RECENT DATA ON SUBSISTENCE AND ENVIRONMENTAL CHANGE FROM SOUTHERN SANTA ROSA ISLAND

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ABSTRACT

Changes in frequencies and types of marine shell species have been observed in some archaeological sites on the northern Channel Islands. A recent 2,300-acre archaeological survey in the watershed of Jolla Vieja Canyon on southern Santa Rosa Island has yielded site data from a variety of both coastal and inland settings. Drainage cuts in the canyon bottom provide vertical profiles of many deep habitation sites along Jolla Vieja Creek and it's tributaries. Observations of cut banks of several sites show changes in frequencies and types of marine shell species, allowing inferences regarding changes in subsistence, paleoenviroment, and land use on the island. Data regarding the timing of these shifts is provided by radiocarbon dating of shell samples from various strata of ten shell midden sites on the south and west sides of the island.

Setting

The southern portion of the island, in which Jolla Vieja Canyon is located, is characterized by rugged hills and steep grass-covered canyons. Water is available year-round in the form of a perennial stream through the canyon. A total of 45 archaeological sites were identified during the recent survey, including lithic scatters, open shell middens, and rockshelters with associated shell middens. Some evidence of spatial distribution was observed, with lithic scatters situated on the ridgelines, middens in drainage bottoms, and rockshelters located at sandstone outcrops situated mainly in upper drainage contours.

Evidence of Environmental Change From Midden Deposits

Most of the sites recorded within the canyon show evidence of severe erosion, and/or have been buried by alluvial sediments. These latter sites are visible only in stream cuts through the terraces. This historic erosion of the drainages provides a cross-section of most midden sites which seems to reveal some stratigraphic variation in shell species that may signal environmental and subsistence change.

The best example of this stratification was observed at CA-SRI-147, which was clearly the major occupation site for the area. Located about two miles up the canyon, SRI-147 is situated at the confluence of two major branches of the upper drainage, and occupies an area measuring 400 x 520 meters. The site contains several rockshelters (one of which contains the only petroglyphs reported on the island), several deep, stratified midden deposits, and a diverse artifact assemblage of flaked and ground stone, and shell ornaments.

The portion of the site which contains the most well-defined stratigraphy consists of a broad, flat terrace that rises about 7 m above the confluence, situated between the north and west branches of the canyon. An exposure of a buried midden deposit which extends for a distance of about 50 m north-south is visible along the cut bank. The width of the deposit is unknown due to a sterile surface layer and grass cover, but most likely extends west to the base of the slope, a distance of about 40 to 50 meters. Numerous burials have been reported for this area of the site, including about 70

removed by Phillip Mills Jones in 1901 (Jones 1956), and one noted during the recent effort (York 1996).

During his investigations in 1901, Jones noted a midden deposit about 20 feet deep exposed in a cut bank. Photographs taken at the time appear to show a deposit which extends from the top of the terrace to the streambed. Recent observations show that the upper 280 cm of this profile are exposed, while the bottom 3 to 4 meters are obscured by an erosional apron. The currently exposed portion of the cut bank contains six distinct strata, and in all but one of the exposed strata the predominant shell species is California mussel (*Mytilus californianus*), mixed to varying degrees with other species including platform mussel (*Septifer bifurcatus*), both red and black abalone (*Haliotus rufescens, H. cracherodii*), barnacle (*Balanus sp.*), chiton (*Mopalia sp.*), sea urchin (*Strongylocentrotus sp.*), and marine snails such as *Tegula sp.* and *Olivella sp.* However, at depths of 210 to 240 cm below surface, a dense stratum of red abalone mixed with small amounts of debitage and a few black abalone shells was observed, although it should be noted that this stratum does not extend the entire length of the exposure. The red abalone shells are nested, and some exceed 20 cm in diameter. A single red abalone shell was collected for radiocarbon dating.

Red abalone middens have been identified at other sites in the northern Channel Islands and in coastal San Luis Obispo Co. (Orr 1968; Greenwood 1972; Glassow 1993), composed either of a relatively thin (25 to 40 cm) red abalone deposit, or a stratum near the bottom of a midden deposit. However, none so far have been identified on the Santa Barbara County mainland, which may be attributed to a lesser dependance upon shellfish as a food source and the sandy beaches along much of the coastline. The strata appear to be discrete, and although not very thick, are composed almost entirely of red abalone shells. Small amounts of black abalone, as is the case with SRI-147, or other shell species may be included in the red abalone lenses. Sites which include these middens have been dated between 3,795+/-100 B.P. to about 8,030 B.P. (Glassow 1993:570, Erlandson 1988). To date, about 26 radiocarbon dates have been published from red abalone middens on the Northern Channel Islands (including Santa Cruz, Santa Rosa, and San Miguel), and an additional 10 unpublished dates from Santa Rosa Island are presented below.

