Prehistoric Fishing on the San Diego Coast

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Abstract

In general, archaeologists working in San Diego County have not considered fishing to have been a regionally important prehistoric activity. However, a review of published and gray literature has revealed that fishing has been an important part of the prehistoric economy for at least the last 8000 years. A synthesis of previous work provides new insights with respect to division of labor, social organization, and intensification. It is suggested that future archaeological research in San Diego County be designed to capitalize on the important potential of fish fauna and fishing gear to increase our understanding of prehistoric cultures on the San Diego coast.

Introduction

In a recent article, Raab et al. remark that "[f]ishing is one of the most extensively investigated prehistoric subsistence activities in coastal southern California (1995b:11)." The authors cite ten references supporting their comment. While there is no argument regarding the broad accuracy of their statement, what is remarkable in examining their references is the dearth of published work pertaining to San Diego County, despite the fact that the region embraces an approximately 130-kilometer-long stretch of the southern California coastline.

The goals of this paper are to summarize and synthesize the archaeological literature pertaining to prehistoric fishing in San Diego County and to consider how the archaeological record pertaining to fish exploitation might contribute to our understanding of regional prehistory.

Background

The published literature discussing prehistoric fishing in San Diego County is limited primarily to work conducted during the early 1960s. Two significant works from this period are the Scripps Estates Site (Shumway et al. 1961) and the doctoral dissertation of Claude N. Warren (1964). Both works address sites of the Early Milling Horizon, known locally as the La Jolla Complex.

Work at the Scripps Estates Site on Torrey Pines Mesa overlooking La Jolla to the south, identified sheephead, spotfin croakers, white croakers, a rockfish species, and a small shark in the recovered materials. Fishing was described as occurring from the shore and, to some extent, from rafts or boats; capture was felt to have been by hook or net, or by hand or with use of poisons in tidepools (Shumway et al. 1961:104-106).

Warren studied collections from several sites in north coastal San Diego County to reach the conclusion that the La Jolla Complex placed a strong emphasis on collecting activities (predominantly plant foods and shellfish) and that hunting and fishing were secondary economic activities. He pointed out that, of the sites investigated at the time, fishing gear was absent, and animal bone of any sort was a very minor component of column samples examined from Batiquitos Lagoon sites (Warren 1964:163-167).

The above cited literature, although approximately thirty-five years old, is still important and widely cited. However, with the volume of archaeological work performed over the ensuing third of a century, primarily under the auspices of state and federal cultural resource management laws in place since about 1970, it is suggested that a synthesis and assessment of more recent prehistoric fish exploitation data is in order.

Summary of Archaeological Literature: The Gray Literature

Gray Literature

To accomplish the stated goals, a search of gray (unpublished) literature was undertaken at San Diego County, South Coastal Information Center through the National Archaeological Data Base (NADB) files. The query, which used nine terms related to fishing and fishing gear, produced only 11 references out of a total of 3,060 reports annotated in the data base. Examination of these 11 reports revealed that five of them either contain no reference to fishing or pertain only to the historic period. However, within the remaining six reports, several other references were mentioned. In addition, local archaeologists were contacted for leads on additional works. In all, 17 pertinent gray literature references were identified, and 15 were located for review. Other reports were reviewed which identified the presence of “fish bones” or “fish vertebra” in the faunal collection, but these reports do not identify fish bone beyond the class level. These reports are not discussed here as they do not contribute to the goals of the paper.

Recent Published Literature

Two fairly recent publications discuss fishing in San Diego County. Roy Salls’ dissertation devotes a section to discussion of three San Diego County archaeological sites, all Early Archaic, and all with very small collections (Salls 1988:298-310). In addition, a sizeable fish bone assemblage from the Early Archaic Allan O. Kelly site is reported on by H. C. Koerper and colleagues (Koerper et al. 1991).

Table 1 provides summary information on the 18 sites which are discussed in the 17 references reviewed. As shown in the table, these sites represent a time range from approximately 8000 years ago up to the protohistoric period. Assemblages from these sites and interpretations by archaeologists responsible for their investigation indicate that twelve of these sites

Table 1. Locations of archaeological sites and scopes of analysis of projects with fish remains in San Diego County.

Site number, Name	Location	Age of Site (yrs B.P.)[1]	Species List	Fishing Methods	Habitats	Season	Reference
W-131, Windsong Shores	Agua Hedionda Lagoon	8390-7040	X				Gallegos and Carrico 1984
SDI-9649, Allan O. Kelly	1.6 km E of Agua Hedionda Lagoon	7940-7280	X	X	X	X	Koerper et al. 1991
SDI-603	Batiquitos Lagoon	7300-3000	X	X	X	X	Salls 1988
W-95, Batiquitos Pointe	Batiquitos Lagoon	7210-6740	X	X	X		Smith and Moriarty 1985
W-4615	Sorrento Valley	7150-3065	X	X	X	X	Salls 1988
SDI-48, Ballast Pt.	Point Loma, San Diego Bay	6600-1300	X	X	X	X	Gallegos and Kyle 1988
SDI-1103	Sorrento Valley	6310-5020	X	X	X	X	Salls 1988
SDI-6153, La Fleur	37 km inland of San Diego Bay	6080-2485	X	X	X		Christenson 1981
SDI-12093	San Diego Bay	5610-5390	X	X	X	X	Carrico and Clevenger 1995
SDI-4513, Rimbach	Sorrento Valley	5040-2820	X	X	X	X	Christenson 1989
SDI-197, Bank Robber	Sorrento Valley	4590-3820	X	X	X	X	Christenson 1987
W-143, Rising Glen	2.4 km SE of Buena Vista Lagoon	2830-450	X	X	X	X	Roeder 1985
SDI-10945	Point Loma, San Diego Bay	2680-2010	X	X	X	X	Pigniolo et al. 1991
SDI-5931	San Diego Bay	1350-820	X	X	X	X	Carrico and Clevenger 1995
SDI-4609, Ystagua	Sorrento Valley	1295-425	X	X	X	X	Roeder 1983
SDI-5017, Rinconada de Jamó	Mission Bay	1110-250	X	X	X		Roeder 1987, Kyle et al. 1997
SDI-12809, McGowan	Otay River Valley, 10 km inland from San Diego Bay	570-300	X	X	X	X	Noah 1997
W-223A, Deer Springs	21 km inland from north San Diego County coast	540-125	X	X	X	X	Quintero 1987

1. Dates are listed as reported in the referenced reports. No attempt has been made to standardize the dates, and sigma values are not included.

can be associated with the early Milling Horizon or Encinitas Tradition, known locally as La Jolla Complex, and six are Late Prehistoric. (One site, Rising Glen, W-143, has radiocarbon dates suggesting both La Jolla and Late Prehistoric components, although it is identified primarily as a Luiseño village site.) Of the 18 sites, most are located within three kilometers of the coast, but three inland sites, one Early and two Late, contain significant fish bone assemblages. The location of each of the sites listed in Table 1 is depicted in Figure 1.

