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# Maritime Adaptation and Seaside Settlement in the North Pacific during the Pleistocene - Holocene Boundary

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# The Cross Creek-Diablo Canyon Complex of South Central California: Mid-latitude Pacific Foragers at the Pleistocene-Holocene Boundary

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Abstract

**S***ituated within 25 km of each other on the central California coast, the Cross Creek (CA-SLO-1797), and Diablo Canyon (CA-SLO-2) sites produced basal components dating 6500-8300 cal BC, making them two of the oldest human occupations on the California mainland. New findings from Diablo Canyon (radiocarbon determinations and faunal analyses) are presented for the first time here, and the two sites are used in tandem to define a complex that represents the mid-latitude northeastern Pacific mainland 8500-10,300 years ago. The sites' faunal and artifact assemblages exhibit marked variation, as Cross Creek produced a typical California Millingstone inventory marked by high frequencies of handstones, milling slabs, core tools (including choppers and core hammers), small edible seeds, yucca heart fragments, and remains of marine shellfish. Projectile points, bifaces, and bones from large animals were uncommon. Diablo Canyon showed lower frequencies of milling and core tools, and greater representation of projectile*

*points, bifaces, flake tools, and bones from small, medium and large animals, including deer and rabbits, marine birds, and fish. Much of this variation is related to the habitats in which the sites are situated as Cross Creek is located 9 km inland in a peri-coastal valley, and Diablo Canyon occurs on the open rocky shoreline. Together, the two components represent residential bases within a semi-permanent settlement system. A combination of marine resource exploitation technologies (including watercraft), hunting weapons, and milling equipment in concert with floral and faunal residues testify to a broad-spectrum adaptation with a distinctive marine component. This lifeway seems consistent with populations moving southward along the shore of the northeastern Pacific. While evidence for use of the California coast at this time depth is commonly lumped under the rubric of the California Paleo-Coastal Tradition, the Cross Creek-Diablo Canyon complex is one of several distinctive regional complexes that illuminate variability in adaptations along the California coast at the terminal Pleistocene/early Holocene boundary.*



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## ntroduction

Over the last decade the antiquity of hunter-gatherer adaptations along the coast of the northeastern Pacific has been progressively pushed back to approximately 9,000-10,000 cal BC, largely on the basis of finds from southern California (Erlandson et al. 2007). Solid radiocarbon evidence for human presence on the southern California islands at this time depth comes from the Arlington Woman/Man<sup>1</sup> site (CA-SRI-173) on Santa Rosa Island (Johnson et al. 2002) and a small but well-dated assemblage of midden constituents from the basal levels of Daisy Cave (SMI-261) on San Miguel Island (Erlandson et al. 1996; Rick, Erlandson and Vellanoweth 2001). With human presence on the California mainland and islands at the Pleistocene/Holocene Transition no longer in doubt, issues that remain to be clarified include the nature of the earliest coastal adaptations, their relationship to early inland lifeways (e.g., the fluted point, big game hunting complexes), and the chronology, cultural affiliations, and origin of the earliest coastal immigrants. As suggested by recent mitochondrial DNA (Eschelman and Smith 2007; Johnson and Lorenz 2006; Merriwether 2002) and linguistic research (Golla 2007; Nichols 2002), the latter issues are complicated by the likelihood that that northeastern Pacific corridor was witness to multiple migrations with some groups merely passing through on their way to more southerly latitudes. Unraveling the history of these early

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coastal migrations will require not only further DNA and linguistic research, but enhanced terminal Pleistocene/early Holocene cultural chronologies that recognize inter-regional and diachronic variation in artifact assemblages and adaptations.

Toward this goal, we summarize here findings from two of the earliest coastal sites on the California mainland: Cross Creek (CA-SLO-1797), and Diablo Canyon (CA-SLO-2). Situated within 25 km of each other (Figure 1), these sites produced faunal remains and artifacts that define lifeways and assemblages on the mid-latitude mainland of the northeastern Pacific 9,000-10,000 years ago. Both sites have been reported previously (CA-SLO-1797; Fitzgerald 1998, 2000; Jones et al. 2002; CA-SLO-2; Greenwood 1972), but new findings from Diablo Canyon (radiocarbon determinations and faunal analyses) are presented here, and the two sites are considered in tandem for the first time. The Cross Creek site, situated 9 km inland, produced an exceptionally robust tool assemblage but a depauperate vertebrate fauna, while Diablo Canyon, on the coast, produced fewer tools and a larger assemblage of bird, mammal, fish, and molluscan remains. Together, the two components represent a reasonably coherent archaeological complex. While evidence for use of the California coast at this time depth is commonly lumped under the rubric of the California Paleo-Coastal Tradition (see Moratto 1984), the Cross Creek and Diablo Canyon sites represent one of several distinctive regional adaptations along the California coast at the