The presence of dense red abalone lenses in middens are indicative of changes in the types of marine resources exploited. Possible reasons for this change include: 1) intentional selection, 2) over-exploitation of other, more easily gathered resources, and 3) changes in the environment affecting shell species distribution in the intertidal.

Today, red abalone occur from Oregon to Baja, and are found most commonly at depths of 20 to 40 feet, although they may occur intertidally in northern waters. Black abalone have a slightly more southern distribution, from northern California to Baja, and are found intertidally (Ricketts and Calvin 1968). The largest of the genus are the red abalone, which consequently provide a much larger meat package. However, since they occur subtidally and in colder waters, it requires a much higher expenditure of calories to collect red abalone than the more easily harvested black abalone or California mussels found in the intertidal.

Optimal foraging strategies require populations to utilize the most abundant and valuable resources before moving on to other options, with other considerations including the amount of preparation time for equipment and to reach foraging grounds. Shellfish in general are easily located, are a dependable resource, and can be collected by all members of a group. Mussel beds are particularly visible and accessible, which may account for their dominance in many rocky shore shell middens. Although some red abalone may have been collected by diving, it seems unlikely that this species was intentionally selected over the more easily collected species to the degree exhibited in the midden deposits.

It has been suggested that changes in the types of shellfish utilized prehistorically are a result of over-exploitation of preferred species (Salls 1992). If so, it is expected that the transitions shown in the stratigraphy of the middens would be gradual, with an increase in the amounts of red abalone and a corresponding decrease in the amounts of mussel. However, this is not the case. The lenses are discrete, with sharp transitions, and become an almost contiguous deposit of red abalone shells in a minimal soil matrix. In addition, Jones and Richman (1995) suggest that while mussel beds may show effects of extensive harvesting, due to their short life spans, larger populations, and rapid reproductive cycles mussel beds are not susceptible to over-exploitation to the point of extinction. For this reason, it seems most likely that the sudden appearance of red abalone middens relates primarily to environmental factors.

In the 1950s, Carl Hubbs (1955, 1958) suggested a general cooling of ocean temperatures, concurrent with the deposition of the red abalone middens, resulting in these shell fish moving higher into the intertidal and replacing the black abalone. Although Hubbs had no data to support this theory, in the 1970s Psias developed a Sea Surface Temperature (SST) Curve for the Santa Barbara Channel, covering the last 8,000 years (Figure 1) (Psias 1978). This curve is based on the examination of micro fossils in sediment cores taken from the channel floor. Glassow (1993) has noted that published dates for red abalone middens appear to cluster at about 5000 and 7000 B.P., corresponding to decreased SSTs in Psias' curve. These decreases are thought to have been of long enough duration to potentially allow red abalone to replace black abalone in the intertidal.

Recent investigations by Glassow and others (1994) concerning oxygen isotopic analysis of California mussel shells from red abalone middens and modern shell revealed that the water in the Santa Barbara Channel averaged about 12.9° C, approximately 2.5° C cooler than today, which would place the SST well below the upper temperature limits of 14° C for red abalone. However, Glassow and others also noted that the radiocarbon dates from SCRI-333 show a lack of correlation with the middle Holocene cool intervals identified on the Santa Barbara Basin sediment core. Some possible reasons given for the discrepancy include the error factors inherent in the calibration of the radiocarbon dates and the reservoir correction, and in Psias' chronology being based on discontinuous varve counts.

Radiocarbon Dates From Red Abalone Middens

The single red abalone shell collected from the midden deposit at SRI-147 and submitted for radiocarbon dating yielded a conventional radiocarbon age of 5500 +/- 60 B.P., calibrated to ages of 3,810 to 3,540 B.C. The calibrations were adjusted for local reservoir correction for marine shell (Stuiver et al. 1993). Don Morris of the Channel Islands National Park has collected samples from middens on the Channel Islands for radiocarbon dating, and has allowed the use of nine previously unpublished dates from red abalone middens for this paper (Table 1).

