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# Another Trans-Holocene Sequence from Diablo Canyon: New Faunal and Radiocarbon Findings from CA-SLO-585, San Luis Obispo County, California

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*Originally reported by Roberta Greenwood in 1972, CA-SLO-585 is one of two sites near Diablo Canyon on the coast of San Luis Obispo County in central California to produce early evidence for trans-Holocene occupation. New radiocarbon dates show that the site is marked by Early–Middle (7,000–3,400 cal. B.C.) and Late (1,000 cal. B.C. to historic contact) Holocene components, both representing residential bases. The Early–Middle Holocene (Milling Stone) component is dominated by the remains of black-tailed deer, cottontail rabbits, and sea otters, along with evidence of the extinct flightless duck. Fish remains show a reliance on rockfish and cabezon. While California mussel dominates the shell remains, modest quantities of estuarine clam and cockle remains support the existence of the Halcyon Bay paleo-estuary. The Late Holocene (Middle and Late Period) component shows the continued importance of deer, an increase in sea otters, and the disappearance of the flightless duck, all of which are comparable to CA-SLO-2, the other trans-Holocene site at Diablo Canyon. Fish remains and fishing artifacts are more abundant in the Late Holocene levels, suggesting a modicum of marine intensification. CA-SLO-585 has greater stratigraphic integrity than CA-SLO-2, where inter-component mixing was apparent. Nonetheless, it shows the same basic patterns, including a trans-Holocene reliance on deer. At a minimum, these findings suggest that deer populations were unevenly distributed in western North America during the Early–Middle Holocene and, where present, were consistently exploited.*

In 1972, Roberta Greenwood reported the results of extensive excavations at six prehistoric shell middens on the coast of southern San Luis Obispo County in central California. Investigated in anticipation of the construction of the Diablo Canyon nuclear power plant, two of the sites (CA-SLO-2 and CA-SLO-585) produced radiocarbon evidence for occupation as early as ca. 9,000 radiocarbon years B.P. that persisted through the Holocene. At the time that Greenwood's report appeared, the Diablo middens were among the oldest coastal sites in the New World, and while they escaped notice in some important syntheses of coastal prehistory during the 1970s (e.g., Osborn 1977), the evidence from CA-SLO-2 has been seminal in later reconsiderations of the importance of coastal resources and marine shorelines in North American prehistory (e.g., Erlandson 1988, 1991, 1994; Erlandson and Colten 1991; Jones 1991; Raab and Yatsko 1992). The findings from Diablo Canyon also contributed substantially to the definition of Moratto's (1984) Paleo-Coastal Tradition and the increased recognition and support for a likely coastal colonization route into the New World (Erlandson, Graham, et al. 2007; Erlandson, Rick, et al. 2007). Not surprisingly, a number of scholars have returned to the Diablo Canyon collections in recent years to re-analyze various constituents in light of theoretical and/or methodological advances made in the ensuing decades. Farqhuar (2003), for example, has re-analyzed flaked stone materials from CA-SLO-2, while Jones, Porcasi, Gaeta, et al. (2008) have recently reported new radiocarbon dates and faunal data from the same site. Stevens (n.d.) is currently re-evaluating that site's formal artifacts, and Roberta Greenwood herself discussed the importance of the Diablo findings in 2004.

Here we present new radiocarbon dates and faunal data from the other trans-Holocene site at Diablo Canyon, CA-SLO-585. Originally dated with four radiocarbon assays, a total of ten dates now documents

