ACKNOWLEDGMENTS

This work would not have been possible without the excellent cooperation of Vail and Vickers Co., the Santa Barbara Museum of Natural History, and the assistance of the National Science Foundation and the United States Navy.

REFERENCES

BERGER, R. 1976. The earliest dates and sites in America. Proceedings IX Congrès Union Internationale des Sciences Préhistoriques et Protohistoriques, Nice, Sec. 4.

———. 1978. Radiocarbon dating with accelerators. J. Archaeol. Sci. 6:1-3.

———. UCLA radiocarbon datelist X. Radiocarbon v. 22 (in press).

BERGER, R., and P. C. ORR. 1966. The fire areas of Santa Rosa Island, California II. Proc. Natl. Acad. Sci. (US) 56:1678-1682.

BROECKER, W. S., and J. L. KULP. 1957. Lamont radiocarbon measurements IV. Science 126:1324-1334.

HRDLIČKA, A. 1928. The origin and antiquity of the American Indian. Smithsonian Report for 1923, U. S. Govt. Printing Office, Washington.

LIBBY, W. F. 1951. Radiocarbon dating. University of Chicago Press, Chicago, Ill.

OLSON, E. A., and W. S. BROECKER. 1961. Lamont natural radiocarbon measurements VII. Radiocarbon 3:141-175.

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

ORR, P. C., and R. BERGER. 1966. The fire areas of Santa Rosa Island, California I. Proc. Natl. Acad. Sci. (US) 56:1409-1416.

Recent Developments in the Archaeology of the Channel Islands

Michael A. Glassow

Department of Anthropology, University of California, Santa Barbara, California 93106

INTRODUCTION

The Channel Islands of southern California provide archaeology with some of its best laboratories in the world for investigating the development of human adaptive systems. Perhaps the most important reason why this is so is that the islands are discrete geographic units on which the diversity and abundance of many of the resources available to human populations may be accurately measured. In addition, the islands vary significantly in a number of environmental characteristics that affect human adaptations, and, as every scientist knows, effective tests of hypotheses require variability in the empirical world. No less important in efforts to develop and test hypotheses concerning human adaptation is the fact that the islands' ecosystems are relatively simpler and potentially easier to understand. Finally, all of the islands contain relatively intact sites in which the exploitation of marine resources is represented. Indeed, the degree of preservation of archaeological resources is especially high on some of the islands, in stark contrast with the coastal strip on the mainland where a large proportion of the sites representing a maritime cultural development has been destroyed. Mention might also be made of the fact that burrowing animals are absent from some of the Channel Islands, especially in the northern group, resulting in greater stratigraphic integrity than is normally found in mainland sites, which often serve as veritable havens for gophers and their kin.

There was comparatively little realization of these distinct advantages in the earlier research beginning in the 1870s, which was primarily concerned with obtaining collections of different kinds of artifacts, almost exclusively from aboriginal cemeteries, that would represent the archaeology of the Channel Islands in museum collections (*e.g.*, Schumacher 1877). Partly because of this early collecting, the archaeological potential of the Channel Islands became widely known, and in the 1920s there was a flourishing of activity by both relatively untrained amateurs and fully professional archaeologists being turned out by the emergent academic discipline of anthropology. Much of the work done at this time, especially that under the auspices of museums, carried on the tradition of the first explorers of Channel Island archaeology (*e.g.*, Heye 1921, Rogers 1929, Bryan 1970; see also Heizer 1969, Heizer and Elsasser 1956, Decker 1970), although somewhat more attention was given to recording provenience of artifacts according to site. Some of the professionals, however, began attempting to define the temporal and spatial variations in the archaeological records of the islands so that their culture histories could be reconstructed, primarily through stratigraphic excavation and simple chronological seriation of collections obtained from cemeteries (*e.g.*, Olson 1930).

After the considerable activity of the 1920s only sporadic archaeological research was carried out on the islands until after the Second World War. The work of Phil Orr on Santa Rosa Island, beginning just after the war and lasting about 20 years, serves as a link between the temporally-oriented workers of the 1920s and the work begun in the early 1950s (Orr 1951, 1968). It was Orr, in fact, who first made extensive use of radiocarbon dating on the Channel Islands.

Beginning in 1953, Clement Meighan and his students at the University of California at Los Angeles (UCLA) began a research program on the Channel Islands. With the founding of the

Archaeological Survey at UCLA in 1958 this program was intensified, involving extensive reconnaissance and some excavation on all of the Channel Islands except Santa Cruz, Santa Rosa, and San Miguel (Meighan and Eberhart 1953, McKusick 1959a, 1959b, McKusick and Warren 1959, Meighan 1959, Reinman and Townsend 1960, Swartz 1960a, 1960b, Reinman 1962, 1964).

The program begun by UCLA merged with that of Charles Rozaire, who not only participated in UCLA and Southwest Museum field projects on the Channel Islands in the late 1950s (Rozaire 1959a, 1959b), but maintained an active field program on many of the islands through the middle 1960s (Rozaire 1965, 1967, Rozaire *in* Bryan 1970). Although much of Rozaire's results is still in preparation, he produced some of the best data we have from his intensive surveys (many carried out by G. Kritzman) and careful excavations.

The major objectives of the research on the Channel Islands during the 1950s and early 1960s were to systematically inventory the archaeological resources of each of the Channel Islands investigated, identify the major periods of prehistoric development on each of the islands, and trace the evolution of maritime ecological adaptation. This latter objective is best characterized by Meighan's well-known study at Little Harbor on Santa Catalina Island (Meighan 1959) and Reinman's investigations on San Nicolas Island (see esp. Reinman 1964). In order to document the characteristics of maritime adaptations, the various workers abandoned the focus on cemetery excavations and began to use the techniques of midden analysis that had developed in California archaeology out of investigations of San Francisco Bay shellmounds. The ecological studies of this era laid the foundation for much of the current research.

Recent environmental legislation gave impetus to a major aspect of Channel Islands archaeological research beginning in the early 1970s. The federal government became committed to a much more active role in managing the cultural resources, which include archaeological sites, on the five Channel Islands it owns. The first steps in the evolving management programs are to inventory the archaeological resources and to assess the current state of archaeological knowledge so that the significance of the resources may be determined. An overview of Northern Channel Island archaeology was recently undertaken in light of the latter objective (Glassow 1977). Rozaire's surveys on Santa Barbara, Anacapa, and San Miguel Islands in the early 1960s anticipated the current inventory programs which are now being carried out on San Clemente Island by Michael Axford, and by Rozaire and his colleagues on San Nicolas Island. In addition, Roberta Greenwood is currently assessing the existing inventories and site conditions on Santa Barbara, Anacapa, and San Miguel Islands.

As part of the current emphasis on the conservation of archaeological resources, archaeologists are also finding themselves in the position of having to salvage information from sites before they are destroyed by some sort of land-modifying development. A crew from the UCLA Archaeological Survey, for instance, undertook salvage excavation at an important site near Avalon on Santa Catalina Island (Finnerty *et al.* 1970), and we can expect to see similar projects on many of the islands in the future.

Beyond the research related in one way or another to cultural resource management, there has been a recent increase in basic research on the Channel Islands. UCLA Archaeological Survey crews undertook extensive surveys on Santa Catalina Island during the early 1970s in order to identify the determinants of site distributions, and they have also expanded the sample of excavated material from the Little Harbor site investigated by Meighan in the 1950s (Nelson Leonard, III, pers. comm., Tartaglia 1976). Excavations were also undertaken at other sites on Santa Catalina Island by Leonard for the purpose of elucidating the nature of the steatite container manufacturing industry that is so obvious at sites on this island.

A similar program was initiated by Albert Spaulding and me on Santa Cruz Island for the purpose of studying the evolution of maritime adaptations. Not only have we surveyed about 10 per cent of the land area of this island, but we have also obtained a number of stratigraphic column samples from a series of coastal sites, most of which have been radiocarbon dated. In addition, we undertook major excavations at a large midden site at Prisoners Harbor.

Summarizing this discussion of the history of archaeological research on the Channel Islands, I would like to point out that in spite of the considerable amount of effort that has been devoted to collecting archaeological data, our knowledge of the prehistories of individual islands is still very sketchy. The type of research that is relevant to modern problem orientations only began in the 1950s and was devoted, for the most part, to surveys and comparatively small-scale excavation programs. Much of the research undertaken since the middle 1960s is still unpublished, although the results will be available within the next few years. But in spite of the fact that scientific archaeological research on the Channel Islands is just beginning, enough data are available to propose some tentative outlines of their prehistories and to compare their cultural developments.

