Natural Resources, Geomorphology, and Archaeology of Site CA-SMA-113 in Quiroste Valley Cultural Preserve, California

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Abstract Interpreting archaeological and paleoecological data with respect to indigenous landscape management practices requires a framework describing the natural resources, history of landscape development, and lifeways in the area under study. With frequent anthropogenic burning, we predict that the landscape around Quiroste Valley would have supported a varied and reliable mixture of plant and animal resources, and people living there would have had access to seasonal resources in different vegetation communities throughout much of the year. Geomorphological research indicates that the Quiroste Valley floor developed during the Holocene and has been stable for the last several thousand years. Results of archaeological research at site CA-SMA-113 suggest that inhabitants consumed a wide range of biotic resources and occupied the site during most of the year. They participated in regional economies by trading the raw materials for shell bead manufacture and possibly Monterey chert. Results of archaeological research at CA-SMA-113 are consistent with cultural developments reported at other local sites in the late Holocene (ca. AD 1000–1775).

Resumen La interpretación de los datos arqueológicos y paleoecológicos con respecto a las prácticas de gestión del paisaje indígena requiere un marco describiendo los recursos naturales, la historia del desarrollo del paisaje, y los modos de vida en el área de estudio. Con la quema antropogénica frecuente,

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predecimos que el paisaje alrededor del valle Quiroste habría sostenido una mezcla variada y fiable de recursos vegetales y animales, y las personas que viven allí habría tenido acceso a los recursos estacionales en diferentes comunidades de vegetación en la mayor parte del año. La investigación geomorfológica indica que el piso del valle Quiroste desarrolló durante el Holoceno y se ha mantenido estable durante los últimos miles de años. Los resultados de la investigación arqueológica en el sitio de CA-SMA-113 sugieren que los habitantes consumieron una amplia gama de recursos bióticos y ocuparon el sitio durante la mayor parte del año. Los habitantes participaron en las economías regionales por el intercambio de materias primas para la fabricación de cuentas de concha y posiblemente sílex Monterey. Los resultados de la investigación arqueológica en CA-SMA-113 son compatibles con los desarrollos culturales reportados en otros sitios en el Holoceno Tardío (ca. 1000–1775 d.C.).

Our research team's eco-archaeological research in Quiroste Valley sought to reconstruct the history of natural landscape development and resource uses by indigenous people and to relate these topics to landscape management practices such as anthropogenic burning (Lightfoot and Lopez, this issue). This article contextualizes other analytical results presented in this issue by providing information about natural resources in the Quiroste Valley research area and an overview of the geomorphological history of the valley. We also describe the low-impact archaeological methods employed to investigate site CA-SMA-113 and the artifacts, features, and ecofacts recovered during the 2007–2009 excavations. Finally, we briefly discuss archaeological findings from CA-SMA-113 in relation to broader cultural developments on the central Coast described by Hylkema and Cuthrell (this issue).

Environment and Natural Resources in the Quiroste Valley Area

Quiroste Valley, located in the Whitehouse Creek watershed about 2 km from the Pacific coast (Figure 1), is encircled by hills that rise 30 to 60 m above the valley floor and provide protection from brisk coastal winds. From site CA-SMA-113 on the valley floor, people would have been able to efficiently access a wide range of abiotic and biotic resources in different micro-environmental zones. The coastline within 10 km of the valley has a mix of both sandy bottom and rocky intertidal areas, producing olivella shells (*Olivella biplicata*), small schooling fishes, marine invertebrates, sea mammals, and intertidal fishes. About 5 km south of Quiroste Valley, an outcrop of the Monterey

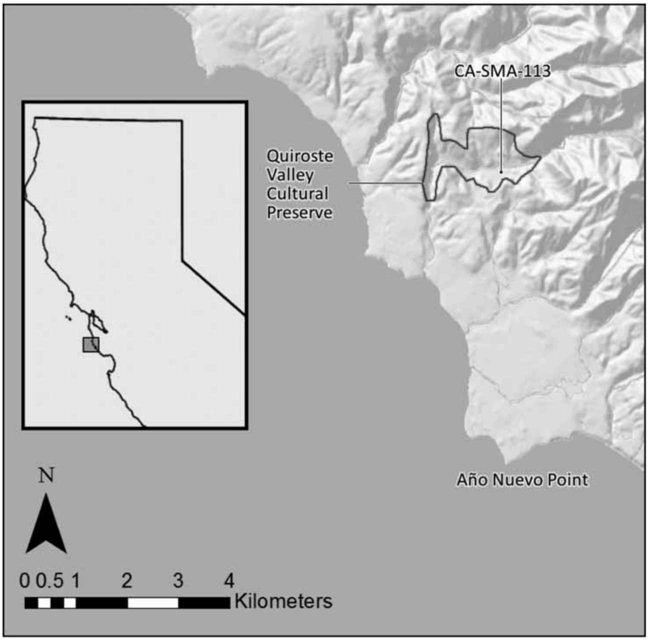

Figure 1. Map of Quiroste Valley Cultural Preserve and location of site CA-SMA-113.