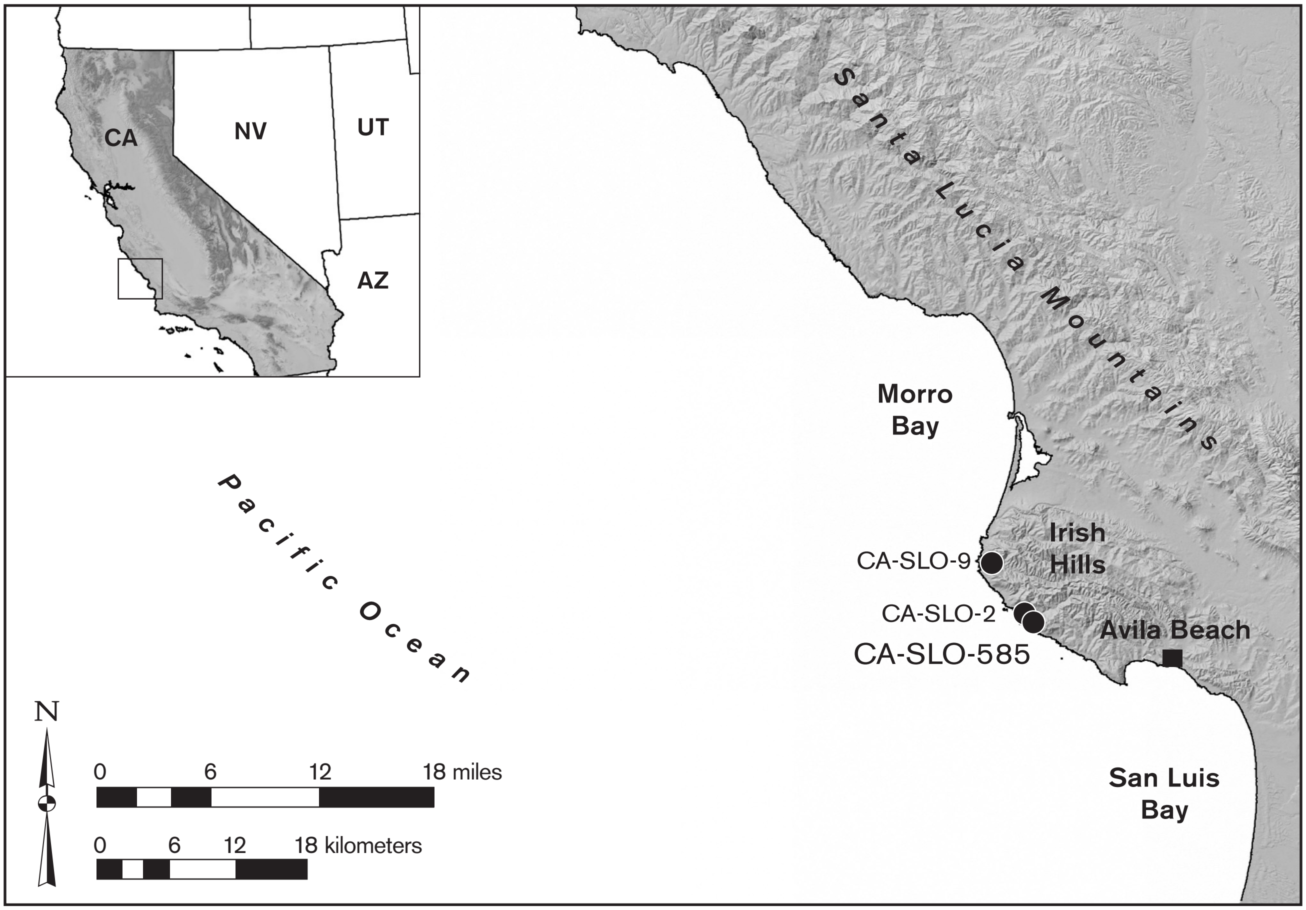

**Figure 1. Location of CA-SLO-585 and other sites mentioned in text.**

intermittent site use between 7,000 cal. B.C. and historic contact. This span of occupation can be divided into two broadly defined temporal components representing the Early–Middle (7,000–3,400 cal. B.C.) and Late (1,000 cal. B.C. to historic contact) Holocene. In contrast to CA-SLO-2, CA-SLO-585 shows little evidence for stratigraphic mixing between these components. The associated faunal assemblages show the same basic, broad-spectrum foraging strategy originally documented at CA-SLO-2 and subsequently described in more detail by Jones, Porcasi, Gaeta, et al. (2008). As also seen at CA-SLO-2, the remains of black-tailed deer (*Odocoileus hemionus*) dominate both temporal components, a trend that runs counter to recent generalizations about Early– Middle Holocene hunting strategies in California (e.g., a primary focus on small game [Hildebrandt and McGuire 2002]). While there are indeed many Early Holocene sites that exhibit a preference for rabbits over deer in California (see Lebow et al. 2007; Porcasi 2008), the Diablo Canyon sites are an exception to that pattern.

## SITE DESCRIPTION

The six sites investigated by Greenwood were located between Diablo Canyon and Pecho Creek on the exposed rocky coast of southern San Luis Obispo County, California (Fig. 1). CA-SLO-585, designated Site 6 by Greenwood, is situated 400 m. inland at an elevation of 52 m. (170 feet). Two discrete loci were investigated at Site 6: 6A and 6B. Locus 6B, on the western periphery of the project area, yielded very little cultural material, but a more substantial midden was encountered at Locus 6A, where Greenwood undertook extensive investigations. Only the findings from Locus 6A are considered here.

Excavation showed that the cultural deposit at CA-SLO-585 extended to a maximum depth of 250 cm. and was semi-stratified. The upper levels of the units at

Locus 6A (0-80 cm.) consisted of a dark midden with a high clay content and modest quantities of fragmented marine shell. Between 80 and 100 cm. below the surface was a dense, compacted layer of largely whole red abalone (*Haliotis rufescens*) shells. This layer was highly indurated, and could only be excavated with a pick and crow bar. Beneath the red abalone layer was a markedly different soil that extended from 110 to 250 cm. and was much more friable than the levels above it. It was also lighter in color and showed deposits of calcium carbonate. At the base of this lower midden, the natural substratum was a black clay with dispersed pockets of calcium carbonate precipitate.

## RECOVERY METHODS

As at CA-SLO-2, Greenwood employed a mixed recovery strategy that was designed to sample both artifacts and faunal remains effectively. A total of 11 units were excavated at Locus 6A, including ten 1 x 2 m. units processed dry with 6 mm. (1/4 inch) mesh and one 1 x 1 m. control column used to sample shell and small fish remains. A total of 39.4 m.$^3$ was excavated by hand. In addition, Greenwood employed a backhoe to excavate the site mechanically in order to recover more formal artifacts (particularly milling slabs and handstones, which were abundant in the site's lower depths). An additional 30.0 m.$^3$ of deposit were excavated mechanically for a total recovery volume of 69.4 m.$^3$. One human burial was found near the base of the lower midden deposit at 180–200 cm. The low frequency of burials contrasts significantly with CA-SLO-2, where a large number of interments caused intercomponent mixing of deposits (Jones, Porcasi, Gaeta, et al. 2008:294).

For the 1 x 1 m. control column, Greenwood dry-screened the deposit through 6 mm. mesh and collected all of the shell retained in the 6 mm. screen. All of the residues that passed through the 6 mm. mesh were also collected, bagged, and sent to the fish bone analyst, John Fitch. Greenwood reported the weight of all of the shell recovered from the control column and analyzed two levels to species. There is nothing in her report to suggest, however, that John Fitch completed the analysis of the fish remains from the column sample, and it is reasonable to assume that he exhausted all of his time and labor in the analysis of the column sample from CA-SLO-2, which took him over 900 hours to complete (Fitch 1972:102).

## RADIOCARBON FINDINGS AND SITE STRUCTURE

Greenwood (1972:4) obtained four radiocarbon dates from the lower levels (160–200 cm.) of CA-SLO-585. Calibrated, these dates range from 7,030 to 3,630 cal. B.C. (Table 1). Based on these findings and the vertical distribution of diagnostic artifacts, she further divided the occupation into three cultural components: a Milling Stone occupation in the basal levels of the deposit

**Table 1**

**RADIOCARBON DATES FOR CA-SLO-585**

| Unit | Specimen No. | Laboratory No. | Depth (cm.) | Shell species[a] | Conventional $^{14}$C Age (years B.P.) | Calibrated Age B.C./A.D. 1 sigma ($\Delta R = 290 \pm 35$)[b] |
|---|---|---|---|---|---|---|
| N11W6 | 1740A | Beta-197954 | 30–40 | *Mytilus californianus* | 1,000 ± 40 | A.D. 1530–1660 |
| N11W6 | 1743A | Beta-206361 | 40–50 | *Mytilus californianus* | 1,100 ± 40 | A.D. 1460–1530 |
| N14-W7 | 1777A | Beta-206362 | 60–70 | *Mytilus californianus* | 3,430 ± 40 | 1,030–900 B.C. |
| N14-W8 | 1806A | Beta-204127 | 80–90 | *Haliotis cracherodii* | 5,260 ± 40 | 3,380–3,320 B.C. |
| N10W1 | 1736A | Beta-197952 | 110–120 | *Saxidomus nuttalli* | 7,630 ± 40 | 5,900–5,780 B.C. |
| N14-W7 | – | GAK-02043 | 120–130 | *Haliotis rufescens* | 7,930 ± 240 | 6,396–5,896 B.C. |
| N8-W1 | – | GAK-02041 | 160 | *Haliotis rufescens* | 5,510 ± 180 | 3,799–3,465 B.C. |
| N14-W7 | – | GAK-02042 | 160–170 | *Haliotis rufescens* | 7,780 ± 220 | 6,215–5,761 B.C. |
| N12-W6 | – | GAK-02040 | 200 | *Haliotis rufescens* | 8,820 ± 260 | 7,461–6,852 B.C. |
| N11W6 | 1760A | Beta-197953 | 210–220 | *Mytilus californianus* | 8,470 ± 40 | 6,870–6,630 B.C. |

[a] All samples were single shells.