THE DEVELOPMENT OF CHANNEL ISLAND CHRONOLOGIES

The degree to which the archaeologist is able to elucidate the nature of prehistoric development depends, to a large extent, upon the precision of a chronological framework, so it is appropriate to begin my review with a survey of the chronological information currently available for the Channel Islands. Initially, I should point out that there are still very real questions regarding when each of the Channel Islands was first inhabited. Phil Orr has contended that human occupation on Santa Rosa Island began on a more or less continuous basis during the late Pleistocene, perhaps as early as 37,000 B.P. (Orr and Berger 1966, Berger and Orr 1966, Orr 1968). Orr's evidence for Pleistocene occupation is rather circumstantial, however, and not enough of the data have been reported to allow a convincing argument to be made. The same must be said regarding a series of early post-Pleistocene dates from San Miguel Island obtained by Johnson (1977). These are purported to be associated with midden strata, but the contents of these strata, especially with regard to items definitely associated with human occupation, have not been reported. Consequently, the question of Pleistocene occupation on Santa Rosa and San Miguel Islands cannot be answered until more adequate data are presented to the archaeological community.

The earliest clear evidence of extensive occupation of the Channel Islands comes from the northern group, in particular Santa Cruz and Santa Rosa Islands. The earliest radiocarbon dates unquestionably associated with human occupation on Santa Rosa Island come from samples collected from cemeteries located on the northwest coast dating between 7,500 and 6,800 B.P. On Santa Cruz Island, the basal levels of two sites, one near the northwestern extreme of the island and one at Punta Arena on the south coast, date about 6,700 and 7,100 B.P., respectively (Table 1). Three dates from purported middens on San Miguel Island also fall within this general range of time (Johnson 1977). Until very recently, the earliest dates so far available for any of the islands in the southern group did not extend beyond 5,000 B.P., and only one reported date, from recent excavations at the Little Harbor site, extended beyond about 4,000 B.P. (Tartaglia 1976, Nelson Leonard, III, pers. comm.). However, information from Michael Axford (pers. comm.) regarding two radiocarbon dates from a site on San Clemente Island indicates a period of occupation around 8,000 B.P. In addition, two other dates fall between 5,000 and 6,000 B.P. (Axford 1978); they appear to indicate that the Southern Channel Islands were occupied as early as, if not somewhat earlier than, the Northern Channel Islands. Three sites on San Nicolas Island, investigated in the 1960s, have yielded dates in the 3,000 to 4,000 B.P. range.

The difference between the earliest dates for the Northern and Southern Channel Islands should not necessarily be taken as representing a difference between time of earliest occupation. The radiocarbon-dating programs have been relatively minimal on the Southern Channel

TABLE 1. Radiocarbon dates and column sample results from Santa Cruz Island.

Site number	Vicinity	Column number	Depth of radiocarbon-dated sample (cm)	Radiocarbon years B.P.	Approximate solar years B.P.†	UCR‡ sample number	Depth of column sample (cm)	Shell density (g/1000 cm³)	Shell (%)	Fish (%)	Mammal (%)
277	Near West Point	1	14-23	3210±150	3395	205	0-20	453.9	99.9	T	T
		1	122-132	5920±150	6580	203	120-130	736.0	99.5	0.1	0.4
		1	152-163	6730±230	7350	387	152-163	586.2	99.9	T	0.1
195	East of Forneys	1					20-40	258.0	96.2	3.3	0.5
	Cove	1	100-109	280±150	unavailable	206	100-120	160.8	95.9	3.7	0.4
		1	380-388	2310±150	2305	207					
		1	406-410	1605±100	1540	386	387-406	810.1	98.9	0.8	0.3
191	Christi Beach	2	55-67	1870±100	1815	399	55-67	171.3	99.2	0.8	0.0
		2	103-115	2010±140	1965	398	103-115	42.0	98.8	0.8	0.4
		4	73-80	1660±100	1595	400	73-80	552.0	99.6	0.2	0.2
236	"	1	100-121	630±100	630	391	100-121	172.1	98.6	1.2	0.2
		1	185-195	1685±100	1625	130	183-195	316.0	97.0	2.7	0.3
		1	238-248	4435±100	4940	131	235-250	133.3	99.9	T	T
		2	205-220	1535±150	1470	132					
145	Mouth of Cañada	1	36-41	1630±150	1565	208	27-40	196.4	97.7	2.0	0.3
	de los Sauces	1	36-41	1710±150	1650	200					
		1	50-55	2545±150	2605	388	50-55	223.0	90.2	1.7	8.1
146	"	1	3-10	5290±150	5930	202	0-19	181.9	99.9	T	T
192	Morse Point	1	17-25	740±150	725	396	0-17	342.0	97.4	2.4	0.2
		1	69-77	650±130	650	397	77-83	118.7	86.2	13.3	0.5
292	"	1	38-44*	3550±170	3825	204	38-50*	554.7	99.7	0.1	0.2
		1	50-57*	4360±180	4850	389	50-57*	437.7	99.6	0.3	0.1
109	Punta Arena	1	100-108	4600±150	5140	209	121-132	443.6	95.7	T	4.3
		2	100-104	4790±150	5480	201	104-119	362.3	97.4	T	2.6
		2	210-232	7140±210	unavailable	390	210-232	178.3	99.9	T	T
127	"	1	11-20	1130±140	1080	403	11-20	415.7	94.7	1.5	3.8
		1	120-130	1955±100	1910	404	120-130	72.6	96.2	0.9	2.9
1	Mouth of Coches	1	7-23	<150	unavailable	395	7-23	446.5	95.4	2.3	2.3
	Prietos drainage	1	123-131	2470±130	2490	394	123-131	198.9	98.4	1.3	0.3
363	Lower Twin Harbors	1	0-16	4380±180	4875	401	0-16	337.5	99.9	T	0.0
	drainages	1	20-29	4265±180	4730	402	20-29	440.7	99.9	T	0.0
369	"	1	12-27	2650±140	2580	392	12-22	394.4	99.9	0.1	T
		1	100-116	4800±120	5375	393	100-116	252.8	99.9	T	T

* Not including 100-cm sterile dune-sand overburden.
† From tables in Damon *et al.* 1974.
‡ University of California, Riverside, Radiocarbon Laboratory.
T = trace.

Islands, whereas the number of dates for Santa Cruz Island and Santa Rosa Island for periods beginning around 7,500 B.P. has been much greater.

Beyond the problem of dating the earliest occupations of the various Channel Islands, chronologies covering the period from the first known occupations of the islands to the time of European contact are still poorly developed. Orr has proposed a chronology for Santa Rosa Island which has four period divisions. His sample of dated site components is so small, however, that his periods may only be said to be a convenient way to order the available data chronologically. The same may be said of Hoover's chronological scheme for Santa Cruz Island, which is based on an analysis of collections, primarily from cemeteries, obtained by Ronald Olson in the 1920s (Hoover 1971). Because of similarities in artifact forms to those from radiocarbon-dated sites on Santa Rosa Island, Hoover believes that the four phases in his sequence span roughly the same length of time as Orr's Santa Rosa Island sequence, beginning around 7,500 B.P.

Established sequences of this sort do not exist for the other Channel Islands, although there has been some recognition that chronological differences do exist. The three sites on San Miguel Island that Rozaire tested in the 1960s have not been radiocarbon dated, but the styles of shell beads, which serve as relatively sensitive time markers, indicate occupation between 5,200 B.P. (possibly somewhat earlier) and 1,000 B.P. For Anacapa Island, shell beads from Rozaire's excavations at two sites on the western islet indicate an occupation perhaps pre-dating 2,000 B.P. and extending into the historic period (Walker n.d.). The collections from Santa

Barbara Island do not contain sensitive time markers, although the presence of shell fishhooks and the relatively shallow deposits (between 45 and 60 cm in depth) appear to indicate relatively late and intermittent occupation, perhaps dating after 1,000 B.P.

On Santa Catalina Island, there has at least been recognition that there was considerable late prehistoric occupation, along with the earlier occupation first identified at Little Harbor (Finnerty *et al.* 1970, Nelson Leonard, III, pers. comm.). A similar differentiation has been made for San Nicolas Island; Reinman (1964) reports that the earlier sites contain only bone fishing gorges, while the later sites contain crescentic shell fishhooks, in addition. Moreover, mortars and pestles are rare in earlier sites but abundant in later ones (see also Reinman and Townsend 1960). On San Clemente Island, McKusick (1959a, 1959b) recognized three complexes, one of which contained historic material dating within the mission era. The other two complexes have no stratigraphic relationship to each other, and both contain shanked fishhooks that may indicate a date after 1,000 B.P.