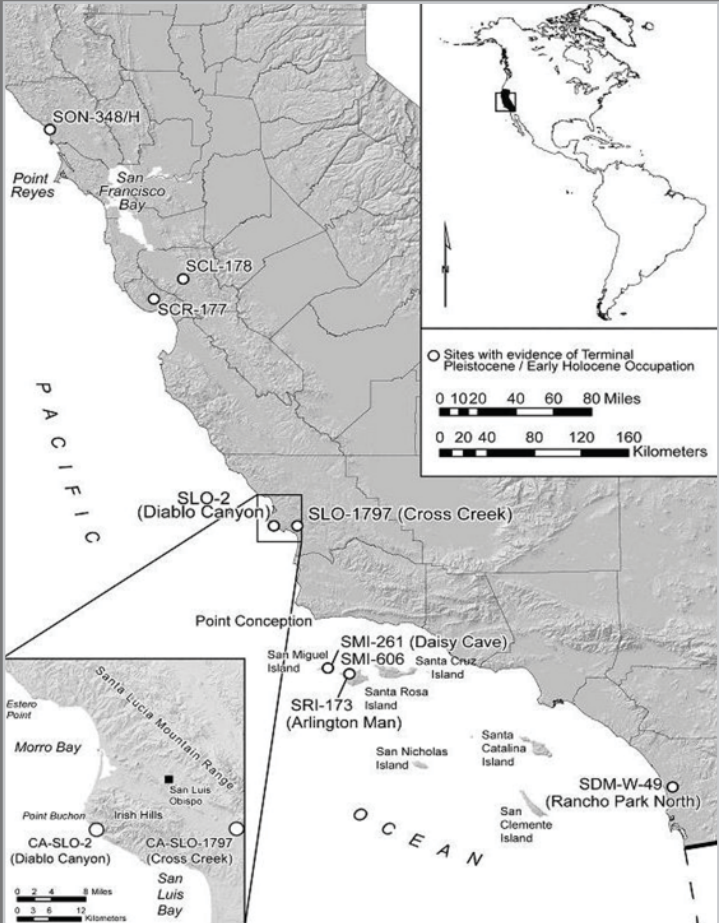


Fig. 1  
Sites mentioned in text

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terminal Pleistocene/early Holocene boundary.

## 1. The Cross Creek Diablo Canyon Complex

The Diablo Canyon Cross-Creek complex is represented by the lower strata (3 and 4) at the Cross Creek site and the lowermost arbitrary levels (280-340 cm) at Diablo Canyon.

### 1.1. The Cross Creek Site (CA-SLO-1797)

The Cross Creek site is situated in a peri-coastal valley, 9 km from the present shoreline of San Luis Obispo County in central California (Figure 1). It was discovered during trenching for a water pipeline in the summer of 1996, and salvage excavations were completed the following winter. Detailed technical reports in which the site was linked to the California Millingstone Culture were completed soon thereafter (Fitzgerald 1998, 2000), and the site was later reported to broader audiences (Jones et al. 2002). The deposit at Cross Creek was relatively shallow with its upper 30 cm marked by two largely sterile strata (Strata 1 and 2) that overlay a dark gray shell midden (Strata 3 and 4), 30-150 cm below the surface. Strata 3 and 4 were variants of a very dark gray clay loam midden within which were found shell fragments, stone debitage, milling tools, core and flake tools, bifaces, projectile points, and very sparse vertebrate remains. Strata 1 and 2 produced very

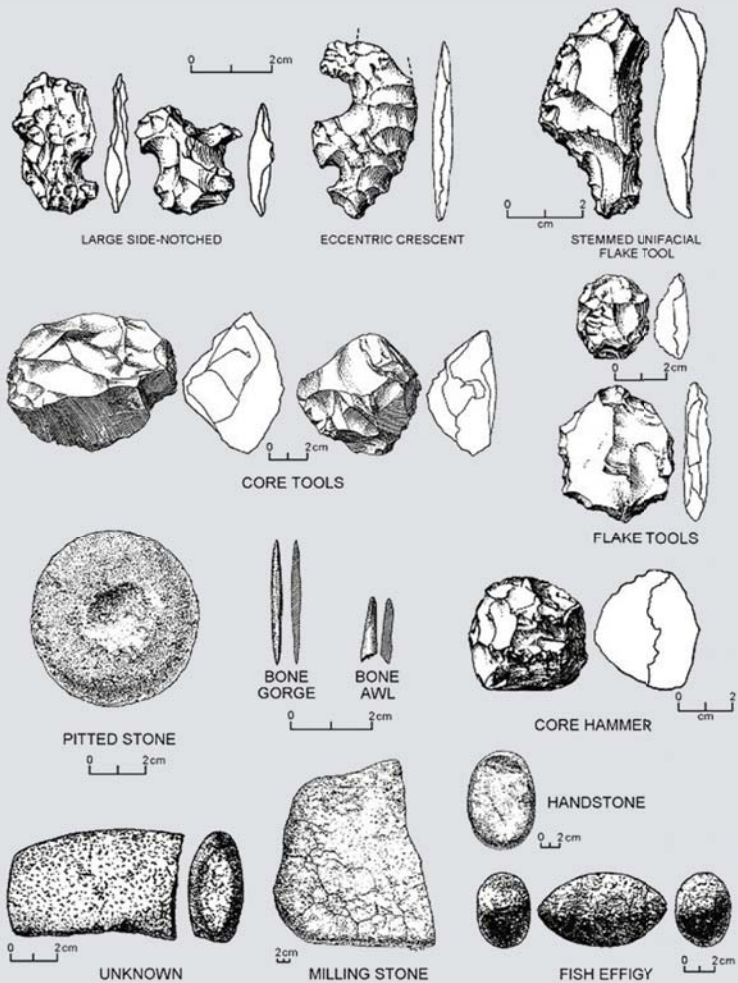


Fig. 2

### The Cross Creek-Diablo Canyon Complex artifact assemblage

Projectile points, flake tools, core tools, stemmed unifacial flake tool, handstone, milling slab, fish effigy and item of unknown function all from the Cross Creek site (CA-SLO-1797); other artifacts generalized from finds made from Diablo Canyon and other terminal Pleistocene/early Holocene Millingstone sites.