[b] Calibrated following Ingram and Southon (1996) using CALIB 4.3 (Stuiver and Reimer 2000).

(ca. 170–250 cm.) dating to ca. 7,000–3,600 cal. B.C., a Hunting Culture occupation in the middle levels beneath the red abalone layer (80–170 cm.) dating to post 3,600 cal. B.C., and a Late Period ("Cañalino") component above the abalone layer (0–80 cm.) dating approximately (without radiocarbon) to post cal. A.D. 500.

Six additional radiocarbon dates were obtained for the current investigation from samples collected in 1968. These generally support Greenwood's assessment of the distribution and age of the cultural components at CA-SLO-585, with some refinements. Dating of the middle-upper levels shows that the red abalone layer was indeed a reliable stratigraphic marker; all dates from below 79 cm. range between 7,030 and 3,350 cal. B.C., while three dates recovered from above the layer range from 970 cal. B.C. (60–70 cm.) to cal. A.D. 1620 (30–40 cm.). These dates also show an occupational hiatus of ca. 2,400 years between the deposition of the red abalone layer and the midden above it, which suggests at least a partial explanation for the survival of so many large whole shells in the layer—the shells were not immediately trampled upon by later site inhabitants. Dates from above the layer reflect occupation during both the Middle and Late cultural periods, which we consider in combination as a Late Holocene component.

Dates obtained from below the red abalone layer are not as well stratified as those from above it. Five dates from between 110 and 220 cm. cluster between 7,030 and 5,840 cal. B.C., and the two remaining dates reflect a Middle Holocene occupation ca. 3,630–3,350 cal. B.C., suggesting yet another occupational hiatus of ca. 2,400 years. However, one of these Middle Holocene dates was beneath (160 cm.) two of the older dates. Overall, the radiocarbon record suggests four intervals of intermittent occupation: 7,000–5,840 cal. B.C., 3,600–3,400 cal. B.C., 1,000 B.C., and cal. A.D. 1500–1650. However, the two earlier occupations are represented exclusively by materials from beneath the red abalone layer, and their combined dating correlates exceptionally well with the span of time associated with the Milling Stone culture on the central coast (8,000–3,500 cal. B.C.). The date of 3,500 cal. B.C. is important culturally in this region because it marks a strong transition from Milling Stone to the Hunting Culture, with assemblages showing increased frequencies of bifaces and projectile points after this juncture in time (Fitzgerald and Jones 1999; Greenwood 1972:4, 90; Jones 1993; Jones et al. 2002, 2007). At CA-SLO-585, this transition corresponds with an abandonment of the site after deposition of the red abalone layer, which is consistent with the patterning at nearby CA-SLO-2, where there is also a dearth of evidence for occupation during the Early Period between 3,000 and 1,000 cal. B.C. (Jones, Porcasi, Gaeta, et al. 2008:296). For this reason, we consider the lower levels of the deposit (80–250 cm.) to represent a single, undifferentiated Milling Stone component, dating from 7,000–3,400 cal. B.C. (which we refer to as Early–Middle Holocene), while the upper site levels (0–80 cm.) mark the Middle and Late periods (1,000 cal. B.C. to cal. A.D. 1700 or Late Holocene). An enhanced sample of radiocarbon dates would undoubtedly improve this characterization and shorten the hiatuses between occupations, but a division of the deposit into these two broadly defined components seems most appropriate in light of the currently available chronostratigraphic data. The recovery volume associated with the Early–Middle Holocene component from the hand excavation sample is 23.4 m.$^3$, while the Late Holocene component is represented by 16 m.$^3$.

## COMPONENT FUNCTION

Because any change in the character of site use over time could contribute to variation in faunal residues (Binford 1978, 1980), it is important to link interpretation of the CA-SLO-585 fauna with an evaluation of the site's role in regional settlement systems *vis-à-vis* an assessment of the function of components. Overall, the CA-SLO-585 tool assemblages show consistent diversity, marked by nearly identical Margalef Diversity Index scores (Table 2). More specifically, both temporal components yielded diverse arrays of ground stone (handstones, milling slabs, mortars, pestles, and pitted stones), bone awls, projectile points, scrapers, and debitage that reflect a wide range of domestic and subsistence activities. CA-SLO-585 clearly functioned as a residential base during both of its major periods of occupation, which is consistent with findings from CA-SLO-2, where Greenwood (1972) and Jones, Porcasi, Gaeta, et al. (2008) associated diverse tool assemblages with continuity in a broad spectrum foraging adaptation over time. Importantly, intercomponent variation in artifact assemblages is

**Table 2**

**ARTIFACT ASSEMBLAGES FROM CA-SLO-585**

| | Early–Middle Holocene 7,000–3,400 cal. B.C. | | Late Holocene 1,000 cal. B.C.–cal. A.D. 1700 | |
|---|---|---|---|---|
| Artifact | N | % | N | % |
| Milling slabs | 13 | 1.8 | 1 | 0.2 |
| Handstones | 47 | 6.5 | 2 | 0.4 |
| Mortars | 1 | 0.1 | 0 | 0.0 |
| Pestles | 3 | 0.4 | 6 | 1.1 |
| Pitted stones | 139 | 19.2 | 88 | 16.1 |
| Projectile points | 33 | 4.6 | 30 | 5.5 |
| Scrapers/flake tools | 359 | 49.6 | 317 | 57.9 |
| Choppers | 19 | 2.6 | 17 | 3.1 |
| Hammerstones | 45 | 6.2 | 19 | 3.5 |
| Shell fishhooks | 0 | 0.0 | 4 | 0.7 |
| Notched stones | 0 | 0.0 | 10 | 1.8 |
| Grooved stones | 3 | 0.4 | 2 | 0.4 |
| Tarring pebbles | 1 | 0.1 | 1 | 0.2 |
| Bone awls | 6 | 0.8 | 5 | 0.9 |
| Bone gorges | 2 | 0.3 | 0 | 0.0 |
| Shell beads | 53 | 7.3 | 45 | 8.2 |
| **Total** | **724** | **100.0** | **547** | **100.0** |
| Margalef Diversity Index* | 1.962 | | 2.063 | |

