and remnants of a submerged forest roughly 50–60 m below modern sea level. Auger sampling of the sea floor along this submerged river channel even produced a basalt flake from a depth of 53 m and local sea level history suggests an age of over 11.5 ka if it came from an intact soil or site (Fedje and Christensen, 1999; Fedje et al., 2004).

On Haida Gwaii, numerous 'intertidal' sites have been identified along the modern coastline or on elevated beaches (i.e., Skoglund's Landing site, see Fladmark, 1990), but their age, structure, and economic orientation remained poorly understood. Fedje and Mackie, 2005 have shown that these intertidal sites span much of the Holocene, but they identified intact remnants of several early sites that help clarify the antiquity and nature of maritime peoples of the northern Northwest Coast. Many of these sites have been impacted by marine erosion, but excavations in intact remnants of several early sites suggest that they represent a widespread maritime tradition extending back at least 10.6 ka, with the use of boats and harpoons and an economy based on seal and sea otter hunting, fishing, shellfishing, and other coastal activities.

One of these intertidal sites is Kilgii Gwaay, located near the southern end of Haida Gwaii (Fedje et al., 2004, 2005a,b,c). Here a large assemblage of stone, bone, wood, and woven artefacts was recovered from a waterlogged stratum dated to about 10.6 ka (9400 ^{14}C yr). The artefacts from Kilgii Gwaay include almost 4000 chipped stone specimens, over 100 pieces of worked wood, and several bone tools. The chipped stone assemblage lacks any hint of a microblade industry, but includes a biface fragment, a unifacial stemmed point, numerous flake tools, cores, and core tools. Bone tools include several perforators, a heavy percussor, and a small unilaterally barbed point. The perishable artefacts consist mostly of withes and wood-working debris, but wooden stakes and wedges, braided twine, wrapped sticks, a two-part haft, and several possible points were recovered (Fedje et al., 2005b, p. 198; figures 11.6 and 11.7). Faunal remains are also well-preserved in the intact site areas, including numerous bones of black bear (*Ursus americanus*), harbour seal (*Phoca vitulina*), sea otter (*Enhydra lutris*), rockfish (*Sebastes* spp.), dogfish (*Squalus acanthias*), lingcod (*Ophiodon elongatus*), cabezon (*Scorpaenichthys marmoratus*), greenling (*Hexagrammos* spp.), Cassin's auklet (*Ptychorhamphus aleuticus*), and short-tailed albatross (*Phoebastria albatrus*). Smaller numbers (<10) of bones from other marine vertebrates were recovered, including river otter (*Lontra canadensis*), northern sea lion (*Eumetopias jubatus*), skate (*Raja* spp.), halibut (*Hippoglossus stenolepis*), salmon (*Oncorhynchus* spp.), sculpin (Cottidae), and other fish, seabirds, and waterfowl. Shellfish remains, mostly California mussels (*Mytilus californianus*), were also present. As Fedje et al. (2005b, p. 203) noted, the early occupants of Kilgii Gwaay practised "a fully developed maritime adaptation in one of the most rugged environments on the coast of the Americas".

Some of the rockfish and halibut specimens weighed over 15 kg and are found in fairly deep water. This requires quite sophisticated fishing gear and most likely a boat of some type. The large numbers of harbour seal, as well as the presence of river and sea otter, supports the focus on marine resources. The birds also tend to be marine species, with the possible exception of the geese. For example, albatross are unlikely to be found on shore and must have been hunted from a boat (Fedje et al., 2005b, p. 201).

Another important early site is the deeply stratified and multicomponent Richardson Island site, located on the southeast coast of Haida Gwaii. Excavations in the basal Component 1, dated between about 10.6 and 10 ka (9300–8900 ^{14}C yr), identified a living surface associated with hearths, postholes, chipped stone artefacts, and small amounts of calcined bone (Fedje et al., 2004). Chipped stone artefacts include leaf-shaped bifaces, abundant bifacial tool-making debris, and unifacial tools (scraper planes, spokeshaves, gravers, etc.), but no microblade technology. Component 2, dated between about 10 and 9.5 ka (8900–8500 ^{14}C yr), contains an early microblade technology widely identified in northern Northwest Coast sites beginning around 10,000 ± 250 cal BP (~9000 ^{14}C yr). Small amounts of calcined animal bone were identified at the Richardson Island site—mostly rockfish—indicating an economy at least partly maritime in character.

A similar sequence has been identified at the multicomponent site of Namu, where a basal component dated between about 11.2 and 10.2 ka (9700–9000 ^{14}C yr) has produced leaf-shaped bifaces, numerous cobble choppers and other core tools, and expedient unifacial flake tools (Carlson, 1996, 1998). After about 10 ka microblade technology also appears in the stratified sequence at Namu. The earliest cultural component at Bear Cove has produced a rich faunal assemblage with abundant marine and land mammals, rockfish and cod, but spans a considerable duration, from 9 to 5 ka (Carlson, 1979, 2003). The well-documented Glenrose Cannery site in the lower Fraser Valley has also produced early Holocene dates (Matson, 1976).

