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Middle Holocene Fisheries of the Central Santa Barbara Channel, California: Investigations at CA-SBA-53

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Studies of fish remains have contributed substantially to current thinking on cultural development in the Santa Barbara Channel region. While several intensive studies of fish remains from Late Holocene and some Early Holocene sites have been conducted, there are virtually no comprehensive studies of fish remains from a Middle Holocene site in the Santa Barbara region. Fish remains from CA-SBA-53, an important Middle Holocene site, indicate that fishing practices were very similar to those of the Early Holocene. In contrast, the fishery of the inhabitants of CA-SBA-53 differs substantially from those of Late Holocene sites, in which pelagic fish are the dominant taxa. At CA-SBA-53, fishing was concentrated during the summer months, was focused on the bay/estuary environment of the Goleta Slough, and involved a variety of technologies.

FOR the most part, archaeological investigations from Middle Holocene sites of the Santa Barbara Channel lack the detailed analysis of vertebrate faunal materials currently available for the Early and Late Holocene (e.g., Moss 1983; Glenn 1990; Bowser 1993; Erlandson 1994). In particular, data from Middle Holocene sites pertaining to teleost (bony) and elasmobranch (cartilaginous) fish remains are practically nonexistent. The paucity of information regarding Middle Holocene subsistence leaves a substantial gap in our understanding of prehistoric maritime adaptations in the Santa Barbara Channel region.

This article concerns the significance of teleost and elasmobranch fish remains obtained from CA-SBA-53 (the Aerophysics site), a Middle Holocene archaeological site along the mainland coast of the Santa Barbara Channel, California. Three radiocarbon dates obtained by the authors and three earlier dates obtained in the 1960s (Harrison and Harrison 1966:34) place CA-SBA-53 within Phase Ey of King's (1990) chronology, 5,100 to 4,600 RCYBP (5,650 to 5,050 calendar years B.P.) (Table 1). This was a period of environmental productivity immediately following the global Altithermal that apparently fostered population growth and a number of significant cultural developments in the Santa Barbara Channel region (Glassow et al. 1988; Erlandson 1997; Glassow 1997). Changes in artifact forms, such as the first appearance of the mortar and pestle and side-notched projectile point forms, characterize this period of time. These artifacts reflect significant subsistence changes whose ramifications remain poorly understood.

The goals in this analysis include identification of the seasons during which fishing took place, determination of the prehistoric habitats where the site occupants fished, identification of the probable methods used to obtain fish, and evaluation of the relative dietary importance of the various fish taxa. Broader issues of Middle Holocene fishing practices with regard to earlier, contemporary, and later times will also be assessed. Ultimately, the intent herein is to establish the relationship of this Middle Holocene fishery with broader subsistence and settlement issues during this period of time.

Table 1
RADIOCARBON CHRONOLOGY FOR CA-SBA-53

Lab No. [a]	Provenience	^{14}C age	$^{13}C/^{12}C$ Adjusted (Conventional) Age	Material	Calendar Age (B.C./A.D.)[b]	Calendar Age (B.P.)
Beta-103595	Unit 3, 60-80 cm.	4,790 ± 60	5,200 ± 60	Pismo clam shell	B.C. 3,460 (3,350) 3,300	5,405 (5,295) 5,250
Beta-101901	Unit 1, 20-40 cm.	5,110 ± 60	5,530 ± 70	Pismo clam shell	B.C. 3,785 (3,705) 3,640	5,735 (5,650) 5,585
Beta-101902	Unit 1, 80-90 cm.	5,090 ± 80	5,520 ± 80	Pismo clam shell	B.C. 3,785 (3,695) 3,625	5,730 (5,640) 5,575
A-0303[c]	N1W18, 31-46 cm.	4,620 ± 80	5,050 ± 80	red abalone shell	B.C. 3,305 (3,105) 3,010	5,255 (5,055) 4,960
A-0302[c]	N1E8, 38-46 cm.	4,890 ± 80	5,320 ± 80	Pismo clam shell	B.C. 3,610 (3,500) 3,365	5,560 (5,450) 5,315
A-0363[c]	N13E26, 61-76 cm.	4,980 ± 60	5,410 ± 60	red abalone shell	B.C. 3,650 (3,615) 3,515	5,600 (5,560) 5,465

[a] Beta-101901's $^{13}C/^{12}C$ ratio of +0.0 added 420 years; Beta-101902's $^{13}C/^{12}C$ ratio of +1.3 added 430 years; Beta-103595's $^{13}C/^{12}C$ ratio of 0.0 added 410 years; all others adjusted by +430 ± 15 years (Erlandson 1988).
[b] Calibrated using Calib 3.0.3 (Stuiver and Reimer 1993); range is one sigma standard error.
[c] Obtained from Harrison and Harrison (1966:34).