It should be apparent from this brief summary of chronological information for the Channel Islands that the data are simply too meager to arrive at any clear understanding of the sequences of cultural development on any of the islands. The formal sequences on Santa Rosa and Santa Cruz Islands are probably premature and will undoubtedly require extensive revision once additional representative samples of occupational components have been clearly defined and dated. It is my impression, moreover, that discrete named periods or phases are really not necessary for understanding the cultural developments on the islands. The following discussions will simply make use of what chronological information is available.

DIVERSITY IN PREHISTORIC SUBSISTENCE

A reasonable place to begin developing an understanding of Channel Islands prehistory is with the study of subsistence systems, since these have so much to do with many other aspects of cultural adaptations. It will be profitable initially to compare some of the general differences between island and coastal mainland archaeological records; these differences will give some idea of how the habitats of the islands exerted considerable influence on prehistoric cultural systems.

Population Density

One of the most obvious clues to subsistence differences between the Channel Islands and the adjacent mainland is the relative density of sites. Generally speaking, densities are much higher on the Channel Islands than on the mainland. Quite a number of scholars have interpreted these higher site densities as indications of high population densities (see Meighan and Eberhart 1953) and have inferred that island population densities were much higher than on the coastal mainland, but there is every reason to believe that the high site densities are really only the result of high population *mobility*. That is, whereas mainland population aggregates may have seasonally occupied, perhaps, only five sites through the course of an annual cycle, the population aggregates on the islands may very well have occupied a far greater number, largely because of a much greater dependence by the islanders upon intertidal resources such as various species of shellfish. That shellfish were of much greater importance on the islands is indicated by a comparison of densities of shell in island and coastal mainland middens (Tables 1 and 2). Although available data are sparse for mainland sites, it appears that densities are usually below 100 g per 1,000 cm³; it is not unusual to find sites on the islands with densities over 400 g per 1,000 cm³. Furthermore, many of the exceptions on the islands are obviously the result of dune-sand accumulation during midden deposition.

Returning for the moment to the question of how dense the populations really were on the Channel Islands, population density is partially dependent upon the abundance and types of food resources in the environment. There are, of course, no good archaeological measures of

TABLE 2. Densities of shell in southern California midden sites.

Site number and location	Periods represented*	References	Maximum shellfish density in g/1000 cm³
SBa-142, Glen Annie Canyon, Goleta	Early	Owen, Curtis, and Miller 1964	11.5
LAn-267, Sweetwater Mesa, Malibu	Early	King 1967	121.0
LA-215, Parker Mesa, Malibu	Early	King 1962	18.0
Ven-3, *Shisholop*, Ventura	Late	Greenwood and Browne 1969	42.4
SMI-1, San Miguel Island	Early to Middle ?	Rozaire 1965	89.1
Surface samples from Anacapa Island sites	probably Middle to Late	McKusick 1959a	247.3
AnI-8, Anacapa Island	Middle to Late ?	McKusick 1959a	131.0
AnI-6, Anacapa Island	Late ?	McKusick 1959a	59.2
AnI-5, Anacapa Island	Late ?	McKusick 1959a	119.1
SNI-16, San Nicolas Island	Late	Reinman 1964	83.0
Little Harbor site, Santa Catalina Island	Middle	Meighan 1959	370.7†

* Early: 7500-3200 B.P., Middle: 3200-1000 B.P., Late: 1000-165 B.P.
† Only average density available

island population sizes, so it is necessary to depend upon ethnohistorical data of population sizes during the early mission period. In this paper I shall confine my investigation of this problem to the Northern Channel Islands and the adjacent coastal mainland which were occupied at the time of contact by Chumash-speaking peoples. Three sets of estimates of Chumash village sizes have been published (Brown 1967, King 1971, Whitehead and Hoover 1975); I have selected King's because it appears to be based on a greater variety of ethnohistoric and ethnographic information. Using the midpoints of each of King's range estimates, Santa Cruz Island, with eleven villages and a total population of 1,187, had a density of 4.76 people per km²; Santa Rosa Island, with eight villages and a population of 637, had a density of 2.94 people per km²; and San Miguel Island, with two villages and a total population of 107, had a density of 2.89 people per km². Anacapa Island had no historically recorded villages. In contrast, the coastal mainland strip from Rincon Point on the east to Gaviota on the west to the crest of the Santa Ynez Range on the north had a population of 4,908, using the mid-range estimates for the 17 villages in this region. The density along this mainland strip was 8.09 people per km², which is nearly twice that on Santa Cruz Island, the most densely occupied of the group.

The much lower population densities on the Northern Channel Islands—and probably on the Southern Channel Islands also—is undoubtedly the result of the much lower terrestrial resource diversity on the islands in comparison to the mainland. In fact, those portions of the coastal mainland with the greatest resource diversity, such as in the vicinity of well-developed sloughs, had much higher population densities than adjacent coastal mainland areas. The vicinity of the Goleta Slough, for instance, had a density of 11.00 persons per km². The greater population density on the mainland also reflects another significant aspect of island subsistence: the relatively greater abundance of marine resources around the peripheries of the islands did not offset the mainland advantage of having bountiful supplies of different kinds of terrestrial food resources.

Turning now to the variation in the density of sites between the different Channel Islands, we note considerable differences among the islands where adequate data are available. San Miguel Island, which has been completely surveyed, contains 542 sites (Charles Rozaire, pers. comm.) and has a density of 14.65 sites per km². Our survey of 15 drainage areas on Santa Cruz Island yielded a sample of 297 sites. If the sample is representative, the total number of sites on the island would be somewhat over 2,700, and the density would be 11.05 sites per km². The Anacapa islets contain 21 recorded sites, which appears to be the total number; the site density is 7.24 per km². Orr's survey data from Santa Rosa Island are not comparable because of the manner in which he grouped sites into "localities," and perhaps also because of the island's much better grass cover which may obscure sites. Forty to forty-five per cent of Santa Catalina Island's area that has been systematically surveyed has yielded about 900 sites (Nelson Leonard, III, pers. comm.), so the island total is probably on the order of 2,100, and the density would be approximately 10.81 sites per km². The intensive survey of San Clemente Island has so far covered about 30 per cent of the island and has yielded a total of 1,164 sites (Michael Axford, pers. comm.). The total for San Clemente Island may therefore be around 3,900, and the density would be 26.75 per km². Santa Barbara Island, with 19 sites, has a density of 7.34 sites per km². Meighan and Eberhart (1953) report only 68 sites on San Nicolas Island, an unusually low number compared to the other islands that appears to be the result of combining several discrete deposits under one site designation (*e.g.*, SNI-16; see Reinman 1964, map 2). Rozaire (pers. comm.) suspects that the density of sites on San Nicolas Island is comparable to that on San Miguel Island.

Although some of the variation in site densities on the Channel Islands may be attributed to differences in technique among even the recent surveys, which are presumed to be generally more intensive and discriminating than earlier surveys, there appear to be some expectable patterns. First, the two smallest islands, Anacapa and Santa Barbara, are very similar in having the lowest site densities of all the Channel Islands. This was probably the result of very sporadic occupation of a few favored localities during periods when fresh water was available. On the other extreme are San Miguel Island and San Clemente Island; San Clemente Island's estimate seems especially high. It is possible that their high densities in comparison with the larger islands may be related to comparatively higher degrees of population mobility caused by greater dependence on marine resources. However, Michael Axford (pers. comm.) expects the unsurveyed portions of San Clemente Island to have lower densities; consequently, the overall density may actually be in line with that on San Miguel Island. This leaves Santa Cruz Island and Santa Catalina Island, which have quite similar densities that appear to be related to roughly comparable diversities of terrestrial resources (Raven 1967). It will be interesting to see how these explanations of differences among the Channel Island population densities hold up when we become more confident of comparability between the survey data from one island to the next.