Cannon (2000) has also reported a ^{14}C date of ~11,400 cal BP (9940 ± 50 RYBP) for charcoal retrieved from near the base of a shell midden (E1Ta-18) on Hunter Island along the central British Columbia Coast. Only preliminary data have been reported for this site, but if the age of the charcoal accurately reflects the antiquity of human occupation, it is one of the earliest shell middens along the Pacific Coast of North America.

4.2. Southern Northwest Coast

The record of early human settlement along the southern Northwest Coast—from the Canadian border to northern California—is different from areas to the north and south. There are no well documented Early Holocene sites along the Washington Coast, only one from the Oregon Coast, and none from the northern California Coast. The dearth of early southern Northwest Coast sites led some archaeologists to propose that humans developed coastal or maritime lifeways relatively late in the area (e.g., Ross, 1990; Lyman, 1991; Lightfoot, 1993; Hildebrandt and Levulett, 1997). Others have attributed the lack of early sites to the lower intensity of research in the area (Jones, 1992) or to the unique geological dynamics of the Cascadia Subduction Zone, which corresponds closely to the area where early sites are rare (Moss and Erlandson, 1998). Once thought to be aseismic, the Cascadia Subduction Zone is now known to be struck every few centuries by very large earthquakes where a deadly combination of subsidence and tsunamis affect large portions of the coast (see Atwater, 1987; Darienzo and Peterson, 1990). The combination of episodic subsidence earthquakes, tsunamis, landslides, and coastal erosion provides a powerful explanation for the dearth of Early Holocene (and Middle Holocene) sites along the southern Northwest Coast (Erlandson et al., 1998; Punke and Davis, 2006).

To explore some of these issues, Moss and Erlandson led a team of researchers who dated scores of coastal middens and intertidal fish weirs in outer coast and estuarine settings. Despite analyzing more than 205 ^{14}C samples from over 110 coastal sites, only one site older than 5000 years was identified (Erlandson and Moss, 1999). From this deflated and low density shell midden (35CU67C) on the southern Oregon Coast, Moss and Erlandson (1998) obtained three dates on burned and unburned mussel shell that averaged about 8.5 ka. Also collected was a large assemblage of cobble cores and core tools, occasional flake tools and biface fragments, and abundant chipped stone debitage from the deflated site area, including numerous small obsidian flakes geochemically determined to have come from distant interior sources in south-central Oregon and northern California. In subsequent work at the same locality, Davis et al. (2004, p. 10) obtained a ^{14}C date of 10,430 ± 150 RYBP (~12.9–11.7 ka) on dispersed charcoal from an artefact-bearing soil and reported that the site was also occupied during the terminal Pleistocene. Charcoal is a common natural constituent in Oregon Coast soils, however, and no clear evidence has been presented that the dated charcoal was cultural in origin or that the ^{14}C date was not affected by the old wood problem. Despite additional excavation at the site, no further dates appear to have been obtained to confirm that a terminal Pleistocene occupation took place at 35CU67C (Davis, 2006a). Hydration measurements from dozens of small obsidian flakes from the site all fall within a narrow range, moreover, suggesting that the obsidian found at the site is from a single occupational event (C. Skinner, pers. commun., 2004). Until further evidence is presented to support the presence of a terminal Pleistocene component, we consider 35CU67C to be an Early Holocene site.

Early Holocene occupations have also been proposed for several other Oregon Coast sites (e.g., Tahkenitch Landing, Neptune, and Blacklock Point) over the years, but the precise age and cultural associations of these sites remains poorly documented (see Moss and Erlandson, 1995, 1998; Erlandson and Moss, 1996). Recently, Hall et al. (2005) reported a possible terminal Pleistocene or Early Holocene occupation at 35CS8, a lithic site located near Bandon on the south-central Oregon Coast. Their evidence—a single chipped stone artefact found below a Middle-to-Late Holocene occupation layer—seems more likely to result from animal burrowing or other stratigraphic mixing (see Moss et al., 2006).

5. The California Coast and the Channel Islands

As is the case further north along the coast, there are currently no serious candidates for pre-Clovis occupations in California that have not been examined and rejected by most scholars. Clovis-like fluted points have been found on the coast and in the interior, but most are isolated finds without stratigraphic, artefactual, or faunal associations (Rondeau et al., 2007). Fluted points from coastal sites show that some Palaeoindians were familiar with California's coastal landscapes, but none of these specimens have been reliably dated (Erlandson et al., 2007b). Without good chronological data for California's fluted points, it is even conceivable that Clovis peoples originated along the Pacific Coast, then moved into the continental interior (Erlandson, 1994, p. 268). It seems more likely, however, that Clovis-like points in California were left by later Palaeoindians spreading westward from the interior of North America.