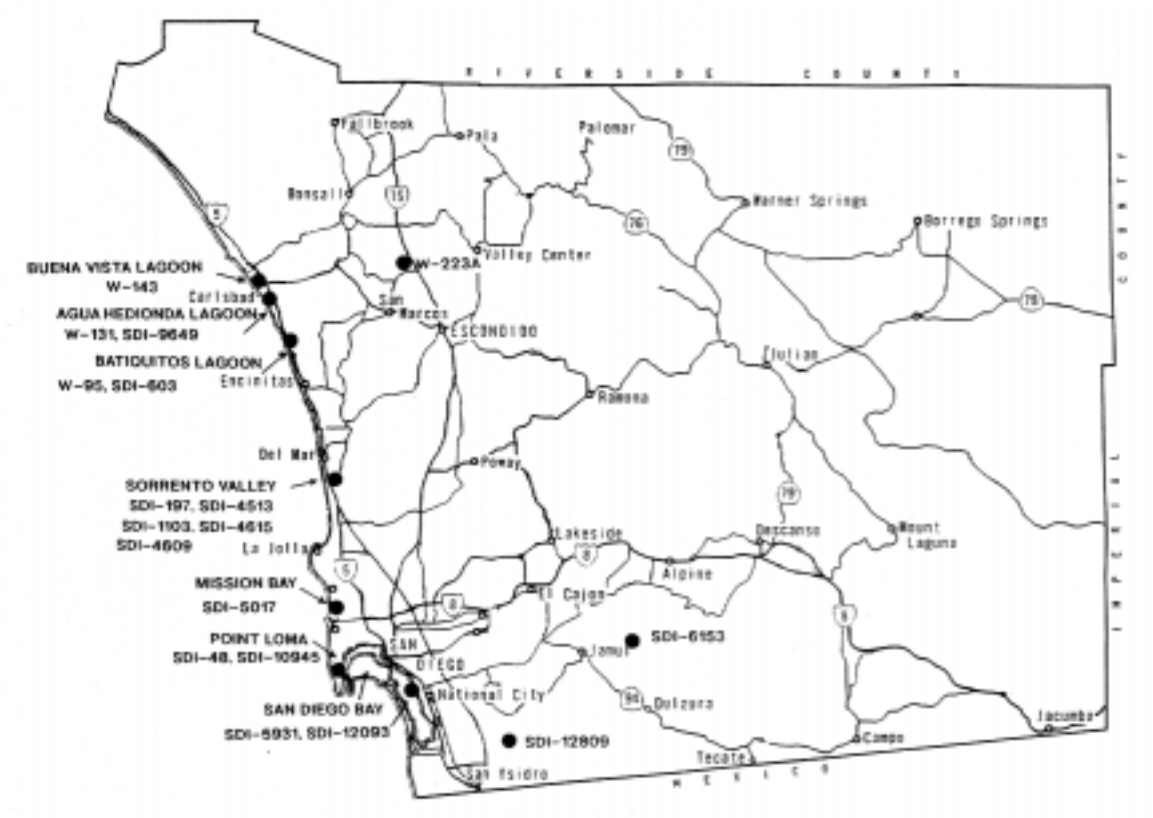

Fig. 1. Locations of archaeological sites in San Diego County with fish remains.

Table 1 also provides information on the types of analysis which were carried out using fish bone assemblages and/or fishing implements recovered from the 18 archaeological sites. Typically taxonomic identifications were made. Quantification consisted of listing the Number of Individual Specimens (NISP) of each species in an assemblage, and occasionally Minimum Number of Individuals (MNI) was calculated. In most cases, no attempt was made to estimate fish size within a particular species. An exception was Christenson's analysis of fish remains from SDI-10945 (Pigniolo et al. 1991), in which she determined, based on examination of cranial elements, that most California sheephead (*Semicossyphus pulcher*) fell into the small and very small categories. No analyses attempted to quantify protein or caloric value of the fish component of the bone assemblage.

Habitats Exploited during the Early Period

In general, analysts assessed habitats exploited by reviewing the natural histories of species as presented in various fish guidebooks. A number of reports contain tables, listing identified fish species and their habitat preferences such as “Mud/sand,” “Kelp,” “Reef,” “Midwater,” “Pelagic,”and the like. Based on examination of the tables and, at times, species counts, the analyst would be able to make conclusions as to what habitats were exploited and to what extent.

To provide a summary of what the recently published and gray literature reveals about habitat exploitation, I will begin by discussing the La Jolla Complex sites, moving down the coast from north to south. For ease of discussion, the La Jolla Complex sites are divided into three groups: northern lagoons, Soledad (Sorrento) Valley, and San Diego Bay.

Although radiocarbon dates for the Rising Glen Site near BuenaVista Lagoon indicate an early site component, the recovered materials relate predominantly to the Late Prehistoric period. Therefore, this site will be discussed in the ensuing section.

Northern Lagoons

Of the reports reviewed for this study, the most northerly locations which produced Early Archaic materials are Agua Hedionda Lagoon and Batiquitos Lagoon. As shown in Table 1, these are also the sites with the oldest radiocarbon dates. Exploited marine fishing habitats are not discussed in the Windsong Shores Site; habitat preferences have been defined for the purposes of this paper and are presented in Table 2. This information indicates that exploited habitats were bays and estuaries; rocky areas, such as reefs; sandy bottom beach areas; and probably kelp beds. As percentages of the various species identified at the site are not available, the relative importance of the various habitats cannot be assessed.

The species list for the Allan O. Kelly Site is very similar to that of the Windsong Shores Site, with a few additions. These include two additional species of estuary-dwelling elasmobranchs (sharks and rays) and small numbers of croakers and perches, indicating kelp bed exploitation. Of interest is that, despite the additional evidence for kelp bed exploitation, only one sheephead bone was identified out of a total of 713 fish bones, 170 of which were identified to at least family level. One element from a California grunion was recovered through 1/16-inch screening of a column sample. This provides additional evidence for sandy beach foraging. In summary, the species recovered from the Kelly Site indicate that the same habitats were exploited by its inhabitants as by the inhabitants of the Windsong Shores Site, with a bit stronger evidence for kelp bed use.

Fish bone from site SDI-603 at Batiquitos Lagoon was analyzed by Roy Salls. The faunal assemblage from this site is predominantly molluscan. Shell midden analysis performed by

Table 2. Fish species and their habitats identified at Windsong Shores Site (W-131).