Shellfish Exploitation

There is another factor that should be mentioned which might have something to do with the variation in densities of sites. This is the fact that there are some differences in the repertoires of exploited shellfish species between the different islands. Within the northern group, mussel (*Mytilus californianus*) nearly always comprises over 90 per cent by weight of the total shell in the midden deposits of any time period (*e.g.*, Rozaire 1965), and black abalone (*Haliotis cracherodii*) is usually next in abundance. There is a possibility that red abalone (*H. rufescens*) is predominant, perhaps even over mussel, in some of the earliest sites on the Northern Channel Islands, although this observation is based primarily on shells found in cemeteries rather than occupation middens (Orr 1968). By comparison, the proportions of different species of shellfish in sites on the Southern Channel Islands are quite variable. The Little Harbor site on Santa Catalina Island revealed a shift from a predominance of black abalone in the lower levels to a predominance of mussel in the upper levels (Meighan 1959). Just the opposite is true at the Eel Cove Canyon Shelter on San Clemente Island, and this site also contained significant amounts of black top (*Tegula funebralis*) shells throughout its depth (McKusick and Warren 1959). We see similar variability on San Nicolas Island, where mussel is even less important in comparison to other species, and the proportions of mussel, abalone, black top, and sea urchin (*Strongylocentrotus* sp.) vary considerably within and between sites (Reinman 1964).

The difference in the importance of mussel between the Northern and Southern Channel Islands appears to be related to its much greater productivity around the Northern Channel Islands. Prehistoric populations on the southern islands compensated for the lower abundance of mussel by using other species. The greater variety of shellfish in the middens on San Clemente Island, and especially on San Nicolas Island, may additionally be related to relatively higher levels of predation on the shellfish populations.

The shift through time in the emphasis on different species of shellfish, which has been noted on all of the Southern Channel Islands for which data are available, has been proposed to be the result of either local depletion of a particular species (Meighan 1959, Tartaglia 1976) or change in human preferences (Reinman 1964). The latter proposal should, it seems, be discarded since food preferences are determined to a large extent by the availability and costs of obtaining resources. The former proposal, however, is also less than satisfying since it implies that a period of hundreds or perhaps thousands of years—the duration of time represented in many of these sites—would be required for a population aggregate to deplete local shellfish resources. While resource depletion may very well be involved, it would probably have been a much more complex phenomenon related to human population growth and decline on each of the islands and perhaps also to minor climatic fluctuations. There is obviously much work that must be done before these processes of change in shellfish species exploitation will be better understood.

Fishing

Although shellfish remains are the most visible constituent in many of the sites on the Channel Islands, their dietary importance was moderate compared with fishing and sea mammal hunting (Meighan 1959, Tartaglia 1976). Of these two subsistence activities, the issues surrounding the importance and strategies of fishing have attracted the most attention. Direct evidence of fishing extends through all of the known prehistory of Santa Cruz Island, and the available evidence appears to indicate the same for all of the other islands. Nonetheless, the emphasis on fishing changed significantly through time. Orr (1968) notes the importance of

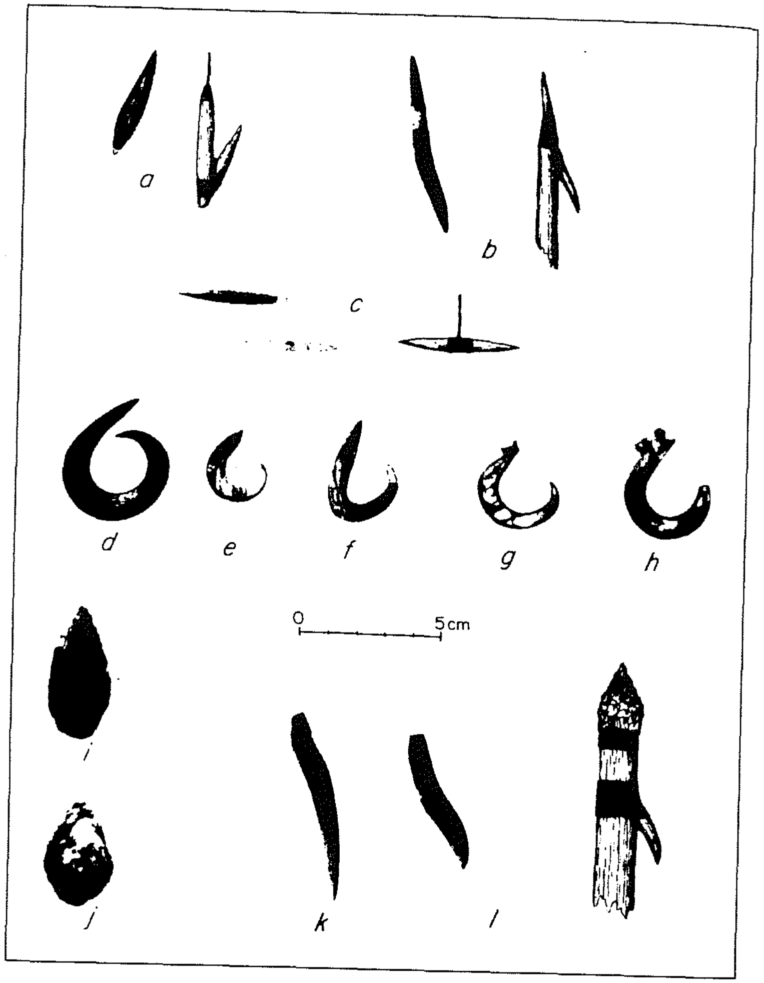

FIGURE 1. a: *Probable bone barb of a compound fishhook from Prisoners Harbor, Santa Cruz Island; drawing shows form of a complete hook.* **b:** *Bone point from Prisoners Harbor, Santa Cruz Island (note asphaltum deposits reflecting technique of hafting); drawing shows hafting technique.* **c:** *Bone fish gorges from Prisoners Harbor, Santa Cruz Island, and Tecolote Point, Santa Rosa Island; drawing shows technique of line attachment.* **d-f:** *Unshanked fishhooks of bone* (**d**) *and mussel shell* (**e, f**) *(note asphaltum deposits with line impressions on* **d** *and* **e**)*; from Christi Beach* (**d, e**) *and Platts Harbor* (**f**)*, Santa Cruz Island.* **g-h:** *Shanked fishhooks of abalone shell from San Nicolas Island.* **i-j:** *Chert projectile points which may have served as harpoon or spear points (asphaltum adhering to base of* **i** *reflects hafting technique); from Prisoners Harbor, Santa Cruz Island.* **k-l:** *Bone barbs that would have been attached to harpoon or spear shafts below the point (both have asphaltum deposits reflecting hafting technique); from Prisoners Harbor, Santa Cruz Island; drawing shows probable hafting arrangement of point and barb.*

fishing on Santa Rosa Island beginning with the Canaliño period, or roughly 2,500 B.P., and our data from Santa Cruz Island indicate a similar date for its increased importance (Tables 1 and 2). In addition, an increase in fishing, not yet dated, was recognized by Reinman (1964) in his analysis of material from San Nicolas Island. Data are not available from the other Channel Islands, but it is expected that the same general pattern will be consistent throughout, although the dates for the increase may vary.

Fishing is also indicated by the presence of fishhooks, which have been found on all of the Channel Islands (Fig. 1). There are a number of different types of fishhooks, and some of them are chronologically significant. More importantly, each type is undoubtedly associated with different fishing techniques or strategies. Recently, Tartaglia (1976) has attempted to identify the functional significance of many of the major fishhook forms; his inferences form the basis of the following discussion.

The earliest type is the bone gorge, which is prevalent in the Little Harbor site between about 5,000 and 4,000 B.P. It is also the earliest type on San Nicolas Island, dating around 4,000 B.P. In addition, fish gorges are the predominant type at a site that appears to date from about 3,200 B.P. on San Miguel Island (Rozaire 1965) and may also be the earliest type at the Prisoners Harbor site on Santa Cruz Island.

Tartaglia (1976) believes that gorges were used to catch shallow-water fish that, upon striking the bait, swallow the attached hook. These shallow-water fish could have been caught either from shore or from boats operating on the landward side of kelp. Significantly, seaworthy watercraft capable of crossing the channel would not have been necessary for this type of fishing.

Circular or "J"-shaped fishhooks of shell and sometimes bone or stone appear to have become important relatively late in prehistory, perhaps after A.D. 1. Circular hooks are especially abundant on San Nicolas Island and appear to indicate a much stronger emphasis on fishing compared with all the rest of the Channel Islands. Tartaglia (1976), citing experiments undertaken by Robinson (1942), believes that the circular hooks were used to obtain near-shore bottom-feeders occupying either sandy or rocky-bottom habitats; these hooks appear to be most effectively used from a boat, although not necessarily one capable of crossing the channel. The "J"-shaped hooks, on the other hand, would be used for trolling in the open waters beyond the kelp (Tartaglia 1976), necessitating the use of seaworthy craft.