Formation containing abundant chert nodules extends from the tip of Año Nuevo Point into the Pacific. This is the only major source of Monterey chert in the region, and numerous archaeological sites along the shoreline attest its use as the primary material for chipped stone tools for thousands of years (Hylkema and Cuthrell, this issue).

Quiroste Valley was also a prime location for accessing terrestrial resources. Average annual precipitation in the area ranges from 65 cm in low-lying coastal terraces to over 90 cm in higher inland locations (U.S. Department of the Interior 2013). Maritime fog mediates the summer drought, allowing the landscape to support a variety of vegetation types. On a coastal/lowland to inland/upland transect, common vegetation in the area today includes northern coastal bluff scrub, coastal prairie, coyote brush scrub, mixed conifer forests, and manzanita chaparral, as well as riparian corridors and other vegetation types (Ford and Hayes 2007; Keeley and Davis 2007). Climax vegetation on coastal terraces and foothills in the region consists of woody vegetation such as northern coastal scrub types, mixed conifer forests, and oak/bay woodlands (Ford and Hayes 2007; Keeley 2005). Repeat aerial photography between 1982 and 2012 shows that these vegetation types invade local grasslands in the absence of disturbance factors such as grazing, plowing, and fire (Cuthrell, this issue).

Multiple lines of evidence presented in this issue indicate that by the late Holocene (specifically, ca. AD 1000–1300), people in the research area burned landscapes frequently, maintaining substantial grassland vegetation (Lightfoot et al., this issue). Surrounded by grassland mosaics extending south and west to the Pacific Ocean, Quiroste Valley inhabitants would have had direct access to a reliable source of small seed foods and herbivore prey. The flatlands on Año Nuevo Point also contained wetlands that likely supported stands of tule (*Schoenoplectus acutus* var. *occidentalis*) for construction material, plant foods such as cattail (*Typha latifolia*), migratory waterfowl, and terrestrial game. East of Quiroste Valley, the Santa Cruz Range rises sharply, with steep canyons covered in redwood and Douglas-fir forests topped by gravelly ridgelines of knobcone pine (*Pinus attenuata*) and maritime chaparral, containing foods such as huckleberry (*Vaccinium ovatum*) and manzanita (*Arctostaphylos* spp.). Tanoak (*Notholithocarpus densiflorus*) in forest understories, as well as other oaks (*Quercus* spp.) on conifer forest margins, would have provided a source of storable food in the fall.

Geomorphology of Whitehouse Creek Watershed

Whitehouse Creek watershed lies within an active tectonic setting straddling the San Gregorio Fault Zone (Supplementary Figure 1) that includes two active segments called the Coastways and Frijoles Faults (Supplementary Figure 2). Their combined average rate of 4.5 to 10 mm/yr right lateral displacement has exceeded 160 km (Weber 1990). Quiroste Valley is situated along Whitehouse Creek downstream of a large canyon draining the Santa Cruz Mountains. The valley is on a down-dropped block between the two fault segments (Figure 2). Although the rate of vertical movement of these blocks is unknown, 19 km to the south Weber (1990) reported an uplift rate of 0.425 mm/yr west of San Gregorio Fault. Combined processes of wave erosion, uplift, and sea level change have also shaped the local topography of lower Whitehouse Creek watershed, creating a series of wave-cut platforms. Faulting, geology, and landsliding around Quiroste Valley are far more complex than depicted in Figure 2, and these conditions have not yet been analyzed in sufficient detail to accurately depict all local geomorphological dynamics.

Our research team employed geomorphological and paleoecological techniques (e.g., stream surveys, dendrochronology, and radiocarbon dating) to establish a sedimentation and human occupation timeline for Quiroste Valley.