Although their relationship to the makers of these fluted points remains unclear, scores of shell middens and other coastal sites from the California Coast have been dated between about 13–9 ka, nearly all of them from south of the San Francisco Bay area (Erlandson and Moss, 1996; Erlandson et al., 2007b) (Fig. 3). These include mainland sites such as Duncan's Point Cave on the Sonoma Coast, CA-SLO-2 and Cross Creek in San Luis Obispo County, CA-SBA-931 on Vandenberg Air Force Base, CA-ORA-64 on Newport Bay, Agua Hedionda (CA-SDI-210) in the San Diego area, and many others (see Table 2). Along the mainland coast, many early sites contain abundant shellfish remains and grinding stones (manos and metates), suggesting an economy dominated by the intensive use of shellfish and small seeds (Erlandson, 1994; Jones et al., 2002). Some researchers have proposed a "pre-milling" Palaeocoastal occupation of the mainland coast prior to 9 ka (Moratto, 1984; Erlandson, 1994), but recent work at the Cross Creek site suggests that the use of milling stones may extend back to 10 ka or more (Jones et al., 2002). Projectile points and fishing equipment are rare in most mainland Palaeocoastal sites, but occasional bones of fish,

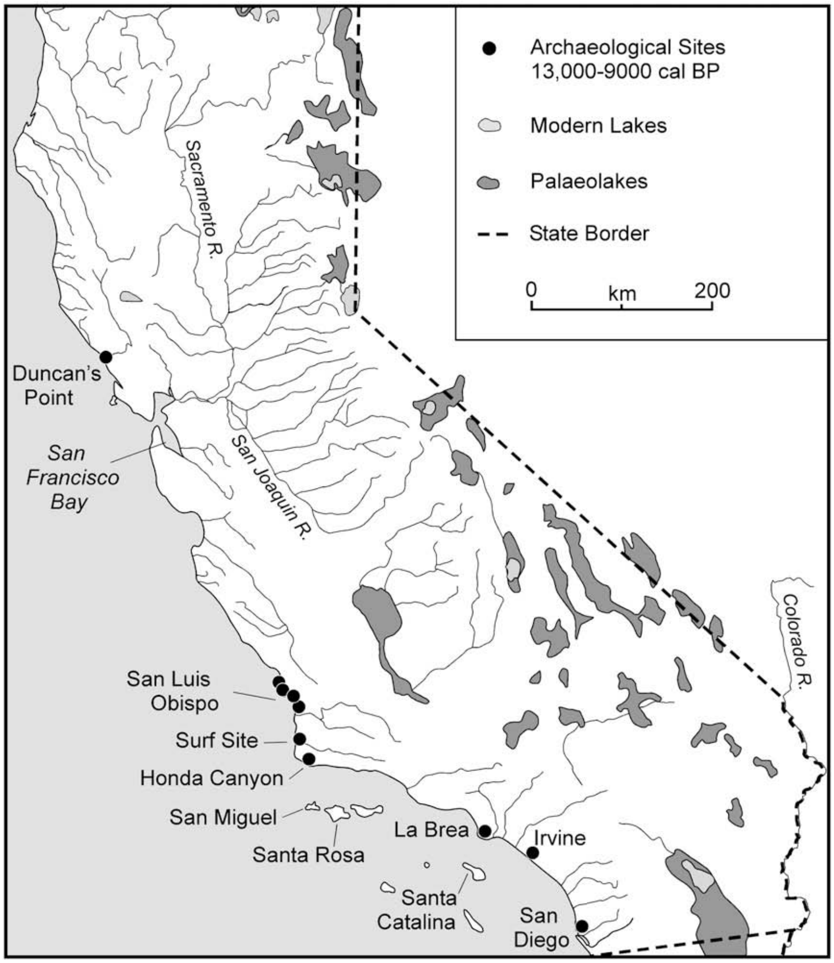

Fig. 3. Map of Alta California showing the location of Palaeocoastal sites and drainage networks. See Table 2 for full listing of sites. Redrawn by G.N. Bailey from an original by J. Erlandson.

sea mammals, seabirds, and land mammals hint at a broader economy, including maritime capabilities more clearly expressed in early Channel Island sites (see below).

Especially impressive clusters of early sites have been documented along the mainland coast in the San Diego, Santa Barbara, and San Luis Obispo areas (see Jones, 1991; Erlandson, 1994; Erlandson and Moss, 1996; Bertrando and Levulett, 2004), many associated with extinct estuaries created by rapid sea level rise during the terminal Pleistocene and Early Holocene. Simple *Olivella* shell beads, made by grinding or chipping the spire off these small marine snails, have been found in many early coastal and interior sites dated between about 11–9 ka (see Erlandson et al., 2005b; Fitzgerald et al., 2005), showing that trade networks existed between California's Palaeocoastal peoples and their interior neighbours at the end of the Pleistocene. Chipped stone crescents have also been found in some mainland Palaeocoastal sites, as have leaf-shaped bifaces, numerous core tools, and hammer stones (Erlandson, 1994). The presence of multiple components and heavy soil mixing by gophers and other burrowing animals at most mainland sites limits the chronological resolution with which many early assemblages can be interpreted, but it seems likely that bone gorges, boats, and other maritime technologies were also used by mainland Palaeocoastal peoples.

California's Channel Islands, located between 20 and 98 km offshore, provide the earliest definitive evidence for the presence of maritime peoples along the Pacific Coast (Erlandson et al., 1996; Rick et al., 2001; Johnson et al., 2002; Erlandson, 2007). The earliest sites are Arlington Springs (CA-SRI-173) on Santa Rosa Island and Daisy Cave (CA-SMI-261) and Cardwell Bluffs (CA-SMI-678/679) on San Miguel island, where terminal Pleistocene occupations show that Palaeoindians used seaworthy boats to colonize the islands by at least 13–12 ka.

