Monographs of the Western North American Naturalist

Volume 7 *8th California Islands Symposium* Article 8

7-21-2014

Prehistoric occupation of the interior of western Santa Cruz Island

Michael A. Glassow
University of California, Santa Barbara, glassow@anth.ucsb.edu

Follow this and additional works at: https://scholarsarchive.byu.edu/mwnan

Recommended Citation

Glassow, Michael A. (2014) "Prehistoric occupation of the interior of western Santa Cruz Island," *Monographs of the Western North American Naturalist*: Vol. 7 , Article 8.
Available at: https://scholarsarchive.byu.edu/mwnan/vol7/iss1/8

This Monograph is brought to you for free and open access by the Western North American Naturalist Publications at BYU ScholarsArchive. It has been accepted for inclusion in Monographs of the Western North American Naturalist by an authorized editor of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.

Monographs of the Western North American Naturalist 7, © 2014, pp. 118–128

PREHISTORIC OCCUPATION OF THE INTERIOR OF WESTERN SANTA CRUZ ISLAND

Michael A. Glassow[1]

ABSTRACT.—Although the majority of prehistoric habitation sites on Santa Cruz Island are located within interior areas more than 0.5 km from the coast, little is known about these sites and how their occupation articulated with coastal settlement. To address this lack of knowledge, small-scale excavation was undertaken at 2 interior habitation sites (CA-SCRI-555 and CA-SCRI-574) in the western sector of the island. Habitation deposits at both sites are <60 cm deep. Radiocarbon dating reveals that CA-SCRI-555 experienced occupation during 3 time intervals: 1800–1400 cal BC, ~2400 cal BC, and ~4400 cal BC. In contrast, dates for CA-SCRI-574 indicate only one time interval: 2800–1900 cal BC. Remains of marine shellfish and vertebrates in the deposits indicate transport of marine foods to both sites. The repertoire of shellfish remains implies that site inhabitants obtained marine foods from coastal areas closest to each site. These interior sites may have been occupied for one or more reasons: (1) as habitation sites occupied occasionally for the purpose of acquiring and perhaps consuming plant food or other interior resources; (2) as easily defended locations given their placement on ridgetops; (3) as way stations during travel to distant parts of the island; and (4) as locations where freshwater is available during dry seasons or years when water is scare at nearby coastal locations. The data resulting from small-scale testing makes evaluating these alternatives difficult, but the variety of food remains, the various types of stone tools, and the wood charcoal from hearth fires all indicate that at least some intervals of occupation were for periods that exceeded a few days. The results highlight the need for data from a large number of interior sites to understand island settlement patterns and ecological adaptation of the island's prehistoric inhabitants.

RESUMEN.—Aunque la mayor parte de los sitos habitacionales prehistóricos de la Isla Santa Cruz están ubicados en áreas interiores a más de 0.5 km de la costa, poco se sabe sobre estos sitios y sobre cómo su ocupación se articulaba con los asentamientos costeros. Con el fin de obtener información, se realizaron excavaciones a pequeña escala en 2 sitios interiores, CA-SCRI-555 y CA-SCRI-574, en el sector oeste de la isla. Los depósitos habitacionales en ambos lugares tienen menos de 60 cm de profundidad. La datación por radiocarbono revela que en CA-SCRI-555 se registró ocupación durante 3 intervalos de tiempo: 1800 a 1400, ~2400 y ~4400 años calibrados antes de Cristo. En contraste, en el caso de CA-SCRI-574, sólo se indica un intervalo de tiempo según las fechas: entre 2800 y 1900 años calibrados antes de Cristo. Los restos de vertebrados y moluscos marinos en los depósitos indican que se transportó alimento de origen marino a ambos sitios. La gama de restos de moluscos demuestra que los habitantes obtuvieron alimentos marinos de las áreas costeras más cercanas a cada sitio. Es posible que estos lugares interiores se hayan ocupado debido a uno o más de los siguientes cuatro motivos: (1) como hábitats ocasionales con el fin de obtener y, posiblemente, consumir alimento de origen vegetal u otro tipo de recursos de las zonas interiores; (2) como lugares que brindaban protección por estar ubicados en las crestas de las montañas; (3) como lugares de paso en el trayecto hacia zonas remotas de la isla; y (4) como lugares donde había agua dulce disponible durante las temporadas de sequía o los años de escasez de agua en lugares costeros cercanos. La información resultante de las pruebas a pequeña escala hace que sea difícil evaluar estas alternativas, pero la variedad de restos de alimentos, los distintos tipos de herramientas de piedra y el carbón vegetal de madera derivado de fogones indican que la duración de por lo menos algunos intervalos de ocupación superó un período de unos pocos días. Los resultados enfatizan la necesidad de obtener información de una gran cantidad de sitios interiores para poder comprender los patrones de ocupación de la isla y la adaptación ecológica de sus habitantes prehistóricos.