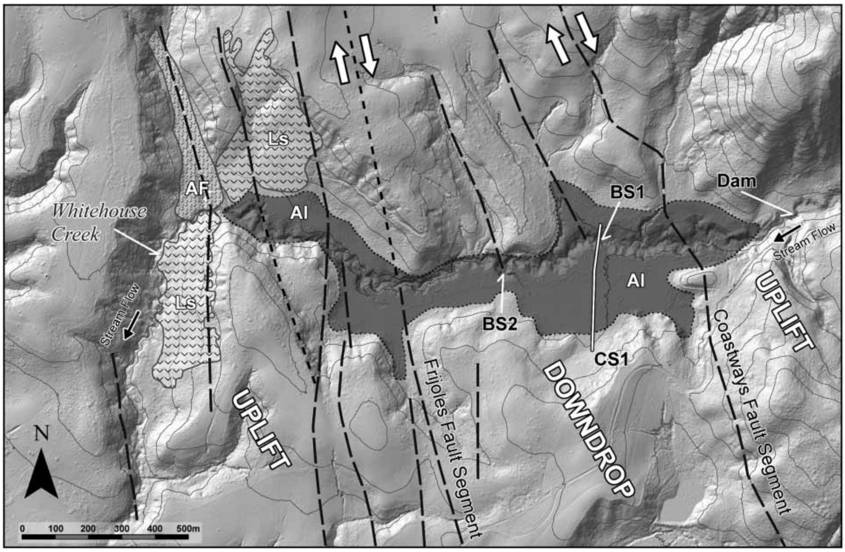

Figure 2. Faulting, landslides, sedimentology, and geomorphological sampling locations in Quiroste Valley over LIDAR basemap (20 m contours). Whitehouse Creek flows from the right side of the image to the left, emptying into the Pacific Ocean north of Año Nuevo Point. A late 1800s dam is shown near the right side of the image. Long dashed lines depict faults mapped by Weber and LaJoie (1980), and small dashed lines are fault traces inferred by L. Collins. Frijoles and Coastways fault segments are part of the larger San Gregorio Fault zone. White arrows with black outline show direction of horizontal displacement and vertical displacement is labeled accordingly. Abbreviations: Ls, landslides; AF, alluvial fan; Al, alluvial Quiroste Valley fill; BS1 bank-sampling site 1; BS2, bank-sampling site 2; CS1 cross section 1. This figure depicts only features discussed in the text; it is not a comprehensive faulting/sedimentology map. LIDAR imagery provided by San Francisco Estuary Institute.

By the beginning of Spanish colonization, the perennial Whitehouse Creek was already deeply incised within its alluvial valley. A late 1800s dam (Figure 2) constructed at the head of Quiroste Valley entrapped bedload from the upper 4.0 km^2 of the 6.8 km^2 Whitehouse Creek drainage, initiating at least 1.5 m of accelerated channel incision since ca. 1885.

The relatively flat floor of Quiroste Valley has been well above Whitehouse Creek floodwaters for thousands of years. Small tributaries draining the low hills adjacent to the valley floor provided runoff that historically maintained a high water table behind an ancient natural levee formed when the creek was much higher. In association with historical cattle ranching and agricultural activities starting in the early to mid-1800s, most of the small tributaries along valley margins were dammed, fields were plowed, and the valley floor, with its local depressional wetlands that may have once been seasonally managed by indigenous peoples, was drained.

Below the valley floor, Whitehouse Creek has a series of inner bank terraces that now provide narrow and relatively flat but discontinuous parallel benches along the channel. Riparian vegetation includes large trees that shade and stabilize these inner terraces, and a number of archaeological sites associated with redwood groves have been identified on them. Although the elevation of these archaeological sites above the creek varies, none are less than ca. 2 m above the streambed. Numerous trees were dated by coring to establish ages of different terraces surveyed along a longitudinal creek profile (Supplementary Figure 3), and cross sections were also surveyed.

At cross section 1 (CS-1 Figure 2), the streambed is about 13.7 m below the valley flat (Supplementary Figures 4, 5, and 6). In the north terrace bank, about 2.7 m above the average streambed elevation, artifacts and shell materials have been recovered in soil buried beneath abundant redwood litter. This north bank is an inset terrace formed sometime after Whitehouse Creek had already deeply

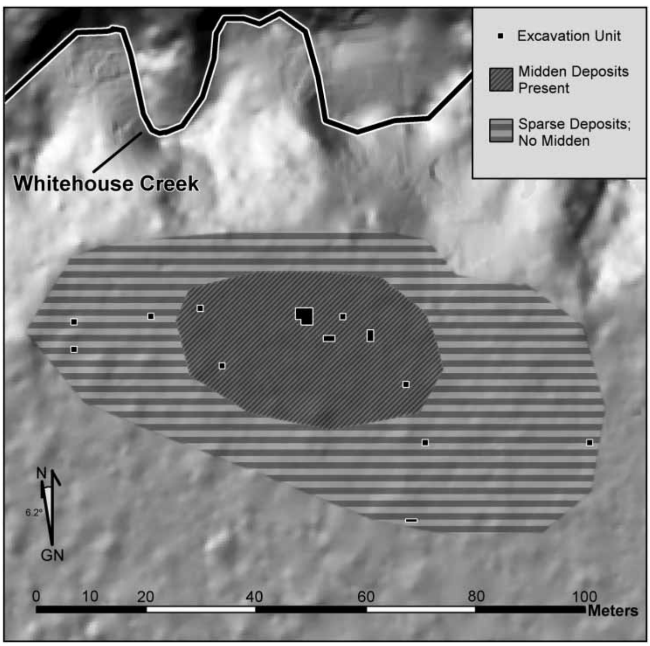

Figure 3. CA-SMA-113 site map showing location of excavation units and approximate site extent over a LIDAR basemap.