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modest quantities of artifacts that testified to more recent, ephemeral occupation of the site area.

Sixteen radiocarbon dates were obtained from Cross Creek strata 1, 2, 3, and 4, and their stratigraphic interfaces (Fitzgerald 1998, 2000). Ten dates were obtained from stratum 3, one from stratum 4, two from the strata 2/3 interface, and three from the 1/3 interface. All dates were obtained from well-preserved, single marine shells. Twelve of these dates were between 7570 and 8350 cal BC, but four dates, associated with stratigraphic interfaces (1/3 and 2/3) reflected later site use associated with strata 1 and 2, including an intrusive *Olivella* saucer bead, dating to cal AD 110 and a *Haliotis* shell dating 2830 cal BC. Eliminating all dates from the stratigraphic interfaces, strata 3 and 4 at Cross Creek yielded 11 dates between 7570 and 8350 cal BC (Table 1). Samples yielding

Table 1

**Radiocarbon Dates from the Basal Components at Diablo Canyon and Cross Creek\***

\* Five dates from stratigraphic interfaces at CA-SLO-1797 excluded.

1 These dates reflect inter-component mixing caused by rodent activity and are considered intrusive within the basal component.

2 This date is rejected.

Sources: Fitzgerald (1998:11-3); Fitzgerald and Jones (1999:76); Greenwood (1972).

Site	Stratum	Unit	Laboratory No.	Depth (cm)	Material	Species	Conventional 14C Age	Calibrated age A.D./B.C. 1 sigma (AR=290±35)
CA-SLO-2	-	S1W12	Beta-197950	280-290	shell	<i>Mytilus californianus</i>	8340±40	6630 (6550)-6470 BC
CA-SLO-2	-	N1/W5	GAK-02044	290	Shell	<i>Haliois</i> sp.	9780±260	9180 (8320)-7540 BC
CA-SLO-2	-	N1-W4	SR-6833	290-300	Bone	<i>Chenichthes lani</i>	8355±25	6632 (6569)-6494 BC
CA-SLO-2	-	S1 W12	Beta-204132	290-300	Shell	<i>Balanus</i> sp.	5120±40 <sup>1</sup>	3500 (3170, 3150, 3140) 3080 BC
CA-SLO-2	-	N1W4	Beta-197947	290-300	Shell	<i>Balanus</i> sp.	5040±40 <sup>1</sup>	3100 (3020)-2930 BC
CA-SLO-2	-	NE-S4-W9	Beta-192961	330-340	Shell	<i>Collisella</i> sp.	8620±50	6974 (6915)-6851 BC
CA-SLO-2	-	NE-S4-W9	Beta-192962	330-340	Shell	<i>Mytilus californianus</i>	8300±50	6586 (6480)-6436 BC
CA-SLO-2	-	S4/W9	UCLA-1686A	320-330	Bone	Human	9480±175 <sup>2</sup>	8330 BC
CA-SLO-1797	3	26	Beta-103837	50-60	Shell	<i>Haliois</i> sp.	9340 ±80	9240 (8780, 8770, 8750)
CA-SLO-1797	3	10	Beta-104767	80-100	Shell	<i>Saxidomus nuttalli</i>	9900 ±270	B.C. 9050 (8350)-7730
CA-SLO-1797	3	31	Beta-104768	90	Shell	<i>Saxidomus nuttalli</i>	9440 ±110	B.C. 8060 (7890)-7540
CA-SLO-1797	3	22	Beta-104769	90	Shell	<i>Saxidomus nuttalli</i>	9640 ±100	B.C. 8320 (8030)-7880
CA-SLO-1797	3	15	Beta-110793	80-90	Shell	<i>Saxidomus nuttalli</i>	9480 ±90	B.C. 8060 (7920)-7640
CA-SLO-1797	3	25	Beta-110794	40-50	Shell	<i>Saxidomus nuttalli</i>	9600 ±70	B.C. 8160 (8010)-7890
CA-SLO-1797	3	10	Beta-111349	80-100	Shell	<i>Tirela stultorum</i>	9330 ±50	B.C. 7910 (7700)-7540
CA-SLO-1797	3	26	Beta-112548	40-50	Shell	<i>Saxidomus nuttalli</i>	9510 ±130	B.C. 8190 (7940)-7570
CA-SLO-1797	3	30	Beta-120346	60-70	Shell	<i>Saxidomus nuttalli</i>	9550 ±40	B.C. 8050 (7970)-7880
CA-SLO-1797	3	1	Beta-120347	80-90	Shell	<i>Saxidomus nuttalli</i>	9480 +/70	B.C. 8040 (7920)-7690
CA-SLO-1797	3/4	33	Beta-106533	140-150	Shell	<i>Tresus nuttalli</i>	9230 ±50	B.C. 7830 (7570)-7480

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these dates were spread throughout the layers along with the milling and other tools. While some modest inter-component mixing clearly occurred at Cross Creek as a result of rodent activity, strata 3 and 4 can be characterized as a single component dating 7570-8350 cal BC.