Implicit in the literature treating the development of fishing on the Channel Islands and adjacent mainland is the assumption that the elaboration of fishing technology reflects an increasingly successful or improved cultural adaptation. Such an assumption neglects the fact that this development represents increasing investments in the manufacture and maintenance of the various tools and facilities associated with the fishing technology. Because of these investments, it is doubtful that the development of fishing technology was simply the result of discovering better ways to obtain food. The determinants of this development may be directly related to a broadly based population growth throughout the Channel Islands and adjacent mainland, and indirectly to the development of trade networks. The increasing importance of fishing, in other words, may have resulted from increasing population pressure on terrestrial and intertidal resources.

Before leaving the subject of fishing, some of the information that is available on variation in species of fish caught by the prehistoric fishermen of the Channel Islands should be noted. Identified collections of fish remains are still very few; in fact, it has only been within the last four or five years that there has been any systematic effort to identify fish remains from Channel Island sites, and most of the results are still unpublished. First, there are striking differences in the sizes and, to a lesser degree, the species of fish remains from a site excavated by Rozaire near Point Bennett on San Miguel Island compared with the remains in the column sample collections obtained from Santa Cruz Island. The most abundant remains from the San Miguel Island site are of lingcod, various rockfishes, sculpins, pile perch, and sheephead, all of which inhabit near-shore zones with rocky substrates. Most of these remains are several times larger than those of the rockfishes, surfperches, and sheephead that predominate in the Santa Cruz Island samples. The San Miguel Island collection also contains mackerel and tuna remains in small quantities, indicating exploitation of offshore waters to a limited extent. So far, no remains of these schooling fish have been found in the Santa Cruz Island column samples. The differences in the fish remains from San Miguel Island and Santa Cruz Island are due, at least in part, to the differences in water temperatures between the islands (Hubbs 1967) and to the considerably more extensive, shallow, rocky-bottom habitat around the perimeter of San Miguel Island, especially off the west end. San Miguel Island is obviously the best endowed of the Northern Channel Islands so far as nearshore fishing is concerned.

Two collections from West Anacapa Island have also been analyzed. The earlier of the two, perhaps dating around 2,000 B.P., contains primarily remains of rockfish and sheephead, which are especially abundant in the lower portions of the deposit. Elasmobranchs are better represented in the upper part of the deposit. The second site, probably dating after 350 B.P., contains an abundance of remains representing mackerel, bonito, and herring. All of these are schooling fish that would have been obtained from the open waters of the channel, the latter almost certainly with some sort of net or seine. This seems to indicate that Landberg's (1975) recent thesis that schooling fish were not important during the late prehistoric period may have to be re-evaluated.

There have yet to be made available analyses of fish remains from any of the Southern Channel Islands. Tartaglia (1976) does note that the lowest levels of the Little Harbor site contain predominantly skipjack, albacore, and some sheephead, whereas these species are absent in the upper levels. Since skipjack and albacore prefer warm waters and do not presently pass close to Santa Catalina Island, Tartaglia suspects their presence indicates that ocean temperatures were relatively warmer near the island than they are today.

While the analyses of fish remains are still too few to recognize more than tentative spatial and temporal patterns of fish exploitation, it has at least been possible to indicate that there is quite a bit of variability both between islands and between sites representing different periods of prehistory. It is likely that species living in near-shore zones with rocky substrates were not only among the first to be exploited, but also were always relatively important. The exploitation of schooling fish in the open channel and perhaps beyond probably began at the time when seaworthy watercraft were developed. This may have occurred as early as 5,000 to 4,000 B.P., if the data from the Little Harbor site are indeed representative. The Anacapa Island data seem to indicate that netting was added to fishing technology relatively late in prehistory. In general, the trend appears to have involved the expansion of the number of ocean habitats exploited and the concomitant elaboration of fishing technology to obtain a broader range of species.

Sea Mammal Hunting

Exploitation of sea mammals, including dolphins, porpoises, and several species of pinnipeds, appears relatively early in the prehistory of the Channel Islands. Meighan (1959) was the first archaeologist in southern California to clearly recognize that sea mammals, along with fish, became important much earlier than the late prehistoric period which began between 2,000 and 1,000 B.P. In his excavations of the Little Harbor site he found that an intensive exploitation of sea mammals had begun by 4,000 B.P., and recent radiocarbon dating at this site indicates that it may have begun a millennium earlier. On San Nicolas Island, sea mammals were equally important during the earliest occupation, and both sea mammals and fish were extremely important in the later occupation of that island (Reinman 1964). Interestingly, the use of sea

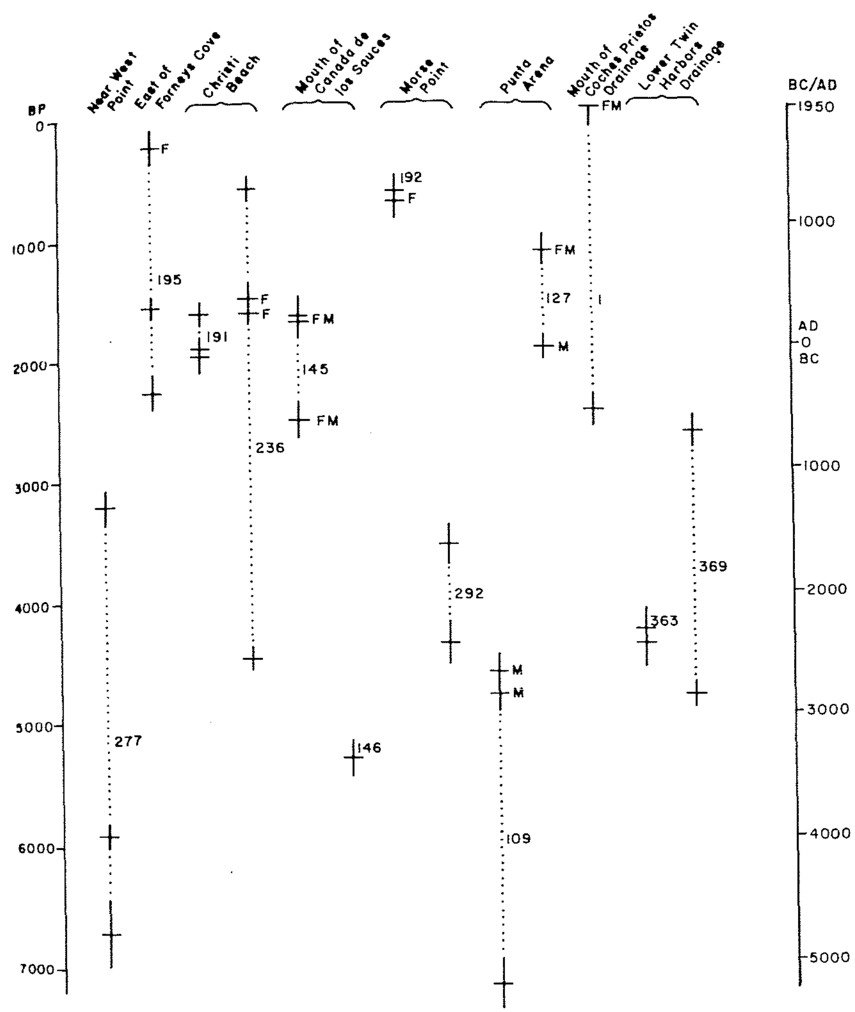

FIGURE 2. *Distribution of radiocarbon dates on Santa Cruz Island (excluding the Prisoners Harbor series).*

mammals—and sharks—on San Nicolas Island is reflected in a unique occurrence of rock art on this island (Reinman and Townsend 1960, Bryan 1970).