incised into its valley fill. This terrace (T-2), now the second terrace above the floodplain, was probably the first terrace above the floodplain at the time of European contact. T-2 represents a period of stability, perhaps lasting hundreds of years. Lying slightly above the functional elevation of the floodplain, it was probably infrequently flooded when it was the first terrace. A bank-sampling site (BS1) was established at the north bank of CS-1. One charcoal sample 2.1 m above the streambed was AMS dated to cal AD 1645–1951 (ca. 210 years ago; #QV-1S2; all cal ^{14}C ranges reported at 2σ; see Supplementary Table 1 for all geomorphological radiocarbon dates), while another collected 0.4 m above the streambed dated to cal AD 877–1312 (ca. 920 years ago; #QV-1S12). Following post-dam stream incision (at least 1.5 m), the T-2 surface was no longer flood-prone, allowing vegetation and archaeological materials to accumulate on the terrace. The present floodplain, about 0.5 m above the streambed, represents an adjustment to diminished stream flow from upstream water diversions.

At CS-1, several redwoods grow on the north bank above T-2. The level of the root/trunk transition (a proxy for ground level at germination) of the lowest redwood is 4.3 m above the average streambed level or 1.5 m above T-2. Tree coring in 2010 indicated the youngest and lowest redwood at CS-1 was about 181 years old (established ca. 1828). The possibly oldest redwood, just upstream of CS-1, is 5.1 m above the streambed and slightly above the third terrace (T-3, 4.3 m above streambed), with an estimated age of 273 years (established ca. 1736). A possible stone manuport and a chipped stone chert tool fragment (bifacially worked, dimensions 4.0 × 2.8 × 0.8 cm, 8.5 g, possibly a cutting tool) were embedded in the bank at the T-2 site, roughly 1.7 m below the bottom of the litter layer.

In 2013, organic materials were collected from a valley fill exposure at BS2 (ca. 400 m downstream of BS1; Figure 2). Field survey and LIDAR data indicate the streambed here is ca. 12.2 m below the southern bank of the valley flat. At 0.46 m above the streambed, the bank shows a distinct layer of organic-rich black clays in contact with overlying medium-sized gravels extending 0.33 m upward (Supplementary Figure 7). The top of the basal black clay layer, which was also observed at several other valley fill exposures, was used as a local elevation datum set at 0.0 m. Approximately 15.2 m upstream, sandstone bedrock exposed in the streambed establishes the valley floor base. We suggest its depth may be about a meter below the streambed at BS2. A basal charcoal sample taken at 0.03 m below datum dated 8572–8255 cal BC (#PVE1RC2), soon after the Pleistocene/Holocene transition. The medium gravels underlie banded light and dark clay layers about 0.8 m thick, ending approximately 1.2 m above datum. From this point to the top of the exposed sediments (4.28 m above datum), there are coarse to medium-sized shale gravels coarsening upwards in a matrix of silt. Charcoal collected at 0.33 m, 1.36 m, and 3.02 m above datum had respective dates of 8229–7938 cal BC (#PVE1RC1), 6421–6249 cal BC (#PVE1RC4), and 5900–5559 cal BC (#PVE1RC6). A sample collected at 1.64 m dated to 8270–7970 cal BC (#PVE1RC3) likely represents older re-deposited charcoal and is excluded from this analysis.

Average sedimentation rates were calculated based on the average age of the four radiocarbon samples and their differences in elevation. For the gravels between the basal clay and the next clay layer (−0.03–0.33 m), the deposition rate was 1.13 mm/yr; for clay and organic-rich layers (0.33–1.36 m), 0.59 mm/yr; and for the exposed gravels above the clay (1.36–3.02 m), 2.26 mm/yr. If the latter rate is used to estimate the rate of deposition of another 9.17 m of alluvium to the top of the valley flat at 12.19 m, then alluvial filling may have taken ca. 4057 years, ceasing ca. 3684 years ago (ca. 1671 BC). If channel incision proceeded to the approximate present-day streambed elevation, its rate averaged 4.8 mm/yr (ca. 12.19 m over 2,542 years), much slower than the 12.0 mm/yr post-dam incision rate of the inset terrace (ca. 1.5 m over 125 years, based on dated materials at BS1). We suggest that the inset terrace built rapidly upwards, perhaps over ca. 450 years, before the oldest redwoods started to grow slightly above the third terrace (ca. 273 years ago).

