OTOLITHS AND OTHER FISH REMAINS
FROM THE CHUMASH MIDDEN AT RINCON POINT (SBa-1)
SANTA BARBARA-VENTURA COUNTIES, CALIFORNIA

By Richard W. Huddleston and Lloyd W. Barker
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OTOLITHS AND OTHER FISH REMAINS
FROM THE CHUMASH MIDDEN AT RINCON POINT (SBa-1),
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By Richard W. Huddleston and Lloyd W. Barker

Abstract: Material from a Chumash village site yielded 45 species of
fishes (29 kinds of bony fishes, and 16 kinds of sharks, skates and rays). The
fish remains, ranging in size from less than 1 to 75 mm, consisted of otoliths,
teeth, jaws (dentary, premaxillary and palatines), vertebrae, stings, dermal
denticles, dorsal spines and scales. As indicated by the species recovered, the
Chumash inhabitants fished from surface regions and surf zones to depths
exceeding 60 feet, utilizing hook and line, gill nets, traps, beach seines, harpoons, spears and capture by hand. The most abundant identified remains
were otoliths of Genyonemus lineatus, scales of Sardinops caeruleus, and
dermal denticles of Squatina californica. None of the identified remains
showed signs of having been altered or modified for use in ornamentation.
Comparison of the fishing habits of the inhabitants of SBa-1 and Ven-3 in
Ventura indicated a similar level of advancement, which was superior and
more fishery-orientated than Ora-190 in Orange County and SLO-2 in San
Luis Obispo County.

INTRODUCTION

Prior to the completion of this study Lloyd W. Barker lost his life acting as
an observer for the California Department of Fish and Game aboard a com-
mercial sealion capturing vessel, which capsized in the Santa Barbara channel.
Because of his untimely death, any errors or omissions are the responsibility of
RWH.

Fish and other faunal remains of midden sites usually have appeared in
archaeological literature as simple lists of identifications without any inter-
pretation or significance. In particular, remains of fishes have been neglected,
often being identified only as “fish” or “shark”. Otoliths (fish earstones) play
an important role in the identification of fishes recovered from middens. The
use of otoliths in archaeological work is not new, being employed first in the

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latter part of the nineteenth century (Thering 1891). It was not until 1969, however, that otoliths were used on a large scale (Fitch 1969a). Fitch noted approximately 19 species of fishes represented by otoliths from a midden in Ventura County.

All bony fishes (fishes other than sharks, skates, rays and chimaeroids) possess some type of discrete aragonitic concretion in the semicircular canals of the otic capsules, called otoliths. Although not well understood, the otolith aids in the hearing and balance of the fish. Since almost all species of fishes have distinctive otoliths, their specific identifications can be made with adequate comparative material.

Bony fishes possess three pairs of otoliths; the sagittae, lapilli and asterisci. Of these, the sagitta generally is the largest, most frequently encountered, and most relied upon for taxonomic interpretation. Many conclusions have been drawn regarding the Indians’ fish-eating habits, based upon the quantity of fish vertebrae (unidentified as to species) present in a given sample from different levels of the midden. Fitch (1972) states that these conclusions are untrustworthy, and normally indicate only that fishes were present; they do not furnish an index of numerical abundance or importance.

A relationship exists between otolith lengths and fish lengths, and once this relationship has been defined for a given species, a reliable estimate of a fish size can be ascertained from a single midden otolith. Otoliths can be deposited in middens by predators through their digestive systems, by scavengers at the midden, or by the Indians. Otoliths that have passed through digestive systems indicate signs of erosion on all surfaces. Species that unlikely would be captured by the inhabitants for food because of their small size or living depth could be of predator origin in the midden, and this often can be determined by the degree of surface erosion. Caution must be used in interpreting these otoliths in relation to the food habits and fisheries of the Indians. Indians sometimes would consume whole small fishes (Follett 1967), which offers the possibility that some of the small eroded otoliths could reflect passage through human digestive systems. Whether these eroded otoliths have passed through a human or nonhuman digestive system often can be determined by examining the habits of the fish in question. For example, Fitch (1969a) noted a myctophid otolith (Ceratoscopelus townsendi) from a Ventura midden. The depth at which this lantern fish lives (rarely coming within 600 feet of the surface) as well as its extremely small size (about three inches) was sufficient evidence to indicate that this fish had not been captured directly by the inhabitants nor passed through a human digestive system; rather, it was probably from the stomach of some predator.

METHODS AND MATERIALS

We recovered less than a hundred pounds of midden material from the site. Our methods of preparing and examining the field sample followed closely methods discussed by Fitch (1967, 1969a, 1972). The field sample was soaked
in a large tub of water, then passed through a \(\frac{1}{4}\)-inch mesh screen. The retained screenings were set aside to dry. Material not retained by the first screen was then passed through an 18-mesh screen. These screenings were dried in an oven at a temperature of 250-300°F. The material that was not retained by this second screen was passed through a 30-mesh screen. Due to the abundance of ash and charcoal in the midden "dirt" and its tendency to cling to all other materials, a secondary screening was necessary. The freshly dried screenings were soaked separately in a solution of one part liquid bleach and two parts water for several minutes, then rescreened. This made the screenings cleaner and reduced them in weight by ten percent. These procedures greatly enhanced our ability to recognize the fish remains and decreased the time required to examine the sample. The \(\frac{1}{4}\)-inch screenings were examined by eye for the larger fish remains, whereas the 18- and 30-mesh screenings were sorted a spoonful at a time under a binocular microscope.

**HISTORY AND PREVIOUS DIGGING**

The Rincon site (SBa-I) became a historic point of contact with the landing of Juan Rodriguez Cabrillo in October 1542. The village, which was called Xucu by the Indians, was visited several times in succeeding centuries: Sebastian Vizcaino, 1602-1603(?); Gaspar de Portola, 1770; and Juan Bautista Anza, 1776. The Rincon area had been ravaged heavily prior to our study. A massive amount of material was removed by Stephen Bowers, an amateur archaeologist, in the early 1870’s, but there are no reports on his findings, and the material subsequently has become lost (Rogers 1929). Leon De Cessac, a French archaeologist, probably worked at the site during the early 1870’s but these reports remain unverified. Rincon was worked partly in the 1920’s by archaeologists D.B. Rogers, the Catlin brothers and W.C. Toby and Jesse Wood. In 1930, Ronald Olson excavated three cemeteries (Olson 1930). Marshall McKusick surveyed the Rincon Point area in 1959 for the University of California at Los Angeles (UCLA) Archaeological Survey. W.H. Harrison and Patricia Lyon, then with the University of California, Santa Barbara, excavated several burials in 1959 and 1960. Patrick Finnerty, formerly of UCLA, excavated two areas in 1961 and 1964 (Finnerty 1961, 1964). Personnel representing the UCLA Archaeological Survey have done the remainder of the excavations: three test pits in April 1963 and extensive excavations in the summer of 1966. Unfortunately, the control column from the 1966 excavation was discarded without having been examined. John E. Fitch, California Department of Fish and Game, removed several hundred pounds of material during the 1966 UCLA excavations and reported three species of fishes: northern anchovy (Engraulis mordax), pacific sardine (Sardinops caeruleus), and Pacific hake (Merluccius productus). Six other species were found but not specifically identified (Fitch 1969b). Fitch gave us his material and we have incorporated it into this report. Most of the Rincon publications report on aspects other than faunal remains. Evans, Grossman and Toney (1968:36)
mention fish remains but state only that "The remains of fish, mainly vertebrae, were numerous and appear to represent shallow water species."