The tool assemblage from Strata 3 and 4 included 74 formal artifacts (Table 2), with 20 crude core/cobble tools, 17 handstones, 12 milling slabs, 9 hammerstones, 7 flake scrapers, 1 biface, and 1 large side-notched projectile point (Figure 2). All of the grinding tools were heavily modified and extremely well made; the slabs were shaped on their exterior and showed consistency in size and material (siltstone and sandstone). Two enigmatic artifacts were also recovered from deep within the paleo-midden: a palm sized quartzite pebble delicately shaped into a symmetrical form with minute incisions at opposing ends (an apparent fish effigy) and a finely shaped, elongated and curved piece of shaped sandstone of unknown function.

Despite a total hand excavation volume of 30.2 m<sup>3</sup>, vertebrate remains were very sparse at Cross Creek. A total of only 55 bone fragments was recovered from strata 3 and 4 (38.1 g), of which only one, an antler fragment, was identified as an artiodactyl (either black-tailed deer [*Odocoileus hemionus*] or a tule elk [*Cervus elaphus*]). A single fish bone, a vertebra from a rockfish (*Sebastes* spp.) was also recovered. With few vertebrate remains, the faunal assemblage was dominated by shellfish, most of which represented estuarine taxa (Pacific littleneck



Artifact	Cross Creek			Diablo Canyon		Grand total
	Stratum 3	Stratum 4	Subtotal	280-340 cm		
Milling slabs	8	4	12	0		12
Handstones	9	8	17	1		18
Cobble/ Core tools	11	9	20	2		22
Scrapers/Flake tools	6	1	7	17		24
Contracting-stemmed projectile points	0	0	0	2		2
Side-notched projectile points	1	0	1	0		1
Bifaces	1	0	1	5		6
Hammerstones	9	0	9	2		11
Pitted stones	0	0	0	7		7
Anvil stones	1	2	3	0		3
Stone/shell beads	2*	0	2	4		6
Bone beads	0	0	0	1		1
Eccentric artifact/ fish effigy	2	0	2	0		2
Bone awls	0	0	0	5		5
Total	50	24	74	46		120

Table 2  
 Summary of Artifacts from the Basal Components  
 at Cross Creek and Diablo Canyon

\*Includes one non-diagnostic spire-lopped Olivella, and one intrusive Olivella saucer bead. Sources: Fitzgerald (1998:11-3); Fitzgerald and Jones (1999:76); Greenwood (1972).

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[*Protothaca staminea*] 53.5%, Washington clam [*Saxidomus nuttalli*] 20.4%, and gaper clam [*Tresus nuttalli*; 2.1%]) from a now-extinct paleo-estuary (Halcyon Bay) 9 km south of the site. Shells from the more distant, open coast (e.g. red abalone [*Haliotis rufescens*]) were also recovered in small quantities. Strata 3 and 4 and the Strata 2/3 interface produced a maximum of 169 g of shell per 10 cm level (1 x 2 m unit processed with 6 mm mesh), and a 1 x 2 m control unit processed with 3 mm mesh produced 1176.9 g of shell from a recovery volume of 1.9 m<sup>3</sup>. Oxygen isotope analysis of the shells indicated that mollusks were collected at a minimum during winter, early spring, and summer.

Large animals were not a major focus of subsistence for the inhabitants of Cross Creek, which is typical of many Millingstone Culture sites (see Wallace 1955, 1978; Erlandson 1994, Fitzgerald and Jones 1999). Although shellfish were important, the inland site location and assemblage of well-formed milling tools indicated that vegetal resources were also exploited. Flotation analysis produced charred seeds from several edible grasses along with fragments of yucca (*Yucca* sp.) heart. Yucca processing has long been linked with the types of chopping and scraping tools common at Cross Creek and other Millingstone sites (Kowta 1969). The seasonality implied by the macrobotanical remains in concert with the oxygen isotope results from the mollusk shells suggested that the site served as a residential base for much of the year. The estuarine clam shells further indicate that site inhabitants were exploiting a foraging radius of

		NISP	%	Weight (g)
<i>Odocoileus hemionus</i>	Black-tailed deer	17	8.95	47.86
<i>Canis</i> sp.	Dog/Coyote	1	0.53	0.77
<i>Sylvilagus</i> sp.	Cottontail Rabbit	8	4.21	3.00
Artiodactyl	Hoofed mammals	10	5.26	21.29
Mammal	Mammal	81	42.63	21.60
Mammal, Large	Mammal, Large	13	6.84	18.55
Mammal, Medium	Mammal, Medium	2	1.05	3.68
Mammal, Small	Mammal, Small	4	2.11	2.04
	Subtotal	136	71.58	119
Arctocephalinae	Fur seals	1	0.53	8.67
Otariidae	Fur seals and sea lions	3	1.58	4.83
Pinnipedia	Pinnipeds	3	1.58	2.40
Mammal, Large, Marine	Mammal, Large, Marine	1	0.53	0.66
	Subtotal	8	4.21	17.00
Aves	Birds	28	14.74	12.05
Aves, Large	Birds, Large	1	0.53	0.54
<i>Cephus columba</i>	Guillemot pigeon	1	0.53	0.38
<i>Chaulestes larvi</i>	Flightless duck	8	4.21	17.27
<i>Phalacrocorax</i> sp.	Cormorants	1	0.53	1.56
<i>Podiceps</i> sp.	Grebe	1	0.53	0.28
<i>Ptychorampbus alencicus</i>	Cassin's auklet	1	0.53	0.17
<i>Puffinus griseus</i>	Sooty shearwater	3	1.58	4.08
<i>Puffinus</i> sp.	Shearwater	1	0.53	1.82
<i>Uria aalge</i>	Common murre	1	0.53	0.50
	Subtotal	46	24.21	39.00
	TOTAL	190	100.00	174.00