Species[1]	Common name	Habitat[2]
Triakididae	soupfin or leopard shark	Soupfins abundant offshore, also come in to coastlines, bays, and shallows; leopards roam inshore sand flats, rocky areas in schools.
Myliobatus californica	bat ray	Inshore bays, sloughs; flat rocky bottoms, kelp beds with sandy patches.
Clupeidae	herring or sardine	Pelagic, swim near surface; several species come inshore in large schools.
Salmonidae	trout or salmon	Rivers, deep ocean, estuaries.
Paralabrax sp.	kelp or sand bass	Kelp bass in reefs or kelp beds; sand bass inhabit rocky or sandy bottoms, reefs.
*Calamus brachysomus**	Pacific porgy	Smooth, non-rocky bottoms; young in bays, estuaries; adults in deeper water.
Amphistichus argenteus	Barred surf perch	Sandy, waveswept beaches, schools in pounding surf.
Sphyraena argentea	California barracuda	Fringes of kelp beds, surface to deep water, large schools sweep inshore to chase anchovies, sardines, preferring rather shallow waters close to shore; young often in bays and lagoons.
Semicossyphus pulcher	California sheephead	Kelp beds or rocky reefs.
Scombridae	tuna or mackerel	Open ocean; come in close to coast in large schools in summer.
*Katsuwonus pelamis**	Skipjack tuna	Found offshore in great schools; in California waters only when temperature and other conditions suit their needs (temperate and subtropical waters).
Paralichthys californicus	California halibut	Soft sandy bottoms from shore to 180 m; surf lines, bays and estuaries.

1. Identifications by Camm C. Swift and Mark Roeder (Gallegos and Carrico 1984:5-12). * denotes possible.

2. Habitat accounts based on Audubon Society (1983) and Goodson (1988).

Warren and Pavesic in 1963 was instrumental in reconstructing the evolving ecology of Batiquitos Lagoon during the Archaic Period (Warren and Pavesic 1963). Of the small number of fish bones recovered from column samples (between 18 and approximately 30 elements, based on Salls' figures), slightly more than half were California sheephead (*Semicossyphus pulcher*). Leopard shark, spotfin croaker, and bonito are also present in small numbers. Based on these data, Salls indicates that the kelp beds may have been exploited more productively than the bay-estuary environment (1988:308-309), and that this may have been due to the effects of silt deposition on the lagoon environment. The bonito element recovered from the site indicates possible deep water fishing. The very few fish bones recovered from nested screening indicates that fishing may not have been an important activity associated with SDI-603.

The Batiquitos Pointe Site is useful in that its five radiocarbon dates cluster within an approximate 500-year period, so the problem of mixed materials spanning broad time periods is eliminated. The site analysis produced 87 fish bones, or 14.6 per cent of the faunal assemblage by count. The authors comment that this small percentage substantiates Warren's statement that there is little or no evidence for an intensive marine orientation by the La Jolla people (Warren 1964:150-154). However, the current study notes that most of the collection was screened through 1/4-inch screen, although a single "analysis unit" was water-screened through 1/16-inch mesh. The materials were combined for the faunal analysis, which shows a surprisingly high percentage of deer and deer-sized bone (178 bones or 29.5 per cent of the total assemblage). It is suggested here that screening techniques may have introduced a bias for large mammals and against fish bones, which are regularly lost even through 1/8-inch screen, and that, in reality, fish may represent a more sizeable portion of the assemblage. Nevertheless, the analysis demonstrated that California barracuda (*Sphyraena argentea*) was the most common species (18 per cent of total fish), followed by undifferentiated members of the ray family (Batoidea) (16 per cent) and, more specifically, bat ray (*Myliobatis californica*) (10 per cent). These species and others found in lesser quantity indicate fishing in shallow sandy-bottomed estuaries, bays, the surf zone, and kelp beds. Of interest is that California sheephead, which often predominates in fish assemblages, is rather uncommon in this site, accounting for only 3 per cent of the fish bone sample. The assemblage also includes several species normally associated with deep offshore waters (Tartaglia 1976:23), most of which are known to move inshore at times (Goodson 1988:passim). Those species less likely to be found inshore are Pacific bonito (*Sarda chiliensis*) and white seabass (*Atractoscion nobilis*). Whether their presence in the site reflects offshore fishing or a deeper bay into which these species ventured is not known.

To summarize the fish faunal data from the northern lagoons, with the exception of species normally associated with deep water and seasonal migration to inshore areas, such as tuna, members of the Salmonidae family, sardines, and barracuda, all species recovered from the northern lagoonal sites still inhabit Agua Hedionda Lagoon (City of Carlsbad 1976). The additional species available in times past may simply reflect a more open, and probably somewhat deeper bay. Of interest is the very low representation of California sheephead in both the Allan O. Kelly and the Batiquitos Pointe sites. This species is often one of the more prominent species in southern California middens. Numbers of Individual Specimens are not reported for Windsong Shores, so how its sheephead count compares to the other northern lagoon sites of this time period is unknown. While the SDI-603 piscine collection is more than half sheephead bones, the collection is very small and may not be representative.

The Batiquitos Pointe Site is the only Early Period northern lagoon site which was found to contain barracuda, and this was the most common species in the assemblage. Barracuda are important seasonality indicators (with their spawning season peaking between May 15 and July 15) (Salls 1988:595), and their absence from other early sites may as much about season of occupation as about habitat use.

The Soledad Valley Sites

The Soledad Valley, also known as Sorrento Valley, area has four Early Period sites with fish faunal assemblages. As shown in Table 1, these sites span a period from approximately 7000 to 2800 years ago. Soledad Valley comprises a long southeast trending slough, with its mouth to the ocean located south of Del Mar and north of the Torrey Pines State Reserve.

Site SDI-1103 is located on a low bench on the inland edge of the slough, approximately 2 kilometers east of the ocean. The Bank Robber Site, SDI-197, also on the slough's inland edge, sits on a knoll above the slough, about 800 meters south of SDI-1103. At the far southern end of Soledad Valley, where it narrows into Soledad Canyon, sits SDI-4513, known as the Rimbach Site. This site is a portion of the ethnohistorically recorded Kumeyaay village of Ystagua, but the faunal collection discussed here is from an early component. (The Late Prehistoric component is addressed later in this paper.) The Rimbach Site is approximately 6.5 kilometers from the ocean, but less than 800 meters from the current southern edge of the Slough. Site SDI-4615 occupies a low rise on the northern creek bank in Carmel Valley. This valley opens into the slough at its northern end approximately 1.6 kilometers east of the ocean. The site is located 1.2 kilometers upstream from the slough.