SPECIES ACCOUNTS

It is difficult to present the species accounts in both an archaeological and an ichthyological approach. We have tried to simplify the matter by separating the elasmobranchs (Sharks, skates and rays) from the teleosts (bony fishes). In each of the two groups, taxa are arranged alphabetically by family, and within each family by genus and species. Common names are listed after each scientific name.

ELASMOBRANCHS

Alopiidae – Thresher sharks

*Alopias vulpinus* – Thresher shark. — Along the west coast of North America the thresher shark ranges from central Baja California north to the Strait of Juan de Fuca, but also is found in all warm seas. Threshers are known to attain a length of at least 5.5 m (18 feet, Joseph 1954). This shark lives near the surface, probably not descending to depths greater than 200 m; they rarely are found near shore. Indians probably utilized a harpoon in obtaining them. Thresher shark remains have been reported from a midden site in Alameda County (Follett 1975a).

Material: 1 jaw tooth; Fig. 1B.

Carcharhinidae – Requiem sharks

*Galeorhinus zyopterus* – Soupfin shark. — Soupfin sharks are large, attaining lengths to 2 m (6.5 feet, Miller and Lea 1972). They are found off Chile and Peru in the southern Hemisphere and from San Juanico Bay, Baja California, to northern British Columbia in the Northern Hemisphere. South of Point Conception this shark often inhabits waters several hundred feet deep (Fitch 1968).

Soupfin shark remains also have been recovered from Ventura (Fitch 1969a, 1975; Follett 1965) and Los Angeles counties (Follett 1963a; Frey 1974; Tartaglia 1976), and at Point St. George site (Gould 1966).

Material: 13 jaw teeth; Fig. 11.

*Mustelus californicus* – Gray smoothhound. — Gray smoothhounds reach lengths of just over 1.5 m (5 feet, Fitch 1972), and range from Mazatlan, Mexico, to Cape Mendocino, California. They are common in shallow water off southern California where they could have been taken easily by gill nets, hook and line or beach seines, by the Indians.

Remains of gray smoothhounds have been reported from middens in Ventura (Fitch 1969a), Orange (Fitch 1975) and San Diego Counties (Follett 1976).

Material: 2 jaw teeth; Fig. 2A.

*Prionace glauca* – Blue shark. — The blue shark ranges throughout warm
seas. In the eastern Pacific, they are found from Chile to the Gulf of Alaska but are absent in the tropics. Individuals off California are usually shorter than 1.8 m (6 feet, Fitch 1972). The Indians probably used harpoon and hook and line to capture this species. Blue shark remains have been recovered also from middens in Los Angeles (Follett 1963b), San Luis Obispo (Fitch 1972), and Orange Counties (Fitch 1975).

**Triakis semifasciata** — Leopard shark. — The leopard shark has been taken from Mazatlan, Mexico, to Oregon and in the Gulf of California. They are common along beaches in bays and attain lengths of 2 m (6.5 feet, Miller and Lea 1972). The Indians could have captured this shark by harpoon, spear, hook and line, traps or beach seines.

Leopard shark remains have been recovered from archaeological sites in Ventura (Fitch 1969a; Follett 1933, 1965), Los Angeles (Follett 1963a, 1963b, 1969), Orange (Fitch 1967, 1975; Follett 1966), Marin, Monterey and San Luis Obispo (Follett 1964, 1974, 1972a; Fitch 1972), Alameda and Contra Costa Counties (Follett 1975a, 1975b), and also from Santa Catalina Island (Tartaglia 1976).

**Material:** 1 jaw tooth. Fig. 1H.

**Dasyatidae — Stingrays**

**Dasyatis dipterura** — Diamond stingray. — This large ray ranges from Paita, Peru, to Kyuquot, British Columbia. They are known to attain a weight of 25 kg. (113-1/2 pounds, Miller and Lea 1972). Diamond stingrays are found in shallow areas to depths of 18 m (55 feet, Miller and Lea 1972) preferring regions of sandy bottom, where they lie on the substrate and cover themselves with sand. The Indians could have captured this species with hook and line, spear or harpoon while fishing in shallow nearshore areas.

The diamond stingray has been reported from only one other midden (Fitch 1975).

**Material:** 4 jaw teeth. Fig. 2E.

**Heterodontidae — Horn sharks**

**Heterodontus francisci** — Horn shark. — This small nonagressive shark is found in the Gulf of California and along the coast of the Californias to Monterey Bay, reaching a length of just over one meter (3 feet 2-1/8 inches, John Fitch, personal communication). Horn sharks are most frequently found in shallow water in rocky bottom habitats, but they may descend to depths of 164 m (492 feet, Miller and Lea 1972). Fitch (1969a) suggests that horn sharks may have been captured by the Indians while free diving as well as with hook and line possibly with traps.

Horn shark remains have been recovered from Indian middens in Orange and Ventura Counties (Fitch 1967, 1969a; Follett 1933).

**Material:** 4 jaw teeth, 1 dorsal spine. Fig. 2F, G, H.
Hexanchidae – Cow sharks

*Notorynchus maculatus* – Sevengill shark. — Sevengill sharks range in the north Pacific from San Carlos Bay, Baja California, to northern British Columbia. The maximum known length is 2.6 m (8 feet-6 inches, Bohnam 1942). These sharks commonly are found in bays, but south of Point Conception they usually inhabit deeper waters of 200 m (600 feet, Fitch 1969a) or more. The Indians probably captured this species using hook and line in deep water.

Remains of sevengill sharks have been found in middens near Ventura (Fitch 1969a, 1975) and in Marin County (Follett 1968).

Material: 1 jaw tooth, Fig. 1E.

Lamnidae – Mackerel sharks

*Carcharodon carcharias* – White shark. — The white shark has a worldwide distribution, and is found in the eastern Pacific from Chile to Alaska. There is an endemic population off California. They probably are not uncommon as reported in the literature (Bigelow and Schroeder 1948; Miller and Lea 1972). Whites are one of the largest sharks attaining lengths of at least 6.4 m (21 feet, Randall 1973). The Indians could have captured this shark by use of a harpoon.

White shark remains have been reported from sites in Ventura (Fitch 1975; Follett 1933, 1965) and Los Angeles Counties (Tartaglia 1976), and two sites in southern New England (Waters 1967).

Material: 3 jaw teeth, Fig. 1D.

*Isurus oxyrinchus* – Shortfin mako. — The shortfin mako reportedly attains a length of 3.9 m (13 feet, Miller and Lea 1972) and weight of 454 kg (1000 pounds, Miller and Lea 1972), but a specimen measuring 3.5 m (11 feet-5 inches, Huddleston unpublished data), harpooned off Anacapa Island in August and weighing 466 Kg (1030 pounds, Huddleston unpublished data), appears to be the largest eastern Pacific one (S. P. Applegate, personal communication). In the eastern Pacific the shortfin mako ranges from Chile to the Columbia River. The Indians probably caught this shark with harpoon.

Remains of shortfin makos have been recovered previously from midden sites in Ventura (Fitch 1969a, 1975; Follett 1933, 1965; Tartaglia 1976) and Los Angeles Counties (Follett 1963a, 1963b, 1969; Tartaglia 1976) and from Santa Catalina Island (Tartaglia 1976).

Material: 4 jaw teeth. Fig. 1A.

Myliobatidae – Eagle rays

*Myliobatis californica* – Bat ray. — Bat rays range from the Gulf of California to Oregon. They have been known to attain a width of about 1.4 m (4 feet-9 inches, Miller and Lea 1972), and a weight of 95 kg (210 pounds, Miller and Lea 1972), but most individuals weigh less than 23 kg (50 pounds, Fitch 1969a). They have been found from the surface to depths of 45 m (150 feet,
Miller and Lea 1972). Bat rays commonly are found in bays and shallow water over sandy or muddy bottoms. Large individuals could have been captured by hook and line, and it is possible that the Indians utilized the caudal stings of these and other rays for harpoon points.