Table 3

### Bird and Mammal Remains from the Basal Component, CA-SLO-2

Identified by Judy Porcasi using reference materials at the Cotsen Institute of Archaeology, University of California, Los Angeles.

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no less than 9 km.

The Cross Creek site is important because it shows exploitation of the littoral zone on the California mainland as early as ca. 8350 cal BC by people with a tool kit different from that originally ascribed to the Paleo-Coastal Tradition. Recognizing Cross Creek as a regional variant of the California Millingstone Culture, Fitzgerald (1998, 2000) and Jones et al. (2002) suggested that the cobble-based choppers and scrapers in the Cross Creek assemblage reflected ties with the Pebble Tool Tradition of the Northwest Coast (Carlson 1990; Carlson and Dalla Bona 1996). Characterized by simple leaf-shaped bifaces, and an abundance of choppers and large scrapers made on cobbles, the Pebble Tool Tradition is thought to reflect a very early coastal occupation by people who eventually expanded their settlements inland along major rivers.

## 1.2. The Diablo Canyon Site (CA-SLO-2)

CA-SLO-2 is an unusually large (ca. 400 x 320 m), deep midden, situated on a narrow coastal terrace on the north bank of Diablo Creek also in San Luis Obispo County. The site is one of nearly 50 middens on the coastal edge of a 20-km long peninsula that extends 8 km into the Pacific Ocean between Morro and San Luis Obispo bays. Of the six sites investigated by Roberta Greenwood in 1968 in anticipation of construction of Diablo Canyon Nuclear Power Plant, CA-SLO-2 was the deepest and most complex. She employed a mixed recovery

		NISP	%
TERRESTRIAL MAMMALS			
<i>Odocoileus hemionus</i>	Black-tailed deer	17	39.53
<i>Canis</i> sp.	Dog/Coyote	1	2.32
<i>Sylvilagus</i> sp.	Cottontail Rabbit	8	18.60
Subtotal		26	60.46
BIRDS			
<i>Cephus columba</i>	Guillemot pigeon	1	2.32
<i>Chendytes laui</i>	Flightless duck	8	18.60
<i>Phalacrocorax</i> sp.	Cormorants	1	2.32
<i>Podiceps</i> sp.	Grebe	1	2.32
<i>Psychorampbus aleuticus</i>	Cassin's auklet	1	2.32
<i>Puffinus griseus</i>	Sooty shearwater	3	6.98
<i>Puffinus</i> sp.	Shearwater	1	2.32
<i>Uria aalge</i>	Common murre	1	2.32
Subtotal		17	39.54
	TOTAL	43	100.00

Table 4

Bird and Mammal Remains identified to the Genus Level or better from the Basal Component, CA-SLO-2

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strategy that was designed to sample artifacts, and micro-, and macro-faunal remains effectively. In the area of her investigations, the site extended to a depth of 3.4 m. A total of 30 1 x 2 m units was excavated and processed with 6 mm (mesh) and two column samples were recovered for microanalysis: a 0.25 x 0.25 column excavated to the base of the deposit (0.8 m<sup>3</sup>) that was water-processed with 1 mm mesh to recover fish bones, and a 1 m x 1 m unit, processed with nested 6 mm and 3 mm (1/8 inch) mesh to recover shell remains. Greenwood (1972:5) reported a total recovery volume of 109 m<sup>3</sup>. Findings from the fish column (Fitch 1972) and shell column were reported in detail in the 1972 monograph, as was the site's artifact collection (Greenwood 1972). Only a small portion of the vertebrate faunal remains was identified in the 1972 site report, however.

As is often the case on the California mainland, Greenwood (1972) found that deep midden at CA-SLO-2 was relatively homogeneous with no evidence of discrete layering or physical stratigraphy. Rather, she noted a gradual transition in soil color between the upper (0-150 cm; black), middle (150-250 cm; very dark brown), and basal (250-340 cm; very dark yellowish brown) levels. A distinct calcium carbonate precipitate (caliche) was noted below 150 cm that is common in deposits of early and middle Holocene in the region. In the absence of physical stratigraphy, Greenwood relied on three radiocarbon dates and a robust assemblage of formal artifacts, to define three cultural components: a basal Millingstone