ENVIRONMENTAL CONTEXT

Prior to its nearly total destruction in 1956, CA-SBA-53 was situated on a prominent knoll at the western edge of the prehistoric Goleta Slough (Fig. 1). The site was in a prime position for exploitation of the Goleta Slough, nearby wetland and terrestrial environments, and the open coast. At the time the site was occupied, the Goleta Slough was a highly productive enclosed bay that provided an array of exploitable habitats, such as mudflats and open, brackish waters of varying depths (Johnson 1980a). CA-SBA-53 has been heavily impacted by historical land use, and only a remnant of this once-extensive site remains. Harrison (1956) estimated that approximately 90% of the 54,000 sq. ft. site was destroyed during the construction of light industrial facilities and other construction efforts.

A wide diversity of ground stone tools, projectile points, and faunal remains characterizes the CA-SBA-53 assemblage. This diversity of artifact forms, as well as the faunal remains, the relatively high density of the cultural remains, and close proximity to a wide variety of subsistence resources, suggests that CA-SBA-53 may have been the principal residential base of the central Santa Barbara Channel mainland coast at this time (Glassow 1997:80).

Climatic and environmental conditions during the Middle Holocene were highly variable both spatially and temporally. Paleoclimatic reconstructions indicate fluctuations between periods of very warm sea surface temperature, and periods of cooler sea surface temperatures and perhaps increased precipitation (Glassow et al. 1988:71; Glassow 1997:81; Kennett 1998:280). A trend toward cooler water temperatures after approximately 5,500 RCYBP has recently been supported by oxygen isotope analysis of mussel shells from a Santa Cruz Island site occupied during this time period (Glassow et al. 1994). Further evidence for cooler sea surface temperatures comes from the prevalence of red abalone shells, a species that prefers cool water temperatures, in middens on the Channel Islands that date between about 5,500 and 4,500 RCYBP (Glassow 1993). Based on an increase in radiocar-

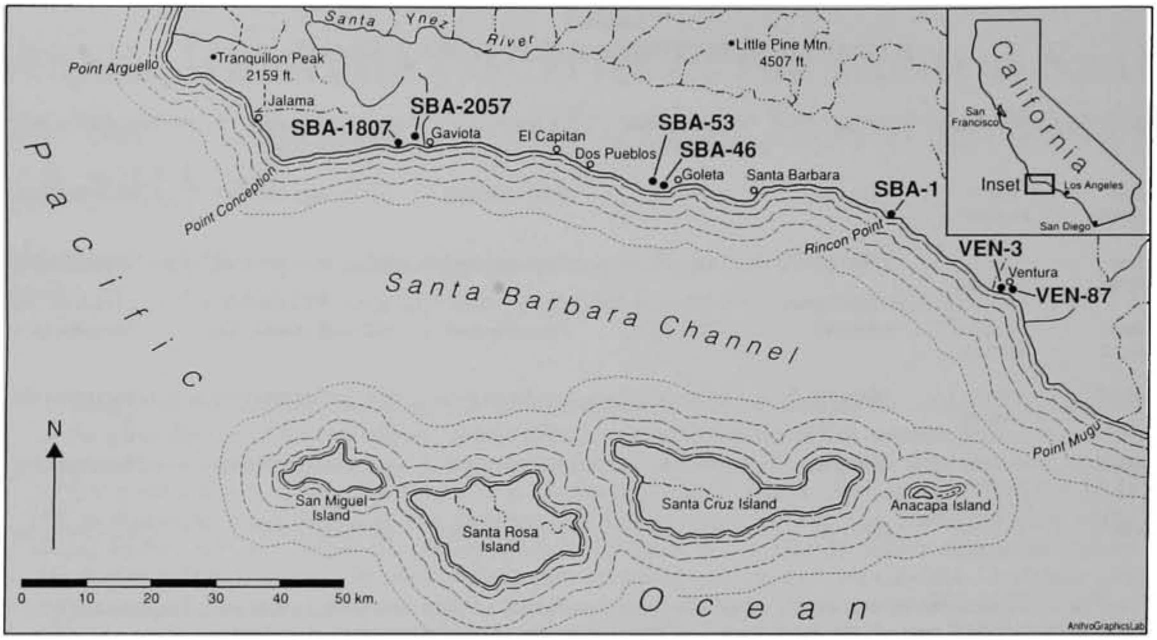

Fig. 1. Location of CA-SBA-53 and other sites discussed in the text.

bon date frequencies, population appears to have increased during this period of environmental productivity.