Bat ray remains have been recovered from several other middens in Ventura (Fitch 1969a, 1975; Follett 1933, 1965; Tartaglia 1976), Los Angeles (Follett 1963a, 1969; Frey 1974; Meighan 1959; Tartaglia 1976) Orange (Follett 1966), Marin (Follett 1968, 1974), Santa Barbara (Harrington 1928), San Luis Obispo Counties (Fitch 1972).
Material: 57 jaw teeth. Figs. 2J,K.

Rhinobatidae – Guitar fishes

Rhinobatos productus – Shovelnose guitarfish. — The shovelnose guitarfish is found from the Gulf of California to San Francisco Bay, but recent reports indicate that it ranges only as far north as Capitola. This cartilaginous fish has been reported to attain a length of about 1.5 m (61.5 inches, Miller and Lea 1972). They are found from the surface to depths of about 13.5 m (45 feet, Miller and Lea 1972), preferring sandy or muddy bottoms. Sometimes shovelnose guitarfish feed in such shallow water as to be nearly beached by the breaking surf. At such times they are taken easily by spear or hand. It is also possible that the Indians used hook and line.

Remains of the shovelnose guitarfish have been recovered from other midden sites in Ventura (Fitch 1969a; Follett 1933; Tartaglia 1976), Orange (Fitch 1967, 1975), and Los Angeles Counties (Follett 1963a, 1963b; Tartaglia 1976) and Santa Catalina Island (Tartaglia 1976).
Material: 1 jaw tooth. Fig. 2C.

Scyliorhinidae – Cat sharks

Cephaloscyllium ventriosum – Swell sharks. — Swell sharks are found from Chile to Monterey Bay, including Guadalupe Island and the Gulf of California. This shark is very abundant around islands south of Monterey Bay, but not those south of Magdalena Bay. Swell sharks prefer rocky kelp bed habitat from shallow water to depths of over 400 m (1380 feet, Miller and Lea 1972); they attain lengths of about one meter (3 feet, Miller and Lea 1972). When caught or threatened they have the ability to inflate their stomachs with air — a possible defensive mechanism. The Indians probably captured this shark using traps in shallow rocky areas, although some could have been taken by hook and line. Swell sharks are reported to be of very poor flavor and the Indians probably did not actively fish for them (S.P. Applegate, personal communication).

Swell shark remains also have been recovered from a midden in Ventura County (Fitch 1969a).
Material: 4 jaw teeth, Fig. 1F.
Squalidae – Dogfish sharks

Squalus acanthias – Spiny dogfish. — The spiny dogfish has been found in the temperate and subarctic regions of both the Atlantic and Pacific Oceans. In the eastern Pacific, this shark has been found off Chile and from Sebastian Viscaino Bay, Baja California, to Alaska. They reach lengths of 130 cm (4 feet 3 inches, Bonham, Sanford, Clegg and Bucher 1949), and occasionally travel in schools in those waters above 390 m (1200 feet, Miller and Lea 1972). Off California they usually are found in depths between 33 and 66 m (100-250 feet, Fitch 1969a). The Indians could have utilized hook and line as well as gill nets to capture this species.

Spiny dogfish remains have been recovered also from Indian middens in Ventura and San Luis Obispo (Fitch 1969a, 1972), and Los Angeles Counties (Tartaglia 1976). This species has also been noted from midden sites in British Columbia, Canada (Niblack 1890; Stewart ms).
Material: 25 jaw teeth. Fig. 1G.

Squatinaidae – Angel sharks

Squatina californica – Pacific angel shark. — The Pacific angel shark is found off Chile and from the Gulf of California to southeastern Alaska, but is not common north of Point Conception and has not been reported from Canada (Hart 1973). This shark has been known to reach a length of 1.8 m (5 feet, Miller and Lea 1972) and a weight of 27 kg (60 pounds, Miller and Lea 1972). Pacific angel sharks prefer shallow water, dwelling on the bottom in sandy or muddy areas. They have been observed from depths between about 3 to 45 m (8 to 150 feet, Fitch 1969a), but prefer a depth of about 20 m. Although the Indians could have used a beach seine to capture this species they probably captured them on hook and line or by harpoon.

Remains of the Pacific angel shark have been recovered from middens in Los Angeles (Follett 1963a, 1963b, 1969; Frey 1974; Tartaglia 1976), Ventura (Fitch 1969a, 1975; Follett 1965; Tartaglia 1976), Orange (Fitch 1967), and San Luis Obispo Counties (Fitch 1969a).
Material: 9 jaw teeth, 365 dermal denticles. Fig. 1C.

Unidentified elasmobranch remains

Three fragments of caudal stings were recovered from SBa-1. Unfortunately caudal stings generally are not useful for making specific identifications because of their similarity. Two fragments of large caudal stings were recovered from the road level sample near the area where most of the Myliobatis californica teeth were recovered (Fig. 21, one only). However, they were not associated with this material and it is possible that they belong to Dasyatis dipterura, which has a similar type of caudal sting. The third smallest fragment was found in one of the hill samples and although it could have been from a small Myliobatis californica it possibly was from Urolophus halleri, the round
stingray. Both species are extremely abundant off southern California in shallow sandy regions, but because of its small size and fragmented nature the sting cannot reliably be assigned to either ray.

Material: 3 caudal stings. Fig. 21.

**TELEOSTS**

**Atherinidae – Silversides**

*Atherinops affinis* – Topsmelt. — Topsmelt range from Santa Maria Bay, Baja California, to Vancouver Island, British Columbia, and attain a length to 365 mm (Schultz 1933). Topsmelt inhabit bays and kelp beds living at or near the surface. They possess small mouths and thus would have been difficult to take by hook and line. The Indians probably used beach seines to obtain this species.

Fitch (1969a, 1972) reported otoliths *A. affinis* from sites in Ventura and San Luis Obispo Counties.

Material: 7 otoliths. Fig. 3A.

*Atherinopsis californiensis* – Jacksmelt. — Jacksmelt are known from Santa Maria Bay, Baja California, to Yaquina Bay, Oregon. Although reported to reach a length of 22 inches, the largest measured individual was 448 mm (17½ inches, Miller and Lea 1972). Jacksmelt are common along coasts, bays and kelp beds. Beach seines probably were used to obtain this species.

An otolith of *A. californiensis* has been reported from a midden near Ventura (Fitch 1969a); it also has been reported from Marin (Follett 1974), San Diego (Follett 1976) and Alameda Counties (Follett 1975a).

Material: 3 otoliths. Not figured.

**Batrachoididae – Toadfishes**

*Porichthys notatus* – Plainfin midshipman. — Plainfin midshipmen have been found in the Gulf of California and range from Gorda Bank, Baja California, to Sitka, Alaska. They are found near the surface and to depths of about 330 m (1000 feet, Miller and Lea 1972). South of Point Conception they usually are confined to deeper waters (Hubbs and Schultz 1939). However, during “nesting” season it is possible to capture juveniles as well as adults from under rocks by hand in the intertidal. Plainfin midshipmen spend daylight hours burrowed in the bottom sediments, emerging at night to seek food. The single otolith recovered from SBA-1 was that of a juvenile and showed signs of digestive wear; it probably was from the stomach of a predator captured by the Indians.

Remains of *P. notatus* have been reported from middens in Ventura (Fitch 1969a), San Luis Obispo (Fitch 1972), Los Angeles (Fitch 1975) and Alameda Counties (Follett 1975a).