Table 3 provides information on the types of fish recovered from the four Soledad Valley sites. As shown in the table, with the exception of SDI-1103, elasmobranchs (rays and sharks) are among the most common fish types identified. These species indicate an emphasis on a shallow sandy or muddy-bottomed bay or estuary. Salls notes that, since SDI-1103 is situated on the edge of the estuary, the site presents an anomaly because shell species exploited are lagoonal, while the very small piscine collection indicates exploitation of kelp beds, rocky areas, and open waters. His explanation relates to water salinity: SDI-1103 is located away from the mouth of the slough in an area of fluctuating salinity. Because this condition often results in an impoverished fish environment, Salls concludes that the SDI-1103 inhabitants were forced to go to the open coast if they were to add fish to their diet (Salls 1988:298). However, Table 3 demonstrates that sites SDI-197 and SDI-4513, despite being located further from the slough mouth, produced sizeable percentages of elasmobranchs. Therefore, other possible explanations for the absence of elasmobranchs at SDI-1103 are sampling error or that fishing was not an important subsistence activity at the site.

Table 3 also indicates an emphasis at all sites on rocky areas, the open bay, and kelp beds. The "Other Bony Fish" category represents a mix of croakers, perches, bass and other species.

In summary, all Soledad Valley sites evidence exploitation of kelp beds and at least an open bay environment. Despite the distance of the Rimbach site from the coast, deep water fish were favored. However, some of these species may have ventured further inland than is possible today. The estuary was also an important habitat area for fish capture.

Table 3. Percentages of various fish species from Soledad Valley La Jolla Period Sites.

Site number	Number of Fish Bones	Percentage Identified	Elasmobranchs	Sheephead	Sardine	Tuna/Mackerel	Other Bony Fish
SDI-1103	37	59	0	8	0	24	68
SDI-197	270	33	11	7	3	3	76
SDI-4615	56	73	25	4	27	4	40
SDI-4513	72	?	22	14	13	15	36

San Diego Bay

Two sites on the bay side of Point Loma date to the La Jolla period. The Ballast Point Site (SDI-48) represents occupation over an approximate 5000-year period, while SDI-10945 produced dates of somewhat over two thousand years ago. The former produced over 12,000 fish bones. Analysis of a sample of them identified 37 species of fish, dominated by sheephead, which constitutes 57 per cent of the identified assemblage by count and 37 per cent by MNI. The next most common species are bat ray and shovelnose guitarfish, two elasmobranchs that each make up 8 per cent of the assemblage. Various sharks occur in the assemblage, with smoothhounds (Triakididae) and Pacific angel shark (*Squatina californica*) most common. Barracudas are rare. As noted by Gallegos and Kyle (1988:ii), the site occupants fished the rocky coast, kelp areas, soft substrate sloughs, and sandy tidal areas. Of interest is the fact that, at this time in prehistory, San Diego Bay was shallower overall, with extended areas of tidal mudflats. By the time SDI-10945 was occupied, the bay had reached its current configuration, with sandy beaches, fewer rocky foreshore areas, and a full bay (Masters 1988).

At SDI-10945, sheephead continue to dominate. Calculations performed from data in catalog tables indicate that the site produced 2777 fish bones of which 488 were identified. Fully 84 per cent of the identified fish bones were sheephead. The authors note that individual specimens are much smaller than at the Ballast Point Site and imply that this is because fishing took place from shore (Pigniolo et al. 1991:12-17). The change might also relate to overexploitation, environmental change, or technology employed. The authors note that, as at Ballast Point, other dominant species include bat ray and Pacific angel shark. Possibly the extremely high percentage of sheephead, even relative to the Ballast Point Site, is related to a fuller bay and fewer mud flats in the Point Loma vicinity.

The La Jolla Complex site on the strand-sheltered portion of San Diego Bay, SDI-12093, produced 62 fish bones. In contrast to both of the Point Loma sites, forty-seven of these, 76 per cent, were elasmobranchs (sharks and rays), dominated by bat ray elements (48 per cent of fish assemblage). Sheephead are completely absent from this site assemblage. These numbers demonstrate that residents of SDI-12093 focused on the adjacent mudflats of San Diego Bay.

The final La Jolla Complex site analyzed for this study is the La Fleur Site, SDI-6153, located in the foothills approximately 37 kilometers east of the strand-protected portion of the bay. The collection is biased toward larger fish, as the site was screened using 1/4-inch mesh. A total of 54 per cent of the 28 identified specimens are soupfin or other sharks of the smoothhound family (Triakididae). Sheephead elements comprise 29 per cent of the collection. Bat ray and white croaker (*Genyonemus lineatus*) make up the remainder of the assemblage (Christenson 1981:36). All these species, with the exception of sheephead, could have been obtained within the sheltered shallow sandy-bottomed waters of San Diego Bay. Sheephead inhabit rocky areas and kelp beds.

To summarize the information from San Diego Bay, apparently sites were situated to exploit the adjacent environment, which consisted in large part of rocky habitats in the Point Loma area and mudflats within the strand-protected portions of the bay.

Summary of La Jolla Complex Habitat Esploitation

With respect to the La Jolla Period sites, the most commonly exploited habitats were bays and estuaries, rocky areas, and kelp beds. Several pelagic species occur in the assemblages, indicating that fishing further offshore probably occurred. However, most of these species occasionally venture toward shore and could have been captured there.

Habitats Exploited during the Late Period

For purposes of this discussion, the six Late Prehistoric sites are divided into a northern category, Sorrento Valley, Mission Bay, and San Diego Bay (including a river valley site upstream from the bay).

The coastal Luiseño village site, known as Rising Glen, or W-143, is located approximately 2.5 kilometers southeast of Buena Vista Lagoon and 3.2 kilometers east of the Pacific Ocean. Rising Glen produced 42 species of fish. Roeder (1985:9) notes that greater than 90 per cent of the bone count from this site represents species which inhabit the lagoon and surf zone along the outer coast. These include, by count, 21 per cent surfperches, 21 per cent herring family (presumably mostly sardines), 13 per cent leopard shark family, 12 per cent shovelnose guitarfish, and 6 per cent bat ray. The other ten per cent of bones are from kelp bed and open ocean species. Out of a total of 897 identified fish elements, only 15, or less than 2 per cent, represent sheephead.

The Deer Springs Site, W-223A, located in the northern inland area, is the latest site included in the study. Archaeological excavations yielded eight species which primarily occupy kelp beds and estuary/bays, and seven pelagic species which normally inhabit areas some distance from shore. The pelagic species are sardines (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), Pacific mackerel, jack mackerel, skipjack tuna, unspeciated tuna, and barracuda. It is

notable that all anchovy elements (N=48, MNI=6) were recovered in a flotation column which was screened through 1/32-inch mesh (Quintero 1987:101). This may explain why W-223A is one of only two sites in this study to produce evidence of anchovy exploitation.