*Formula from Magurran (1988).

also consistent with the temporal ordering in regional culture histories (Jones et al. 2007). The Early–Middle Holocene component shows an abundance of milling slabs and handstones, as well as the site's only bone gorge fishhooks. No notched stones or circular shell fishhooks were recovered from the Early–Middle Holocene levels. These findings are consistent with most characterizations of Milling Stone assemblages that mark the 8,000–3,500 cal. B.C. period in the central coast region (Erlandson 1991, 1994; Fitzgerald and Jones 1999; Greenwood 1972; Jones et al. 2007; Wallace 1954, 1955). In contrast, the Late Holocene component produced very few milling slabs or handstones, but did yield four shell fishhooks and ten notched stones. The latter seem to be functionally linked (as sinkers) with hooks, and have been recovered exclusively from Late Holocene (late Middle and/or Middle-Late Transition Period) components in the region (Codding and Jones 2007). The addition of fishing implements of this type (hooks and notched stones) during the Late Holocene was also evident at CA-SLO-2 (Greenwood 1972; Jones, Porcasi, Gaeta, et al. 2008) where they were interpreted as evidence for a slight increase in fishing, but no major change in the overall character of site use over time.

## FAUNAL REMAINS

### *Analytical Methods*

The faunal remains from CA-SLO-585 were curated by Roberta Greenwood at the San Luis Obispo County Archaeological Society Collection Facility after she completed her report in 1972. The collection, borrowed from the facility in 2004, included all bird, mammal, reptile, and fish remains recovered from the 1 x 2 m. units processed with 6 mm. mesh. Faunal identifications were made through a direct comparison with museum-curated specimens. For birds, mammals, and reptiles, reference collections from the Los Angeles County Museum of Natural History and the Zooarchaeology Laboratory at the Cotsen Institute of Archaeology at University of California, Los Angeles were used, while reference materials on file at the Department of Biology, California State University, Bakersfield, were used for fish remains. All specimens were identified to the most discrete taxonomic level possible based on diagnostic features. In the absence of such features, unidentifiable bones were assigned to classes (i.e., Mammal, Aves, etc.), and (for birds and mammals) to size categories (small, medium, or large). In addition, the element, part of element, side, age, number, weight, and evidence of modification (i.e., burned, gnawed, cut, or worked) were—to the greatest degree possible—recorded for each specimen. For fish remains, only the element and its weight were recorded.

### *Birds and Mammals*

Altogether, 876 bird, mammal, and reptile specimens weighing 1388.68 g. were identified (Tables 3–5). As is typical of most sites in central California, specimens were highly fragmented, and the majority could not be identified to the genus level. This total includes the remains of several small burrowing animals, including Botta's pocket gopher (*Thomomys bottae*) and the California ground squirrel (*Spermophilus beecheyi*). Eliminating these possibly intrusive elements, as well as other rodents and reptiles and a single historically-introduced specimen of cow/steer (*Bos taurus*), and

## Table 3

### SUMMARY OF BIRD AND MAMMAL REMAINS FROM CA-SLO-585*

| | | Early – Middle Holocene | | | Late Holocene | | |
|---|---|---|---|---|---|---|---|
| **Taxon** | **Common name** | **NISP** | **% NISP** | **Weight (g.)** | **NISP** | **% NISP** | **Weight (g.)** |
| Anseridae | Goose | 1 | 0.18 | 0.76 | 0 | 0.00 | 0.00 |
| *Arctocephalus townsendi* | Southern fur seal | 1 | 0.18 | 30.27 | 0 | 0.00 | 0.00 |
| Artiodactyl | Deer | 29 | 5.30 | 64.07 | 15 | 4.64 | 26.57 |
| Aves | Bird | 69 | 12.70 | 36.15 | 29 | 8.98 | 17.94 |
| Aves, large | Large bird | 7 | 1.29 | 6.39 | 0 | 0.00 | 0.00 |
| Aves | Raptor | 0 | 0.00 | 0.00 | 1 | 0.31 | 0.30 |
| *Canis* sp. | Coyote/Dog | 2 | 0.37 | 2.79 | 4 | 1.24 | 4.01 |
| Carnivora | Carnivore | 2 | 0.37 | 0.50 | 1 | 0.31 | 1.16 |
| *Chendytes lawi* | Flightless duck | 17 | 3.13 | 36.66 | 0 | 0.00 | 0.00 |
| Delphinidae | Dolphin/porpoise | 1 | 0.18 | 1.02 | 0 | 0.00 | 0.00 |
| *Enhydra lutris* | Sea otter | 13 | 22.39 | 43.31 | 17 | 5.26 | 122.18 |
| Gavidae | Loon | 1 | 0.18 | 2.51 | 1 | 0.31 | 0.67 |
| *Lepus californicus* | Jack rabbit | 1 | 0.18 | 0.19 | 0 | 0.00 | 0.00 |
| *Lynx rufus* | Bobcat | 1 | 0.18 | 3.65 | 0 | 0.00 | 0.00 |
| Mammal | | 96 | 17.60 | 41.58 | 80 | 24.77 | 31.09 |
| Mammal, large | | 136 | 25.00 | 172.45 | 68 | 21.10 | 70.23 |
| Mammal, large marine | | 4 | 0.74 | 8.50 | 9 | 2.79 | 17.36 |
| Mammal, medium | | 19 | 3.50 | 12.46 | 9 | 2.79 | 7.49 |
| Mammal, medium/large | | 1 | 0.18 | 1.14 | 8 | 2.48 | 5.30 |
| Mammal, medium/small | | 2 | 0.37 | 1.37 | 1 | 0.31 | 0.25 |
| Mammal, small | | 17 | 3.13 | 5.47 | 16 | 4.95 | 4.11 |
| *Mephitis mephitis* | Striped skunk | 0 | 0.00 | 0.00 | 1 | 0.31 | 1.61 |
| *Microtus* sp. | Vole | 1 | 0.18 | 0.04 | 0 | 0.00 | 0.00 |
| *Odocoileus hemionus* | Black-tailed deer | 30 | 5.50 | 141.65 | 16 | 4.95 | 111.72 |
| Otariidae | Earred seal | 11 | 2.00 | 86.15 | 2 | 0.62 | 6.35 |
| *Phalacrocorax* sp. | Cormorant | 4 | 0.74 | 6.00 | 6 | 1.86 | 10.03 |
| *Phoca vitulina* | Harbor seal | 8 | 1.47 | 88.25 | 7 | 2.17 | 49.02 |
| Pinnipedia | Pinniped | 6 | 1.10 | 13.77 | 4 | 1.24 | 17.82 |
| *Pituophis* sp. | Gopher snake | 2 | 0.37 | 0.29 | 0 | 0.00 | 0.00 |
| Procellariidae | Shearwater/fulmar | 1 | 0.18 | 1.37 | 0 | 0.00 | 0.00 |
| *Puffinus griseus* | Sooty shearwater | 5 | 0.92 | 5.09 | 0 | 0.00 | 0.00 |
| Rodentia | Rodent | 6 | 1.10 | 0.68 | 3 | 0.93 | 0.21 |
| Serpentes | Snake | 1 | 0.18 | 0.08 | 0 | 0.00 | 0.00 |
| *Spermophilus beecheyi* | Calif.ground squirrel | 4 | 0.74 | 1.45 | 5 | 1.55 | 1.14 |
| *Sylvilagus audubonii* | Cottontail rabbit | 20 | 3.68 | 5.39 | 4 | 1.24 | 1.37 |
| *Taxidea taxus* | Badger | 0 | 0.00 | 0.00 | 1 | 0.31 | 1.57 |
| *Thomomys bottae* | Pocket gopher | 21 | 3.86 | 3.91 | 11 | 3.41 | 1.38 |
| *Uria aalge* | Common murre | 1 | 0.18 | 1.39 | 4 | 1.24 | 2.93 |
| Ursidae | Bear | 1 | 0.18 | 9.50 | 0 | 0.00 | 0.00 |
| *Zalophus californianus* | California sea lion | 2 | 0.37 | 14.71 | 0 | 0.00 | 0.00 |
| **Total** | | **544** | **99.99** | **850.96** | **323** | **99.99** | **513.81** |