Taxon	Common Name	NISP
<i>Anarrhichthys ocellatus</i>	Wolf-eel	9
<i>Cymatogaster aggregata</i>	Shiner Surfperch	1
<i>Damalichthys tacea</i>	Pile Surfperch	1
Embiotocidae	Surfperch	14
<i>Engraulis mordax</i>	Northern Anchovy	1
<i>Hyperprosopon argententeum</i>	Walleye surfperch	1
<i>Ophiodon elongatus</i>	Lingcod	1
<i>Parichthys notatus</i>	Plainfin midshipman	3
<i>Raja</i> spp.	Skate	2
<i>Sebastes</i> spp.	Rockfishes	5
<i>Squalus acanthias</i>	Spiny Dogfish	4
<i>Xiphister mucosus</i>	Rock Prickleback	1
	Subtotal	43
Unidentified	Unidentified	172
	Total	215

Table 5

Fish remains from CA-SLO-2 Column Sample processed with 1.0 mm (1/16 inch) mesh from Fitch (1972) (Sample= 0.125 m3)

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occupation dating ca. 3000-7400 BC (230-340 cm); a Hunting Culture component dating 3000 BC- AD 1000 (120-230 cm); and a post AD 1000 Late Period or Canaliño component above 120 cm. The two dates in excess of 7000 BC from the base of the deposit indicated that CA-SLO-2 was, at the time of its reporting in 1972, one of the oldest coastal sites in North America.

A total of 34 radiocarbon dates is now available from CA-SLO-2, and all vertebrate faunal remains have been identified<sup>4</sup>. The enhanced chronometric data generally corroborate Greenwood's cultural-stratigraphic assessment of the site's occupational history, although four components can now be recognized rather than three. With respect to the issue of the early coastal settlement of North America, the basal component continues to be of seminal importance. As at Cross Creek, radiocarbon results indicate some vertical, inter-component mixing due to rodent activity. Nonetheless, an early Millingstone component has been isolated at the base of the deposit between 280 and 340 cm below surface. Eight radiocarbon dates are available from these levels (Table 1). One of these, obtained by Greenwood (1972:4) from a sample of human bone, yielded a date of 8770 cal BC which is anomalously older than all other dates from the site. Given the uncertainties about collagen extraction techniques used in 1972, it seems best to reject this date. Of the remaining seven assays, two shell samples produced dates of only 3150 and 3020 cal BC, reflecting down-mixing of materials from further up in the deposit. The remaining five dates are between



Taxon	Common name	NISP	%	Wt. (g)
Carcharhinidae	Requiem sharks	1	1.44	1.13
<i>Parichthys</i> sp.	Specklefin, or plainfin midshipman	1	1.44	0.11
<i>Sebastes</i> spp.	Rockfishes	6	8.69	1.77
<i>Ophiodon elongatus</i>	Lingcod	6	8.69	2.63
<i>Scorpaenichthys marmoratus</i>	Cabezon	18	26.08	4.72
Embiotocidae	Surfperches	2	2.90	0.32
Stichaeidae	Pricklebacks	1	1.44	0.12
<i>Xiphister</i> sp.	Rock or kelp prickleback	1	1.44	0.22
Subtotal		36	52.12	11.02
Actinopterygii	Unidentified ray-finned fish	33	47.82	4.48
Total		69	100.00	15.5

Table 6

Fish remains from CA-SLO-2 excavation units processed with 6 mm (1/4 inch) mesh (Sample= 2.9 m3).

Identified by Ken Gobalet using reference materials at the Department of Biology, California State University, Bakersfield.

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6480 and 8320 cal BC, which is largely coeval with the basal occupation at Cross Creek (7570-8350 cal BC). One highly fragmentary human burial was found in the deepest levels of the site and two others were found in slightly later Millingstone levels.

The tool assemblage recovered from the basal levels of Diablo Canyon includes a total of 46 items (excluding debitage). The small assemblage is generally consistent with Cross Creek albeit with some important variation related to the site's coastal setting. While two cobble choppers and a single handstone were recovered, the dominant artifacts were not milling tools but rather scrapers/flake tools (N=17), bifaces (N=5) and pitted stones (N=7). The function of the latter remains elusive, but they are commonly found in large quantities along the central California coast (rarely inland) and clearly reflect some type of marine resource processing. Their absence from Cross Creek is consistent with the inland setting of that site. The Diablo finds also included bone awls and two contracting-stemmed projectile points. At Cross Creek, projectile points from strata 3 and 4 were limited to large-side notched examples. Large side-notched points were also abundant at Diablo Canyon above 280 cm, and it is clear from their dating elsewhere in the area (e.g., CA-SLO-1756 [Fitzgerald 1997]) that the type is associated with early Holocene Millingstone expressions. Contracting-stemmed points on the other hand are the most ubiquitous type found in the region and are commonly recovered in large numbers from later (mid-Holocene) contexts. Recent cultural historical summaries (e.g., Jones 1993; Jones et al. 2007) have tended to dismiss the

Diablo Canyon finds as intrusions from the upper site levels, but there is also a possibility, as Greenwood argued in 1972, that the specimens belong with the site's basal component and are part of terminal Pleistocene/early Holocene assemblages in this region (see also Bertrando 2004). Also overlooked at CA-SLO-2 are eccentric crescents several of which were recovered from the site's basal levels.