The creation of large estuary systems along the mainland coast was another environmental phenomenon of the Middle Holocene. Sea levels were rising relatively rapidly during the Early Holocene and did not begin to stabilize until approximately 5,000 B.P. (Inman 1983). This sea level rise led to the creation of numerous estuaries and embayments along the southern California coast (Erlandson 1994). While many of the smaller estuaries began to fill with silt, the Goleta Slough, which formed around 7,000 to 8,000 B.P., persisted into the historic period as a large, enclosed bay with surrounding mudflats (Johnson 1980a; Stone 1982; Erlandson 1994:34-35, 1997). The high proportion of estuarine shellfish species in Early and Middle Holocene middens and clustering of sites around these estuaries lend further support to the significance of these environments in prehistoric economies (Colten 1989; Erlandson 1997; Glassow 1997).

Radiocarbon dates place CA-SBA-53 within a period of population growth and apparently increased environmental productivity around 5,000 B.P. (Glassow 1997). However, environmental conditions were highly variable within the region, with many differences in exploitable habitats between locations along the mainland coast, in the interior, and on the Channel Islands. The results presented herein represent an initial attempt at developing an understanding of Middle Holocene fishing practices in the Santa Barbara Channel region. Further research is needed before the full range of Middle Holocene fishing and other subsistence activities may be understood.

ARCHAEOLOGICAL RESEARCH AT CA-SBA-53

A variety of archaeological investigations have taken place at CA-SBA-53. The most extensive investigations took place before 1960 using relatively crude techniques. David Banks Rogers (1929:142-147) was the first to record and excavate the site, which he referred to as Campbell 1. Rogers dug several trenches at the site, mostly in pursuit of human remains and the grave goods usually associated with burials. During the course of his work at the site, he identified several mortars with asphaltum around their rims (hopper mortars). The presence of mortars, absence of formal structural remains, lack of burial goods, and low proportion of metates led Rogers (1929:146-147) to conclude that this site was distinct from others in the Santa Barbara Channel region he had excavated up to that point. As a consequence, his collections from CA-SBA-53 led to his conception of the Hunting People, a seminomadic population that he thought had migrated into the region (Rogers 1929:356-366).

The Hunting People were the middle group in Rogers's (1929:356-366) three-period sequence, falling between the period of the Ancient Ones or Oak Grove People and the later period of the Canaliño. Sites that Rogers attributed to the Hunting People typically were occupied during the Middle Holocene; however, some are now known to date to the Early and Late Holocene as well (Glassow 1997:75). The Hunting People differed from later groups because of their seminomadic lifestyle, artifact forms, and burial practices. Rogers (1929: 145) briefly noted the presence of land and sea mammal remains at CA-SBA-53 but made no mention of teleost or elasmobranch fish remains.

The first fairly systematic excavation at CA-SBA-53 took place in the late 1950s under the direction of William Harrison (Harrison and Harrison 1966). Through the use of radiocarbon dating, the Harrisons identified a more complex prehistory than was originally recognized by Rogers. Similar to Rogers, they proposed that this site was occupied by people who had migrated from beyond the Channel region, and they referred to the period of occupation by these peoples as the Extraños phase, the initial phase of the Hunting People (Harrison and Harrison 1966:64).

The Harrisons excavated 115.8 $m.^3$ of soil, of which 13 $m.^3$ were field screened and sorted (Harrison and Harrison 1966:13-14; Glassow 1997:76). A bias towards larger items is clearly illustrated in their analysis of faunal remains, as taxonomic identifications emphasize vertebrates of relatively large size. They recovered only 65 fish vertebrae and centra, of which 13 are from sharks, five from swordfish, and the remainder from unidentified teleosts (Harrison and Harrison 1966:54). In contrast, the collection that is the topic of the analysis presented here contains over 5,000 whole and fragmentary fish vertebrae (none of which are from swordfish), obtained from only 2.7 $m.^3$ of deposit. Clearly, the recovery techniques used by the Harrisons, which were dictated by the emergency salvage context of their excavations, did not provide a collection of fish remains representative of those actually present in the site deposits.