The ethnohistoric village of Ystagua was located at the head of Sorrento Slough, approximately 6.5 kilometers from the mouth of the slough. Archaeological excavations yielded nineteen fish species with Pacific mackerel and sheephead predominant, followed in abundance by barracuda. In addition to the mackerel, other pelagic schooling fish, specifically albacore, skipjack, bonito, yellowtail, and barracuda, are also present in the collection. Roeder suggests that Ystagua fishers exploited both the Del Mar kelp beds and open coastal waters several miles offshore. Some inshore fishing over sandy or muddy bottoms also occurred, but, based on bone counts, this environment was not as important in the subsistence economy.

Moving south to Mission Bay, the next Late Prehistoric site with fish bones is SDI-5017, part of the ethnographically recorded Kumeyaay village of Rinconada de Jamó. Today Mission Bay is a dredged recreational water body, but prehistorically it was the northern extension of the broad meandering mouth of the San Diego River, which variously found its outlet both north and south of Point Loma. Only the fraction of fish bone recovered from screening through 1/4-inch mesh was analyzed. Most abundant in both quantity and diversity were those species common to the kelp beds and off-shore areas. Sheephead was the most prevalent species, comprising 30.9 per cent of the 220 bones recovered. Adding rocky environment species to the kelp bed and open water numbers reveals that approximately 78 per cent of recovered bones come from fish normally found outside the bay environment. A cursory examination of the fraction of bones recovered from smaller screens revealed a large number of vertebrae from smaller fish, such as anchovies and sardines (Roeder 1987:4). These were not included in the percentages reported here. Rays, sharks, and other elasmobranchs common to a bay/estuary environment make up the remaining 22 per cent of the collection. Roeder notes that the nearby bay environment is not well-represented, but does not propose a reason for this anomaly (Roeder 1987:4). It is interesting that the molluscan assemblage shows a strong focus on collection from the bay environment (Gross 1987:9).

The pattern of fish exploitation noted at Rinconada appears to have similarities with that from SDI-5931, a Late Prehistoric site on the east side of San Diego Bay in the strand-protected area. Although 37 per cent of the assemblage by count consists of bones of elasmobranchs which inhabit a bay/estuary/mudflat environment, a sizeable portion of the assemblage consists of fish that would be most likely found in kelp bed or rocky shore areas. These include white surfperch (*Phanerodon furcatus*) and white sea bass, which comprise 24 per cent and 14.8 per cent, respectively, of the identified bony fish remains. The similarity to Rinconada is made more apparent when one examines the results of fish analysis of SDI-12,093, the La Jolla Complex site located near SDI-5931. As noted in the previous section, fully 76 per cent of the recovered specimens were elasmobranchs, indicating a pronounced focus on the bay/estuary environment during the earlier period.

The final Late Prehistoric site examined for this study is SDI-12809, located 10 kilometers inland in the Otay River Valley. The analyzed fish bone collection is very small, consisting of 31 bones. Forty-five per cent of these bones are elasmobranchs, indicating an estuary recovery. California sheephead, Pacific mackerel, barracuda, and surfperch are also represented, demonstrating that kelp beds and offshore waters were exploited.

In conclusion, the Late Prehistoric Period shows a continuing exploitation of bay/estuary, kelp bed, rocky area, and offshore environments. Unlike any of the early period sites, two Late Period sites contain anchovy bones, but this may be a result of sampling error. There is some indication that there was a reversal in the ratio of bay/estuary to kelp bed/off-shore species at bayside sites from the early to late period. If this reversal is real, it remains to be determined whether it represents a change in species availability (the bays may have been more silted in, although they had also experienced a rise in sea level), improved technology for catching kelp and offshore species, and/or an overall intensification which resulted in proportionally more forays into open water areas.

Fishing Methods

Fishing methods were determined both deductively, from the presence of fishing gear in a site, and inferred, based on modern or ethnographic accounts of fishing techniques or on behavior and habitats of the fish species identified. Table 4 summarizes the extent of archaeological recoveries of fishing gear in San Diego County archaeological sites, at least as identified in the NADB files and in the literature reviewed for this paper. These tools provide the only direct evidence for prehistoric fishing methods employed in the San Diego area. As shown in Table 4, fewer than 40 artifacts that clearly relate to fishing activities have been identified. However, many sites yielded fragmented bone artifacts, typically classified as awls, which in fact may have been fishing gorges or spear tips. It is only recently, as archaeologists have become more attuned to the presence of fish bones in archaeological sites, that the standard classification of “awl” is being questioned for coastal sites.

Lynne Christenson analyzed the worked bone collection from the Ballast Point Site, which included a number of bone gorges and composite hook barbs or shanks. She states that, “bone gorges and composite fishhooks are indicative of a fishing economy not found in Late Prehistoric coastal sites in San Diego County” (Christenson 1988:7-11). She reiterates this statement in her analysis of the worked bone assemblage for SDI-4513 and adds that “composite fishhooks are determinants of La Jollan Period sites” (Christenson 1989:7). The information presented in Table 4 tends to support the conclusion that composite fishhooks may be diagnostic of the La Jolla Complex, although the recovery of a possible composite fishhook from Rinconada de Jamó leaves this open to question (Kyle et al.1997:4-14).

Circular shell fishhooks are strongly correlated with Late Prehistoric sites in Table 4. The distribution of fishhooks through time, as shown in the table, parallels that of other areas of

Table 4. Fishing implements recovered from San Diego area archaeological sites (chronological order).

Site No.	Bone Gorge	Composite Fishhook	Circular Fishhook	Sinker	Spear Point
SDI-9649	1?				
SDI-48	13[1]	5[1]			1?[2]
SDI-4513	2-4?	1		1[3]	
SDI-197	1?				
SDI-10945		2			1?
SDI-5017	?	1	1[4]		
SDI-4609			1		
SDI-8303			1[5]		
SDI-12809			1?[6]		
W-137			>1[7]		

1. Three are complete bipointed gorges. Ten are unipointed objects, all of which appear to be broken at approximately midpoint and correspond in size and shape to bipointed bone gorges (Gallegos and Kyle 1988:7-15) Gorges are found throughout the time periods represented at the site; composite fish hooks are from levels dated c. 1300-2500 years B.P. (Gallegos and Kyle 1988:12-26).

2. Based on drawing of artifact #1122, this bone object could be a spear point. It was not identified as such by the authors (Gallegos and Kyle 1988).

3. (Kyle, Gallegos, and Carrico 1989).

4. This abalone circular fishhook was radiocarbon dated to 250±50 B.P. (Kyle et al. 1997).

5. 650 B.P. (Gallego 1999:personal communication).