Presently, insufficient information exists to establish how much the rates were influenced by tectonic vertical offset rates (cf. the 0.425 mm/yr uplift rate reported by Weber [1990]) versus erosion rates driven by other factors that affect sediment and water supply such as landslides, fire, and rainfall. One preliminary hypothesis is that incision of the valley floor was punctuated by episodic events such as landslide breaching. Actual process rates might have been much faster with long periods of stability. A large landslide upstream of Quiroste Valley (Supplementary Figure 2), if Late Pleistocene in age, would support this hypothesis and explain the presence of the early Holocene lacustrine clays at site BS2. This slide appears to have blocked the canyon and created an upstream Pleistocene alluvial valley. Landslides downstream of Quiroste Valley, if early Holocene in age, may explain the valley's formation.

Analysis of contours of the Quiroste alluvial valley and landslides adjacent to the creek indicates a likelihood that seismically induced landsliding near the Frijoles Fault entrapped sediment upstream of the large northern bend of Whitehouse Creek (Figure 2). Ongoing landsliding and alluvial fan deposition may have created blockages that continued for some time (Supplementary Figure 8). Significant alluvial valley filling is distinctly absent downstream of the bend. Sediment trapping by these mechanisms is further supported by the absence of a delta fan deposit at the mouth of Whitehouse Creek.

History of the Quiroste Valley Area After Spanish Colonization

The earliest written description of Quiroste Valley was recorded by members of the Spanish overland expedition into Alta California led by Gaspar de Portola in 1769. In late October, after resting at Waddell Creek, the expedition skirted the coastal cliffs to the north and ascended Año Nuevo Point. Crossing the peninsular flatlands, they headed toward a large settlement encountered by scouts in the previous days. Portola estimated the size of this village at about 200 people (Smith and Teggart 1909:37), and Fr. Juan Crespi wrote that it contained a "very large round house like a half orange, grass-roofed, which, by what we saw inside it, would hold the entire village" (Brown 2001:577). Additional details about this encounter are provided by Hylkema and Cuthrell (this issue).

Based on landscape descriptions and records of the distances traveled, we think the settlement described above must have been located in Quiroste Valley. Crespi described the location as "a small valley all surrounded by very grass-grown knolls," later adding that "the valley has soil which though not extensive could have some irrigated planting done on it" (Brown 2001:577), suggesting flatlands on the valley floor. The expedition's engineer, Miguel Costanso, wrote that the valley was "situated at the foot of a mountain range and in front of a ravine covered with pine and savin [i.e., redwood], among which descended a stream" (Teggart 1911:97). The ravine described is likely the steep-sided Whitehouse Canyon, a distinct landscape feature visible from the hills around Quiroste Valley. Portola and Crespi estimated travel time from Waddell Creek to the village at two and a half and three hours, respectively, and Crespi and Costanso both reported two leagues (ca. 8 km) as the distance traveled (Brown 2001; Smith and Teggart 1909; Teggart 1911). Quiroste Valley, located ca. 9 km from Waddell Creek along the route likely followed by the expedition, fits the description of the landscape features well, and it is the only location in a range from 8 to 12 km northwest of Waddell Creek that does so.

At the beginning of the American Period, Quiroste Valley was used for cattle ranching as part of the Rancho Punta de Año Nuevo, and by the late 1860s large quantities of lumber from a timber mill in Whitehouse Canyon were shipped out from a wharf on Año Nuevo Point (Bischoff 2009:92; Mowry 2004). In 1902, there were six residences in the Whitehouse Creek watershed, with one on the Quiroste Valley floor (U.S. Geological Survey 1902). By the early 1940s, aerial photographs show extensive agricultural fields and pastures covering most flat areas in and around Quiroste Valley.

Previous Archaeological Research

Site CA-SMA-113 is a late Holocene to early historic (ca. AD 1000–1775) habitation site just south of Whitehouse Creek on the edge of the Quiroste Valley floor. The site lies on the flat at the margin of the deeply incised creek channel and its riparian vegetation corridor, which today hosts extensive alders, buckeyes, and scattered redwood groves (Figures 1 and 3). The site was first identified in surveys of Quiroste Valley by Mark Hylkema and Gary Parsons in 1982. Surveys identified nine other archaeological sites in the valley, ranging from the middle to late Holocene in age (Simpson-Smith and Edwards 2004a, 2004b). A former resident of Quiroste Valley reported that CA-SMA-113 once had an extensive mound of midden material about 1.5 m high, which was leveled in the 1940s. Geomorphological processes could not have formed the reported mound, thus its presence indicates substantial occupation of the site after the time that currently intact deposits were formed (ca. AD 1000–1300). Based on the extent of the site, its date, and the presence of a large mound there, we think CA-SMA-113 is the most likely candidate among all sites in the valley for the Quiroste settlement described by members of the Portola expedition in 1769.