The Arlington Springs site was discovered in 1959, when Orr (1968) found human bones eroding from a thin palaeosol exposed near a spring in Arlington Canyon. The palaeosol formed in a stratified sequence of arroyo fill sediments 11 m below the modern surface. A ^{14}C date on charcoal found near the bones of Arlington Man suggested that he died about 10,000 RYBP, an age later supported by a date on human bone of 10,080 $\pm$ 810 RYBP (Berger and Protsch, 1989: 59), with a calibrated age of about 12 ka. More recent AMS dating of collagen extracts from the bones of Arlington Man produced dates ranging from about 11,000 to 6600 RYBP, but Johnson et al. (2002: p. 543) argued that the oldest ($\sim$13 ka) is the most likely age of Arlington Man. A more conservative view is that he died sometime between about 13 and 12 ka, especially if he consumed some marine resources (as seems likely on the Channel Islands) as no marine reservoir effect has been applied in calibrating the dates on human bone collagen (Erlandson et al., 2007b). However, recent AMS dates on charcoal and mouse bones from the palaeosol in which Arlington Man's bones and small amounts of chipped stone tool-making debris were found suggest an age close to 13 ka (Stafford et al., 2008).

More evidence for a terminal Pleistocene settlement of the Channel Islands comes from Daisy Cave (CA-SMI-261) on San

Table 2
Palaeocoastal sites (>9000 years cal BP) along the Alta California Coast

Site name	General location and context	^{14}C age (cal BP)	Site description or contents	Primary references
Duncan's Point Rock Shelter (CA-SON-348/H)	Sonoma County Coast	~9500 (1 date)	Stratified shell midden with basal deposits	Schwaderer, 2002
Lodge Hill (CA-SLO-369)	Cambria	~9100 ± 100 (2 shell dates)	Multicomponent shell midden	Parker, 2004
Cross Creek Site (CA-SLO-1797)	San Luis Obispo County, near palaeoestuary	10,300–9000 cal BP (shell dates)	Multicomponent estuarine shell with milling tools, etc.	Jones et al., 2002
Diablo Canyon (CA-SLO-2)	San Luis Obispo County, near mouth of Diablo Canyon	~10,000 cal BP (shell, human bone, collagen)	Stratified shell midden, with basal deposits containing human burials, crescents, milling tools	Greenwood, 1972
CA-SLO-585	San Luis Obispo County, in Diablo Canyon area	~9000 cal BP (marine shell)	Stratified shell midden with early basal component	Greenwood, 1972
CA-SL0–832/1420	San Luis Obispo County, in Pismo Beach area	~9900–9200 cal BP (3 shell dates)	Shell midden	Jones et al., 2002
Surf Site (CA-SBA-931)	Knoll overlooking mouth of Santa Ynez River, N. Santa Barbara, CO	~9500 cal BP (shell dates)	Shell midden dominated by California mussels	Glassow, 1996
Honda Canyon Site (CA-SBA-530)	Coastal terrace, N. Santa Barbara County	~9000 cal BP (shell dates)	Dense shell midden	Glassow, 1996
Arlington Springs Man (CA-SRI-173)	NW coast of Santa Rosa Island, near mouth of Arlington Canyon	~13,000–12,000 (human bone collagen)	Scattered bones of "Arlington Man" found in arroyo fill ~11 m below surface	Orr, 1968; Johnson et al., 2002
Arlington Point (CA-SRI-6)	NW coast of Santa Rosa Island, just east of Arlington Canyon	~9300 cal BP (marine shell date)	Buried shell midden exposed in sea cliff, black abalones and mussels dominate, with fish bone, and expedient stone tools	Erlandson et al., 1999
Garanon Canyon (CA-SRI-1)	NW coast of Santa Rosa Island, near freshwater source	~9200 cal BP (marine shell)	Low density shell midden dominated by CA mussel shells	Erlandson and Morris, 1992
Daisy Cave (CA-SMI-261)	Northeast coast of San Miguel Island, cave and rock shelter site	11,600–8500 cal BP (shell, charcoal, bone dates)	Stratified midden with terminal Pleistocene and Early Holocene strata. Faunal remains, bone gorges, shell beads, sea grass cordage in Early Holocene strata	Erlandson, 2007; Rick et al., 2001
Cardwell Bluffs (CA-SMI-678/679)	East end of San Miguel Island, adjacent to chert sources	12,000–11,600 cal BP (5 marine shell dates)	Low density shell midden, with red abalone shells and numerous bifaces, crescents, extensive lithic scatter	Erlandson, unpublished data
Seal Cave (CA-SMI-604)	Harris Point area, north coast of San Miguel Island	10,200–9200 cal BP (3 shell dates)	Stratified shell midden with rocky shore shellfish, fish remains, bone gorge	Rick et al., 2003
CA-SMI-522	Pt Bennett area, western San Miguel Island	~10,100–9000 cal BP (shell, charcoal dates)	Substantial midden deposit dominated by rocky shore shellfish; bone gorges, bifaces, and *Olivella* beads	Erlandson and Rick, 2002
CA-SMI-608	South coast of San Miguel Island west of Crook Point	~9700–8600 cal BP (6 shell dates)	Shell midden with two loci; diverse technological assemblage (gorges, (*Olivella* beads, bifaces, etc.)	Erlandson et al., 2005a,b; Braje, 2007
Bath Beach Site (CA-SMI-507)	Northwest Coast of San Miguel, Bath Beach Springs area	~9400–9000 cal BP (3 shell dates)	Large shell midden, largely deflated, with numerous leaf-shaped bifaces, and other stone tools	Erlandson et al., 2008
Running Springs West (CA-SMI-548)	Northwest coast of San Miguel, on bluffs next to freshwater spring	~9600 cal BP (marine shell dates)	Small shell midden dominated by rocky coast shellfish remains	Erlandson et al., 2004a
RS Cliffs (CA-SMI-610)	Northwest coast of San Miguel, near spring complex	~9250 cal BP (2 marine shell dates)	Low density shell midden dominated by California mussel shell	Erlandson, unpublished
Busted Balls I (CA-SMI-606)	Busted Balls Cove, NW coast of San Miguel Island	~9200–9000 (shell, charcoal dates)	Low density shell midden near spring; multiple small midden loci with heavy focus on shellfish (mussel) collecting	Erlandson et al., 2004b
La Brea Woman (CA-LAN-159)	La Brea Tar Pits, Los Angeles	~10,200 cal BP? (human bone collagen)	Human skeleton with associated *Olivella* beads	Berger et al., 1971