Santa Cruz Island, the largest of the northern Channel Islands of California, contains an estimated 3000 archaeological sites (Glassow 2010: 6.1) that have deposits spanning roughly 10,000 years of prehistory (Gusick 2012). Although habitation sites with the largest accumulations of archaeological deposits are within 100 m of the coast, the majority of sites are actually located inland. The distribution of these interior sites is extensive, with no more than a few hundred meters separating one site from another. Most interior sites are small in area, often well under 100 m in maximum dimension; and their deposits typically are shallow, often <50 cm thick. As is true of coastal sites, many contain abundant shellfish remains, which facilitate their discovery. Interior sites often are on ridgetops but can also be located in canyons that have relatively flat bottomlands (Peterson 1994, Glassow et al. 2009, Perry and Delaney-Rivera 2011).

[1]Department of Anthropology, University of California, Santa Barbara, CA. E-mail: glassow@anth.ucsb.edu

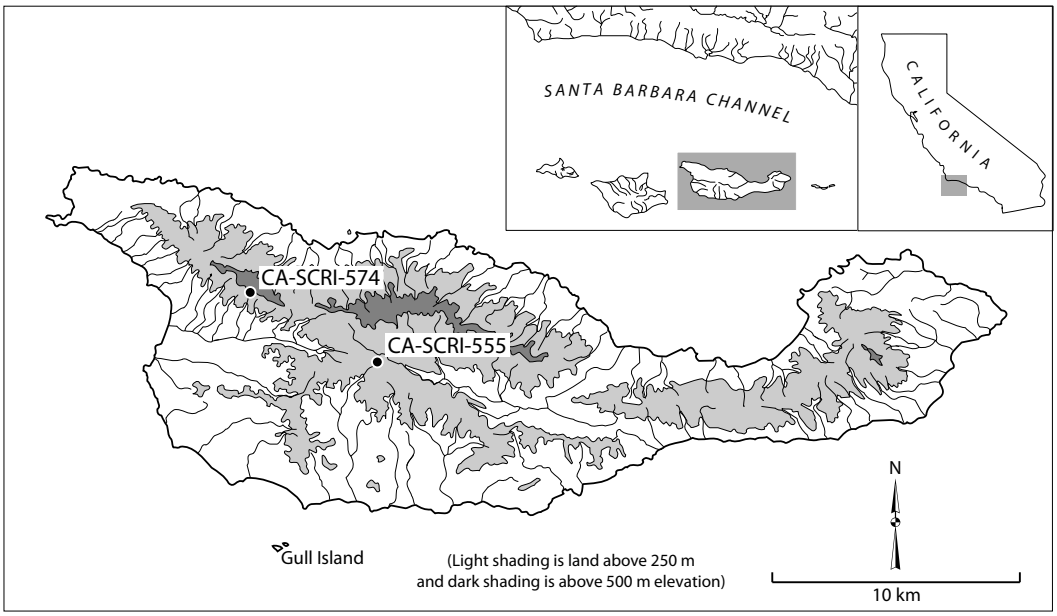


Fig. 1. Santa Cruz Island showing locations of the 2 sites.

In 2005, two of these interior sites, CA-SCRI-555 and CA-SCRI-574 (Fig. 1), were the subject of small-scale testing, and the analysis of the resulting collections is the subject of this paper. The investigation of these 2 sites is related to a long-term effort of several investigators to understand the manner in which occupation of interior sites articulated with subsistence-settlement systems on the island (Perry 2003, Kennett 2005, Perry and Delaney-Rivera 2011, and ongoing research). The small-scale testing of the 2 sites was conducted with the objective of obtaining organic samples for radiocarbon dating and characterizing the essential components of the midden deposits.

Four hypotheses may account for the occupation of an interior site. First, a site may have been occupied for acquisition of terrestrial resources, some of which may have been most abundant in the island's interior. The most likely resource is plant foods. Coastal locations around the island contain a comparatively narrow range of plant resources, grasslands and scrublands along the south coast being examples, whereas most interior locations are adjacent to a broad diversity of plant resources, many being minimally available at coastal locations. An example is manzanita berries (*Arctostaphylos* spp.), which are often abundant on ridge crests. Various raw materials such as toolstone also may have attracted use of interior sites. Second, interior sites may have been occupied for defense against attacks from hostile groups living elsewhere on the island. This hypothesis seems most plausible with regard to sites located on high, narrow ridges: locations that do not appear to afford easy access to various interior resources. Third, some interior sites may have been way stations occupied when individuals or groups traveled distances on the island that required more than several hours of travel time. An example would be people living in the island's western sector traveling to outcrops on the eastern end of the island to acquire chert. Fourth, certain interior sites may have been occupied when freshwater was seasonally unavailable near the coast but present near the interior site. For instance, water flows cease in the lower segments of some drainages, but springs may still flow in upland, interior locations. The small amount of excavation at each of the 2 sites, as well as the comparatively small number of sites on the island for which data from excavation exists, places limitations on the extent to which these alternative hypotheses may be evaluated. Although some inferences about the context for site settlement are possible, the purpose of such small-scale excavation should be viewed in the context of a long-term

TABLE 1. Volumes of excavated deposits (all units 20 × 20 cm).