Material: 1 otolith. Fig. 3C.
Bothidae – Left-eyed flounders

*Paralichthys californicus* – California halibut. — California halibut are found from Magdalena Bay, Baja California, to Quillayute River, British Columbia, and an isolated population occurs in the Gulf of California. They have been known to reach a length of 1.8 m (5 feet, Fitch 1969a), and a weight of 33 kg (72 pounds, Fitch 1969a). They are uncommon north of Morro Bay. California halibut usually are found in shallow water at depths of less than 36 m preferring sandy habitat. During the spawning season (from February through July) they frequent shallower water where they could have been captured easily by hook and line and beach seines.

Remains of California halibut have been reported from middens in Los Angeles (Follett 1963b, 1969; Tartaglia 1976), Orange (Follett 1966), and Ventura Counties (Fitch 1969a, 1975; Follett 1933; Tartaglia 1976), and from midden sites along the coast of British Columbia (Boas 1895, 1916; Niblack 1890; Leechman 1973; Ducker 1955, 1965; Sapir 1915; Garfield 1939, 1966; Stewart ms).

Material: 1 Premaxillary. Fig. 6F.

Carangidae – Jacks and pompanos

*Seriola dorsalis* – Yellowtail. — The schooling yellowtail range from Chile to southern Washington and also are found in the Gulf of California. They attain a length of 1.8 m (5 feet, Miller and Lea 1972) and a weight of 36 kg (80 pounds, Miller and Lea 1972). Generally they live near the surface but may descend to 24 m. The Indians probably captured this species by hook and line in offshore areas.

Yellowtail remains have been reported from middens in Los Angeles (Follett 1963a, 1963b, 1969; Tartaglia 1976) and Ventura Counties (Tartaglia 1976).

Material: 1 vertebra. Not figured.

*Trachurus symmetricus* – Jack mackerel. — Jack mackerel, a schooling species, are known from Magdalena Bay, Baja California, to southeastern Alaska, and from offshore to several hundred kilometers. They sometimes are found inshore around rocky headlands. Fitch (1972) reported that a 5.25 pound (2.4 kg) jack mackerel measured 28.5 inches (724 mm) in total length and possessed otoliths 11.4 mm in length. *Trachurus symmetricus* is reported to reach a length of just under one meter (32 inches, Miller and Lea 1972). They live in the upper 45 m. The Indians probably captured this species with hook and line or gill nets.

Jack mackerel remains also have been reported in midden sites in Ventura (Fitch 1969a), San Diego (Fitch 1969b), San Luis Obispo (Fitch 1972) and Los Angeles Counties (Tartaglia 1976).

Material: 1 otolith. Not figured.

Clinidae – Kelpfishes

*Neoclinus uninotatus* – Onespot fringehead. — Onespot fringeheads are known only from Ensenada, Baja California, to Bodega Bay, a restricted geo-
graphic distribution. They are a nearshore species occurring in waters 3 to 27 m (10-90 feet, Miller and Lea 1972) deep, and reach lengths to 247 mm (9 inches, Miller and Lea 1972). The eroded condition of the otolith recovered from SBA-1 indicated that it probably had passed through the digestive system of a predator captured by the Indians. The otolith is from a specimen too small to have been captured by the gill nets used for white croakers, although many are taken by hook and line.

*N. uninotatus* remains have not been reported from any other midden. Material: 1 otolith. Fig. 3B.

Clupeidae – Herrings

*Sardinops caeruleus* – Pacific sardine. — Pacific sardines are schooling fish with a broad distribution in the eastern Pacific from Guaymas, Mexico, to Kamchatka. They have been known to reach lengths of about 39.4 cm (approximately 16 inches, Miller and Lea 1972). Scales of *S. caeruleus* are distinctive among the clupeids. The transverse slits and perforations in the scale are distinctive for identification. Scales of *S. caeruleus* were exceedingly abundant throughout the samples examined with the exception of those from the slope of Rincon Hill. This species was probably captured by beach seines or gill nets. Follett (1965, 1968, 1969, 1972a, 1976) reported remains of *S. caeruleus* (as *S. sagax*) from the Conejo Rock Shelter, Tomales Bay site, Century Ranch site, Mission La Soledad cemetery and a site at Rancho Carrillo, Ventura, Marin, Los Angeles, Monterey, and San Diego Counties; Fitch (1972, 1975) noted their remains at sites in San Luis Obispo and Ventura Counties. Material: 3 otoliths. Fig. 3D.

Embiotocidae – Surfperches

*Amphistichus argenteus* – Barred surfperch. — Barred surfperch range from Playa Maria Bay, Baja California, to Bodega Bay, attaining lengths to 43 cm (17 inches, Fitch 1969a) and a weight of two kg (4.5 pounds, Fitch 1969a). This species is most abundant in breaking surf and other shallow waters, particularly sandy bottom areas; they rarely are captured in rocky areas. Barred surfperch have been captured at the surface to depths of 73 m (240 feet, Miller and Lea 1972). This species probably was captured by beach seines, although large individuals could have been taken by hook and line.

Barred surfperch remains also have been recovered from midden sites in Orange (Fitch 1967), Ventura (Fitch 1969a, 1975; Tartaglia 1976; Follett 1933) and Los Angeles Counties (Tartaglia 1976). Material: 1 jaw tooth. Fig. 5A.

*Cymatogaster aggregata* – Shiner surfperch. — The shiner surfperch is a small fish; most individuals are shorter than 177 mm. They range from San Quintin Bay, Baja California, to Port Wrangell, Alaska, and have been taken from the surface to depths of about 136 m (480 feet, Miller and Lea 1972). Shiner surfperch usually prefer water shallower than 18 m. This species, which
does not exceed 100 g (¼ pounds, Fitch 1972) in weight, probably was captured by the Indians using beach seines.

Fitch (1972) reported shiner surfperch otoliths from a midden site at Diablo Cove, San Luis Obispo County. Material: 2 otoliths. Fig. 3G.

*Damalichthys vacca* – Pile perch. — The pile perch has been taken from Guadalupe Island to Port Wrangell, Alaska. They are recorded from surface waters to depths of 45 m (140 feet, Miller and Lea 1972). A record-sized specimen measured 44.2 cm (17.4 inches, Fitch 1969a) and weighed slightly less than 1.8 kg (4 pounds, Fitch 1969a). The pile perch is found over sandy and rocky bottom habitat as well as around kelp beds. The Indians probably captured pile perch using hook and line and possibly gill nets and beach seines.

Follett (1964) found pile perch remains from the Drakes Bay site and Fitch (1969a, 1972) reported their remains from Ventura and San Luis Obispo Counties. They also have been reported from midden sites in Marin (Follett 1967), Monterey (Follett 1973), Ventura and Los Angeles Counties (Tartaglia 1976). Material: 2 pharyngeal bones, 58 pharyngeal teeth. Fig. 5B,E.

*Hyperprosopon argenteum* – Walleye surfperch. — This surfperch ranges from Point Rosarito, Baja California, to Vancouver Island, British Columbia, including Guadalupe Island. They have a recorded size to 30.5 cm (12 inches, Miller and Lea 1972). A 27.3 cm (10-¾ inch, Fitch 1969a) fish weighed just over 397 g (14 ounces, Fitch 1969a). The walleye surfperch has been known from surface waters to a depth of 18 m (60 feet, Miller and Lea 1972). They prefer sandy bottom or flat rocky habitat. This species probably was captured by the Indians using beach seines.

Walleye surfperch remains have been recovered from middens in Ventura and San Luis Obispo Counties and Drakes Bay (Fitch 1969a, 1972; Follett 1964). Material: 2 otoliths. Fig. 31.