(*continued on next page*)

Table 2 (*continued*)

Site name	General location and context	^{14}C age (cal BP)	Site description or contents	Primary references
Irvine Site (CA-ORA-64)	Upper Newport Bay (estuary) Orange County	~9050 cal BP (AMS dates on shell)	Huge multicomponent shell midden, early estuarine component with *Olivella* beads	Erlandson et al., 2005b
Agua Hedionda (CA-SDI-210)	San Diego County; adjacent to Agua Hedionda estuary	~9800 cal BP (shell dates)	Multicomponent shell midden, with mix of estuarine and outer coast shellfish	Moriarty, 1967
Harris Site (CA-SDI-149)	San Diego County	~10,000 cal BP	Lithic site near spring	Warren, 1966

Notes: General calendar date estimates, based on calibration ages derived from CALIB, including marine reservoir corrections for marine or mixed samples.

Miguel Island, first occupied about 11.5 ka. Overlooking a rugged stretch of rocky coast, Daisy Cave is a narrow fissure about 11 m long and 1–2 m wide associated with a small rock shelter and a dense shell midden on the slope in front of the cave. The cave provides shelter from strong winds that buffet San Miguel much of the year. Because offshore waters drop off relatively steeply, Daisy Cave also remained relatively close to the coast throughout the Holocene. The unique combination of shelter and proximity to the sea attracted people to Daisy Cave for more than 11 ka. Terminal Pleistocene occupation of the cave was limited, but a thin soil horizon known as Stratum G produced a few chipped stone artefacts associated with a small assemblage of shellfish remains (Erlandson et al., 1996; Rick et al., 2005). Despite the limited nature of the occupation, the assemblage shows that Palaeocoastal peoples foraged for red abalones, mussels, turban snails, and other shellfish in rocky intertidal habitats and that Palaeoindians were building and using seaworthy boats much earlier than most scholars would have thought possible 20 years ago.

Between 10 and 8.5 ka, people visited Daisy Cave repeatedly and left behind a much broader range of materials. These Early Holocene strata have produced a variety of well-preserved artefacts and faunal remains associated with early maritime peoples, including numerous expedient stone tools, a few projectile points and bifaces, bone bipoints or fish gorges that are the oldest fishhooks from the Americas, more than 1500 pieces of cordage and a few woven items made from sea grass (Connolly et al., 1995), *Olivella* shell beads, tens of thousands of marine shells and fish bones, and occasional bones of sea otter, seals, and sea birds (Rick et al., 2001, 2005; Erlandson, 2007). Shellfish remains were dominated by California mussels, black abalones, turban snails, and other species from rocky intertidal habitats. Over 27,000 fish bones from at least 18 fish taxa were also found in the Early Holocene levels (Rick et al., 2001), mostly from smaller fish (surfperch, rockfish, cabezon, and California sheephead) common in rocky nearshore and kelp forest habitats. Dietary reconstructions suggest that shellfish and fish dominated the Daisy Cave economy, but the relatively eclectic nature of coastal foraging at Daisy Cave suggests that its Palaeocoastal occupants were capable of taking a variety of marine resources between 10 and 9 ka.

Several other Palaeocoastal sites dated between about 12 and 9 ka have been identified on San Miguel and Santa Rosa islands (Table 2). The oldest of these is CA-SMI-678/679 at Cardwell Bluffs, a large lithic scatter and shell midden complex recently dated at 12–11.5 ka, is associated with two chert sources near the east end of San Miguel Island. Lithic sites in the vicinity of this chert source have produced several chipped stone crescents and stemmed Channel Island Barbed points, distinctive artefact types considered to be diagnostic of the terminal Pleistocene or Early Holocene. Although heavily eroded, the site contains several low density shell midden loci, where in situ shells from red abalones and other rocky nearshore shellfish are associated with chipped stone tool-making debris.