In 2003, a Cabrillo College field school directed by Rob Edwards and Mark Hylkema conducted auger tests, surface test unit surveys, and test excavations at CA-SMA-113 (Simpson-Smith and Edwards 2004a). Fifteen surface test units recovered cultural materials to a depth of 20 cm, and three of these were further excavated to sterile subsoil. Three California mussel (*Mytilus californianus*) specimens from a column sample were radiocarbon dated, returning calibrated age values from ca. AD 1010 to 1680 (Simpson-Smith and Edwards 2004a:20). Results of this study indicated CA-SMA-113 was roughly 50 × 100 m in extent with cultural deposits up to 110 cm in depth that contained shell, debitage, faunal remains, fire-affected rock (FAR), *Olivella* shells, and ground and chipped stone artifacts.

Archaeological Research at CA-SMA-113 from 2007 to 2009

Based on the results of previous work at the site, our team identified CA-SMA-113 as a promising location for archaeological research on late

Holocene anthropogenic burning and foodways practices. In collaboration with the Amah Mutsun Tribal Band and the California Department of Parks and Recreation, we developed a low-impact excavation methodology designed to minimize disturbance to the site while providing high-quality data on resource use by site inhabitants. By limiting the extent of excavations, we also sought to decrease the chance that human remains would be disturbed, a factor of considerable importance to tribal members. Geophysical techniques, including magnetometry, soil resistivity, and ground-penetrating radar (GPR), were used to map the distribution of subsurface features prior to excavation. Magnetometry was employed most extensively, recording data from ca. 4,500 m^2 of CA-SMA-113 (Supplementary Figure 9). Magnetometry surveys identified FAR accumulations, excavation units from prior fieldwork, metal objects, and geomorphological features underlying the site. Resistivity and GPR surveys were conducted in areas identified as locations with probable features.

Excavations at CA-SMA-113 included 22 1-m^2 units representing 14.7 m^3 of archaeological deposits (Figure 3). Plow scars on FAR suggested that the plow zone at the site extends ca. 25 to 30 cm below the modern ground surface. An in situ FAR accumulation (Feature 2) uncovered at 25 cm depth supported this interpretation. The site has been heavily impacted by pocket gopher (*Thomomys bottae*) bioturbation in all cultural levels. Deposits lacking discrete stratigraphic boundaries were excavated in 10-cm vertical intervals and dry screened through 6.4 mm (2007) or 3.2 mm (2007–2009) mesh. From each excavated context, a 5- to 10-liter sample was systematically collected for flotation analysis. In 2007, 10-liter samples were collected for wet screen analysis using 3.2 and 1.6 mm mesh.

Deposits with discrete stratigraphic boundaries (i.e., "features") were excavated by cultural levels. Discrete deposits were collected in toto for flotation processing when they were ca. <10 liters in volume. Larger discrete deposits were excavated in 5-cm vertical intervals, with 10-liter flotation samples collected from each level. Flotation samples were also collected judgmentally from non-discrete levels containing areas with different matrix or ecofact inclusions. A total of 201 flotation samples was collected. To recover small faunal and other ecofact remains, all flotation sample heavy fractions were sorted into >6.4 and 3.2–6.4 mm size fractions, and a column of eight samples was sorted down to 1.6 mm.

Eighteen of 24 AMS dates from the site are from the Bonny Doon Phase, ca. AD 1000–1300 (Supplementary Table 2; Hylkema and Cuthrell, this issue). Three dates from ca. AD 1225–1770 attest to later occupation of the site, possibly up to the early historic era. Two of three dates prior to ca. AD 1000 originated from materials collected from non-cultural levels. If the site was occupied during the past ca. 700 years, deposits associated with this time period were probably destroyed through twentieth century bulldozing and plowing, leaving earlier deposits beneath the plow zone relatively intact.

Artifacts and Features at CA-SMA-113

The artifact assemblage at CA-SMA-113 is dominated by Monterey chert debitage, with 5,949 specimens >6.4 mm in size (Supplementary Table 3). Only one formal chert tool and six modified chert flakes were recovered, however secondary and tertiary flakes were abundant (n = 1,062), suggesting that the site inhabitants used an expedient flake technology to produce cutting implements. Proximity to the rich Monterey chert outcrop on Año Nuevo Point likely accounts for the lack of material conservation in the chipped stone technology of site inhabitants. Like other late Holocene sites in the area (Hylkema and Cuthrell, this issue), Franciscan chert from the interior is rare (<1 percent of debitage). All but one of the formal chipped stone artifacts from CA-SMA-113 were of obsidian sourced from the Napa Valley area, but obsidian was also rare in the debitage assemblage (<1 percent).