Site	Unit	Max. depth (cm)	Unit volume (L)	Site volume (L)
SCRI-555	1	22	8.80	
SCRI-555	2	20	8.00	
SCRI-555	3	30	12.00	28.80
SCRI-574	1	40	16.00	
SCRI-574	2	58	23.20	39.20

research program aimed at generating more data from a much larger number of sites.

SITE CHARACTERISTICS AND METHODS

Fieldwork at the sites occurred over a 3-day period in July 2005. Units 20 × 20 cm were excavated at each site: 3 at CA-SCRI-555 and 2 at CA-SCRI-574 (Table 1). Excavation with hand tools was in 10-cm arbitrary levels unless a statigraphic break in the deposits was encountered. Deposits were sifted through eighth-inch mesh screens, and all materials caught by the screens were bagged for transport to UCSB (University of California, Santa Barbara). Each site was mapped with a total station; however, the files produced by the data collector became corrupted and could not be used to produce site maps.

CA-SCRI-555 (Fig. 2) is located on a grass-covered knoll at 410 m above sea level along a ridge that forms the southern flank of the island's Central Valley. The site was recorded in 1994 by UCLA (University of California, Los Angeles) archaeological field school students under the direction of Jeanne Arnold. As seen on the ground surface, site deposits are in 2 concentrations, each 15–20 m in diameter and each containing an area approximately 3–5 m in diameter of relatively higher concentration of midden constituents. The 2 high-density areas are roughly 20 m apart along an east–west axis. The broad timespan represented by the radiocarbon dates for this site (Table 2) implies that the relatively simple pattern of midden concentrations visible on the site surface is not representative of patterns below surface created during the different intervals of site occupation.

This location is near a point on the island that is farthest from any point on the coastline, making this site among the "most interior" on the island. The northern margin of the Laguna Canyon watershed is directly south, and tributaries draining into the Central Valley are to the north. Despite a search within drainages north and south of the site, no source of freshwater within 500 m was located. It is possible that a spring once existed nearby but has disappeared due to loss of soil and vegetation resulting from intensive sheep grazing during the late 19th and early 20th centuries. A few hundred meters downslope within the Laguna Canyon tributary, however, is a depression apparently caused by an ancient landslide, which is now filled with gravel. Perhaps a vernal pool was within this depression at the time of site occupation.

Units 1 and 3, spaced approximately 2 m apart on a north–south axis, were in the high-density area of the western midden, and Unit 2 was in the high-density area of the eastern midden. Depths from surface to sterile deposits in the 3 units varied between 20 and 30 cm (Table 1). Noticeable stratification was encountered only in Unit 3. Between 10 and 20 cm below surface were clumps of very compact midden. Also, a distinct layer of caliche devoid of cultural material occurred between 25 and 27 cm below surface. Three centimeters of midden occurred below the caliche layer.

CA-SCRI-574 (Fig. 3) was recorded in 1995 during a UCSB field class survey under my direction. The site is located on a ridge descending southward into Cañada Christy from the steep, rugged slope directly below crest of the main northern ridge of the island. This ridge is one of 10 along Cañada Christy's north side, each of which contains several ridgetop sites at points where land is relatively flat. CA-SCRI-574 is within a few hundred meters from the steep slope ascending to the top of the main northern ridge, at an elevation of 300 m above sea level. The relatively flat area of the site is 42 × 75 m, and midden deposits spill down the steep slopes on both the east and west sides of the site. Outcrops of volcanic bedrock exist along the western margin of the site, and a mortar hole is on the top of one segment of this outcrop (Fig. 4). An alignment of 4, or possibly 5, large stones near the northwestern margin of the site may relate to a structure of some sort, but the pattern of their distribution is too vague to be confident. A perennial spring is located 380 m northeast of the site within a drainage descending from the main northern ridge; and because the spring is



Fig. 2. CA-SCRI-555 looking north-northwest. The fieldworkers are standing on the grass-covered knoll where the site is located.

TABLE 2. Radiocarbon dates (all dates derived from single fragments of *Mytilus californianus* valves).

Site	Provenience	Conventional age	Calibrated date, 2s interval	Lab number
SCRI-555	Unit 2, 0–10 cm	3780 ± 25	1609–1394 BC	NOSAMS-101030
SCRI-555	Unit 2, 10–20 cm	3920 ± 30	1800–1518 BC	NOSAMS-101031
SCRI-555	Unit 3, 10–20 cm	4500 ± 35	2574–2283 BC	NOSAMS-101032
SCRI-555	Unit 3, 10–20 cm	6200 ± 90	4671–4257 BC	Beta-210317
SCRI-555	Unit 3, 27–30 cm	6110 ± 29	4450–4254 BC	D-AMS 1348
SCRI-574	Unit 2, 40–50 cm	4270 ± 70	2356–1897 BC	Beta-210319
SCRI-574	Unit 2, 10–20 cm	4570 ± 70	2821–2799 BC 2779–2312 BC[a]	Beta-210318

[a]This is the most probable (0.987) of the 2 dates resulting from 2 intersections with the Marine 09 calibration curve.

close to the same elevation as the site, the access is relatively easy.