Most of the other early island sites are situated near springs located some distance from the Early Holocene coast and may have been campsites occupied during the dry summer season, when freshwater springs would have pulled coastal peoples away from the coast. Several early shell middens have produced bone gorges and *Olivella* beads similar to those found at Daisy Cave. Human population densities are usually thought to have been relatively low during the Early Holocene, but the growing number of early Channel Island sites suggests that more people were present than previously believed—which seems consistent with the several millennia of demographic expansion expected given the presence of fluted points on the adjacent mainland and the terminal Pleistocene occupations of Arlington Springs, Daisy Cave, and Cardwell Bluffs. With shorelines of comparable age heavily impacted by rising seas and coastal erosion, moreover, the known Palaeocoastal sites may represent just a fraction of the sites that once existed in the area.

So far, no shell middens older than 9000 years have been definitively identified on the southern Channel Islands. Chipped stone crescents have been found on Santa Catalina and San Nicolas (Jertberg, 1986), however, suggesting that maritime peoples also settled the southern islands by at least the Early Holocene. Well-documented excavations at an 8600–8400 year old shell midden at Eel Point (CA-SCLI-43) on San Clemente Island, located almost 80 km off the San Diego Coast, have produced evidence for a relatively sophisticated boat and maritime technology (Cassidy et al., 2004). Harvesting of abalones and other shellfish appears to have been an important subsistence pursuit of the early Eel Point occupants, but faunal data also suggest that they regularly fished and hunted sea mammals (Porcasi et al., 2000).

5.1. Baja California

That the early Channel Island sites may represent a broader Palaeocoastal tradition along the arid coasts of North America is supported by recent archaeological research in Baja California. Just a decade ago, Baja California was a virtual black hole in our knowledge of early settlement along the Pacific Coast of North America, with only one poorly documented site dated to the Early Holocene (Erlandson and Moss, 1996). Until recently, areas along the Gulf of California Coast (see Davis, 1968; Ritter, 1976, 1979, 1985, 2006) and the Sierras (Gutierrez and Hyland, 2002) had seen more archaeological research than the Pacific Coast. In the last decade, however, several teams working on or near the Pacific Coast have identified terminal Pleistocene and Early Holocene shell middens with assemblages reminiscent of Palaeocoastal sites in Alta California (Fig. 4, Table 3).

The origins of these coastal or maritime peoples remain obscure, but here again the earliest widely accepted archaeological materials in the area are Clovis-like fluted points that are probably terminal Pleistocene in age. Lacking associated ^{14}C dates, these fluted points have been recovered from the surface of several peninsular sites (Aschmann, 1952; Gutierrez and Hyland, 2002; Hyland, 2006). Baja California may seem an unlikely place for Clovis hunters, but observation of Pleistocene megafaunal remains can be traced back to Jesuit missionaries of the mid-18th

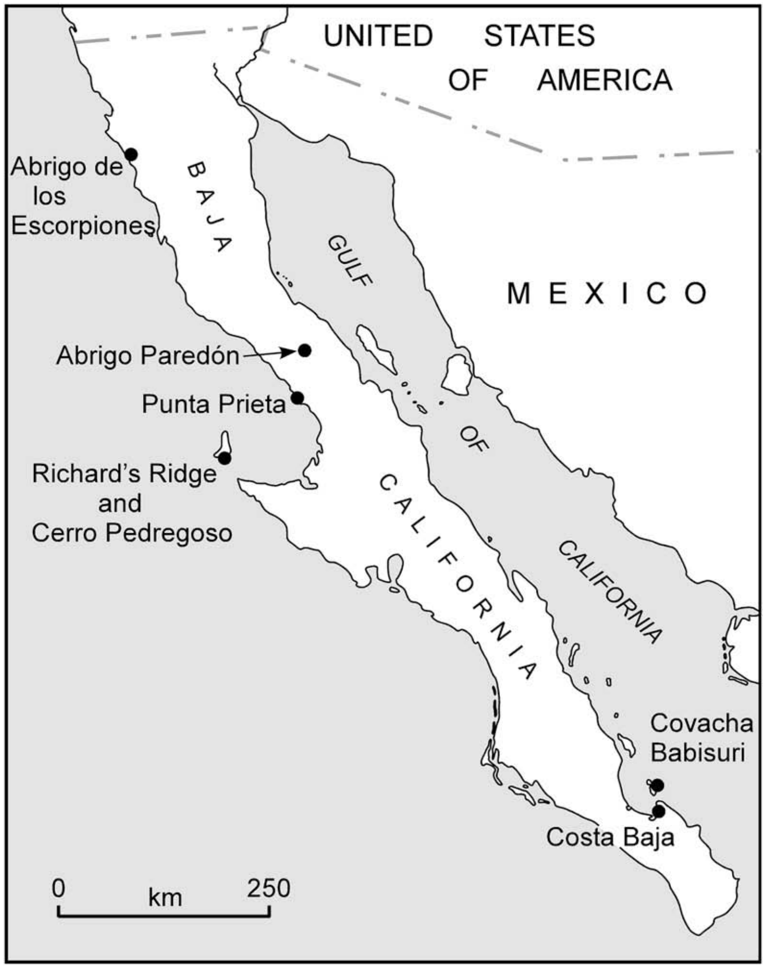

Fig. 4. Map of Baja California showing the location of Palaeocoastal sites. See Table 3 for site details. Redrawn by G.N. Bailey from an original by M. des Lauriers.