The most common formal artifact type recovered from CA-SMA-113 was pitted and/or grooved stones (n = 10, Supplementary Table 4). This type includes cobbles that display pitting on opposite faces of the stone, circumferential grooving, or notching, and is common in local late Holocene sites on the central coast (Hylkema 1991). At other sites, these artifacts usually display only one type of modification. North of Half Moon Bay, CA-SMA-134 (ca. AD 1150–1380) yielded 152 pitted stones, but only two displayed both pitting and notching (Hylkema 1998). At CA-SMA-113, three of ten specimens exhibited both pitting and grooving. Hylkema (1991, 1998) described grooved or notched stones as net weights or fishing line weights, and pitted stones as anvils for processing small invertebrates or nuts.

Ground stone tools associated with plant food processing recovered from CA-SMA-113 included eight pestles and three handstones. No mortars or mortar fragments were recovered, and only one milling stone fragment was recovered.[1] Eight igneous cobblestone choppers that were recovered may have been used to crush bones for marrow extraction, producing the highly fragmented faunal assemblage described by Gifford-Gonzalez et al. (this issue), or to process fibrous or woody plant materials. Five obsidian projectile points were recovered: one Desert Side-notched point, one serrate point, one corner-notched point (smaller than the Middle Holocene corner-notched points illustrated in Hylkema and Cuthrell, this issue: Figure 3) and two unidentified point fragments. These types are consistent with late Holocene points recovered from local contemporaneous sites (Hylkema 1991).

Six features were excavated, including one shallow pit over a meter in diameter (Feature 4), three potential hearths (Features 7, 8B, and 9), and two FAR accumulations (Features 2 and 8A). All except the shallow pit (Feature 4) were small, and all deposits from these were collected for flotation processing. Feature 4, a pit up to 25–30 cm deep (preserved portion) ca. 1.0 × 1.2 m in diameter, may have been used for roasting root or bulb foods, as indicated by the higher FAR levels in surrounding midden deposits. The pit was filled with numerous distinct lenses of ash and food debris. Sampled individually through flotation, these discrete deposits provided the richest source of archaeobiological data from the site.

Marine Invertebrates at CA-SMA-113

Marine invertebrate shell was a common constituent of midden deposits at CA-SMA-113 (Kim 2011). Most shell in nondiscrete deposits was highly fragmentary, generally <3.2 mm in size. Shells were less fragmentary in discrete deposits, particularly in Feature 4. Shell from the >6.4 mm portion of wet screen samples and the heavy fraction of flotation samples was sorted into nine taxon categories (Supplementary Figure 10, Supplementary Table 5). Counts were recorded based on diagnostic elements (i.e., non-repeating, providing an MNI) for the taxon categories mussel (*Mytilus californianus*), turban snail (*Tegula* spp.), and limpet (Acmaeidae), while counts of other (less common) shell types were recorded on all elements (see Supplementary Table 5). Weights of marine shell were recorded by quantification of all diagnostic and non-diagnostic elements by taxon.

California mussel comprised the majority of the marine invertebrate assemblage by count (53.8 percent). Other taxa accounting for greater than 5 percent of the assemblage by count included leaf barnacle (*Pollicipes* sp.; 11.2 percent), chiton (Polyplacophora; 11.2 percent), barnacle (*Balanus* spp.; 7.3 percent), and turban snail (5.6 percent). By weight, the assemblage contained mostly mussel (74.4 percent) and turban snail (15.5 percent). Differences in assemblage composition by count versus weight result from quantification of non-diagnostic elements in weight data. The dominance of mussel and turban snail is a common pattern in local contemporaneous sites, including CA-SMA-118, CA-SMA-18, and CA-SMA-134 (Hildebrandt et al. 2009; Hylkema 1998).

To explore seasonality of site use at CA-SMA-113, isotopic analysis of $\delta^{18}O$ was performed on 35 California mussel shells from five contexts (see Supplementary Figures 11–14, Supplementary Table 6) that were AMS dated to ca. cal AD 900–1300. Calcite layers of shells were sampled using three-spot transects collected at 2-mm intervals beginning 1 mm from the growth edge. Sea surface temperatures (SST) were calculated from $\delta^{18}O$ values using the fractionation equation reported by Ford et al. (2010:Eq. 4). Proxy SST values from mussel $\delta^{18}O$ were compared to an 89-year record of monthly SST at Pacific Grove, California (Hopkins Marine Station 2012) to estimate month of harvest for each shell (see Supplementary Information Online for additional details on isotopic analysis).