6. Possible fishhook (McGowan 1977).

7. The recovery of abalone fishhooks from this site is mentioned in Roeder 1985 and attributed to a report by Flower, Ike, and Roth (1977), which could not be located for this study. The site form for W-137 describes a Luiseño site, containing more pottery than any other late coastal site in the area and with scant evidence of a “proto-Scraper Maker” (i.e., San Dieguito) occupation (Rogers 1929).

the Southern California Bight, although the generally-recognized persistence of bone gorges throughout all time periods is not demonstrated by the current study (cf. Tartaglia 1976:105). However, as mentioned earlier, some worked bone tools probably have been misidentified in the past, both because they are fragmentary and because archaeologists were not recognizing evidence of fishing in San Diego County sites. Therefore the association of bone gorges strictly with the early Milling Period sites may be more apparent than real.

It should be noted that circular fishhooks have been shown to date to at least 3000 years ago on San Clemente Island (Raab et al. 1995:14-15), and a radiocarbon date of 2780±100 B.P. was obtained on a circular fishhook from ORA-378, the Christ College Site, in Irvine (Koerper et al. 1988). The relatively rare and late occurrence of circular fishhooks in San Diego County is striking. Ivan Strudwick (1986) reported three additional, but undated,

circular fishhooks, two from the La Jolla Shores site (SDMM-W-1) and one from San Onofre (SDI-1972), bringing the total recovery from San Diego County to no more than ten.

As part of his analysis of Batiquitos Lagoon site SDI-603, Salls reexamined the worked bone collection from the site, concluding that some of the pointed objects were probably fishing gear, and that those which were too large for that purpose might be awls or punches used in net, weir, and trap construction (Salls 1988:310).

All other paraphernalia related to prehistoric fishing must either have been perishable or consists of artifacts with purposes not yet recognized by archaeologists. For example, Salls presents a plausible argument that doughnut stones, most often interpreted as digging stick weights, are actually seine net weights (1988:166-168).

Almost without exception, the authors of the reports reviewed for this study commented that rafts or boats would have been required to exploit the species identified in the site assemblages. Likewise, most authors propose nets of various types, hooks and line, and spears and harpoons as constituting the prehistoric fishing kit. One possible tool, which has not been proposed, is a club, which could have been used to more quickly dispatch a large and possibly aggressive fish, once hauled up. This practice was observed ethnographically for the Northwest Coast tribes, where it was reported for the Tlingit that “since some [halibut] weighed 100 pounds or more, it was a tricky business to haul them up, club them, and slip them over the gunwale into the boat” (De Laguna 1990:211).

Season of Capture

Most authors attempted to identify the season(s) during which fish were captured. Time of year can be identified either directly, through examination of growth rings on otoliths, or inferentially, by review of data on seasonal availability of individual species. Quintero demonstrated concordance between the two methods in her analysis of fish capture seasonality at the Deer Springs Site (1987:101-128). Table 5 presents information on season of fish capture from the literature reviewed for this study. Although otolith analysis has the ability to define season of capture quite narrowly, for example, “early summer”, “mid-winter”, and the like, for the purposes of this review, Table 5 uses just four seasons.

Examination of Table 5 reveals that all sites analyzed for fish season of capture contained evidence of summer or summer into fall activity. This is the time of year when certain resident species are most active and/or have moved into warmer estuary waters for spawning. In addition, a number of offshore pelagic species, such as tuna and barracuda, come inland at this time of year. Therefore, it would not be surprising if this was the season during which aboriginal populations of San Diego County focused subsistence activities on fishing.

Table 5. Season of catch for identified fish remains at San Diego County archaeological sites.

	Basis for Determination			Season of Catch		
Site Number	Otoliths	Species Habits	Spring	Summer	Fall	Winter
W-131			X	X[1]		
SDI-9649	X[2]	X[3]		X	X[3]	X[3]
W-95		X		X[4]		
SDI-48	X[2]	X	X	X	X	X
SDI-12093	X[2]			X[5]		
SDI-4513		X	X	X	X	X
SDI-197		X		X	X	
W-143	X[2]	X	X	X	X	X
SDI-10945	X[2]			X	X	
SDI-5931	X[2]			X	X	
SDI-4609		X[6]	X	X	X	
SDI-5017		X[7]		X	X	X?
SDI-12809		X		X	X	
W-223A	X	X		X	X	

1. Inference based on review of species list (presence of tuna).
2. With the exception of W-223A (Quintero 1987), all otolith analyses were performed by Richard Huddleston.
3. Inference based on Koerper et al. (1991:50) interpolation that two thirds of fish bones in site sample are sardines (estimated N=990). Sardines aggregate inshore from September to March (Salls 1988:310).
4.Inference based on high percentage of barracuda in site. Barracuda appear in March and decline by October, and are at their peak from mid-May to mid-July (Salls 1988:595).
5. Early summer.
6. Based on diversity of species and large numbers of bones, Roeder (1983:C-23) suggests that fish may have provided year-round food. Species habits suggest fishing during at least the three seasons identified here.
7.Inference based on review of species list (presence of summer/fall seasonal pelagic skipjack and barracuda and fall/winter sardines).

When using fish habits to infer seasonality, one must use caution when interpreting negative evidence as meaning a site was not occupied during that season. Just because there is no evidence pointing to winter fishing does not mean it did not occur. For example, Pacific sardines come inshore between October and March and might normally indicate a winter occupation, especially if recovered from an archaeological site in large numbers. However, the vertebrae of this species are quite small and would not always be recovered through standard field screening techniques.

Otolith analysis provides stronger support for seasonality analyses, assuming a sufficient number are recovered from a site to eliminate sampling error problems. Conclusions regarding the three sites in Table 5 with evidence of year-round occupation relied heavily on data supplied by otoliths.

Data in the table show that during both the early Milling and Late Prehistoric periods, Native Americans relied on fish to supply some portion of their diet, probably on a year-round basis. Late summer and early fall appear to be the seasons when fish were most heavily exploited, but there are indications of continued fishing during winter months, as well.

Discussion: Extensification and Intensification

The literature search conducted for this study indicates that fishing may have played a more important role in prehistoric subsistence strategies than has been acknowledged previously. It has been shown that a large number of species, representing a variety of marine habitats, has been exploited for at least the last 8000 years.

The process in which more and more microenvironments come to be exploited over time, reflecting greater complexity in economic activity, is known as “extensification” (Whitlam 1983, cited in Nelson 1990:484). The evidence for San Diego County indicates that a great deal of extensification had already occurred by 8000 years ago. Evidence for the origins of fishing on the San Diego coast, and for much of the extensification process, probably has been obliterated by rising sea levels, as the coastline once extended up to several kilometers west of its current location (Masters 1985:30).