As expected, the sites on San Miguel Island, where extensive rookeries currently exist, contain abundant remains of pinnipeds. These animals were a major food resource on this island from the time of the earliest occupation. Phillip Walker (pers. comm.), who has analyzed the faunal remains not only from Rozaire's excavations, but also from a number of other Santa Barbara Channel Island and mainland sites, believes that sea mammal meat may have been extensively traded from the source on San Miguel Island. For Santa Cruz Island, the available

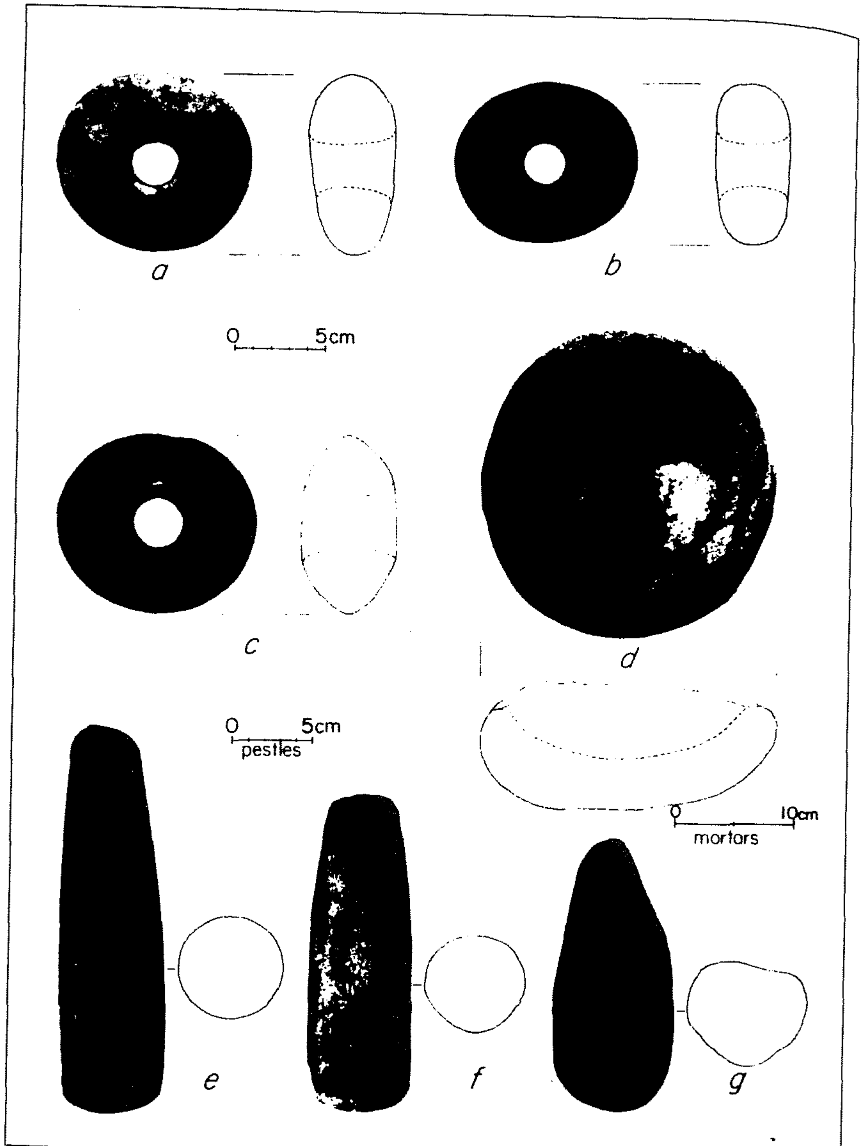

Figure 3. **a-c:** *Digging-stick weights of basalt* (**a, b**) *and serpentine* (**c**)*; from Punta Arena* (**a, b**) *and Christi Beach* (**c**)*, Santa Cruz Island.* **d:** *Sandstone mortar from Twin Harbors, Santa Cruz Island.* **e-g:** *Pestles of sandstone* (**e**)*, shale* (**f**)*, and basalt* (**g**)*; from Prisoners Harbor* (**e, f**) *and Punta Arena* (**g**)*, Santa Cruz Island.*

data indicate that sea mammals were a dietary constituent from the time of the earliest occupation and that they became very important, along with fish, by about 3,000 B.P. There is some evidence that they may have been intensively exploited by about 4,500 B.P., at least at some localities on the island (Table 1 and Fig. 2).

Walker (pers. comm.) has pointed out that the importance of sea mammals in the aboriginal diets of southern California maritime peoples has been greatly underestimated, seemingly because their exploitation is not emphasized in the ethnohistoric or ethnographic literature. Certainly the archaeological record indicates that sea mammals were dietarily very important on all of the Channel Islands by the late prehistoric period; sea mammals probably contributed protein to the aboriginal diet in an amount equal to or greater than that supplied by fish (Meighan 1959).

The means by which sea mammals were obtained has yet to be fully worked out. Pinnipeds are most easily obtained at their rookeries with a tool no more elaborate than a club, which is probably the principal reason why their remains are so prevalent in San Miguel Island middens. It is doubtful that pinnipeds were obtained from watercraft, given the difficulty of approaching the animals. Nevertheless, pinnipeds could have been stalked when they hauled out, although a harpoon or spear may have been necessary to ensure the catch. Dolphins and porpoises, of course, would have been obtained from watercraft by taking advantage of their natural curiosity; undoubtedly they were also salvaged when they washed ashore. Meighan (1959) suspects that the inhabitants of the Little Harbor site used spears to hunt these animals since he found no evidence of harpoons. This interpretation may be incorrect, however, since there are aboriginal harpoons in Santa Barbara Channel sites that were made by hafting a chert point onto a wood foreshaft and insetting a bone barb into the side of the shaft. Suitable chert points are present in the Little Harbor collection, and some of the bone items classified as fish gorges resemble harpoon barbs (Fig. 1). Whether or not such devices were true harpoons—that is, with lines attached—has not yet been verified.

Terrestrial Resources

Regarding terrestrial resources utilized by Channel Island aboriginal populations, comparatively little can be said because of the paucity of data. We can be sure that the few land mammals on the Channel Islands never constituted a major resource, although they probably were exploited to some extent. On the other hand, each of the Channel Islands does contain a variety of plant resources that could have been harvested. Santa Cruz and Santa Catalina Islands appear to have the greatest variety and abundance of food plants. Oaks and island cherry, both providing pulpy seeds, stand out as potentially highly-productive resources on these islands. In addition, a number of chaparral species on these and other islands could have provided significant amounts of seeds. Grasslands were extensive on all of the Channel Islands; these would also have provided various seeds, as well as roots, bulbs, and tubers (*e.g.*, the blue dick, *Dichelostemma pulchellum*). Various seeds can be preserved in midden sites in a carbonized state; however, there are only casual reports that these have been found in late prehistoric sites (Meighan 1959).

Other more direct evidence of plant resource exploitation is the occurrence of various stone milling implements and digging-stick weights (Fig. 3). Mortars and pestles have been reported for all the Channel Islands; if they were used for the same purposes as mainland examples, they indicate the use of various seeds, especially pulpy ones such as acorns. There is some evidence that mortars and pestles were multipurpose. Their abundance on San Nicolas Island (Meighan and Eberhart 1953, Bryan 1970) does not seem to be easily accounted for, considering the small size of the island and the scarcity and low diversity of food plants that must have characterized the island even before overgrazing in the last century. Significantly, one of the accounts of the famous "lone woman" of San Nicolas Island mentions that the mortar and pestle was used to pound dried abalone meat (Meighan and Eberhart 1953, Heizer and Elsasser 1961), so it is possible that the mortar's major use on the Channel Islands was in preparing dried meat of all sorts (Hudson 1976). If this is so, the prevalence of mortars and pestles in the later periods of Channel Island prehistory may reflect the importance of meat storage, in contrast with earlier times when only fresh meat was eaten.

Digging-stick weights, or "doughnut stones," are much more abundant in all of the Channel Island sites than in mainland sites. These tools were used in procuring roots, bulbs, and tubers, which were presumably of relatively more importance on the Channel Islands. The greater emphasis on these resources on the islands compared with the mainland may reflect a dependence on more marginal plant foods, especially during seasons when fish and sea mammals were difficult to obtain.

In ending this discussion of subsistence, it should be pointed out that data from aboriginal sites on the Channel Islands have great potential for studies of aboriginal diet. The remains of marine resources are especially well preserved in the sites, and even the meager amount of information currently available is enough to demonstrate that there were considerable differences through time. The data also indicate that there were significant differences between the Channel Islands as a group and the adjacent mainland, so it should eventually be possible to discern in some detail the various ways that islands restrict cultural adaptations.

TRADE

It has been well known for many years that Santa Catalina Island was a source of exported manufactured steatite vessels which were distributed throughout much of coastal southern California (Schumacher 1878, Meighan and Rootenberg 1957, Finnerty *et al.* 1970). Steatite vessels and effigy art forms are also found abundantly on San Clemente Island (McKusick and Warren 1959) and San Nicolas Island (Bryan 1970). They are less abundant in the Santa Barbara Channel region, apparently because another form of talc schist, a serpentine found in the San Rafael Mountains behind Santa Barbara, was extensively exploited instead.