*Unidentified vertebrate and specimens with mixed proveniences are excluded

## Table 4

### ECONOMICALLY SIGNIFICANT BIRD AND MAMMAL REMAINS FROM CA-SLO-585 IDENTIFIED TO THE GENUS LEVEL OR BETTER

| | | Early – Middle Holocene | | | Late Holocene | | |
|---|---|---|---|---|---|---|---|
| Taxon | Common name | NISP | % NISP | Weight (g.) | NISP | % NISP | Weight (g.) |
| **TERRESTRIAL MAMMALS** | | | | | | | |
| *Canis* spp. | Dog/coyote | 2 | 1.90 | 2.79 | 4 | 6.67 | 4.01 |
| *Lepus californicus* | Jack rabbit | 1 | 0.95 | 0.19 | 0 | 0.00 | 0.00 |
| *Lynx rufus* | Bobcat | 1 | 0.95 | 3.65 | 0 | 0.00 | 0.00 |
| *Mephitis mephitis* | Striped skunk | 0 | 0.00 | 0.00 | 1 | 1.67 | 1.61 |
| *Odocoileus hemionus* | Black-tailed deer | 30 | 28.60 | 141.65 | 16 | 26.67 | 111.72 |
| *Syvilagus* sp. | Cottontail rabbit | 20 | 19.00 | 5.39 | 4 | 6.67 | 1.37 |
| *Taxidea taxus* | Badger | 0 | 0.00 | 0.00 | 1 | 1.67 | 1.57 |
| **Subtotal** | | **54** | **51.40** | **153.67** | **26** | **43.35** | **120.28** |
| **MARINE MAMMALS** | | | | | | | |
| *Arctocephalus townsendi* | Guadalupe fur seal | 1 | 0.95 | 30.27 | 0 | 0.00 | 0.00 |
| *Enhydra lutris* | Sea otter | 13 | 12.40 | 43.31 | 17 | 28.30 | 122.18 |
| *Phoca vitulina* | Harbor seal | 8 | 7.62 | 88.25 | 7 | 11.67 | 49.02 |
| *Zalophus californianus* | California sea lion | 2 | 1.90 | 14.71 | 0 | 0.00 | 0.00 |
| **Subtotal** | | **24** | **22.87** | **176.54** | **24** | **39.97** | **171.20** |
| **MARINE BIRDS** | | | | | | | |
| *Chendytes lawi* | Flightless duck | 17 | | | 0 | 0.0 | 0.00 |
| *Phalacrocorax* sp | Cormorant | 4 | 3.81 | 6.00 | 6 | 10.00 | 10.30 |
| *Puffinus griseus* | Sooty shearwater | 5 | 4.76 | 5.09 | 0 | 0.00 | 0.00 |
| *Uria aalge* | Common murre | 1 | 0.95 | 1.39 | 4 | 6.67 | 2.93 |
| **Subtotal** | | **27** | **25.72** | **49.14** | **10** | **16.67** | **12.96** |
| **Grand total** | | **105** | **99.99** | **379.35** | **60** | **99.99** | **304.44** |

## Table 5

### ECONOMICALLY SIGNIFICANT BIRD AND MAMMAL REMAINS (NISP) FROM CA-SLO-585 IDENTIFIED TO THE GENUS LEVEL OR BETTER BY DEPTH (CM.)