The 2 units excavated at this site were located approximately 5 m apart within the area of highest midden density. Unit 1, the northernmost, extended to a depth of 40 cm below surface. Midden deposits were relatively more compact between 13 and 20 cm and from 25 to 30 cm. Unit 2 extended to a depth of 58 cm below surface, and relatively compact midden again was encountered in this unit, in this case between 20 and 30 cm.

At UCSB, collections were water-screened, dried, and sorted into constituent categories. Shellfish remains, which comprised the bulk of the collections, were separated according to taxon. With regard to the shell from Unit 2 at SCRI-574, however, only 200-g subsamples of each level's shell was sorted into taxa. At both sites, bone was in small quantities and highly fragmented, allowing simple categorization into fish, mammal, and unidentifiable. Stone flakes were separated by material: chert and volcanics. Other artifacts were identified by type. A collections catalog presents these data along with provenience information and was the basis for data analysis. The collections, field records, and collections catalog are housed



Fig. 3. CA-SCRI-574 looking northeast. The 2 fieldworkers standing in the far background are near the site's northern margin.



Fig. 4. Mortar hole within a bedrock outcrop at CA-SCRI-574.

within the Collections Processing Laboratory of UCSB's Department of Anthropology and eventually will be transferred to the department's Repository for Archaeological and Ethnographic Collections.

Radiocarbon dates were obtained for both sites: 5 for CA-SCRI-555 and 2 for CA-SCRI-574 (Table 2). All were derived from single fragments of California mussel (*Mytilus californianus*) valves that were scraped clean of adhering residues and washed in distilled water prior to submission. An initial series of 3 radiometric dates was obtained from Beta Analytic, and another 3 were AMS dates obtained from the National Ocean Sciences Accelerator Mass Spectrometry Facility at the Woods Hole Oceanographic Institute. A seventh, also an AMS date, was obtained from DirectAMS.

RESULTS

Chronology of Site Occupations

Occupation at the 2 sites occurred at various times during the middle Holocene (Table 2). Artifacts in the collections from the sites (Table 3) are not particularly time-diagnostic, although a spire-lopped *Olivella* bead from CA-SCRI-574 is consistent with the radiocarbon dates pertaining to this site, in that this bead type is known to have been manufactured between roughly 4000 and 600 BC (Bennyhoff and Hughes 1987:121–122; King 1990: 28, 107–108, 239).

The radiocarbon dates pertaining to CA-SCRI-555 span a period between approximately 4600 and 1400 BC (Table 2). The 3 earliest dates are from Unit 3, one of the units in the western midden deposit at this site. Two of these dates are from the 10–20 cm level and are roughly 1000 years apart. This depth is above the caliche layer in the deposits of this unit (see Methods), and the disparity between the dates implies that the 25 cm of deposits above this layer span roughly 2000 years, although use of the site most likely was intermittent over this long interval of time. A third date obtained from the stratum below the caliche layer is close to the age of the earlier date from above this layer. This indicates that the caliche layer does not separate deposits of significantly different ages. The remaining 2 dates for this site pertain to Unit 2, located in the eastern midden deposit. Their overlap in time implies that the 20 cm of homogenous deposits within this area of the site dates to a relatively narrow bracket of time, perhaps <100 years.

Two radiocarbon dates pertain to CA-SCRI-574, both from Unit 2. Curiously, the dates are in reverse order stratigraphically. The dates span an interval between roughly 2800 and 1900 BC, and it is possible that multiple, distinct occupations occurred during this interval. The stratigraphic changes in the deposits within this unit hint at this possibility.

Midden Constituents

Midden constituents at the 2 sites are similar in character. At both sites, California mussel shells comprise the bulk of the collections, equaling over 80% by weight of shellfish remains at both sites (Table 4). Shells of other taxa are much less abundant, and bones of vertebrates also are in small amounts (Table 4). Shell density, a rough measure of midden accumulation rate, varies among the units at each site (Table 5). At CA-SCRI-555, shell density is very low within Unit 2, located in the eastern midden area. Shell density is much higher within the western midden area but varies significantly between the 2 units within this area, even though they are only 2 m apart. Most likely Unit 1 was just beyond the highest density area. Shell density at CA-SCRI-574 is relatively high, although it also varies between the 2 units excavated at this site.

Shellfish taxa other than the California mussel are much more diverse at CA-SCRI-574 than at CA-SCRI-555, and the lower diversity at CA-SCRI-555 is consistent over time (Table 6). Some of the taxa, such as small gastropods and small limpets, probably were introduced fortuitously into the middens at both sites, given their very small size. Most likely they were attached to shells of mussels brought to the sites. Shells of acorn barnacles (*Balanus* spp.) and leaf barnacles (*Pollicipes polymerus*), not included in Table 6 but present in all levels of all units, also probably came to the sites attached to mussel shells. Conversely, purple sea urchin (*Strongylocentrotus purpuratus*), represented by spine and test fragments in all unit deposits, undoubtedly was a food resource.