Interestingly, the Northern Channel Islands were also involved in manufacturing specialization. King (1971) has carefully compiled a variety of ethnohistoric and ethnographic accounts indicating that the Chumash on the Northern Channel Islands manufactured nearly all of the shell beads—and perhaps ornaments, as well—that are found in mainland sites throughout much of southern California, including interior regions. The archaeological record of the Northern Channel Islands bears witness to this specialization. Nearly every late prehistoric site on Santa Cruz Island contains abundant olivella shell detritus resulting from bead manufacture, along with small chert bladelets with narrowed chipped tips that were used to drill holes in the beads (Fig. 4). In addition, many of the sites on the eastern third of Santa Cruz Island, where the outcrops of high-quality chert occur, contain abundant chert refuse resulting from the manufacture of the bladelets. Heizer and Kelley (1961, 1962) have referred to the cores from which the bladelets were struck as "burins," but there is no evidence that these cores were used in the manner implied by the popular usage of the term "burin."

The dates of the beginnings of these manufacturing emphases on Santa Catalina and Santa Cruz Islands have not yet been firmly established. Shell beads and steatite objects generally do not occur in any abundance in southern California archaeological sites until relatively late in prehistory, presumably after A.D. 1000. This date is consistent with the analysis of radiocarbon-dated material from the Prisoners Harbor site, but would not mean that manufacturing specialization did not occur earlier on a lower level of intensity.

The question of what determined these manufacturing specializations on the Northern Channel Islands and Santa Catalina Island presents us with one of the most intriguing problems

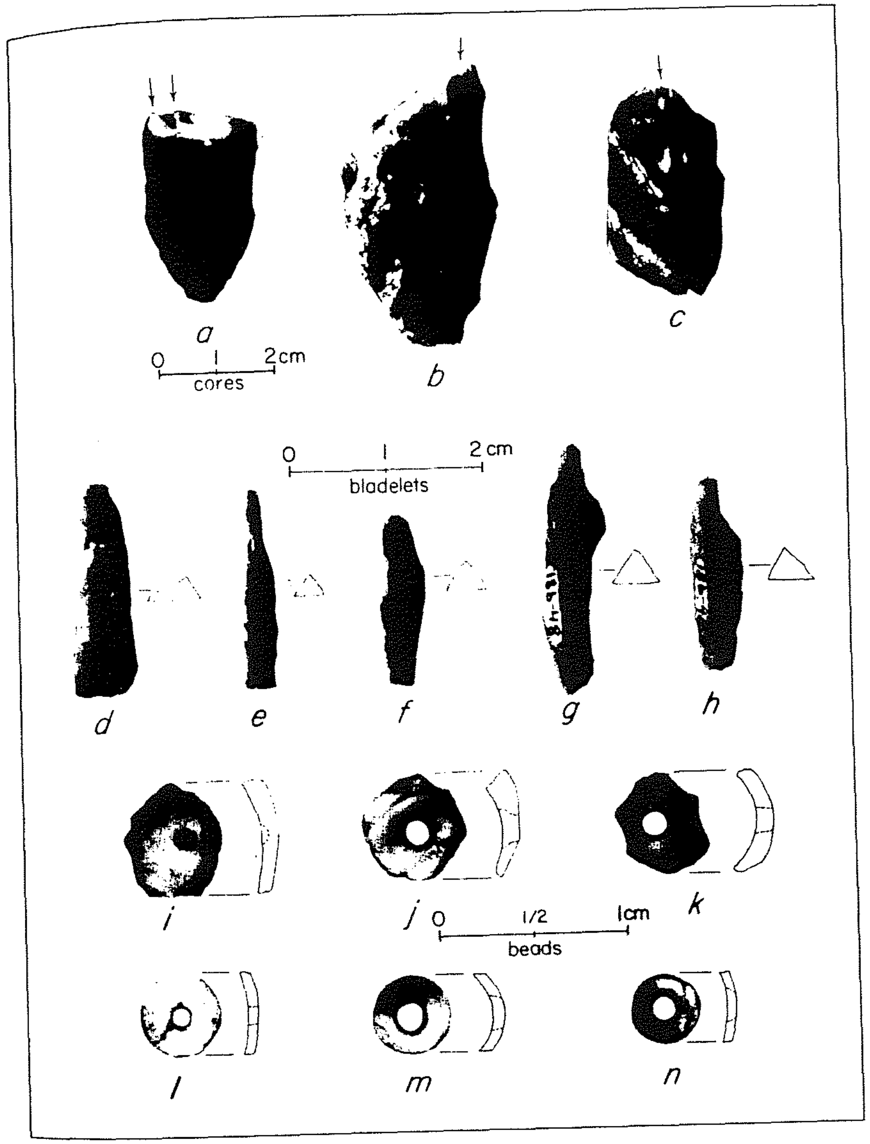

FIGURE 4. a-c: *Chert bladelet cores from Prisoners Harbor, Santa Cruz Island (arrows point to scars resulting from removal of bladelets).* **d-e:** *Unmodified chert bladelets from Christi Beach, Santa Cruz Island.* **f-h:** *Chert bladelets with prepared tips apparently broken from use; from Christi Beach, Santa Cruz Island.* **i:** *Shell bead blank made from callus of olivella with partially-drilled hole; from Christi Beach, Santa Cruz Island.* **j-k:** *Olivella callus beads with unprepared margins (***j** *with dorsal grinding); from Christi Beach, Santa Cruz Island.* **l-n:** *Finished olivella wall beads from Christi Beach, Santa Cruz Island.*

of Channel Islands archaeology. King (1971) points out that exchange allowed resources to be spread beyond the region of their natural occurrence and that shell beads, which served as a form of money, allowed value to be "stored" until it was needed. Steatite objects may have served roughly the same purpose. Thus the islanders were able to obtain from the mainland a variety of foods, and probably raw materials as well, in exchange for manufactured items; in so doing they were able to compensate for the impoverished terrestrial environments of the islands. But were the islands so impoverished? Santa Cruz Island, at least, contains terrestrial food resources seemingly ample enough to have made a significant contribution to the diets of the aboriginal inhabitants. The explanation of the manufacturing specialization may, instead, be found to lie in the economics of the system of exchange of manufactured items. The islanders may very well have found it less costly in terms of energy expenditure to manufacture beads or steatite objects in order to obtain mainland resources than to exploit the island terrestrial resources (Glassow, n.d.).

CONCLUDING REMARKS

In concluding this paper, a few notes concerning the complexity in the archaeological record of Santa Cruz Island and other Channel Islands may be useful in designing strategies for future research into Channel Islands prehistory. First, individual sites may contain episodes of midden deposition distributed intermittently through the course of 3,000 years of island prehistory; a 2,000-year time span is not at all uncommon. As a result, the study of settlement patterns is greatly hindered, since the location of all sites that were contemporaneously occupied during any one time in prehistory cannot be determined from surface indications alone. This observation also implies that behavioral processes that only occur over short periods of time cannot be used to account for changes in artifacts or midden constituents that continue through the whole thickness of the deposit. As an example, hypotheses accounting for changes in faunal remains in the sites by reference to local resource depletion do not seem too viable, since local depletions would occur in the course of several years rather than a few thousand years.

Second, rates of deposition vary considerably from one site to another. A site on the northwest corner of Santa Cruz Island (SCrI-277), having radiocarbon dates spanning 3,000 years, contains only 1.6 m of deposits. Conversely, one of the shellmounds at Forneys Cove (SCrI-195) contains over 4 m of deposits that were accumulated in 2,000 years. The obvious conclusion based on these facts is that the depth or size of a site is no indicator of its age; the depositional histories of Channel Island sites probably varied considerably. Some depositional processes—for instance, those resulting from a heavy emphasis on shellfish collecting—result in higher rates of accumulation than others. Moreover, accumulation rates are probably affected by the length of time a site is occupied through an annual cycle, as well as by the frequency of occupation through the course of prehistory.

Third, subsistence practices may or may not change through 2,000 or 3,000 years of occupation at a site. The three north coast sites on Santa Cruz Island from which we obtained column samples do not show any significant changes in midden constituents from bottom to top, yet some of the south coast sites do show significant shifts. This implies that certain microhabitats on the island appear to restrict variety in subsistence practices much more than do others. Consequently, we cannot very easily generalize about subsistence changes based on data from just one site.

The most important conclusion that can be derived from these three observations is that a research program with the objective of developing an outline of the prehistory of any one of the Channel Islands must consider the archaeological resources of the island as a whole, or, to put it in modern archaeological parlance, the research must be regionally oriented.