*Phanerodon furcatus* – White seaperch. — White seaperch have been captured from Point Cabras, Baja California, to Vancouver Island, British Columbia. They have been known from the surface to depths of 42.4 meters (140 feet, Miller and Lea 1972). This species travels in loose schools over sandy bottoms. A record-sized specimen weighed about 369 grams (13 ounces, Fitch 1969a). The Indians probably captured this species using beach seines near shore and gill nets in deeper waters.

Previously white seaperch have been recovered from a midden in Ventura County (Fitch 1969a). Material: 5 otoliths. Fig. 3H.

*Embiotocids* — (genus and species undetermined). — Of the 19 species of surfperches that are found in marine waters off California, 17 occur off southern California. Of these, one is found only around islands, thus there are 16 possible marine species that could have been captured by the inhabitants of SBA-1. It is possible that some of the 227 unidentified pharyngeal teeth be-
longed to some of the other species not listed above or from freshwater sources.

**Engraulidae – Anchovies**

*Engraulis mordax* – Northern anchovy. — The northern anchovy is one of the most abundant fishes off our coast. This schooling fish has been found from Cape San Lucas, Baja California, to Queen Charlotte Island, British Columbia. They are known to attain a length of 229 mm (9 inches, Miller and Lea 1972) but specimens over 177 mm are rare. During fall and winter, northern anchovies apparently move offshore and return inshore during spring (Baxter 1966). During the day, anchovies remain well below the surface, rising to the surface at night. They are consumed by nearly all predatory fishes off California as well as by birds and marine mammals. The Indians could have caught *E. mordax* by beach seine, although some of the otoliths show signs of digestive wear and were probably from stomachs of predators captured by the Indians.

Northern anchovy remains have been reported from midden sites in Orange (Fitch 1967), Ventura (Fitch 1969a, 1975) and Los Angeles Counties (Fitch 1975; Tartaglia 1976). Fitch (1969b) previously reported otoliths of *E. mordax* from SBa-1. Material: 148 otoliths. Fig. 3E.

**Labridae – Wrasses**

*Oxjulis californica* – Senorita. — This small wrasse has been taken from Cedros Island, Baja California, to Sausalito, California. Ranging from surface waters to depths of 54.5 m (180 feet, Miller and Lea 1972), senorita prefer shallow water rocky habitat with kelp vegetation. A 229 mm (9-inch, Fitch 1968) individual weighed 113 g (4 ounces, Fitch 1968). The Indians probably caught this species with gill nets.

*O. californica* remains have been reported from midden sites in San Luis Obispo (Fitch 1972), Ventura and Los Angeles Counties (Tartaglia 1976). Material: 2 otoliths, 7 premaxillary bones, 26 pharyngeal bones. Figs. 3F; 5A; 6C.

*Pimelometopon pulchrum* – California sheephead. — California sheephead range from Cape San Lucas, Baja California, to Monterey, with an isolated population in the northern Gulf of California. Although abundant in southern California waters, it is not common north of Point Conception. This fish is abundant in thick kelp beds and slightly rocky habitat. They are known to reach a length just under one meter (3 feet, Miller and Lea 1972) and a weight of 16.5 kg (36.25 pounds, Fitch 1968). The Indians could have captured California sheephead by hook and line, in traps, or by free diving, especially on offshore islands.

California sheephead remains also have been recovered from many other midden sites: Arroyo Grande, Point Mugu, Arroyo Sequit, Century Ranch, La
Jolla, Santa Catalina Island and San Pedro (Wallace 1962; Follett 1933; Mitchell 1959; Follett 1963a, 1963b; Shumway, Hubbs and Moriarty 1961; Meighan and Eberhart 1953; Meighan 1959; Frey 1974), and from Orange (Fitch 1967), Ventura (Fitch 1969a; Tartaglia 1976) and Los Angeles Counties (Tartaglia 1976).

Material: 1 jaw tooth. Fig. 5C.

Mericlucciidae – Hakes

Merluccius productus – Pacific hake. — The Pacific hake ranges from Magdalena Bay, Baja California, to Alaska and along the Asiatic coast; there is an isolated population in the Gulf of California. They have been known to reach a length of nearly one meter (3 feet, Fitch 1972) and a weight of 3.6 to 4.5 kg (8 to 10 pounds, Fitch 1972). Although found from the surface to depths of 1000 m (3000 feet, Miller and Lea 1972), most individuals off California inhabit waters shallower than 270 m (750 feet, Fitch 1972). The Pacific hake is a schooling fish that moves inshore and offshore much the same as the northern anchovy, and is preyed upon heavily by marine mammals. No Pacific hake remains were recovered from the samples examined by us, but Fitch (1969b) reported jaw fragments and vertebrae of Pacific hake from a sample (general sample) he examined from the slope region of Rincon Hill.

Pacific hake remains have been recovered from Indian midden sites in Ventura and San Luis Obispo Counties and at Tomales Bay and Point St. George (Fitch 1969a, 1969b, 1972; Follett 1968; and Gould 1966).


Sciaenidae – Croakers

Cynoscion nobilis – White seabass. — White seabass are found from Magdalena Bay, Baja California, to Juneau, Alaska, with an isolated population in the northern Gulf of California. Although reported to grow as large as 41 kg (90 pounds, Miller and Lea 1972), a 38 kg (83.75 pound, Fitch and Lavenberg 1971) individual is recognized as the world record. The white seabass prefers depths of 21 to 45 m (75 to 150 feet, Fitch and Lavenberg 1971) but has been taken from surface waters to depths of 121 m (400 feet, Miller and Lea 1972). Although large adults have few natural enemies, the largest of the two sagittae that we recovered at SBA-1 was eroded, indicative of digestive wear possibly due to consumption by a large predator. Otoliths of C. nobilis have been used by California’s Indians for necklace ornaments (Fig. 7). The Chumash probably caught white seabass on hook and line while fishing just offshore.

C. nobilis remains have been found at Malaga Cove and Santa Catalina Island (Walker 1951; Meighan 1959), Arroyo Sequit and Century Ranch sites (Follett 1963a, 1963b; Mitchell 1959), Ventura (Fitch 1969a, 1975; Tartaglia 1976), San Nicolas Island (Charles Rozaire, Natural History Museum of Los Angeles County, personal communication), Marin (Follett 1974), Contra Costa (Follett 1975b) and Los Angeles Counties (Tartaglia 1976), and a midden
site at Punta Pequena, San Juanico Bay, Baja California (Huddleston, unpublished data).

Material: 2 otoliths. Figs. 4A, B.

*Genyonemus lineatus* — White croaker. — White croakers attain lengths to 412 mm (15.4 inches, Miller and Lea 1972). They have been found from Magdalena Bay, Baja California, to Vancouver Island, British Columbia, but are not common north of San Francisco Bay. White croakers prefer sandy or muddy bottom habitat and frequently are taken in shallow waters, although they have been known from depths of 188 m (330 feet, Miller and Lea 1972). A random sample of 100 *G. lineatus* otoliths from SBA-1 ranged in size from 7.0 to 12.5 mm representing fish from 152 to 266 mm in length. This narrow size range indicates a selective method of fishing, probably the use of gill nets.

Remains of *G. lineatus* were reported previously from SBA-1 and near Ventura (Fitch 1969b, 1969a, 1975), Conejo Rock shelter and a site near La Jolla (Follett 1965; Shumway et al. 1961), San Diego County (Follett 1976) and from a site in San Pedro (Frey 1974).

Material: 932 otoliths. Fig. 4C.

*Seriphus politus* — Queenfish. — This fish is found from west of Uncle Sam Bank, Baja California, to Yaquina Bay Oregon, but is rare north of Monterey. Queenfish attain lengths of 305 mm (12 inches Fitch 1972) and a weight just over 284 g (10 ounces, Fitch 1972). They prefer much the same habitat as the white croaker, and most of the individuals probably were captured in gill nets along with the white croakers. Queenfish are not taken as easily by hook and line as white croakers, but it is possible that some were captured that way.