The research indicated one possible area of extensification with regard to fishing along the San Diego coast. As revealed in Table 6, very few sheephead remains were recovered from sites dating to the eighth millennium before present. An exception to this is site SDI-603, which had very few fish bones in the assemblage, and has more recent dates associated with it. Examination of the species list for the Allan O. Kelly and Batiquitos Pointe sites demonstrates that kelp beds were not the focus of exploitation. The Kelly Site contains only one sheephead bone and one white seabass bone, these constituting the only evidence for kelp bed exploitation. The Batiquitos Pointe Site contains three bones each of sheephead and kelp rockfish (*Sebastes atrovirens*) as well as a single bone from a white seabass. With information currently available, it is not possible to determine whether the paucity of kelp bed species in these sites relates to the existence of fewer kelp beds at this time in prehistory or to some other reason, such as a fishing economy that had not yet begun to exploit this habitat. Relevant to this question is the observation that sheephead are nearly absent from Late Prehistoric sites in the northern part of the County. Sheephead seem to become more common in some of the Soledad Valley sites, which date somewhat younger than those of the northern lagoons, and are strikingly dominant at both of the Point Loma sites.

A topic of great interest in southern California archaeology at present relates to the process of intensification of faunal exploitation (Arnold 1992; Raab et al. 1995a; Raab et al. 1995b). Intensification can be discerned in the archaeological record by increased densities of bone in later levels of a stratified site; by decreasing individual size (indicating over-exploitation); by

Table 6. Percentages of sheephead bones by count in sites in San Diego County.

Site number, Name	Age of Site (yrs B.P.)	Site Location	Percentage of Sheephead Bones
W-131, Windsong Shores	8390-4740	N. lagoon	unknown
SDI-9649, Allen O. Kelly	7940-7280	N. lagoon	<1
SDI-603	7300-3000	N. lagoon	56[1]
W-95, Batiquitos Pointe	7210-6740	N. lagoon	3
W-4615	7150-3065	Soledad	4
SDI-48, Ballast Point	6600-1300	Point Loma, S. D. Bay	57
SDI-1103	6310-5020	Soledad	8
SDI-6153, La Fleur	6080-2485	Inland of S.D. Bay	29[1]
SDI-12093	5610-5390	S. D. Bay	0
SDI-4513, Rimbach	5040-2820	Soledad	24[1]
SDI-197, Bank Robber	4590-3820	Soledad	22
W-143, Rising Glen	2830-450	North	2
SDI-10945	2680-2010	Point Loma, S. D.Bay	84
SDI-5931	1350-820	S. D. Bay	0
SDI-4609, Ystagua	1295-425	Soledad	8
SDI-5017, Rinconada	1110-250	Mission Bay	31
SDI-12809	570-300	Otay River, S.D. Bay	6
W-223A, Deer Springs	540-125	North	0

1. Based on bias introduced by large screen size, small sample size, or the manner in which percentages were calculated, these values may be inflated relative to values presented for other sites. See text for details.

evidence of more advanced fishing technologies; or by extended seasonal exploitation for a given species.

With the evidence currently available, it is not possible to identify intensification at San Diego County sites by increased densities of bones from stratified sites. There simply have not been any excavations performed, nor data collected or analyzed, in such a way as to permit this type of analysis. The only indication for possible species over-exploitation comes from Christenson's work at SDI-10945 on Point Loma. She indicates that sheephead recovered from this site are substantially smaller than those from the Ballast Point Site which is about two kilometers away. The explanation offered for the disparity between the two sites is that fishing was carried out from the shore at SDI-10945, whereas a broader environment was exploited by the inhabitants of Ballast Point (Pigniolo et al. 1991:12-17). However, Salls indicated for the Eel Point Site on San Clemente Island, that a decrease in size of sheephead was indicative of a "continued pressure on this long-lived, territorial, but limited faunal resource" (Salls 1992:165). This possibility warrants further consideration for sites along the Point Loma coastline.

The evidence for technological advances in fishing practices comes in the form of fishhooks. Again there is insufficient information at this time to demonstrate whether the introduction of various fishhook types resulted in improved capture abilities. While the Ballast Point Site contains substantial evidence for a fishing focus, the site occupation spans a 5000 year period and composite fishhooks appear to come from levels dated only from 1300-2500 years ago (Gallegos and Kyle 1988:12-26). Published stratigraphic information is insufficient to determine whether there was improved capture of any particular species with the introduction of the new technology.

There is some possible negative evidence regarding the question of fishing intensification during the Late Prehistoric Period. It has been demonstrated that circular shell fishhooks greatly increased fishing productivity on San Clemente Island starting about 3000 years ago (Raab et al. 1995b:15). Archaeological evidence available to date suggests the circular shell fishhook may not have been adopted to any great extent in San Diego. This could suggest that intensifying productivity of the fishing economy was not a concern to aboriginal populations. However, it might also indicate that other fishing techniques were more effective in the marine environments off the coast of San Diego County.

Another bit of negative evidence suggesting that intensification was limited in the San Diego area is the lack of a plank canoe building technology. Various authors have pointed to the very high costs associated with construction of plank canoes and the association of ocean-going canoes with intensified (offshore) fish and sea mammal hunting (cf. Arnold 1992; Hildebrandt and Jones 1992). The evidence gathered for this study supports previous suggestions that, in lieu of further marine intensification, San Diego coastal inhabitants added an inland focus on acorn harvesting to their subsistence system (Hildebrandt and Jones 1992:389; Warren 1964:187).

With regard to increased period of pursuit, Table 5 demonstrates that, at least at some sites, fishing occurred year-round during both the early and late periods. Therefore, overall, the currently available evidence does not indicate any great degree of intensification over time.

Importance of a Fishing Economy

Christenson (1988:7-11) states that “bone gorges and composite fishhooks are indicative of a fishing economy not found in Late Prehistoric coastal sites in San Diego County.” The results of the literature search indicate that further work is necessary to determine what types of fishhooks were important to Late Prehistoric people, but it also clearly demonstrates a continued focus on fishing at coastal sites. The evidence from six Late Prehistoric sites indicates that fishing practices which developed during the La Jolla Period carried over into the Late Prehistoric times. There is strong evidence for continued exploitation of a wide variety of habitats, for year-round capture of marine fishes, and for either sedentary occupation along the coast or inclusion of coastal fishing forays in a seasonal round. It is likely that fish constituted a

smaller percentage of the diet during the Late Prehistoric than it did during the La Jolla Period, given later expansion into more inland areas. However, no quantitative studies have been performed to date which would demonstrate the dietary contribution of fish to either La Jolla or Late Prehistoric coastal populations.