The greater frequency of scraping tools, bifaces, and projectile points at Diablo Canyon is consistent with a faunal assemblage that includes considerably more vertebrate remains than Cross Creek. The 190 specimens identified from the basal component show a fairly broad taxonomic range, including large and small terrestrial mammals, marine mammals and birds (Table 3). Overall, the assemblage shows an emphasis on terrestrial mammals (72%) followed by birds (24%) with very few marine mammals (4%). Focusing only on specimens identified to the genus level or better (Table 4), the basal component is dominated by the remains of black-tailed deer (*Odocoileus hemionus*) (NISP=17; 40%), cottontail rabbit (*Sylvilagus* sp.) (NISP=8; 19%), and the extinct flightless duck (*Chendytes lawi*) (NISP=8; 19%). Aquatic birds overall, including the sooty shearwater (*Puffinus griseus*) and the flightless duck account for 37% of the NISP. Exploitation of the flightless duck was most likely accomplished with watercraft as this highly vulnerable aquatic species could not have existed on the mainland and was probably adapted to predator-free islands and offshore rocks.

The high frequency of deer bones was unexpected given the dearth of such remains at Cross Creek and other early Holocene sites in the region (Erlandson 1994; Jones, Mikkelsen and Hildebrandt 2004; Jones et al. 2004). A number of authors have generalized that Millingstone people emphasized the trapping of small and medium-sized game (Hildebrandt and McGuire 2002; McGuire and Hildebrandt 1994; 2005; Fitzgerald and Jones 1999; Jones et al. 2002) over the hunting of deer, but the

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Diablo Canyon findings stand in contrast with such generalizations. Even if inter-component mixing contributed to the high frequency of deer bone in the site's lowest levels, upper levels of the deposit including a slightly later Millingstone component are also dominated by deer (NISP=183; 43%). The Diablo Canyon people trapped rabbits and collected aquatic birds from offshore rocks using watercraft, but they were also heavily involved in deer hunting.

Fish remains were also much more abundant at CA-SLO-2 than at Cross Creek. Two samples obtained with different recovery methods are available from the basal component. In the original site report, Fitch (1972) documented 215 fish elements from the basal levels of a 0.25 x 0.25 m column sample processed with 1.0 mm (1/16 inch) mesh (Table 5). Of the 43 specimens identified to the family level or better, the dominant species from this sample were surf perches (*Embiotocidae*; NISP=14), wolf-eel (*Anarrhichthys ocellatus*; NISP=9), and rockfishes (*Sebastes* spp.; NISP=5). More recently, fish remains from the basal levels of 1 x 2 m excavation units were identified by Dr. Ken Gobalet (Table 6). This sample represents a larger recovery volume (2.9 m<sup>3</sup>) processed with larger mesh (6 mm), and therefore produced fewer elements (NISP=69). Not surprisingly, this larger-mesh sample is dominated by the remains of larger fish: cabezon (*Scorpaenichthys marmoratus*; NISP=18), lingcod (*Ophiodon elongates*; NISP=6), and rockfishes (*Sebastes* sp.; NISP=6). All of these fishes are today common on the rocky reefs, stony bottom shelves, and kelp forests along the exposed coast near Diablo Canyon. Fitch (1972:115) felt

that most of these species could have been caught with shore-based traps although he conceded that some type of watercraft was probably also used to access the outer fringes of kelp beds and offshore rocky islands. In all likelihood, the larger fish were probably caught with bone gorges attached to lines. No gorges were recovered from the deepest levels of CA-SLO-2, but examples were found in the site's upper Millingstone levels and one was also identified at a nearby site dating 5800 cal BC (CA-SLO-215; T. Jones, Porcasi and Gobalet 2004:61). Bone gorges also are known from 6000-7000 cal BC contexts in the Santa Barbara Channel (King 1990) and San Clemente Island (Salls 1988).

Shellfish were also more abundant at CA-SLO-2 due to the site's coastal setting. While a sample processed with 6 mm mesh from Cross Creek yielded only 845 g of shell/m<sup>3</sup>, the basal levels from CA-SLO-2 produced 129 kg/m<sup>3</sup> (6 mm mesh). The sample was dominated by open, rocky coast taxa common to the littoral habitats adjacent the site including California mussel (*Mytilus californianus*; 88.3%), turban snail (*Tegula funebris*; 5.2%), and red abalone (*Haliotis rufescens*; 2.1%).

### 1.3. Summary

The basal levels of the Cross Creek and Diablo Canyon sites represent largely contemporaneous occupations between ca. 8300-6500 cal BC. In the most recent literature, the larger, more cohesive artifact collection from Cross Creek has tended to overshadow the findings from Diablo Canyon. We suggest, however, that tool and faunal assemblages from these two sites should be considered together as a complex that collectively represents the terminal Pleistocene/early Holocene on the central California mainland. With respect to artifacts, the Diablo Canyon findings show that, in addition to the Millingstone inventory found at Cross Creek, this complex also includes

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pitted stones, simple bone awls, bi-pointed bone gorges, and possibly eccentric crescents (Figure 2). The pitted stones and gorges are related to marine resource acquisition/processing activities that simply did not take place inland at Cross Creek. Importantly, the fish bones and remains of the marine birds, particularly the flightless duck indicate that this technological complex also included some type of watercraft. Radiocarbon dates from the Channel Islands 125 km to the south indicate that people were using watercraft there ca. 11,700 years ago (Erlandson et al. 1996) so the use of boats at Diablo Canyon should come as no surprise.