Fitch (1969a, 1972, 1975) reported *S. politus* otoliths from sites in Ventura and San Luis Obispo Counties.

Material: 42 otoliths. Fig. 4D.

Scombridae — Mackerels and Tunas

*Pneumatophorus japonicus* — Pacific mackerel. — This transpacific species is found in the eastern Pacific from Chile to the Gulf of Alaska. Attaining a length of 635 mm (25 inches, Miller and Lea 1972) and a weight of 2.9 kg (6-½ pounds, Miller and Lea 1972), this schooling species is found from the surface to depths of 45.5 m (150 feet, Miller and Lea 1972). The Pacific mackerel, like the bonito, will take nearly any bait, and the Indians probably captured them by the use of hook and line.

Follett (1963a, 1963b, 1965) reported Pacific mackerel remains from two sites in Los Angeles County and from the Conejo Rock Shelter in Ventura County. Fitch (1969a, 1975) reported their remains from midden sites near Ventura, and Follett (1976) reported their occurrence from a site in San Diego County. They have also been reported from a midden site at Cape Brinera (Sidimi) USSR (Besednov 1973).

Material: 4 otoliths. Figs. 4E.; 6A.

*Sarda chiliensis* — Pacific bonito. — The schooling Pacific bonito ranges
from Chile to the Gulf of Alaska but is absent in tropical waters and uncommon north of Point Conception. They have been reported to attain a length of just over one meter (40 inches, Miller and Lea 1972). A 686-mm (27 inches, Fitch 1969a) specimen weighed 4.8 kg (10-1/2 pounds, Fitch 1969a). This fish usually travels at or near the surface and will take nearly any bait. The Indians probably captured Pacific bonito with hook and line. Follett (1933, 1963a, 1963b) reported Pacific bonito remains from two middens in Los Angeles County and from one in Ventura County. Fitch (1969a) noted their remains from a Ventura County midden and Tartaglia (1976) noted them from sites in Ventura and Los Angeles Counties.

Material: 33 dentaries. Fig. 6B.

**Scorpaenidae – Rockfishes**

*Sebastes atrovirens* – Kelp rockfish. — The kelp rockfish ranges from Pt. San Pablo, Baja California, to Timber Cove, Sonoma County. They have been known to attain a length of 425 mm (16-3/4 inches, Fitch 1969a) and a weight of just over 1.4 kg (3 pounds, Fitch 1969a). Kelp rockfish inhabit depths from subtidal to 45.5 m (25 fathoms, Phillips 1957) but are most abundant at about 10 m or less. The inhabitants of SBA-1 probably caught kelp rockfish by hook and line in shallow water just offshore or in traps.

Remains of *S. atrovirens* also have been reported from a midden in San Luis Obispo County (Fitch 1972).

Material: 1 otolith. Fig. 4F.

*Sebastes diploproa* – Splitnose rockfish. — This deep-living rockfish ranges from north of San Martin Island, Baja California, to Prince William Sound, Alaska. They are known to reach a length of 457 mm (18 inches, Miller and Lea 1972) and a depth of 473 m (250 fathoms, Phillips 1957). The single broken otolith recovered from SBA-1 showed little digestive wear. Because this species has not been known to come nearer than 212 m (700 feet, Miller and Lea 1972) it may not have been captured directly by the Indians. We suspect that it was derived from the digestive system of a deep-feeding predator such as a marine mammal, which was captured by the Indians.

Remains of *S. diploproa* have not been reported from any other midden.

Material: 1 otolith. Fig. 4H.

*Sebastes goodei* – Chilipepper. — *S. goodei* have been captured from Magdalena Bay, Baja California, to near Cape Scott on the northwest coast of Vancouver Island, British Columbia. They range from the surface to great depths. The deepest recorded specimen was taken at 327 m (1080 feet, Miller and Lea 1972); the largest specimen captured measured 559 mm (22 inches, Phillips 1957). Chilipeppers frequently are captured by sport fishermen, but only from skiffs or boats anchored or drifting over deep rocky habitat. Although young individuals usually remain in shallow water, all of the otoliths we recovered at SBA-1 were from adult fish. The Indians probably captured this fish by hook and line while fishing in deep water.
Follett (1963a) reported *S. goodei* from a midden in Los Angeles County. Material: 9 otoliths. Fig. 4G.

*Sebastes miniatus* – Vermilion rockfish. — Ranging from San Bonito Island, Baja California, to Vancouver Island, British Columbia, this rockfish has been captured at a depth of 200 m (110 fathoms, Phillips 1957); juveniles prefer shallow water. Vermilion rockfish attain lengths of 762 mm (30 inches, Phillips 1957). The Indians probably caught this species while fishing with hook and line in intermediate depths. Remains of vermillion rockfish have been recovered from Indian middens at Pt. St. George and Scripps Estate (Gould 1966; Shumway et al. 1961).

Material: 2 otoliths. Fig. 41.

*Sebastes* spp. – (Species undetermined). — At least 58 species of rockfishes (genus *Sebastes*) inhabit waters off California. Some of the fragmented *Sebastes* otoliths we recovered from SBa-1 probably belonged to one or more of these species.

Serranidae – Sea basses

*Stereolepis gigas* – Giant sea bass. — Sometimes placed in the family Percichthyidae (temperate basses), the giant sea bass has been taken from the Gulf of California to Humbolt Bay, but is not abundant north of the Channel Islands off southern California. A record specimen weighing 252 kg (557 pounds, Fitch and Lavenberg 1971) was caught in 1962. An individual weighing 197 kg (435 pounds, Fitch and Lavenberg 1971) was found to be 72 to 75 years old (Fitch and Lavenberg 1971). Large individuals prefer rocky bottom habitat and depths of 35 to 46 m, just outside kelp beds. During the spawning period, which is from June to September, large individuals are relatively abundant in shallow waters where they can be taken easily with hook and line.

Fitch (1969a) reported branchiostegals rays of *S. gigas* from a midden near Ventura.

Material: 1 vertebra. Fig. 51.

Sphyraenidae – Barracudas

*Sphyraena argentea* – Pacific barracuda. — Ranging from Cape San Lucas, Baja California, to Kodiak Island, Alaska, the Pacific barracuda reaches a length of 1.2 m (46½ inches, Fitch and Lavenberg 1971) and a weight of 7.7 kg (18 pounds 3 ounces, Fitch and Lavenberg 1971). There is an unverified record of 1.5 m. Most common south of Morro Bay, this schooling species remains near shore in depths from the surface to 18.8 m (60 feet, Miller and Lea 1972). Schools of juveniles will sometimes wander into shallow bays. Although today barracudas often are captured by gill nets, the inhabitants of SBa-1 probably took barracudas by hook and line.

Remains of Pacific barracuda have been recovered from midden sites in Ventura (Fitch 1969a, 1975; Follett 1933, 1965; Tartaglia 1976), Los Angeles
(Follett 1963b, 1969; Tartaglia 1976) and San Diego Counties (Follett 1976). Material: 6 otoliths. Figs. 5D, 6C, D, E.

Xiphiidae – Swordfish

*Xiphias gladius* – Swordfish. – This species is found worldwide in warm and temperate seas, but in the eastern Pacific it is found from Chile to Oregon. The swordfish occurs off our coast only during a few summer months each year. They frequently rest at the surface but have been seen at depths greater than 666 m (2000 feet, Fitch and Lavenberg 1971). The largest recorded specimen measured 4.5 m (14 feet 1 1/4 inches, Fitch and Lavenberg 1971) and weighed 535 kg (1182 pounds, Fitch and Lavenberg 1971). This specimen was captured off the coast of Chile in 1953. The Indians probably obtained swordfish with harpoons during summer months.