Division of Labor

It has been suggested that, because the economic focus during the early Milling Period was on the gathering of shellfish and plant resources, there was minimal division of labor on the basis of sex. For example, Erlandson suggests (1991:99), given the evidence for the preeminence of plant and shellfish gathering during the Early Holocene, that men actively engaged in gathering activities, resulting in a less rigorous sexual division of labor and a more egalitarian society. McGuire and Hildebrandt (1994) examined correlations between milling gear, projectile points/bifaces, and burials recovered from southern California Milling Stone Horizon and Late Holocene sites. The presence of milling stones with over 93 per cent of the earlier period burials, regardless of the individual's sex, suggests that gender roles were not strongly circumscribed, that men and women engaged relatively equally in plant processing, and that subsistence tasks were carried out by heterogeneous groups of women, men, and children.

This concept for a gathering economy and minimal sexual division of labor may be extended to include fishing, as there are also many fish species, especially those inhabiting bays and estuaries, which can be harvested using essentially a gathering technology. For example, grabbing or spearing elasmobranchs which have been caught in mudflats or behind weirs during receding tides, and hauling in nets which have been stretched across mouths of inlets, are activities which suggest no need for a sexual division of labor. However, I believe that this literature search has produced enough information relative to fishing on the San Diego coast to indicate that some level of sexual division of labor may have existed with respect to fishing.

There are a number of species which are more common in kelp bed or open ocean environments. Fishing these would have required the construction and piloting of boats or rafts into deep water areas. Very large fish would have been regularly encountered and occasionally captured. For example, bat rays can reach 90 kilograms, and skipjack tuna, while usually under 60 centimeters in length, have been known to grow to 1 meter and weigh up to 18 kilograms. Pacific bonito can reach the same length and are recognized for their fighting spirit once hooked. Pacific angel shark and soupfin shark reach 1.5 and 2 meters in length, respectively (Goodson 1988:passim).

It is suggested, given the requirements of child rearing, that adult women, while probably involved in nearshore fishing, would not have been regular participants in offshore fishing. Furthermore, certain forms of fishing would have required a considerable time investment in the construction and maintenance of equipment, including tule rafts, nets, hooks, and spears. While these tools could have been constructed by either women or men, given the recognized

importance and time-consuming aspect of gathering shellfish, plants, and shoreline fish, it is suggested that much of the work involved in constructing equipment for offshore fishing, such as watercraft and hooks, may have been performed by fishermen.

Social Organization

If offshore fishing was primarily a male occupation, and men were the primary builders of rafts, it is likely that cooperative efforts would have developed, resulting in the establishment of "fishing partners." This would have been particularly important when it came to catching and hauling in large fish, regardless of whether the particular species was considered dangerous. In addition, Salls' graphic representation of seine net hauling shows a net stretched out between two boats, each of which was occupied by two individuals. While this drawing is a hypothetical reconstruction, the implications are reasonable. One person in each boat would haul the net; the other would pilot the craft. It also seems reasonable that at least two sets of fishing partners would cooperate in the capture of large fish.

The above arguments suggest that certain types of fishing could have been group activities, such as was the case for jackrabbit drives, and may have required the joint efforts of more than one family. In addition, the establishment of fishing partners who would work together in what could be a dangerous occupation suggests long-term male relationships, and a possible preference for patrilocal residence.

Finally, a comparison of the Rising Glen and Deer Springs sites suggests important implications with respect to social organization. As shown in Fig. 1, these two sites are the most northerly in this study, located at almost identical latitudes. Information in Table 1 indicates that they both were occupied, at least in part, during the latter part of the Late Prehistoric Period, and both have been defined as Luiseño occupation sites. The Rising Glen Site, located near Buena Vista Lagoon, was apparently occupied year-round. Analysis of 22 otoliths disclosed that 14 of them were from fish captured during summer (mid-May to early October), seven were captured in early to mid-winter, and one was from a fish caught during late winter (March to mid-May). In addition, the presence of sardines in the assemblage indicates capture during the period from September to February (Cardenas and Robbins-Wade 1985:104; Roeder 1985:1).

In contrast, the faunal collection from Deer Springs includes 34 otoliths (MNI=28), all of which indicate capture between July and October. Quintero interprets these fish as representing "last catches," which were brought to the inland occupation site at the end of a summer encampment at the coast. Analysis of seasonal annuli of a large number of artiodactyl teeth from Deer Springs demonstrated that this inland site was occupied from November through April. Quintero suggests that the season at the coast may have lasted from May until October.

Looking at these two sites in concert suggests interesting implications. The data reveal that during the Late Prehistoric Period, there were both seasonal and year-round occupations of the coastal area. The fact that some populations stayed along the coast year-round while others left would seem to indicate that coastal resources were sufficient during the summer to support larger populations, but could only support relatively smaller populations during the winter. Possibly deer hunting also became a more important occupation along the coast during the winter months.

Ethnographic references and archaeological reconstructions normally point to the importance of the late fall season of acorn and pinyon gathering as a time when people congregated in large groups in mountain areas to trade goods, find marriage partners, and carry out some of the important life cycle ceremonies. The data presented here, based on the analysis of fish bones in archaeological sites, indicates that summer may also have been an important gathering time on the coast. This possibility should be given further consideration as archaeologists continue to try to reconstruct settlement/subsistence patterns for the San Diego area.

Conclusions

In many cases, San Diego County archaeologists have not sufficiently studied fish fauna from archaeological sites. The first shortcoming has been the use of field techniques which are biased against the recovery of fish bone. The second has been a failure to identify fish bone beyond the class level, once recovered. The studies examined here are exceptions and point out the importance of designing field and laboratory procedures to recover fish bone and to budget for specialty analyses. The third shortcoming has been to focus analysis only on descriptive matters, such as the habitats exploited, methods used, and season of occupation. While these results have been very important in broadening our understanding of site activities, prehistoric technology, seasonal settlement, and cultural patterns, the literature search did not produce studies which attempted to quantify the importance of different components of the prehistoric diet or to investigate topics such as intensification or over-exploitation.

Nearly all archaeological research performed in San Diego County over the last twenty- five years has been a result of pre-development requirements by permitting jurisdictions. Investigation of a site normally occurs in three stages: locating and recording; evaluating for significance; and performing data recovery. The last stage, data recovery, is often optional. It is suggested that, during the second stage of investigation, field techniques should be implemented that would ascertain the presence of fish fauna in the site. Some questions can be answered only with the assistance of piscine faunal collections. Therefore, if fish remains occur at a site, the research design could be formulated carefully to provide for collection of the appropriate data to answer questions important to our understanding of prehistoric culture. This is critically important at this time, as continued development in southern California is rapidly diminishing the regional archaeological record.

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