In light of a recent discussions that emphasize the trapping of small- and medium-sized animals and the intensive processing of plant foods during the early Holocene in California (e.g. Hildebrandt and McGuire 2002; McGuire and Hildebrandt 1994; 2005), reconciling the variation in faunal remains between Cross Creek and Diablo Canyon is both challenging and important. While the Cross Creek tools and fauna are consistent with an adaptation focused on hunting/trapping of smaller animals and gathering of shellfish and plant foods, the Diablo Canyon fauna represent a different lifeway. The foraging populations who occupied Diablo Canyon at the onset of the Holocene exploited a broad range of terrestrial and marine resources. While they focused on deer, they also pursued marine birds on offshore rocks, collected mussels and abalone, and caught fish. They further relied on certain indeterminate plant resources although milling tools were considerably less abundant than at Cross Creek.

Turner (2003) objected to the use of the minor shellfish remains from Cross Creek to argue for a coastal migration route. The lifeway represented at Diablo Canyon, however, shows a greater use of marine resources including some exploited with watercraft. The Diablo Canyon people were by no means intensively maritime, but they pursued a broad-spectrum adaptation that included a decidedly marine component. The contrasting emphasis on terrestrial plant foods at Cross Creek must be at least partially related to the site's inland setting.

The relationship of the two sites to one another *vis-à-vis* systems of seasonality and settlement is also important with regard to overall conceptualizations of the foraging strategies that operated at this early time along the California coast. Seasonal indicators from Cross Creek suggest that the site was occupied on a nearly year-round basis (Jones et al. 2002:226) while the site's diverse tool assemblage further indicated that it functioned as a residential base from which foraging was undertaken within a radius of at least 9 km. The diversity of materials recovered from the basal component at Diablo Canyon also clearly indicates a residential function. While no isotopic or other seasonality data are available from CA-SLO-2, the diverse faunal assemblage suggests more than short-term seasonal occupation, perhaps even year-round site use. Indeed, while the inhabitants of Cross Creek and Diablo Canyon shared certain cultural traits and exploited the same habitats, the sites seem to mark spatially distinctive variants of a semi-permanent settlement system that featured extended use of individual residential bases. While populations probably fluctuated between coastal and interior long-term residential encampments, individual sites may well have been occupied for years at a time before they were abandoned. Given the exceptionally rich resource base present along the coast and the low populations that almost certainly were present at this time depth, frequent seasonal migrations were probably not necessary or optimal.

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## Discussion

The Cross Creek and Diablo Canyon sites have been used to support two different definitions of the California Paleo-Coastal Tradition. While the two sites indeed exhibit marked variation in their faunal and artifact assemblages, most of this variation seems related to differences in micro-habitat and is not the result of distinctive cultural origins or separate human populations. By 10,000 years ago, the central California coast was inhabited by related, inter-dependent populations with distinct settlement preferences: inland people who made regular forays to the coast but who specialized in exploitation of small game and vegetal resources and coastal inhabitants who exploited a wider range of marine and terrestrial resources. The overall complex representing this semi-permanent settlement strategy shows a combination of marine resource exploitation technologies (including watercraft), hunting weapons, and milling equipment with ecofactual residues that testify to a broad-spectrum adaptation with a distinctive marine component. The adaptation inferred from this complex seems even more likely to have originated from populations moving southward along the shores of the northeastern Pacific. The use of watercraft, in particular, can be more firmly established at Diablo Canyon than with the Cross Creek findings alone. Further, the large side-notched projectile points that highlight the Cross Creek-Diablo Canyon complex suggest typological connections along the north Pacific Rim as these specimens are very similar to stemmed points



found at Ushki Lake on the Kamchatka Peninsula dating ca. 11,000-11,500 cal BC (Goebel et al. 2003:Figure 4A). A stemmed unifacial flake tool from Cross Creek also resembles unifacial end scrapers from Ushki (Goebel et al. 2003:Figure 4L). Clearly, the Cross Creek-Diablo Canyon complex is younger than the Ushki finds, but it also does not represent the earliest coastal colonization of California either since radiocarbon dates from the Channel Islands and fluted projectile points from coastal and near coastal settings are older. Whether the Cross Creek-Diablo Canyon Complex represents a later colonization event or the outgrowth of earlier coastal adaptations remains to be determined. At present, however, this is still one of the earliest well-defined complexes on the California mainland.

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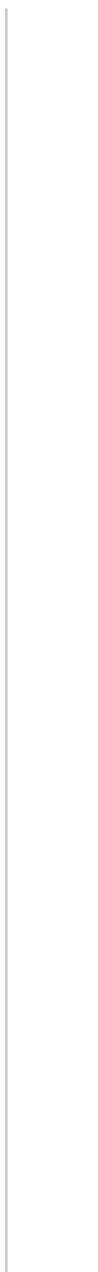
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## Notes

- 1 The skeleton identified as Arlington Woman by Johnson et al. (2002) has more recently been identified as a male.
- 2 Paleo-Coastal Tradition.
- 3 Calibrated with CALIB 4.3 and the southern California upwelling correction value of  $225 \pm 35$ . All other dates calibrated with the central California upwelling correction value of  $290 \pm 35$  following Ingram and Southon (1996).
- 4 Funding for dating and analysis of faunal remains from Diablo Canyon was provided by California Sea Grant R/CZ-187. Figure 1 was compiled by Brian Coddling, and Figure 2 by Rusty van Rossmann. We are grateful to Sarah Mellinger for assistance in compiling references.





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