Swordfish remains have been reported from midden sites in Ventura County (Fitch 1969a; Follett 1933) and from the Burton Mound Site (Harrington 1928). Material: 7 vertebrae. Figs. 5F, G.

ELEMENTS OF IDENTIFICATION

Otoliths were by far the most important element in identifying teleosts from SBa-1. Twenty of the 29 species (representing 69 percent) were identified from otoliths; the next most useful elements were premaxillaries, pharyngeal bones, dentaries and vertebrae. Four species were identifiable by each of these elements, representing only 14 percent of the teleost species. For identifying elasmobranchs, which do not possess otoliths, teeth were the most important element. All 16 of the sharks were identifiable on the basis of teeth alone. One species also was identified from dermal denticles and another by a dorsal fin spine, each representing less than 6.5 percent of the elasmobranch species. Small mesh screens are not only necessary for retaining small otoliths, but are important in the collecting of elasmobranch remains. From the 1/4-inch screenings a total of four species could be identified; from the 18-mesh, eight species; and from the 30-mesh, 11 species. Six species of four families were retained only by the 30-mesh screen. Utilizing screens smaller than 30- or 32-mesh is not practical. There are otoliths which will pass through such screens, but they represent fishes that would not likely have been utilized as food by the Indians who inhabited these sites. It would be desirable to examine a large midden sample with 30-mesh screens, but if a shortage of time makes this impossible at least a 6×6-inch control column should be given this fine screening examination.

OTOLITHS IN ORNAMENTATION

A necklace in the Natural History Museum of Los Angeles County (LACM) no. A. 5600/99 from a San Nicolas Island site, mentioned by Fitch
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<td>(*) Wing spines.</td>
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(1969a), is constructed of white seabass otoliths and *Olivella* shells (Fig. 7). The 30 otoliths (14 right sagittae + 16 left sagittae) have been drilled through the thick knob-like protrusion on the outer face. The otoliths apparently were drilled part way through on one side and then turned over and completed from the other side. The hardness of otoliths as well as their vulnerability to fracture when drilling pressure is applied indicates that great patience was required to complete this necklace. None of the otoliths from SBa-1 showed any signs of such drilling or unnatural modification.

Also in the LACM collection is an artifact (no. L.2100. A. 902.70-1) from another midden in Los Angeles County (L.An-174) in which white croaker otoliths were used in a decoration (Fig. 8) believed to be a portion of a water jug (C. Rozaire, personal communication). Small pebbles and shell fragments are embedded randomly in the asphalt; these are probably a natural encasement. A faint fabric-like pattern is detectable on part of the asphalt surface. Sixteen white croaker sagittae (22 present in an earlier photograph) also are embedded in the asphalt in an "L"-shaped pattern. All of the otoliths are embedded with the outer face showing and nearly all with the end pointing inward. There is no apparent pattern in the placement of right and left sagittae. Three white croaker sagittae were loose in the bottom of the tray and several "empty" otolith impressions can be seen in the "L"-shaped pattern in the asphalt. It is assumed that the otoliths are merely a form of decoration; no other explanation is suggested at present. None of the otoliths recovered from SBa-1 shows any asphalt or tar residues to suggest their possible use as ornaments, trinkets or fetishes.

COMPARISON BETWEEN THE FISH REMAINS AND FISHING TECHNIQUES OF SBa-1 AND OTHER SITES

The oceanic environment adjacent to SBa-1 and Ven-3 in Ventura County is nearly identical, both sites possessing offshore kelp beds, sandy regions and
nearby rocky habitat; and similar species of fishes inhabit their coastal regions. The similarity of the fishing cultures of these two villages is reflected in the fish remains (Table 2). Thirty-one (72 percent) of the 41 species from SBa-1 (which likely were captured by the inhabitants as food items) also were recovered from the Ven-3 midden. Of the species thought to have been captured directly by the inhabitants, 48 percent from SBa-1 probably were captured by hook and line compared to 52 percent from Ven-3. Twenty-eight percent of the species of SBa-1 probably were captured by gill nets compared to 33 percent from Ven-3. Probable beach seine captures accounted for 40 percent of the species from SBa-1 and 44 percent of the species from Ven-3. Eight percent of the species of SBa-1 were captured by other methods compared with 11 percent of the species of Ven-3. These figures are only approximate since in several cases some of the species probably were captured by more than one method. Unfortunately, there are no age-data correlations between our samples from SBa-1 and those from the Ven-3 site reported by Fitch (1969a). It is apparent that these two villages were utilizing similar fishing techniques and were oriented strongly towards a marine fishery. This is in contrast with the inhabitants of Oza-190 in Orange County, who apparently utilized only hook and line and traps in taking fish (Fitch 1967). The inhabitants of SLO-2, San Luis Obispo County, also were apparently not fishery oriented, although they occupied the same site for several thousand years: "There is no evidence that they progressed beyond a hook and line fishery . . ." (Fitch 1972).

ELASMOBRANCH REMAINS

The relative scarcity of shark teeth in the SBa-1 midden when compared to the total number of vertebrae recovered is perhaps the result of one or two factors. First, sharks could have been decapitated at or near their point of capture or at a "cleaning station", reducing the total weight to be carried and the chance of being "bitten". Second, the teeth could have been utilized in some form of ornamentation or other artifact usage, but there is no indication of this.

ANALYSIS OF FISH REMAINS

In attempting to analyze the fishery habits of the inhabitants of SBa-1 we selected only the bony fishes for which an approximate minimum number of individual (MNI) fish could be determined. Further, we utilized only those species that were presumed to be food sources. We omitted the anchovies because it was not possible to determine how many of the otoliths were from stomachs of predators captured by the Indians. The number of otoliths for each species was divided by two (since each fish has two sagittae), a practice which assumes that both right and left sagittae were recovered, but if not true, establishes a minimum number. For other elements (identifications based solely on vertebrae, etc.) only a MNI of one was interpreted, although in the case of the
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swordfish the seven vertebrae could have come from seven different individuals.

Since it was not possible to determine the MNI for the elasmobranchs because of the abundance of teeth in a single jaw, no attempt was made to indicate preference or selective fishing for this group. According to present-day taste standards the thresher shark is considered choice, followed closely by the white shark and the shortfin mako, but all of these are fast-swimming forms and not easily taken (S.P. Applegate, personal communication).

A minimum of 538 bony fishes was represented by the teleost remains. Although we considered 23 species to be potential food fishes, 19 of these constituted only 6.4 percent MNI; whereas white croaker constituted 86.6 percent MNI. Single representatives of such large fishes as the giant sea bass and swordfish would yield large poundage of food, but the relative scarcity of their remains in SBa-I tends to indicate only limited or occasional usage and we do not believe that they were relied upon heavily for food. The large percentage of white croaker suggests strongly that the Indians either preferred this species or else it was easy to catch and not undesirable.

Although a hook and line fishery would account for the greatest diversity of teleostean species when compared with other fishing methods used by the Indians, it could not have accounted for more than 6.6 percent of the MNI. Beach seining probably took the second greatest number of species, but only 2.76 percent MNI. Fewer species were taken by gill netting but this method apparently accounted for nearly 92 percent MNI. All other methods yielded only a fraction of one percent MNI. Gill netting is indicated as the primary method of fish gathering.