Isotopic analysis suggests that people at CA-SMA-113 harvested mussels primarily during spring and fall, with about 83 percent of analyzed shells collected during these seasons (Supplementary Figure 15). None of the analyzed shells indicated mussel harvesting in late winter. There is considerable variability in seasonality between contexts sampled, with two contexts indicating mussel harvest mainly during the fall (#01-0290-000 and #01-0338-000) and one indicating harvesting throughout the year (#01-0337-000). This could reflect differences in the temporal span of original deposit formation or variation in mussel harvesting practices between site inhabitants.

Biotic Resource and Landscape Use at CA-SMA-113

From the residential base in Quiroste Valley, CA-SMA-113 inhabitants procured Monterey chert from the only major coastal cryptocrystalline lithic source in the region, as well as *Olivella* shells and a wide range of terrestrial and marine food resources. Access to these resources may have placed them in a favorable economic position relative to adjacent groups, who probably did not have direct access to one or more of these resource categories (Hylkema and Cuthrell, this issue). Although whole and fragmentary *Olivella* shells were common at CA-SMA-113 (522 from dry screens, 35.5 specimens/m^3), no finished beads were recovered from dry screens or from >1,500 liters of sorted heavy fraction material. The presence of olivella shells but lack of finished beads is a pattern observed in several late Holocene sites around Año Nuevo Point.

Faunal remains from CA-SMA-113 reported by Gifford-Gonzalez et al. (this issue) indicate regular consumption of mule deer (*Odocoileus hemionus*), lagomorphs, rodents, and both rocky intertidal and small schooling marine fishes. Although Whitehouse Creek is a perennial stream, freshwater fish bones were uncommon, at less than 3 percent of the identified fish assemblage. Site inhabitants also seem to have avoided consuming birds, possibly due to cultural beliefs expressed through place-based food practices. Quiroste Valley may have been understood as a special place on the landscape that required modifications to foodways since ca. AD 1000–1300. The high ubiquity of tobacco (*Nicotiana* sp.) at the site also supports this interpretation (Cuthrell, this issue). Along with historical records of a large ceremonial structure in the valley in 1769, the archaeological data may reflect a long history of place distinction at CA-SMA-113. If so, the artifact and ecofact assemblages at the site may not be entirely representative of those at other contemporaneous residential sites.

Botanical remains at CA-SMA-113 suggest that grassland seed foods were important to site inhabitants (Cuthrell, this issue). Ratios of seed foods to nut foods are comparable to values reported by Wohlgemuth (2004) for Emergent Period (ca. AD 750–1750) sites in interior central California, where regular seed food use has been well documented. The assemblage of nut remains at CA-SMA-113 is distinct from many contemporary inland sites in its high proportion of hazel, which comprises the majority of the nut assemblage. Based on its fruit production characteristics and contemporary distribution in the area, this pattern suggests that hazel management may have been a component of resource enhancement practices in Quiroste Valley (Cuthrell, this issue; Fine et al., this issue). There is little direct macrobotanical evidence for consumption of starchy roots, tubers, or bulbs in the CA-SMA-113 archaeobotanical assemblage, although one feature at the site may have been an earthen oven used to cook geophyte foods.

Conclusion

From their residential base in Quiroste Valley, the inhabitants of CA-SMA-113 hunted, harvested, and consumed a wide range of seasonally and spatially predictable biotic resources during the period ca. AD 1000–1300. By controlling access to the local Monterey chert source, procuring and trading olivella shells, and managing coastal terrace landscapes (see Lightfoot et al., this issue), they may have maintained direct access to a broad suite of resources including items that other local groups would have had to acquire through trade. These factors could have contributed to the development of the local *Quiroste* polity described by Hylkema and Cuthrell (this issue). Use of summer and fall ripening plant resources, as well as mussels collected mainly during the spring and fall, attest to occupation of CA-SMA-113 during most or all of the year.

Macrobotanical and zooarchaeological data, as well as other paleoecological data sets presented in this issue (Cowart and Byrne, this issue; Evett and Cuthrell, this issue), indicate that in the late Holocene, native people managed the coastal landscape using fire, increasing the extent and productivity of grasslands and enhancing habitats for herbivorous fauna (Lightfoot et al., this issue). Potential prohibitions on bird consumption as well as regular use of tobacco at CA-SMA-113 suggest that Quiroste Valley may have been understood as a special place for hundreds of years prior to Spanish documentation of a large ceremonial structure there. Except for these potential place-based distinctions, cultural materials at CA-SMA-113 are consistent with contemporary late Holocene sites in the region that indicate the use of bow-and-arrow technology, increased territorial circumscription, a high degree of sedentism, and greater participation in regional economies.

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Note

1. The milling stone fragment recovered at CA-SMA-113 was from an undated, non-discrete stratum located ca. 70 m from the center of the midden, and it is not clear whether it is contemporaneous with the CA-SMA-113 occupation from AD 1000–1300.

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