| Taxon | 0–20 | 20–40 | 40–60 | 60–80 | 80–100 | 100–120 | 120–140 | 140–160 | 160–180 | 180–200 | 200–220 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Canis latrans* | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 6 |
| *Lepus californicus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| *Lynx rufus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| *Mephitis mephitis* | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Odocoileus hemionus* | 1 | 2 | 7 | 6 | 11 | 6 | 3 | 4 | 4 | 1 | 1 | 46 |
| *Syvilagus* sp. | 0 | 0 | 2 | 2 | 1 | 4 | 0 | 2 | 4 | 4 | 5 | 24 |
| *Taxidea taxus* | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Arctocephalus townsendi* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| *Enhydra lutris* | 0 | 3 | 9 | 5 | 7 | 3 | 0 | 0 | 1 | 0 | 2 | 30 |
| *Phoca vitulina* | 0 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 0 | 0 | 0 | 15 |
| *Zalophus californianus* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| *Chendytes lawi* | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 1 | 5 | 4 | 2 | 17 |
| *Phalacrocorax* sp. | 0 | 1 | 1 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 10 |
| *Puffinus griseus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 5 |
| *Uria aalge* | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 5 |
| **Total** | **1** | **10** | **29** | **20** | **23** | **21** | **6** | **12** | **20** | **11** | **12** | **165** |

further restricting analysis to specimens identified to the genus level or better, the sample includes 165 NISP (Table 4), representing seven terrestrial mammals, four marine mammals, and four marine birds, including *Chendytes lawi*, the extinct flightless sea duck. With the exception of six unidentified vertebrate specimens, all other specimens were identified to the family or class level. Admittedly, this sample is small, particularly in comparison with CA-SLO-2, but its value lies in the relative stratigraphic integrity of the recovery context. Overall, the collection is dominated by the remains of black-tailed deer (NISP=46; 27%), sea otters (*Enhydra lutris*, NISP=30; 17.6%), and cottontail rabbits (*Sylvilagus* sp.; NISP=24; 14%) which were also the dominant taxa at CA-SLO-2.

The Early–Middle Holocene component (NISP=105) showed a preponderance of black-tailed deer (NISP=30; 28.6%), sea otters (NISP=13; 12.4%) and cottontail rabbits (NISP=20; 19%). Seventeen bones represent the extinct flightless duck. Remains of terrestrial animals (NISP=54; 51.4%) outnumber marine species (NISP=24; 22.87%). The Late Holocene component (NISP=60) is nearly identical and is also dominated by black-tailed deer (NISP=16; 26.7%) and sea otters (NISP=17; 28.3%), followed by *Canis* sp. (dog/coyote) and cottontail rabbit, each represented by four NISP (6.7%) in this component. A more fine-grained reading of the vertical distribution of bird and mammal remains (Table 5) shows an increase in rabbit bones in the lower levels of the deposit (160–220 cm.), but the number of specimens still falls far short of the more than 1,000 rabbit bones at CA-SBA-530, only 50 km. to the south at Vandenberg Air Force Base (Lebow et al. 2007). Overall, at CA-SLO-585 deer comprised the most important taxon throughout the site's occupation, remaining nearly constant in relative abundance. Sea otters increased in relative importance through time, while the absence of bones of the flightless duck in the later component is consistent with the species being rendered extinct ca. 1,000 cal. B.C. (Jones, Porcasi, Erlandson, et al. 2008). Other marine mammals and birds were insignificant in the overall assemblage and showed no change. The dominance of deer in the Early–Middle Holocene corroborates the pattern at CA-SLO-2, which was seen as one of the few cases in California where a component of this age was dominated by a large game species.

### *Fish*

Altogether 875 fish bones were identified from the 6 mm. sample, 514 of them to the family level or better (Table 6). Among the 15 taxonomic classes represented

**Table 6**

**SUMMARY OF FISH REMAINS FROM CA-SLO-585**

| | | Early – Middle Holocene | | | Late Holocene | | |
|---|---|---|---|---|---|---|---|
| Taxon | Common name | NISP | % NISP | Weight (g.) | NISP | % NISP | Weight (g.) |
| Elasmobranchiomorphi | Sharks, skates, rays | 0 | 0.00 | 0.00 | 1 | 0.15 | 0.64 |
| Carcharhinidae | Requiem sharks | 2 | 0.86 | 0.54 | 0 | 0.00 | 0.00 |
| *Rhinobatis productus* | Shovelnose guitarfish | 0 | 0.00 | 0.00 | 1 | 0.15 | 0.54 |
| *Myliobatis californica* | Bat ray | 0 | 0.00 | 0.00 | 1 | 0.15 | 0.09 |
| *Merluccius productus* | Pacific hake | 1 | 0.43 | 0.18 | 0 | 0.00 | 0.00 |
| *Sebastes* sp. | Rockfishes | 54 | 23.28 | 12.68 | 175 | 26.88 | 37.47 |
| Hexagrammidae | Greenlings | 0 | 0.00 | 0.00 | 1 | 0.15 | 0.07 |
| *Hexagrammos* sp. | Kelp or rock greenling | 1 | 0.43 | 0.08 | 5 | 0.77 | 0.4 |
| *Ophiodon elongatus* | Lingcod | 8 | 3.45 | 1.82 | 8 | 1.23 | 2.68 |
| *Scorpaenichthys marmoratus* | Cabezon | 69 | 29.74 | 19.79 | 123 | 18.89 | 38.45 |
| Embiotocidae | Surfperches | 18 | 7.76 | 2.02 | 16 | 2.46 | 3.56 |
| Stichaeidae | Pricklebacks | 6 | 2.59 | 0.99 | 9 | 1.38 | 1.44 |
| *Cebidichthys violaceus* | Monkeyface prickleback | 0 | 0.00 | 0.00 | 4 | 0.61 | 0.68 |
| *Xiphister* sp. | Rock or kelp prickleback | 1 | 0.43 | 0.09 | 9 | 1.38 | 1.06 |
| Pleuronectiformes | Left or righteyed flounders | 0 | 0.00 | 0.00 | 1 | 0.15 | 0.25 |
| Actinopterygii | Ray finned fish | 69 | 29.74 | 8.86 | 292 | 44.85 | 33.95 |
| **Total** | | **229** | **100.00** | **47.05** | **646** | **100.00** | **121.28** |

in the identifiable sample, the remains of rockfish (*Sebastes* sp.; NISP=229) and cabezon (*Scorpaenichthys marmoratus*; NISP=192) were most abundant, both of which are common in the kelp beds and rocky areas along the Diablo coast today. These two taxa also dominate both temporal components by considerable margins. The density of fish bone/m.$^3$ in the midden shows an increase across the two components, with only 9.8 bones/m.$^3$ in the Early–Middle Holocene versus 40.3 bones/m.$^3$ in the Late Holocene component. Of course, it is important to reiterate that this sample is limited to materials recovered from a 6 mm. mesh; a smaller mesh would have undoubtedly produced more remains and taxa. Nonetheless, this does not imply that the dominant taxa would be different if a smaller mesh had been employed. Material recovered from CA-SLO-9, a similar site on the rocky coast ca. 11 km. north of CA-SLO-585, were dominated by the same two species, and recovery techniques there were almost exclusively limited to 3 mm. mesh (Codding and Jones 2007).