The nine additional radiocarbon samples, from eight sites on the south and west sides of Santa Rosa Island (Figure 2), have yielded conventional dates ranging from 5310 +/-90 to 7330 +/-70 B.P., calibrated to ages from 3685 - 3285 B.C. to 5720 - 5445 B.C..

Glassow, while acknowledging the small sample size, has previously noted that the 24 published uncorrected radiocarbon dates for red abalone middens seem to cluster at about 5000 and 7000 B.P. (Glassow 1993). However, as shown in Figure 3, the ten previously unpublished dates, which include nine collected by Morris and one by Dames & Moore, fill in the "gap" between the two time periods. It appears that the red abalone middens are a phenomenon of the middle Holocene, and occurred throughout the period from about 3,800 to approximately 8,000 B.P. Although some radiocarbon dates are missing for this period, the current sample size is relatively small,

and it is likely that middens which correspond to these "gaps" have not yet been discovered.

The ten new dates from Santa Rosa Island appear to cluster at about 5500 B.P., with single dates at 6600 and 7300 B.P.. These dates appear to correspond to SSTs of approximately 22°, 19°, and 21° C, respectively, some of the warmer SSTs exhibited in the last 8,000 years, and well above the 14° C upper temperature limits for red abalone. Mussels have been shown to exhibit a decrease in growth rate in waters below 14° C and above 20° C, with an 89 to 100% mortality rate in waters above 25° C (Suchaneck 1985:83). The relatively high SSTs at these periods could have negatively affected the mussel populations in the Santa Barbara Channel, causing a stress situation in which human populations of the northern channel islands would have had to resort to alternative or less easily gathered shellfish species. However, the period between 3,900 B.P. and 5,200 B.P., while reflecting variable climatic conditions, was in general a time of cooler SSTs. Dates within this period, allowing for previously mentioned discrepancies, may very well have corresponded with cooler water temperatures.

Platform Mussel Shells in Midden Deposits

Several of the sites within Jolla Vieja Canyon appear to be late period sites, one of which was confirmed by radiocarbon dating. Several sites within the canyon contain significant amounts of platform mussel (*Septifer bifurcatus*), and some, including DM-13 and DM-42, exhibit strata with high frequencies of platform mussel. This selection is unusual because the mussel is a small (1_ to 2 inch) shell, found singly on the undersides of rocks in the intertidal zone (Ricketts and Calvin 1968). Compared to the California mussel, it is a difficult species to harvest, and provides a minimal return. A sample of platform mussel shells from site DM-42 was submitted for radiocarbon dating, and the results are described below.

DM-42 is a small rockshelter located in a small side drainage about 1.3 miles up the canyon. The shelter contains two midden deposits, one of which has partially eroded, exposing the profile of the cultural deposit. The midden is exposed to a depth of about 120 cm below surface. Similar to most of the midden sites in the canyon, the cultural constituents are dominated by California mussel shells, with platform mussels also very common, and small amounts of red and black abalone, chiton, turban snails *(Tegula sp.)*, fish and bird bone, and a woven vegetal material which may be sea grass. A sample of a lens of platform mussel shells near the top of the midden submitted for radiocarbon dating yielded a calibrated date of AD 1420 to AD 1720 at 2 sigma, and AD 1465 to AD 1655 at 1 sigma (Beta 87201).

The faunal constituents of the midden are generally what could be expected for a late period site on the Channel Islands. Shellfish was an important resource from the early period throughout the Santa Barbara area, with a gradually increasing reliance upon fish and marine mammals on the mainland. However, on the islands, shellfish was not replaced in importance until the late period. Platform mussel shells are common in the midden deposit at DM-42 with a lens of higher density in the upper levels. This seems to suggest a possible over-exploitation of the California mussel beds at that time. The platform mussel is most likely a stress resource, since it is not as easily harvested in large numbers, and has minimal return compared to the California mussel.

Conclusions

Recent studies by Glassow et al (1994) have indicated that some of these dense abalone middens were deposited concurrent with periods of cooler SSTs that have been documented by Psias. These cooler temperatures, it is thought, may have allowed the red abalone to move into the intertidal zone and been more accessible for collection. It should be noted, however, that our ten new radiocarbon dates on red abalone from Santa Rosa Island cluster slightly later in time, around 5500 B.P., which according to Psias was a period of relative warmth. Although due to

uncertainties in both the radiocarbon dates and in Psias' curve there is no reason to doubt that these later red abalone middens represent cooler SSTs, it is also notable that a number of red abalone dates fall between 6,000 and 7,000 B.P., a period of sustained high SSTs according to Psias. It is also worth noting that periods of cool SSTs occurring during the late Holocene (2,000 to 3,000 B.P. [Figure 1]) have not yet been found to have resulted in red abalone middens. Clearly, more archaeological and paleoenvironmental data are need to resolve these issues.