century, who reported the remains of probable proboscideans near modern-day San Ignacio in the Central Sierras (del Barco 1789 (1988)) where several fluted points have been found (Gutierrez and Hyland, 2002). Another fluted point was found recently at the Arce-Meza site (PAIC-70) on Isla Cedros which was connected to the mainland until about 10 ka but is now located about 23 km offshore (Des Lauriers, 2006a). At the Arce-Meza site, large bifaces, unifacial scrapers, a variety of expedient flake tools, and large amounts of debitage were observed on the surface.

Except for the fluted point, similar lithic assemblages have been documented at the Richard's Ridge (PAIC-49) and Cerro Pedregoso

Table 3
Palaeocoastal sites (~9,000 cal BP or older) of Baja California

Site name	General location	^{14}C age (cal BP)	Site description or contents	Primary references
Abrigo de los Escorpiones Rock Shelter	West Coast between Punta Santo Tomas and Cabo Colonet	8870–8040 (16 dates) 10,120 ± 40 (1 date)	6.5 meter deep shell midden deposit, with marine fauna, bone tools, fish hooks, and large leaf-shaped points	Gruhn and Bryan, 2002
Abrigo Paredón	Laguna Seca Chapala Northern Central Desert	9070 ± 60 BP 8650 ± 60 BP	Small rock shelter on pluvial lake shoreline	Gruhn and Bryan, 2002 Davis, 2003
Punta Prieta Rockshelter	Near Pacific Coast, ~110 km North of Guerrero Negro	8890 ± 60 BP	Date on "cache of 15 turban shells" Cultural origin uncertain	Erlandson and Moss, 1996
Richard's Ridge (PAIC-49)	Isla Cedros, Pacific Coast Central Peninsula	12,100 cal BP (shell: 10,745 ± 25 BPl	Dense shell midden with diverse lithic assemblage	Des Lauriers, 2006a,b
Cerro Pedregoso (PAIC-44)	Isla Cedros	11,800–9100 cal BP 10,095 ± 30 BP (charcoal) 10,520 ± 30 BP (shell) 10,520 ± 30 BP (shell) 9870–8300 BP (11 dates)	Dense, stratified shell midden with extensive lithic assemblage and faunal assemblage dominated by a nearly exclusive maritime focus	Des Lauriers, 2006a,b
Covacha Babisuri	Isla Espiritu Santo, southern Sea of Cortez, Baja California Sur	10,000–8600 BP (6 shell dates)	Stratified rock shelter deposit, with anomalously old dates (fossil shell?)	Fujita, 2006, pp. 85–86 from basal deposits
Costa Baja Rock Shelters	Baja California Sur, ca 5 km north	~8000 BP (2 dates)	Two neighbouring rockshelters	Fujita, 2006, pp. 85–86

(PAIC-44) sites on Cedros, stratified shell middens dated to the terminal Pleistocene and Early Holocene. Radiocarbon dates on marine shell and charcoal from midden deposits at Cerro Pedregoso range from about 11.8 to 9.1 ka, while a single mussel shell from Richard's Ridge has been dated to $\sim$12,100 $\pm$ 150 cal BP. These two sites have produced large and small bifaces, centripetal cobble-cores, ground stone tools, and flaked tools made from Pismo clam (*Tivela stultorum*) shells (Des Lauriers, 2006a,b), as well as diverse faunal assemblages. At Cerro Pedrogoso, the fauna is dominated by marine shellfish, bony and cartilaginous fish, sea turtle (cf. *Caretta* sp.), Guadalupe fur seal *(Arctocephalus townsendii*), and sea birds, along with quantities of sea grass and other carbonized marine floral remains. Isla Cedros has endemic populations of pygmy mule deer (*Odocoileus hemionus cerrosensis*) and brush rabbit (*Sylvilagus bachmanii cedrosensis*), but only one rabbit bone was recovered from excavations, compared to over 1000 identified bones of marine vertebrates.

While these localities are the first for which radiocarbon dates confirm such an early occupation on Isla Cedros, at least five other sites on the island have similar surface manifestations, lithic assemblages, and shellfish assemblages. Like the terminal Pleistocene and Early Holocene sites on the Northern Channel Islands, the Isla Cedros material indicates a strong focus on the exploitation of a diverse range of marine and littoral resources from a very early date (Des Lauriers, 2006a). Here, too, the strong emphasis on marine resources and relatively intensive early occupation of Isla Cedros suggest a population familiar with coastal settings and aquatic resources.

Several other Baja California sites dating to the Early Holocene or terminal Pleistocene have been identified in the past decade. These sites are spread along the 1600 km length of the peninsula, and most are in the early stages of research, mirroring the general archaeological situation in the region. Currently, most early peninsular sites are located near the coast and have strong emphases on littoral resources (Gruhn and Bryan, 2002; Fujita, 2006). One exception is the "interior" site of Abrigo Paredón (Gruhn and Bryan, 2002; Davis, 2003), which dates as early as 9070 $\pm$ 60 RYBP. This site, which lies on the shoreline of a small pluvial lake basin about 50 km from both the Pacific and Gulf of California coastlines, has a relatively shallow ($\sim$50 cm) deposit dominated by lithic debitage, limited quantities of small mammal (i.e. *Lepus* sp.) bone, and some Pacific Coast shellfish remains (Gruhn and Bryan, 2002).