Vertebrate bone is in such small fragments that distinction only between mammal and fish is possible (Table 5). Fragments of fish bone are rare at both sites, although they are more prevalent at CA-SCRI-574 than at CA-SCRI-555.

TABLE 3. Manufactured artifacts, distinctive stones, hematite, and asphaltum nodules.

a. Manufactured artifacts

Site	Unit	Level (cm)	Artifact type	Material	Mass (g)
SCRI-555	3	10–20	Drill fragment	Chert	1.42
SCRI-555	3	27–30	Retouched flake	Chert	6.89
SCRI-574	1	0–10	Core fragment	Chert	18.83
SCRI-574	1	0–10	Large end-ground bead (B2c[a])	*Olivella biplicata*	1.05SCRI-
SCRI-574	1	10–20	Ornament fragment	Unidentified shell	0.09
SCRI-574	2	0–10	Spheroid	Stone	0.07
SCRI-574	2	20–30	Core (questionable)	Chalcedony	103.11
SCRI-574	2	30–40	Crystal	Quartz	0.11
SCRI-574	2	30–40	Abraded shell fragment	*Mytilus californianus*	0.93
SCRI-574	2	30–40	Barrel bead (B3[a])	*Olivella biplicata*	0.19

[a]Type designations for shell bead follow Bennyhoff and Hughes 1987.

b. Flake counts and mass by material

	Chert		Chalcedony		Volcanic		Obsidian		Total	Density
Site	CNT[a]	Mass[b]	CNT	Mass	CNT	Mass	CNT	Mass	CNT	(flakes · L^{-1})
SCRI-555	16	4.75	3	0.06	4	20.95	—	—	23	0.8
SCRI-574	31	20.76	15	3.14	26	40.55	1	0.06	73	1.9

[a]CNT = count
[b]Grams

c. Hematite nodules

Site	Unit	Level (cm)	Mass (g)
SCRI-555	3	0–10	0.88
SCRI-555	3	10–20	0.27
SCRI-555	3	27–30	0.05
SCRI-574	1	10–20	0.12
SCRI-574	1	20–30	0.15
SCRI-574	2	10–20	0.22
SCRI-574	2	30–40	0.09

d. Asphaltum nodules

Site	Unit	Level (cm)	Mass (g)
SCRI-574	2	10–20	0.15
SCRI-574	2	20–30	0.07

TABLE 4. Abundance of *Mytilus* and animal bone.

			Mammal (probably pinniped)		Fish	
Site	*Mytilus* mass (g)	*Mytilus* (% total shellfish)	Count	Mass (g)	Count	Mass (g)
SCRI-555	3848.64	82.2	27	3.39	1	0.06
SCRI-574	4606.65[a]	88.3[a]	29	4.64	9	0.85

[a]Data pertain to Unit 1 only.

The bulk of the mammal bone probably is of pinnipeds, but the small size of the fragments makes identification uncertain.

Considering the small excavated volumes, manufactured artifacts are relatively abundant (Table 3a). CA-SCRI-555 yielded 2, and CA-SCRI-574 yielded 6, as well as 2 natural objects, a spherical stone and a quartz crystal that presumably were used in specific activities such as rituals. Of note in the CA-SCRI-574 collection are 2 shell beads, both of which are bead types made over a broad time span during the middle Holocene (King 1990:28, 107–108, 239). Both sites also yielded small nodules (<3 mm in length) of hematite (Table 3c). Though none of them exhibited evidence of abrasion, they undoubtedly are a product of hematite use in the production of red paint pigment. CA-SCRI-574 also yielded a few small nodules of asphaltum (Table 3d), which may have come from artifacts with asphaltum coatings (e.g., baskets for water transport).

TABLE 5. Shell density per unit.

Site	Unit	Total shell (g)	Unit volume (L)	$g \cdot L^{-1}$
SCRI-555	1	2941.37	8.8	334.25
SCRI-555	2	348.97	8.8	39.66
SCRI-555	3	1392.37	12.0	116.03
SCRI-574	1	5218.14	16.0	326.13
SCRI-574	2	9953.34	23.2	429.02

Flakes of chert, chalcedony, and various volcanic rocks (basalts, andesites, etc.) are present at both sites, although they are in higher density in the CA-SCRI-574 deposits (Table 3b). Many of the chert flakes are tan in color and may have come from one of the many outcrops in the eastern sector of the island (Perry and Jazwa 2010) or from a yet-undiscovered source much nearer the sites, northwest of Diablo Peak, where bedrocks similar to those on the eastern end of the island occur. Darker-colored cherts also may be from the eastern sector of the island, but this is less certain. Chalcedony is present in the volcanic bedrocks of the island's northern mountain range, and its greater prevalence at CA-SCRI-574 undoubtedly reflects the site's adjacency to outcrops of these bedrocks and consequently more convenient access. The one small flake of obsidian from CA-SCRI-574 is likely the result of occasional import of obsidian artifacts from the mainland. No ground stone artifacts were found at the sites, although Arnold et al. (1994) reported the presence of a possible stone mortar rim fragment at CA-SCRI-555, as well as a possible hammerstone.