### *Shellfish*

Greenwood (1972:67–68) reported a sample of shell data from the 1 x 1 m. control column, including the weight of all shell recovered from the column (Table 7), and the percentages of species identified in two excavation levels, 30-40 and 170-180 cm., based on an approximately 50% sample of shell from each of these two levels. Applying the species percentages from the 50% samples to the total shell weights allows for an extrapolation of the full representation of each taxon in the two analyzed levels (Table 8). Both levels were dominated by the remains of species common to the high energy, exposed rocky habitats found near Diablo Canyon today. These included California mussels (*Mytilus californianus*), turban snails (*Tegula* spp.), abalone (*Haliotis* spp.), and limpets (*Collisella* spp.). Mussels were the dominant taxon in both the Early–Middle (56.9%) and Late (62.1%) Holocene components, which is typical for the Diablo area and most of the central coast region in general. At CA-SLO-2, for example, mussels accounted for over 70% of the shell assemblages through the Holocene. The second most abundant shellfishes at CA-SLO-585 were turban snails, with three species (*T. funebralis*, *T. brunnea*, and *T. montereyi*) together accounting for 28.8% of the Early–Middle Holocene component and 22.1% of the Late Holocene component. While there can be little doubt that these small snails required more labor to process than many other mollusks (Jones and Fearneau 2002; Raab 1992), they occur in significant proportions at a number of locations along the central coast, particularly in the San Simeon area (Joslin 2006; Rudolph 1985). This is clearly a reflection of habitat variability, as certain areas apparently supported dense populations of these snails (Joslin 2006), a fact which would have facilitated more efficient bulk processing. At CA-SLO-2, an increase in turban snails through the Holocene is seen as modest evidence for economic intensification (Jones, Porcasi, Gaeta, et al. 2008), but no such pattern is evident at CA-SLO-585.

**Table 7**

**SHELL WEIGHTS FROM 1 X 1 M. CONTROL COLUMN FROM CA-SLO-585 (6 mm. mesh) (from Greenwood 1972:68)**

| Depth (cm.) | Shell Weight (g.) |
|---|---|
| 0–10 | 350.0 |
| 10–20 | 1,700.0 |
| 20–30 | 2,100.0 |
| 30–40 | 5,726.9 |
| 40–50 | 4,525.0 |
| 50–60 | 4,300.0 |
| 60–70 | 6,400.0 |
| 70–80 | 14,200.0 |
| **Subtotal** | **39,301.9** |
| 80–90 | 41,950.0 |
| 90–100 | 23,606.0 |
| 100–110 | 7,900.0 |
| 110–120 | 9,100.0 |
| 120–130 | 11,650.0 |
| 130–140 | 8,450.0 |
| 140–150 | 16,750.0 |
| 150–160 | 10,500.0 |
| 160–170 | 10,500.0 |
| 170–180 | 11,980.0 |
| 180–190 | 7,400.0 |
| 190–200 | 520.0 |
| **Subtotal** | **160,306.0** |
| **Grand total** | **199,607.9** |

*Includes 19,800 g. of *Haliotis rufescens*
** Includes 6,706 g. of *Haliotis rufescens*

Greenwood's shellfish data also show an exceptionally high frequency of red abalone in two levels (80–100 cm.) associated with the red abalone layer

### Table 8

**MOLLUSCAN SPECIES FROM CA-SLO-585 BY COMPONENT (from Greenwood 1972:68)**

| | | Early – Middle Holocene )170–180 cm.) | | Late Holocene (30–40 cm.) | |
|---|---|---|---|---|---|
| **Taxon** | **Common name** | **%** | **Shell weight (g.)** | **%** | **Shell weight (g.)** |
| *Mytilus californianus* | California sea mussel | 56.9 | 6,816.6 | 62.1 | 3,556.4 |
| *Tegula funebralis* | Black turban snail | 23.8 | 2,851.2 | 20.5 | 1,174.0 |
| *Haliotis rufescens* | Red abalone | 1.4 | 167.7 | 4.4 | 251.9 |
| *Haliotis cracherodii* | Black abalone | 0.0 | 0.0 | 2.2 | 126.0 |
| *Protothaca staminea* | Littleneck clam | 6.5 | 778.7 | 0.7 | 40.1 |
| *Tegula brunnea* | Brown turban snail | 4.8 | 575.0 | 1.6 | 91.6 |
| *Balanus* sp. | Barnacle | 1.6 | 191.7 | 1.8 | 103.1 |
| *Brachyura* sp. | Crab | 1.6 | 191.7 | 2.0 | 114.5 |
| *Mopalia muscosa* | Mossy chiton | 0.5 | 59.9 | 1.7 | 97.4 |
| *Cryptochiton stelleri* | Gumboot chiton | 0.5 | 59.9 | 0.7 | 40.1 |
| *Tivela stultorum* | Pismo clam | 0.4 | 47.9 | 0.1 | 5.7 |
| *Lottia gigantea* | Owl limpet | 0.2 | 23.9 | 0.3 | 17.2 |
| *Saxidomus nuttalli* | Washington clam | 0.1 | 11.9 | 0.0 | 0.0 |
| *Tresus nuttalli* | Gaper clam | 0.2 | 23.9 | 0.0 | 0.0 |
| *Olivella biplicata* | Olive snail | T | T | 0.0 | 0.0 |
| *Pollicipes polymerus* | Leaf barnacle | 0.5 | 59.9 | 0.8 | 45.8 |
| *Astrea gibberosa* | Red top snail | 0.0 | T | 0.2 | 11.4 |
| *Crepidula adunca* | Hooked slippersnail | 0.1 | 11.9 | T | T |
| *Crepidula coei** | | T | T | T | T |
| *Tegula montereyi* | Monterey turban snail | 0.2 | 23.9 | T | T |
| *Diodora aspera* | Rough keyhole limpet | 0.0 | T | T | T |
| *Strongylocentrotus purpuratus* | Purple sea urchin | T | T | 0.1 | 5.7 |
| *Katharina tunicata* | Katy chiton | T | T | 0.1 | 5.7 |
| *Stenoplax heathiana* | Heath's chiton | T | T | 0.1 | 5.7 |
| *Mopalia lignosa* | Woody or lined chiton | T | T | 0.0 | 0.0 |
| *Ocenebra circumtexta* | Circled rock snail | T | T | 0.1 | 5.7 |
| *Thais canaliculata*** | Channeled dogwinkle | T | T | T | T |
| *Collisella* spp. | Limpets | T | T | T | T |
| *Sanguinolaria nuttalli* | Purple clam | 0.2 | 23.9 | 0.0 | 0.0 |
| *Trachycardium quadragenarium* | Spiny prickly cockle | T | T | 0.0 | 0.0 |
| *Clinocardium nuttalli* | Nuttall's cockle | T | T | 0.0 | 0.0 |
| *Pseudochama exogyra* | Pacific jewel box | 0.1 | 11.9 | 0.0 | 0.0 |
| Unidentifiable | | 0.3 | 35.9 | 0.3 | 17.2 |
| **Total** | | **99.9** | **11,967.4** | **99.8** | **5,715.2** |