At the coastal rockshelter of Abrigo de los Escorpiones, Gruhn and Bryan (2002) uncovered a stratified shell midden at least 5.6 m deep. With basal deposits dating between about 10 and 9 ka, faunal remains suggest a strong focus on the collection of rocky-shore shellfish. One ^{14}C date exceeds 10,000 RYBP, but Gruhn and Bryan (2002) cite a more conservative age estimate, based on a consideration of the context for each sample and issues of stratigraphic integrity. Further excavations are planned to seek deposits predating 9 ka (Gruhn and Bryan, 2002).

Another early site is located on Espiritu Santo Island in the Sea of Cortez, just inside the southern tip of the peninsula (Cabo San Lucas). At the Covacha de Babisuri rockshelter, Fujita (2006) excavated a stratified deposit with cultural materials dating to at least 10,000 RYBP. Shells recovered below the 10,000 year old level produced dates in excess of 30 ka, but these anomalously old dates may indicate the use of fossil shell by the terminal Pleistocene occupants of the shelter. Similar to Isla Cedros, Espiritu Santo was probably connected to the mainland during the LGM, but had become an island by the time these coastal peoples settled there. Here, the early occupation of an island, one with very few terrestrial resources, also suggests an initial occupation of the peninsula by people familiar with the exploitation of marine resources.

6. Conclusions

Geological and archaeological data suggest that the distribution and abundance of early archaeological sites along various segments of North America's Pacific Coast are strongly influenced by the unique geological history of each region. Despite the challenges posed by postglacial sea level rise, coastal erosion, glaciation, and tectonics, recent archaeological research along the Pacific Coast has identified important sites that shed considerable light on the antiquity and nature of early human settlement along the western edge of North America. In the Pacific Northwest, California, and Baja California, archaeologists have now identified evidence for the maritime settlement of islands by at least 11.5 ka. In California, Palaeocoastal peoples used seaworthy boats to settle the Northern Channel Islands as early as 13 ka, roughly contemporary with Clovis (see Waters and Stafford, 2007). Such discoveries, along with doubts about the availability of the interior ice-free corridor until approximately 13 ka, have pushed a coastal migration theory to the forefront of the debate about how and when the Americas were first colonized. The coastal migration theory has also gained credibility in recent years because of evidence for Pleistocene seafaring in eastern Asia (Erlandson, 2002; Fedje et al., 2004) and early occupations along the Pacific Coast of South America (e.g., Dillehay, 1997; Keefer et al., 1998; Richardson, 1998; Sandweiss et al., 1998).

Erlandson et al. (2007a) proposed that kelp forests along North Pacific coastlines may have provided a "kelp highway" for maritime peoples migrating from northeast Asia into the Americas, with a similar suite of marine resources, reduced wave energy, and holdfasts for boats along a linear migration corridor entirely at sea level. Whether such a coastal migration actually took place—or represented the earliest colonization of the American continents—has yet to be demonstrated, but a variety of archaeological, anthropological, geological, and genetic evidence suggests that such a scenario is increasingly likely (Erlandson, 1994, 2002; Dixon, 1999; Fedje et al., 2004; Kemp et al., 2007). When, how, and from where the first maritime peoples first reached the Pacific Coast remains uncertain. The Monte Verde site is not universally accepted, and the presence of fluted Clovis-like points in coastal areas from Washington to Baja California leaves open the possibility that the early maritime peoples in the area are descended from Palaeoindians armed with a fluted point technology. With the antiquity of maritime settlement along various areas of the west coast pushed back to between at least 13 and 11.5 ka, however, it is now clear that models featuring a late settlement of the west coast and a gradual development of maritime capabilities are no longer viable.

By about 10 ka, archaeological evidence from all three geographic areas of the Pacific Coast demonstrates that coastal peoples had used seaworthy boats and other maritime technologies for more than a millennium. In all three areas, geography, faunal remains, or isotopic evidence indicate that these Palaeocoastal peoples: (1) used boats to explore and colonize offshore islands; (2) actively hunted, fished, and foraged in marine ecosystems; and (3) had economies that were fully maritime—with a majority of their calories or protein derived from marine resources. By 10 ka, Palaeocoastal peoples along the Pacific Coast had developed the earliest examples of several maritime technologies known in the New World, including barbed bone harpoons in the Pacific Northwest, bone gorge fishhooks on the Channel Islands, early cordage and basketry made from sea grass, and shell beads traded to interior peoples. This represents a much more sophisticated maritime adaptation than most scholars would have considered possible a decade or two ago. Because even earlier coastlines lie deeply submerged and largely unexplored offshore, understanding the origins of these maritime Palaeocoastal peoples is a challenge that requires a systematic archaeological search of the drowned terrestrial landscapes that flank the Pacific Coast of North America.

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