DISCUSSION

A large proportion of the interior sites on Santa Cruz Island, if not the majority, date to the middle Holocene (Perry 2003, Kennett 2005, Perry and Delaney-Rivera 2011), a pattern also noted on Santa Rosa Island (Orr 1968: 99–100, 179–180; Kennett 2005:134). Consequently, the periods of occupation at CA-SCRI-555 and CA-SCRI-574 are not surprising. Both sites may have been occupied ca. 2300 BC, but CA-SCRI-555 was occupied substantially earlier and later. The diverse dates for CA-SCRI-555 reveal that the occupational histories of some interior sites is complex, and many more radiocarbon dates, ideally coming from at least several more units than were excavated, would be necessary to develop a clear picture of the occupational sequence. Similarly, the stratigraphic reversal of the 2 dates for CA-SCRI-574 indicates that a larger number of dates would be needed to ascertain the occupational sequence at this site. Indeed, it is possible that each site witnessed many relatively short intervals of regular visitation, each lasting perhaps no more than a few decades. Discerning such a pattern of occupation would be nearly impossible through radiocarbon dating, in light of the inherent error associated with each date.

The faunal remains imply that shellfish, particularly California mussels, were an important food resource for the occupants at both sites; and the small quantities of mammal and fish bones imply that vertebrates supplemented shellfish. However, this picture of the site occupants' diet may be misleading. The bedrock mortar at CA-SCRI-574 probably indicates that plant foods were collected and processed at this site, and it is possible that occupants of both sites consumed more plant foods than shellfish. Collection and analysis of paleoethnobotanical remains would be necessary to evaluate this possibility. Interestingly, differences between the 2 sites in diversity of taxa represented by the shellfish remains may reflect differences in the intertidal habitats where they were collected. The much higher diversity at CA-SCRI-574 likely results from acquisition of shellfish along rocky intertidal coastlines in the western sector of the island, or perhaps from the north coast. Occupants of CA-SCRI-555 undoubtedly acquired shellfish from the south coast, probably in the vicinity of the mouth of Laguna Canyon. Water temperature varies between these 2 locations, as do aspects of intertidal community structure (Blanchette et al. 2006). However, the ways in which these differences might have affected the diversity of shellfish taxa collected prehistorically are unknown.

In light of the considerable distances site occupants would have had to travel to acquire shellfish, the large quantities of shellfish remains at the 2 sites is surprising. A possible explanation is that occupants, having come from coastal locations, brought shellfish with them each time they visited the site. Shellfish could have served as a food supply until resources in the vicinity of the sites were acquired and processed. Another possible explanation is that shellfish provided a good protein

TABLE 6. Presence of minor shell taxa.

Taxon	Site			
	555 (~1600 BC)	555 (~2400 BC)	555 (~4400 BC)	574
Chiton				X
Crab				X
Black abalone (*Haliotis cracherodii*)				X
Red abalone (*Haliotis rufescens*)				X
Red or pink abalone (*Haliotis rufescens* or *corrugata*)		X		
Abalone (*Haliotis* spp.)				X
Wavy top (*Lithopoma undosum*)		X		X
Giant keyhole limpet (*Megathura crenulata*)				X
Purple olive (*Olivella biplicata*)				X
Platform mussel (*Septifer bifurcatus*)				X
Large gastropod			X	
Purple sea urchin (*Strongylocentrotus purpuratus*)	X	X	X	X
TOTAL NUMBER	1	3	2	10

source needed to maintain a reasonably balanced diet. The Food and Nutrition Board of the National Academies' Institute of Medicine (2005:844) recommends protein amounts between 10% and 35% of energy intake for adults to remain healthy. Given that food resources near the sites were primarily plant foods that would not supply adequate dietary protein for humans, marine foods may have been necessary if populations were to reside at an interior site for extended periods. Consequently, site occupants may have made occasional forays to the coast to acquire marine foods, particularly mussels, which would have stayed fresh in their shells for a few days.

Aside from the acquisition and processing of food resources, various industrial activities took place at the 2 sites. The cores in the collection (including cores documented when CA-SCRI-555 was recorded) imply some onsite production of flakes to be used as tools. The retouched flake in the CA-SCRI-555 collection presumably is an example. As well, the ubiquitous presence of small flakes of chert and volcanic rock indicates that retouching of flakes and perhaps other kinds of flaked stone tools took place at both sites. The drill fragment from CA-SCRI-555 implies a more elaborate industrial activity.