DISCUSSION

Fish remains were very scarce in all samples obtained from the slope of Rincon Hill. The slope area is believed to be an older region of occupation, estimated to be 2000 to 1000 B.C. (Evans et al. 1968). Three radiocarbon dates obtained from samples collected by Lyon and Harrison in 1959-60, were 1320 B.C. ± 250 years, 1470 B.C. ± 130 years and 1580 B.C. ± 60 years (Radiocarbon 1963:290). Sufficient fish remains were recovered from Rincon Hill to indicate that fish were utilized in the Indians' diet. The lack of variety, the absence of open ocean or deep dwelling species, and the overall sparseness of the fish remains indicate a minimal usage of fish as a food source. This probably reflects inadequate technical skills or inefficient fishing methods at that stage of cultural development.

This is in contrast with the lower and more recently occupied region of the SBa-I complex. Based on the fish material we recovered the occupants of the lower area displayed highly advanced fishing techniques and depended upon the sea as a primary source of food. The occupation of this lower region persisted into historic times.

Among the samples from the lower region were remains of many pelagic or open ocean fishes, species which could not have been captured from shore.
Based on the life habits of the fishes (presumably these habits have not changed in the last several thousand years), the inhabitants of this lower region were utilizing crafts to carry them well beyond the surf zone and kelp beds where they harpooned swordfish, white sharks, thresher sharks, blue sharks and shortfin makos. With deep hook and line fishing they were able to take skates, spiny dogfish and rockfish; closer to shore, hook and line methods were practical in kelp bed areas to obtain California sheephead. In shallow waters and surf zones beach seines would explain the presence of smaller-mouthed fishes such as topsmelt, jacksmelt, and some of the small surfperches as well as bat rays and sting rays. Use of gill nets was demonstrated by the abundance of white croaker otoliths of nearly identical sizes. Fishes that inhabit shallow water and are approached easily, such as the shovelnose guitarfish and the horn shark, could have been taken by hand or spear.

A variety of fishing gear has been reported for the Chumash: plank canoes, harpoons, fish spears, harpoon arrows, shellfish hooks, bone fish hooks, traps and nets (Hoover 1973; Richie and Hager 1973). Concerning the SBa-1 sites only shell fish hooks have been reported (Evans et al. 1968). Evans et al. (1968:24-25) described a "donut-shaped stone" as follows: "One artifact . . . is a round cobble which has had a cylindrical hole (which) contains a large amount of asphaltum." This stone was nine centimeters in diameter, 6.8 cm thick and had a bore diameter of 3 cm. It is obvious from this description that they were dealing with a stone fishing weight (sinker) probably similar to those illustrated by Hoover (1973, plate 4, fig. B and C). Vague descriptions of "pointed bone artifacts" and "hammered stones" by Evans et al. (1968) render it impossible to determine if some of these materials were remnants or represented bone fish hooks, bone gorges, or fishing weights. Such artifacts should have been present at the site.

Olson (1971) noted that "ear bones" could at times be of value in age determination but failed to mention their significance in establishing specific identifications. Further, he suggests that the lack of fish remains in some sites could be due to the possible cartilaginous skeletal elements such as found in Salmo; this theory overlooks the fact that Salmo otoliths, as with most otoliths, are aragonitic in composition. Even fishes which possess poorly ossified skeletal structures, if present in the midden, would leave behind their otoliths.

In his discussion on shark remains, Olsen (1971:2-6) states, "A number of cartilaginous fish are poisonous when eaten by man, and it is not known whether the recovered shark and ray elements are the residue of meals or represent some other use by man." S.P. Applegate (personal communication) states that none of the sharks or rays occurring in waters off North America is poisonous when eaten by man. Therefore, there is no reason to assume that the shark and rays recognized in a midden site do not constitute food items.

Unfortunately the randomness of our samples and the disrupted state of the Rincon site (SBA-1) prevented a study of an interesting transgression of the SBA-1 inhabitants from a terrestrial hunting to a marine-oriented people.
Figure 1. A. *Isurus oxyrinchus* tooth, 18.9 mm high; B. *Alopias vulpinus* tooth, 6.0 mm high; C. *Squatina californica* tooth, 3.8 mm high; D. *Carcharodon carcharias* tooth, 22.5 mm high; E. *Notorynchus maculatus* incomplete tooth, 9.0 mm length of base; F. *Cephaloscyllium ventriosum* tooth, 2.7 mm high; G. *Squalus acantbias* tooth, 3.7 mm length of base; H. *Prionace glauca* worn tooth, 8.5 mm high; I. *Galeorhinus zyopterus* tooth, 4.1 mm high.
Figure 2. A. Mustelus californicus tooth, 1.1 mm high; B. Raja sp. tooth, 2.1 mm high; C. Rhinobatos productus tooth, 1.4 mm high; D. Triakis semifasciata tooth, 3.2 mm high; E. Dasyatis dipterura tooth, 1.7 mm high; F. Heterodontus francisci anterior tooth, 2.9 mm high; G. Heterodontus francisci posterior tooth, 7.6 mm high; H. Heterodontus francisci incomplete dorsal spine, 31.4 mm; I. Myliobatoidei incomplete caudal sting, 49.0 mm; J. Myliobatis californica dorsal view median tooth, 26.3 mm length of base; K. Myliobatis californica ventral view median tooth.
Figure 3. A. Atherinops affinis left sagitta, 5.1 mm; B. Neoclinus uninotatus left sagitta, 1.9 mm; C. Porichthys notatus eroded right sagitta, 1.3 mm; D. Sardinops caeruleus right sagitta, 3.5 mm; E. Engraulis mordax right sagitta, 4.0 mm; F. Oxyjulis californica left sagitta, 1.9 mm; G. Cymatogaster aggregata right sagitta, 6.7 mm; H. Phanerodon furcatus right sagitta, 8.4 mm; I. Hyperprosopon argenteum right sagitta, 6.7 mm.
Figure 4. A. Cynoscion nobilis eroded left sagitta, 25.7 mm; B. Cynoscion nobilis left sagitta, 21.1 mm; C. Seriphus politus left sagitta, 9.3 mm; D. Genyonemus lineatus left sagitta, 18.0 mm; E. Pneumatophorus japonicus left sagitta, 5.3 mm; F. Sebastes atrovirens right sagitta, 10.1 mm; G. Sebastes goodii left sagitta, 19.8 mm; H. Sebastes diploproa eroded right sagitta rostrum missing, 10.2 mm; I. Sebastes miniatus right sagitta, 18.7 mm.
FIGURE 5. A. Pneumatophorus japonicus incomplete right dentary, 42.9 mm B. Sarda chilensis left dentary, 56.3 mm; C. Sphyraena argentea right dentary, 64.4 mm; D. Sphyraena argentea right palatine, 51.8 mm; E. Sphyraena argentea incomplete right pre-maxillary, 30.3 mm; F. Paralichthys californicus incomplete left pre-maxillary, 45.1 mm; G. Oxyjulis californica right dentary, 10.9 mm.
Figure 6. A. *Amphistichus argenteus* pharyngeal tooth, 4.8 mm; B. *Damalichthys vacca* pharyngeal tooth, 6.0 mm high; C. *Piomelometopon pulchrum* tooth, 7.3 mm high; D. *Sphyraena argentea* left sagitta, 15.2 mm; E. *Damalichthys vacca* lower pharyngeal bone, 26.2 mm wide; F. *Xiphius gladius* vertebra, 46.9 mm length; G. *Xiphius gladius* end view of vertebra, 47.6 mm diameter; H. *Oxyjulis californica* lower pharyngeal bone, 5.2 mm wide; I. *Stereolepis gigas* vertebra, 60.0 mm high.
Figure 7. Necklace, LACM no. 5600/99, constructed with Cynoscion nobilis otoliths and Olivella shells.
Figure 8. Fragment of "water jug" LACM no.L.2100.A.902.70-1 containing otoliths of Genyonemus lineatus.
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