Craig and Johnson (1978) also performed a limited testing project at CA-SBA-53, but recovered a relatively limited artifact assemblage. The site was again tested by one of us (MAG) in 1985, with the aid of an archaeological field class from the University of California, Santa Barbara (UCSB). The class excavated three 1 m. x 1 m. test units in a small area of intact deposits near the western margin of the site, in an area that is now an irrigated lawn. Delco Defense Systems Operations, until recently the occupants of the property, graciously gave permission for these excavations.

METHODS

All the faunal materials analyzed in this study are from the three units excavated in 1985. The three units were excavated in 20-cm. arbitrary levels, and all soils were water screened through 1/8-in. mesh. Washed and dried materials retained in the screens were sorted in a laboratory at UCSB. Numerous researchers have pointed out that smaller fishes are greatly underrepresented when mesh sizes smaller than 1/8-in. are not used (e.g., Fitch 1969:56, 58; Bowser 1993:148; Erlandson 1994; Pletka 1996:44). Pletka's (1996:44) analysis of Santa Cruz Island fish remains revealed that small fish from 1/16-in. samples increased the total of smaller fish by 14% when compared with the 1/8-in. samples. While an analysis of materials smaller than 1/8-in. mesh would certainly increase the quantity of fish identified in the CA-SBA-53 assemblages, particularly of small fish such as clupeids and surfperches, the fragmentary nature of the bones probably would render many of these bones unidentifiable to specific taxa. The relatively large number of fish bones recovered using 1/8-in. mesh, including hundreds of bones from small taxa, suggests that the data presented in this analysis are sound for determining the importance of the various fish taxa present in the deposits. Nonetheless, a future analysis of fish remains smaller than 1/8-in. mesh could potentially increase our knowledge of the importance of small fish at CA-SBA-53.

The initial phase of sorting entailed separating all of the vertebrate faunal remains from the other cultural materials. The majority of the faunal remains were highly fragmented and could be assigned only to the general categories: small fauna, large land mammal (deer or elk), sea mammal, medium to large mammal (land or sea mammal), bird, reptile/amphibian, teleost fish, and elasmobranch fish. With few exceptions, the high fragmentation made it possible to identify only the vertebrae of teleost and elasmobranch fishes to more specific taxa. Except for a few surfperch and sheephead teeth and jaw fragments, teleost bone (other than vertebrae) was also too poorly preserved for more specific identification.

Over 5,000 complete or fragmentary vertebrae were evaluated during this study. All taxonomic identifications were performed using comparative collections housed at the UCSB Department of Anthropology. Again, the poor preservation and high fragmentation of faunal materials at CA-SBA-53 rendered the vast majority of the vertebrae unidentified beyond the general categories of either teleost or elasmobranch. Except for collections from the 80 to 90 cm. level of Unit 1 (20% unidentified), approximately 60% of the total weight of the vertebrae was unidentified to specific taxa. Many of the fragmentary vertebrae were equivocal, with features that could be indicative of two or sometimes three different fish species, often from entirely different families. Taking a conservative approach, these ambiguous vertebrae were identified as either teleost or elasmobranch and excluded from further analysis (Table 2). These unidentified specimens, however, most likely do not represent any species different from the taxa already identified in this analysis. In other words, the high percentage of unidentified fish vertebrae presents a bias only in terms of MNI (minimum number of individuals) and meat weight estimates derived from MNI, but has little bearing on inferences pertaining to the range of habitats exploited, seasonal variation, or method of capture.

Due to the ambiguities associated with poor preservation at the site, most identifications were made to the family or genus level (see Table 3). Identifications to the species level was possible only when a vertebra was clearly of that species and not a close relative. Several of the family level categories contain only certain species and deserve further explanation.