The midden accumulation, soil discoloration, charcoal, and manufactured artifacts indicate that occupation at each site persisted over periods at least a few days long. The sites were not simply occupied for a portion of a day while individuals traveled from one location to another on the island, although certainly this use could have occurred as well. The shallowness of the midden deposits and the high fragmentation of the faunal remains (both shell and bone) imply that accumulation of midden constituents was slow and intermittent, allowing the constituents to weather through exposure to the elements, probably between episodes of occupation. In short, although the sites are likely to have been residential bases, they were occupied intermittently for relatively short periods of time.

The manner in which each site articulated with a settlement system is uncertain and may have shifted from one time interval to the next. If site occupants were residentially mobile, groups occupying these 2 sites also likely occupied others in the interior and on the coast, and some of these other sites may have been more popular than either of these. If instead the occupants were logistically mobile, these sites may have been occupied for the purpose of acquiring resources, most plausibly plant food resources, which then were transported back to a central base. The small amount of data from just these 2 sites is insufficient for evaluating these 2 alternatives.

The differences between CA-SCRI-555 and CA-SCRI-574 are intriguing. In comparison to CA-SCRI-555, CA-SCRI-574 has somewhat denser shellfish remains and a somewhat higher proportion of mussels, a greater weight of vertebrate bone, a greater prevalence of fish bone, more abundant chert and volcanic stone flakes, and a greater variety of other artifacts. These differences indicate that occupation at CA-SCRI-574 was more intensive, as was articulation with the coast. Perhaps episodes of occupation at this site were longer, and the site's

role in a settlement system was more significant. The availability of a reliable source of freshwater nearby may be a factor influencing intensity and duration of occupation at this site.

Returning to the 4 hypotheses for occupation of interior sites such as CA-SCRI-555 and CA-SCRI-574, the available data do not allow the first to be evaluated because the types of resources that may have been acquired by the site occupants are not apparent, although plant food resources are a strong candidate. Regarding the second hypothesis, both sites are in relatively defensive locations, and this is particularly the case with CA-SCRI-574 which is surrounded by steep slopes on 3 sides and does not appear to be close to easily accessible resource areas. The third hypothesis, that the sites were occupied as way stations, has largely been rejected, although it may account for some of the occupation at the sites. The fourth hypothesis, that interior sites were occupied if freshwater was available during seasons when it was unavailable on the coast, may apply to CA-SCRI-574 given its proximity to a perennial spring. It seems less applicable to CA-SCRI-555 since a nearby source of freshwater has not been located. In the end, not only would more information about the 2 sites be helpful in evaluating the hypotheses, but data from many other sites also would be necessary since the place of any one site within a settlement system can be understood only in the context of information from the suite of sites to which it belongs.

CONCLUSIONS

The preceding discussion highlights the need for substantially more information than is currently available about sites in the island's interior to test the hypotheses presented above and in general to determine the nature of island settlement systems. Although small-scale testing projects such as described here have their place in generating information, comparable data would be needed from many more sites, probably a few hundred of the estimated 3000 on the island. Information acquired from each site ideally should include chronology of occupation, extent of site deposits per period of occupation, basic information about midden constituents, and environmental context. Moreover, the tested sites should be evenly distributed throughout the island. Once information from additional sites is acquired, temporal and spatial patterns undoubtedly will emerge that will allow testing of the hypotheses discussed above, as well as others concerning the nature of island settlement systems. Indeed, patterns already are beginning to emerge. Based on information from small-scale testing at roughly 50 sites in the island, it is already apparent that coastal settlement began to be emphasized and interior settlement de-emphasized beginning sometime between 3000 and 2000 BP (Kennett 2005:169; Perry 2003:248–249).

Additional data from small-scale testing projects would help reveal aspects of settlement systems. First, larger suites of radiocarbon dates than were obtained from CA-SCRI-555 and CA-SCRI-574 would help clarify the occupational histories of the sites, particularly in instances where occupation took place during multiple time periods, as is obviously the case at CA-SCRI-555. Second, collection and analysis of macrobotanical remains, even if sample volumes are relatively small, would provide information about the kinds of plant food resources acquired (Gill 2013). Analysis of microbotanical residues adhering to stone tools used to process plant foods also would be helpful, but such tools typically are encountered only occasionally during small-scale testing. Third, oxygen-isotope profiles of mussel valve fragments with intact posterior margins would allow inferences about season of site occupation (Killingley 1981; Kennett 2005: 151–153; Braje 2010:107–109). Fourth, information about the depositional processes that created the site deposits as well as the postdepositional pedogenetic processes would help efforts to elucidate the occupational histories of the sites. A clearer idea of depositional patterns at interior sites also would emerge if small-unit testing, such as that at CA-SCRI-555 and CA-SCRI-574, was supplemented by auger tests dispersed throughout much of the site areas.