The presence of high frequencies of platform mussel in components that appear to date to the late period seem to point to a period of economic stress occurring within the past several hundred years. Whether or not this is a part of a larger pattern is not clear, but it may relate to local disruption that reduced the availability of other shellfish species.

In conclusion, only a brief examination of the eroded cross-sections of midden sites within Jolla Vieja Canyon on south Santa Rosa Island shows clear changes in the exploitation of certain species of shellfish over the course of the Holocene. More intensive investigations at these sites would likely reveal specific information regarding the nature and timing of these shifts.

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Table 1. Recent Radiocarbon Dates From Santa Rosa Island

Lab No.	Conventional Age (B.P.)	Calibrated Age (B.C.)	Site
Beta 83996	5560+/-70	3935 - 3610	SRI-92-27
Beta 83997	5490+/-70	3845 - 3515	SRI-92-46
Beta 83999	5310+/-90	3685 - 3285	SRI-92-58
Beta 84002	7330+/-70	5720 - 5445	SRI-92-110[1]
Beta 84003	5830+/-70	4235 - 3900	SRI-92-110[2]
Beta 84004	5820+/-60	4215 - 3910	SRI-92-112
Beta 84005	5620+/-60	3960 - 3660	SRI-92-118
Beta 84006	5480+/-70	3810 - 3500	SRI-92-132
Beta 84008	6680+/-70	5185 - 4790	SRI-93-38
Beta 87202	5500+/-60	3810 - 3540	CA-SRI-147

Note: 1, lowest of three lenses; 2, middle of three lenses

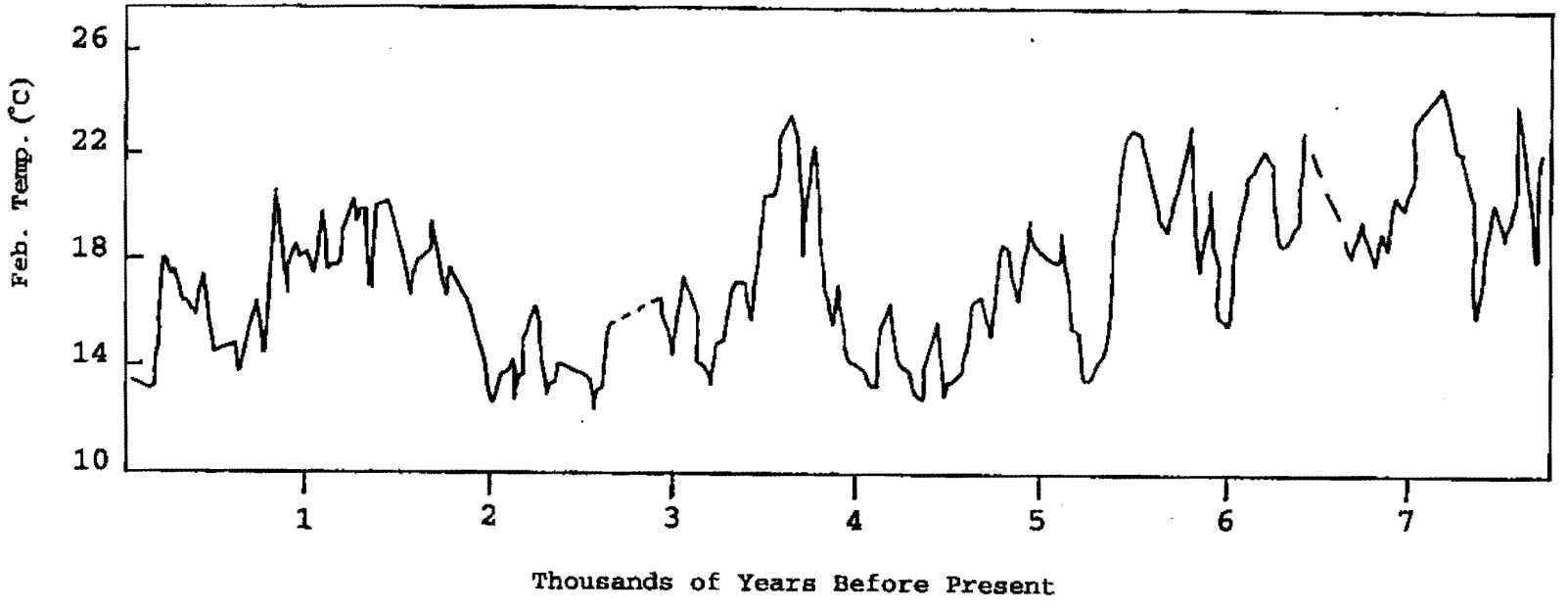


Figure 1. Santa Barbara Channel Sea Surface Temperature Curve
(adapted from Psias 1978)