*Now *Crepidula incurve*
** Now *Nucella canaliculata*

(Table 7). Unfortunately, no red abalone shell specimens from the layer were available for radiocarbon dating when we borrowed the collection in 2004. Other radiocarbon dates indicate that red abalone was harvested between ca. 7,400 and 3,500 cal. B.C. (Table 1). Midden finds show red abalone fragments in both the Early–Middle and Late Holocene, with slightly more in the latter (Table 8).

Greenwood (1972:67) also noted small quantities of the remains of estuarine clams and cockles at CA-SLO-585, including gaper clam (*Tresus nuttalli*), Washington clam (*Saxidomus nuttalli*), and Nuttall's cockle (*Clinocardium nuttalli*), which she attributed to long-distance foraging trips made to Morro Bay, 15 km. to the north. However, in recent decades, shellfish and other findings from the Pismo Beach/Avila area to the south indicate that a substantial paleo-estuary was present there during the Early–Middle Holocene (Dills 1977; Jones et al. 2002). The exact location and configuration of the so-called "Halcyon Bay" have not been established, but the occurrence of oysters and estuarine clams that have been observed in substantial quantities in middens indicates that the paleo-estuary extended to the vicinity of Avila Beach and would have been considerably closer for the inhabitants of CA-SLO-585 (9 km.) than Morro Bay. All of these estuarine taxa are absent from the Late Holocene component at CA-SLO-585, which is consistent with estimates that most of Halcyon Bay was drowned by sea level rise by ca. 1,000 cal. B.C. (Jones et al. 2002:223).

The density of shell/m.$^3$ was considerably higher for the Early–Middle Holocene (133.6 kg./m.$^3$) than the Late Holocene component (49.1 kg./m.$^3$), although the highest shell density was in the red abalone levels (80–100 cm.), which yielded 327.8 kg./m.$^3$. This suggests that shellfish were of greater dietary importance to Early–Middle Holocene foragers than Late Holocene people, a fact which has been demonstrated repeatedly in California (e.g., Erlandson 1994; Erlandson et al. 2005; Jones 1992, 2003; Porcasi 2008).

## SUMMMARY AND DISCUSSION

Data from Diablo Canyon have been important both historically and more recently in documenting the antiquity of and trans-Holocene variation in marine resource use in California. Most salient have been the findings from CA-SLO-2, which produced exceptionally robust artifact, faunal, and mortuary assemblages that illuminate a broad-spectrum Early–Middle Holocene coastline adaptation incorporating nearshore marine and terrestrial resources (Jones, Porcasi, Gaeta, et al. 2008). Deer were an important part of the initial adaptation represented at CA-SLO-2, and they remained a dietary staple through the Holocene. The site also revealed modest evidence for resource intensification in the form of an increased exploitation of sea otters, fish, and abalone concomitant with a decline in the remains of the flightless duck (*Chendytes lawi*), which was hunted into extinction by ca. 1,000–500 cal. B.C. The presence of superimposed burial populations at CA-SLO-2 provided rare empirical evidence for population growth through the Holocene, but the interments also created some intercomponent mixing (Jones, Porcasi, Gaeta, et al. 2008).

Data from CA-SLO-585 corroborate many of the patterns observed at CA-SLO-2, but without the mortuary assemblages and their associated problems. Like the Milling Stone occupations (8,300–3,000 cal. B.C.) at CA-SLO-2, the Early–Middle Holocene component at CA-SLO-585 is dominated by black-tailed deer, cottontail rabbits, and sea otters, with numerous bones from the extinct flightless duck. Fish remains show a reliance on rockfish and cabezon, and shell remains are dominated by mussels. Modest quantities of estuarine clam and cockle remains provide support for the existence of the Halcyon Bay paleo-estuary. The Late Holocene component at CA-SLO-585 shows the continued importance of deer, an increase in sea otters, and the disappearance of the flightless duck, all of which are comparable to CA-SLO-2. As at CA-SLO-2, fish remains and fishing artifacts are more abundant in the Late Holocene levels, suggesting a modicum of marine intensification, albeit nothing like the intensified fishing in the Santa Barbara Channel during the Middle-Late and Late periods (e.g., Arnold 1992; Erlandson and Rick 2002; Kennett 2005:189–191; Rick 2007).

Overall, the findings from CA-SLO-585 corroborate the Early–Middle Holocene and diachronic patterns revealed at CA-SLO-2, indicating that patterns at the latter site were not wholly compromised by a mixing due to burials. Together, the two sites provide important insights into the adaptations of Early–Middle Holocene inhabitants of the central California coast, and illuminate a relatively muted subsistence intensification across the Holocene. Importantly, the Diablo sites contrast with many other Early Holocene sites in California that show a heavy focus on the exploitation of rabbits (Hildebrandt and McGuire 2002). The dominance of deer remains in the Milling Stone components at CA-SLO-2 and CA-SLO-585 suggests that hunters in the Diablo area pursued deer more heavily than rabbits during the Early–Middle Holocene. This does not necessarily negate Hildebrandt and McGuire's (2002) hypothesis that rabbit hunting was an optimal subsistence pursuit for male hunters, but it does suggest that deer populations may have been unevenly distributed across western North America during the Early Holocene, and that they were consistently exploited where present.

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