Large-scale projects entailing excavation of substantial portions of the midden deposits at interior sites would yield a wider variety of information pertinent to explicating island settlement systems. They would provide information about depositional features that may occur at interior sites, such as dwellings and baking pits, and of course yield more robust samples of floral and faunal remains allowing more detailed inferences about subsistence

activities. As well, they would yield information about site structure that might allow development of more sophisticated sampling designs for small-scale projects. However, large-scale projects are expensive and require substantial time and effort devoted to excavation and analysis. Consequently, few such projects will be possible over the next several decades, and selection of sites for large-scale investigation must be made strategically, based on information about which sites would most likely contribute insights about the nature of the island's subsistence-settlement systems during specific periods of prehistory. From this viewpoint, not only would a program of small-scale testing provide data useful in its own right for explicating the nature of settlement systems, it also may be considered an initial phase of research providing information needed on selecting sites for large-scale investigation.

Acknowledgments

Many thanks to Kristina Gill, Lisa Hosale, Mark Neal, and Elizabeth Sutton for helping with the fieldwork. Thanks is also due to the undergraduate laboratory assistants and students enrolled in an archaeological laboratory methods course, who aided in processing the collections and creating the catalog. For logistical support in the field, I am grateful to Lyndal Laughrin and his staff at the Santa Cruz Island Reserve research station on Santa Cruz Island and to the staff of The Nature Conservancy, at whose facilities we resided during fieldwork. Finally, I gratefully acknowledge the help of my colleague Jennifer Perry, with whom I have been interacting over the years regarding prehistoric occupation of the island's interior.

Literature Cited

ARNOLD, J.E., AND FIELD COURSE STUDENTS. 1994. Archaeological site record for CA-SCRI-555. On file at the Central Coast Information Center, Department of Anthropology, University of California, Santa Barbara, CA.

BENNYHOFF, J.A., AND R.E. HUGHES. 1987. Shell bead and ornament exchange networks between California and the western Great Basin. Anthropological Papers of the American Museum of Natural History 64(2). American Museum of Natural History, New York, NY.

BLANCHETTE, C.A., B.R. BROITMAN, AND S.D. GAINES. 2006. Intertidal community structure and oceanographic patterns around Santa Cruz Island, CA, USA. Marine Biology 149:689–701.

BRAJE, T.J. 2010. Modern oceans, ancient sites, archaeology and marine conservation on San Miguel Island, California. University of Utah Press, Salt Lake City, UT.

FOOD AND NUTRITION BOARD, INSTITUTE OF MEDICINE OF THE NATIONAL ACADEMIES. 2005. Dietary reference intakes. National Academies Press, Washington, DC.

GILL, K.M. 2013. Paleoethnobotanical investigations on the Channel Islands: current directions and theoretical considerations. Pages 113–136 *in* C.S. Jazwa and J.E. Perry, editors, California's Channel Islands: the archaeology of human–environment interactions. University of Utah Press, Salt Lake City, UT.

GLASSOW, M.A., EDITOR AND COMPILER. 2010. Channel Islands National Park, archaeological overview and assessment. Channel Islands National Park, Ventura, CA.

GLASSOW, M.A., O.A. CHADWICK, R.L. PERROY, AND J.T. HOWARTH. 2009. Alluvial history and human prehistory in Pozo Canyon, Santa Cruz Island, California. Pages 53–65 *in* C.C. Damiani and D.K. Garcelon, editors, Proceedings of the 7th California Islands Symposium. Institute for Wildlife Studies, Arcata, CA.

GUSICK, A.E. 2012. Behavioral adaptations and mobility of Early Holocene hunter-gatherers, Santa Cruz Island, California. Doctoral dissertation, Department of Anthropology, University of California, Santa Barbara, CA.

KENNETT, D.J. 2005. The Island Chumash, behavioral ecology of a maritime society. University of California Press, Berkeley, CA.

KILLINGLEY, J.S. 1981. Seasonality of mollusk collecting determined from O-18 profiles of midden shells. American Antiquity 46:152–158.

KING, C.D. 1990. Evolution of Chumash society, a comparative study of artifacts used for social system maintenance in the Santa Barbara Channel region before A.D. 1804. Garland Publishing, New York, NY.

ORR, P.C. 1968. Prehistory of Santa Rosa Island. Santa Barbara Museum of Natural History, Santa Barbara, CA.

PERRY, J.E. 2003. Changes in prehistoric land and resource use among complex hunter-gatherer-fishers on eastern Santa Cruz Island, California. Doctoral dissertation, Department of Anthropology, University of California, Santa Barbara, CA.

PERRY, J.E., AND C. DELANEY-RIVERA. 2011. Interactions and interiors of the coastal Chumash. California Archaeology 3:103–125.

PERRY, J.E., AND C.S. JAZWA. 2010. Spatial and temporal variability in chert exploitation on Santa Cruz Island, California. American Antiquity 75:177–198.

PETERSON, R.R., JR. 1994. Archaeological settlement dynamics on the south side of Santa Cruz Island. Pages 223–232 *in* W.L. Halvorson and G.J. Maender, editors, The Fourth California Islands Symposium: update on the status of resources. Santa Barbara Museum of Natural History, Santa Barbara, CA.

Received 2 Feburary 2013
Accepted 16 August 2013
Early online 21 July 2014