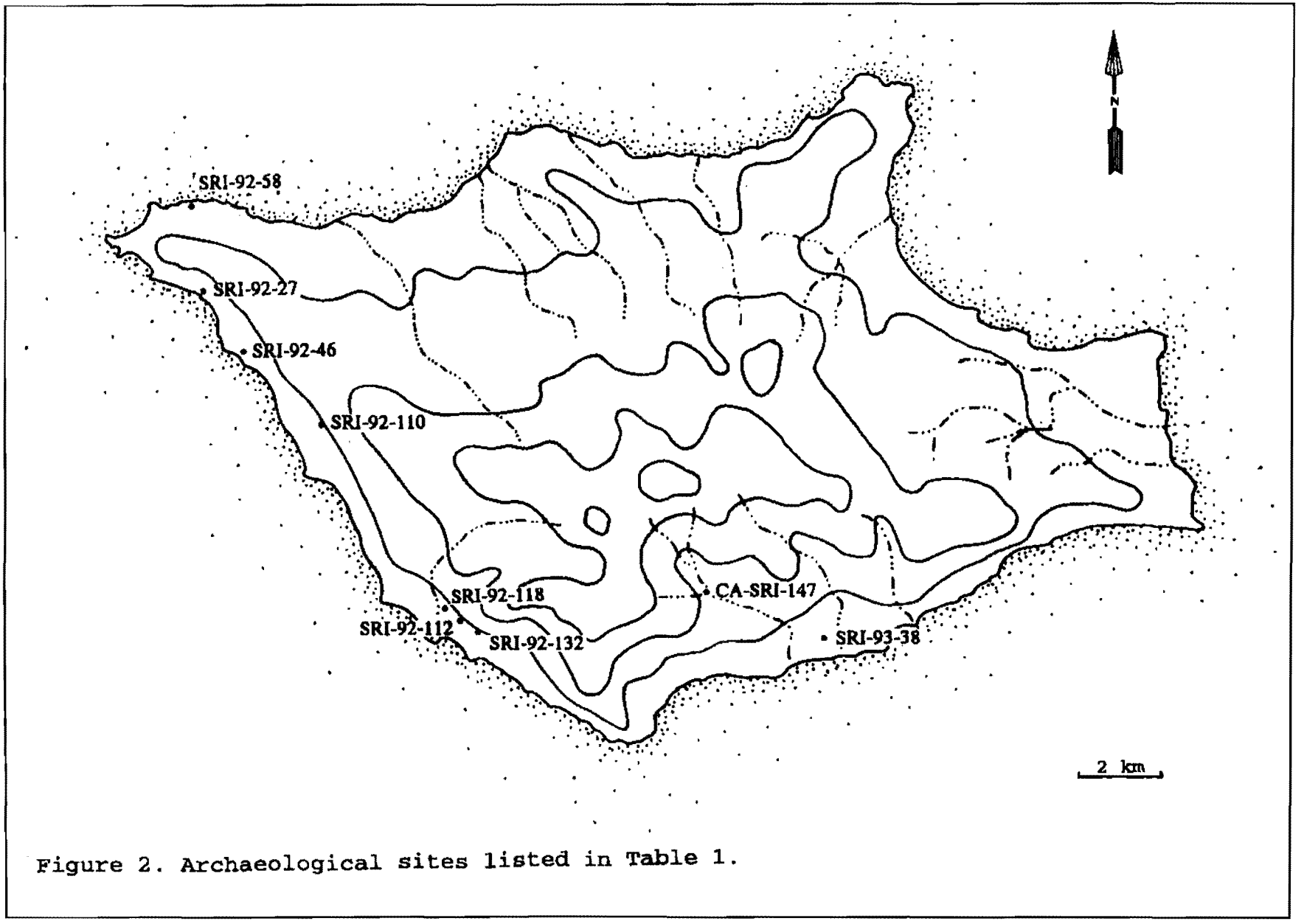
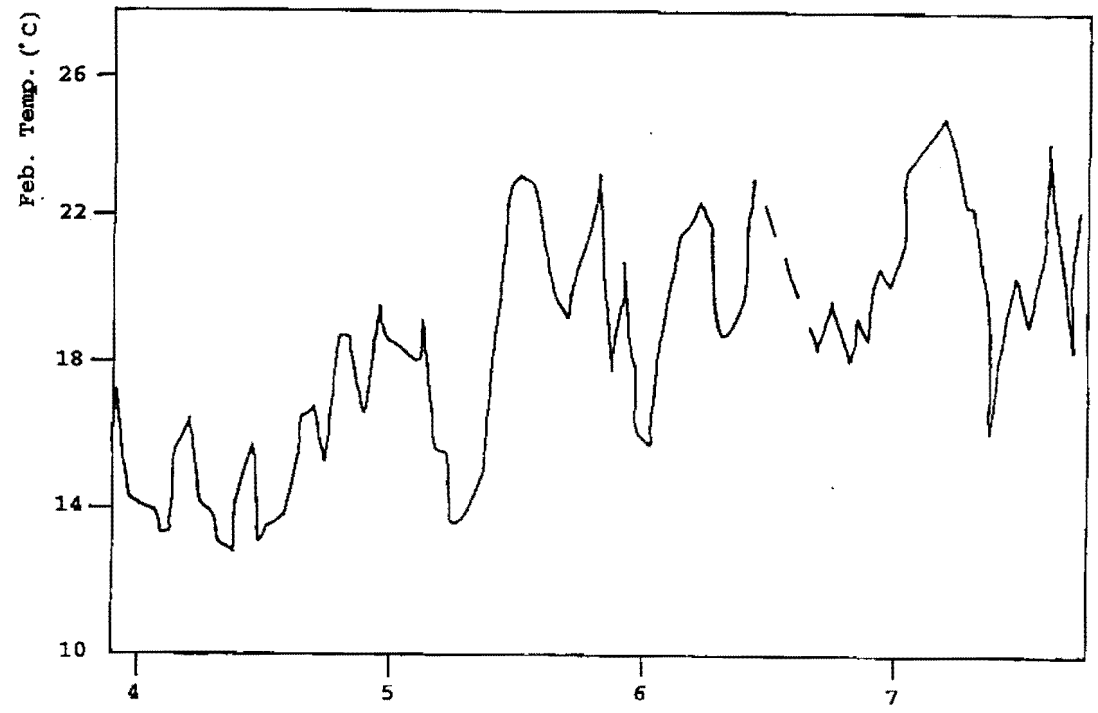
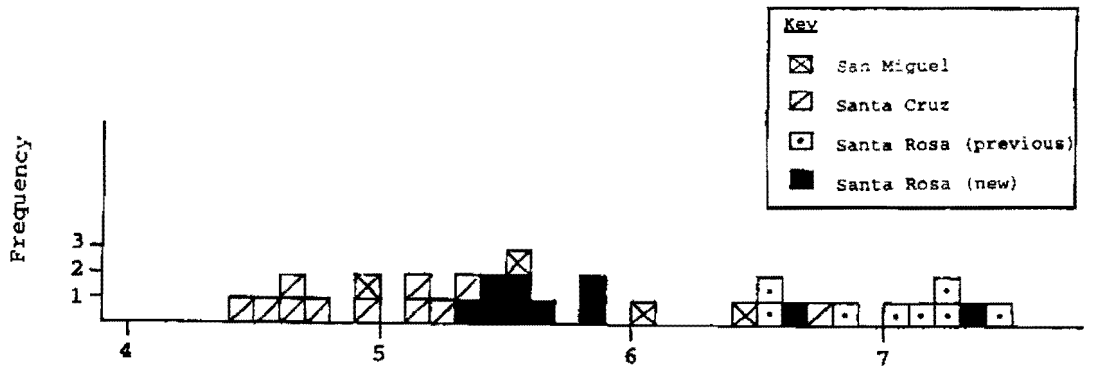


Figure 2. Archaeological sites listed in Table 1.





Radiocarbon Dates From Northern Channel Islands Red Abalone Middens

Figure 3. Comparisons of radiocarbon dates from Northern Channel Islands red abalone middens and Santa Barbara Channel Sea Surface Temperature Curve.