ACKNOWLEDGMENTS

The research on Santa Cruz Island was supported by National Science Foundation grant no. GS-36573 awarded to Albert Spaulding and the author. In addition, portions of the background research for this paper were supported by two purchase orders from the National Park Service. I gratefully acknowledge these sources of financial support.

REFERENCES

AXFORD, M. 1978. Current archaeological investigations on San Clemente Island, California. Abstracts of papers, Multidisciplinary symposium on the California Islands, Santa Barbara Museum of Natural History, Santa Barbara, Calif.

BERGER, R., and P. C. ORR. 1966. The fire areas on Santa Rosa Island, California, II. Proc. Natl. Acad. Sci. 56:1678-1682.

BROWN, A. K. 1967. The aboriginal population of the Santa Barbara Channel. Univ. Calif. Archaeol. Surv. Reports, 69.

BRYAN, B. 1970. Archaeological explorations on San Nicolas Island. Southwest Mus. Papers 22.

DAMON, P. E., C. W. FERGUSON, A. LONG, and E. I. WALLICK. 1974. Dendrochronologic calibration of the radiocarbon time scale. Amer. Antiquity 39:350-366.

DECKER, D. A. 1970. Early archaeology on the Channel Islands: potential and problems. Unpubl. ms., Univ. California Archaeol. Surv. files.

FINNERTY, P., D. DECKER, N. LEONARD, III, T. KING, C. KING, and L. KING. 1970. Community structure and trade at Isthmus Cove: a salvage excavation on Catalina Island. Pacific Coast Archaeol. Soc. Occas. Paper 1.

GLASSOW, M. A. 1977. Archaeological overview of the Northern Channel Islands, including Santa Barbara Island. Western Archaeological Center, National Park Service, Tucson, Ariz.

———. n.d. The concept of carrying capacity in the study of culture process. *In* M. B. Schiffer, ed., Advances in Archaeological Method and Theory, v. 1. Academic Press, New York, N.Y. (in prep.).

GREENWOOD, R. S., and R. O. BROWNE. 1969. A coastal Chumash village: excavation of Shisholop, Ventura County, California. So. California Acad. Sci. Memoir 8.

HEIZER, R. F., ed. 1969. San Nicolas Island archaeology in 1901, by Philip Mills Jones. Masterkey 43:84-98.

HEIZER, R. F., and A. B. ELSASSER, eds. 1956. Archaeological investigations on Santa Rosa Island in 1901, by Philip Mills Jones. Univ. California Anthropol. Records 17(2).

———, eds. 1961. Original accounts of the lone woman of San Nicolas Island. Univ. California Archaeol. Surv. Reports, 55.

HEIZER, R. F., and H. KELLEY. 1961. Scraper plane burins. Masterkey 35:146-150.

———. 1962. Burins and bladelets in the Cessac collection from Santa Cruz Island, California. Amer. Philosophical Soc. Proc. 106:94-105.

HEYE, G. C. 1921. Certain artifacts from San Miguel Island. Indian Notes and Monogrs. 7(4). Museum of the American Indian, Heye Foundation, New York, N.Y.

HOOVER, R. L. 1971. Some aspects of Santa Barbara Channel prehistory. Ph.D. thesis, University of California, Berkeley, Calif.

HUBBS, C. L. 1967. A discussion of the geochronology and archaeology of the California Islands. Pp. 337-341 *in* R. N. Philbrick, ed., Proceedings of the symposium on the biology of the California Islands. Santa Barbara Botanic Garden, Santa Barbara, Calif.

HUDSON, D. T. 1976. Marine archaeology along the southern California coast. San Diego Mus. Papers, 9.

JOHNSON, D. L. 1977. The late Quaternary climate of coastal California: evidence for an ice age refugium. Quaternary Res. 8:154-179.

KING, C. 1962. Excavations at Parker Mesa (LAn-215). Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1961-62:91-157.

———. 1967. The Sweetwater Mesa site (LAn-267) and its place in southern California. Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1966-67:25-76.

———. 1971. Chumash inter-village economic exchange. Indian Historian 4:31-43.

LANDBERG, L. C. W. 1965. The Chumash Indians of southern California. Southwest Mus. Papers, 19.

McKUSICK, M. B. 1959a. Introduction to Anacapa Island archaeology. Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1958-1959:71-104.

———. 1959b. Three cultural complexes on San Clemente Island, California. Masterkey 33:22-25.

McKUSICK, M. B., and C. N. WARREN. 1959. Introduction to San Clemente Island archaeology. Univ. California Los Angeles Archaeol. Surv., Ann. Rep., 1958-1959:107-186.

MEIGHAN, C. W. 1959. The Little Harbor site, Catalina Island: an example of ecological interpretation in archaeology. Amer. Antiquity 24:383-405.

MEIGHAN, C. W., and H. EBERHART. 1953. Archaeological resources of San Nicolas Island, California. Amer. Antiquity 19:109-125.

MEIGHAN, C. W., and S. ROOTENBERG. 1957. A prehistoric miner's camp on Catalina Island. Masterkey 31:176-184.

OLSON, R. L. 1930. Chumash prehistory. Univ. California Publ. Amer. Archaeol. Ethnol. 28:1-21.

ORR, P. C. 1951. Ancient population centers of Santa Rosa Island. Amer. Antiquity 16:221-226.

———. 1968. Prehistory of Santa Rosa Island. Santa Barbara Museum of Natural History, Santa Barbara, Calif.

ORR, P. C., and R. BERGER. 1966. The fire areas on Santa Rosa Island, California. Proc. Natl. Acad. Sci. 56:1409-1416.

OWEN, R. C., F. CURTIS, and D. S. MILLER. 1964. The Glen Annie Canyon site, SBa 142: an early horizon coastal site of Santa Barbara County. Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1963-64:431-517.

RAVEN, P. H. 1967. The floristics of the California Islands. Pp. 57-67 *in* R. N. Philbrick, ed., Proceedings of the symposium on the biology of the California Islands. Santa Barbara Botanic Garden, Santa Barbara, Calif.

REINMAN, F. M. 1962. New sites on San Nicolas Island, California. Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1961-1962:11-21.

———. 1964. Maritime adaptation on San Nicolas Island, California: a preliminary and speculative evaluation. Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1963-1964:50-84.

REINMAN, F. M., and S. TOWNSEND. 1960. Six burial sites on San Nicolas Island. Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1959-1960:1-134.

ROBINSON, E. 1942. Shell fishhooks of the California coast. Bishop Mus. Occas. Papers 17:57-65.

ROGERS, D. B. 1929. Prehistoric man of the Santa Barbara coast. Santa Barbara Museum of Natural History, Santa Barbara, Calif.

ROZAIRE, C. E. 1959a. Archaeological investigations at two sites on San Nicolas Island, California. Masterkey 33:129-152.

———. 1959b. Excavations at site Anl-8, Le Dreau Cove. Univ. California Los Angeles Archaeol. Surv., Ann. Rep. 1958-1959:91-93 and *passim*.

———. 1965. Archaeological investigations on San Miguel Island. Unpubl. report submitted to National Park Service.

———. 1967. Archaeological considerations regarding the Southern California Islands. Pp. 327-336 *in* R. N. Philbrick, ed., Proceedings of the symposium on the biology of the California Islands. Santa Barbara Botanic Garden, Santa Barbara, Calif.

SCHUMACHER, P. 1877. Researches in the kjokkenmoddings and graves of a former population of the Santa Barbara Islands and the adjacent mainland. Bull. U.S. Geol. Geogr. Surv. of the Territories 3:37-61.

———. 1878. Ancient olla manufactory on Santa Catalina Island. Amer. Natur. 12:629.

SWARTZ, B. K. 1960a. Blade manufacture in southern California. Amer. Antiquity 25:405-407.

———. 1960b. Evidence for the Indian occupation of Santa Barbara Island. Kiva 26:7-9.

TARTAGLIA, L. J. 1976. Prehistoric maritime adaptations in southern California. Ph.D. thesis, University of California, Los Angeles, Calif.

WALKER, P. L. n.d. An ethnozoological analysis of faunal remains from four Santa Barbara Channel Island archaeological sites. Unpubl. ms., University of California, Santa Barbara, Calif.

WHITEHEAD, R. S., and R. L. HOOVER. 1975. Ethnohistoric Chumash placenames (map). *In* Papers on the Chumash. San Luis Obispo Co. Archaeol. Soc. Occas. Paper 9. San Luis Obispo, Calif.