The category "mackerel undifferentiated" (Table 3) includes both jack and Pacific mackerel, as these two species are difficult to differentiate, especially if the vertebrae are slightly damaged (Bowser 1993:144). The family Atherinidae includes jacksmelt, topsmelt, and possibly grunion. Clupeidae includes Pacific herring and Pacific sardine. Surfperches (Embiotocidae) were also not differentiated beyond the family level due to similarities among several species found in Santa Barbara Channel waters. Sciaenidae, the croaker family, includes vertebrae that are either queenfish, white croaker, or spotfin croaker. Identifications to the species level within each of these categories were not made due to problems posed by similarities in the physical appearance of these vertebrae, even though sizes of mature fish species in these families do vary. However, it is the opinion of the authors that evaluation of size alone is insufficient for a confident identification.

Elasmobranch centra were identified to family, genus, and species (Table 3). The small number of dermal denticles and teeth were not identified due to a lack of adequate comparative materials. The

Table 2
WEIGHTS AND PERCENTAGES OF TELEOST AND ELASMOBRANCH VERTEBRAE[a] AT CA-SBA-53

	Unit 1		Unit 2		Unit 3		Total	
	weight	%	weight	%	weight	%	weight	%
Teleost								
identified	21.6	55.0	7.6	36.0	10.7	28.0	39.9	--
unidentified	17.6	45.0	13.4	64.0	28.2	72.0	59.3	--
Total	--	--	--	--	--	--	99.2	74.5
Elasmobranch								
identified	3.0	30.0	4.4	54.0	5.8	37.0	13.2	--
unidentified	7.1	70.0	3.8	46.0	9.7	63.0	20.7	--
Total	--	--	--	--	--	--	33.9	25.5
Grand Total	49.3	--	29.2	--	54.4	--	133.1	100.0

[a] Weights and percentages of teleost and elasmobranch vertebrae that were identified or not identified to more specific taxa. All weights are given in grams and are from Units 1, 2, and 3, at levels 0 to 90 cm.

family Triakididae represents leopard sharks, small soupfin sharks, and possibly smoothhounds. This category was not further identified due to problems distinguishing between the centra of these species. In Table 4, any identification with a question mark should be considered tentative due either to inadequate comparative materials or the vertebrae being slightly distorted.

The relative dietary importance of the various teleost fish taxa was determined using MNI and estimated meat weight calculations. MNI estimates were based on the number of nonatlas vertebrae present in the sample, divided by an average number of vertebrae for a given species, genus, or family.[1] When calculating the MNI, large fragments and whole vertebrae were each counted as one specimen. No elements beyond vertebrae were preserved in numbers sufficient for MNI calculations.

The high fragmentation, poor preservation, and large number of unidentified vertebrae presented numerous problems in the calculation of MNI. As with any MNI calculation, these results should be regarded as relative rather than absolute indicators. Nevertheless, this indicator provides useful information of a more specific quality than mere presence/absence data. Specifically, MNI estimates may be used to determine relative meat weight estimates for comparative analysis (Grayson 1984:173).

Johnson (1980a:73-74), Salls (1988:235), and Rick et al. (n.d.) noted problems in calculating the MNI of elasmobranchs. To prevent grossly over- or underestimating the meat yield from elasmobranchs, yields based on MNI were calculated only for teleost fish. To determine the dietary importance of teleost relative to elasmobranch fish, the weights of bones from each were totaled by unit and multiplied by a bone to meat weight conversion factor as outlined in Erlandson (1994:57-58) (Table 5). The elasmobranch multiplier used in this analysis is a ratio that combines the ratios for brown smoothhound and California thornback. Preparation of additional elasmobranch multipliers are underway and more refined numbers will eventually

Table 3
IDENTIFIED FISH AT CA-SBA-53 AND THEIR PREFERRED HABITATS

Taxa	Preferred Habitat[a]	Method of Capture[b]	Season[c]
Teleost			
Atherinidae (silversides)	bays, estuaries, nearshore	seines, dip net	spring/summer optimum
Clupeidae (herring, sardine)	midwater, nearshore, estuaries	seine, dip net, gill net	variable, nearshore/estuary in summer
Embiotocidae (surfperches)	surf zone, kelp beds, estuaries, rocky shores	beach seine, gill net, hook and line	all year
Heterostichus rostratus (giant kelpfish)	shallow, rocky bottoms	hook and line, seine, gill net	all year
mackerel undifferentiated	midwater, nearshore	hook and line, seine, gill net	nearshore in summer
Merluccius productus (Pacific hake)	midwater, nearshore sandy bottoms	hook and line, gill net, drag net	all year
Ophiodon elongatus (lingcod)	sand/mud bottoms, bays, nearshore	hook and line, gill net, seine	all year
Paralabrax clathratus (kelp	kelp beds, shallow water	hook and line, gill net	all year
Paralichthys californicus (California halibut)	bays, estuaries, nearshore, midwater	hook and line, seine, drag net	young summer/ fall in estuary
Platichthus stellatus (starry flounder)	estuaries, nearshore	hook and line, seine, drag net	all year
Pleuronichthiformes (flatfish)	bays, estuaries, nearshore, midwater	hook and line, seine, drag net	all year
Pleuronichthys sp. (turbot)	estuaries, nearshore	hook and line, seine, drag net	all year
Porichthys sp. (midshipman)	bays, sandy bottoms	hook and line, seine, drag net	late spring/summer
Salmo gairdnerii (steelhead trout)	anadromous in sea, coastal streams, estuaries	hook and line, weir, fish spear	winter
Sciaenidae (croakers)	estuaries, surf zone, sandy beaches	hook and line, seine, gill net	all year
Scomber japonicus (Pacific mackerel)	midwater, nearshore	hook and line, seine, gill net	nearshore in summer
Scombridae (mackerel/tunas)	midwater, kelp beds	hook and line, gill net	nearshore in summer
Sebastes sp. (rockfish)	bays, nearshore, kelp beds, midwater, rocky shores	hook and line, seine, gill net, drag net	all year
Semicossyphus pulcher (California sheephead)	rocky bottom, kelp beds	hook and line, gill net	all year
Trachurus symmetricus (jack mackerel)	midwater, nearshore, kelp beds (especially summer)	hook and line, seine, gill net	nearshore in summer
Elasmobranch			
Myliobatus californica (bat ray)	sand, muddy bays, estuaries	harpoon, fish spear, drag net	spring/summer, early fall
Platyrhinoidis triseriata (thornback)	coastal sand or muddy bottoms, estuaries	fish spear, drag net	all year

Table 3 (continued)
IDENTIFIED FISH AT CA-SBA-53 AND THEIR PREFERRED HABITATS

Taxa	Preferred Habitat[a]	Method of Capture[b]	Season[c]
Rhinobatus productus (shovelnose)	coastal sand, muddy bottoms, estuaries	hook and line, fish spear, hand	late summer, early fall
Triakididae (smoothhound, leopard, soupfin)	bays, estuaries, some offshore	hook and line, fish spear, harpoon, seine	spring/summer
Urolophus halleri (stingray)	sand or muddy bottoms, estuaries	fish spear, drag net	June-September in estuaries

[a] Compiled from Eschmeyer (1983), Johnson (1980a, 1980b), and sources cited therein.
[b] Compiled from Johnson (1980a, 1980b), and sources cited therein.
[c] Compiled from Eschmeyer (1983), Johnson (1980a), Moss (1983), and sources cited therein.

be available (Rick et al. n.d.). However, we believe that the combination of smoothhound and thornback used in this article gives an adequate coverage of the range of species present in the CA-SBA-53 assemblage. While numerous factors such as differential preservation and preparation techniques may obscure these results, this quantification is a basis for inferring the relative dietary importance of these two distinct classes of fish. Other methods for determining the dietary significance of elasmobranchs either do not clearly demonstrate the dietary importance of this resource or grossly over- or underestimate the value of elasmobranchs.

Live weights for teleost fish were calculated using an average weight for the taxa represented in the collection, and these are consistent with weights used in recent Santa Barbara Channel fish analyses (Moss 1983; Glenn 1990; Bowser 1993; Pletka 1996). Estimated meat weights were determined by multiplying the average modern live weight for each taxon by its MNI to provide a proportional indicator of the importance of each fish taxon.

For the purposes of analysis, the MNI and estimated meat weight calculations were divided by unit but not by level because the amount of variation in taxa and their proportional variation among levels within each unit is minimal. Moreover, the amount of mixing of the deposits at CA-SBA-53 and the closeness of the radiocarbon dates from the upper and basal levels further justified lumping together level data for ease of analysis. Table 4 presents the MNI and meat weight information for all of the taxa found at CA-SBA-53 within each unit from surface to 90 cm. in depth. MNI calculations by level for each of the three units are on file at the UCSB Department of Anthropology (Rick 1997).

Researchers encounter numerous problems in determining precise information regarding the habitat of a fish species. Ambiguities caused by seasonal migrations between habitats and the use of multiple habitats by one species of fish posed the most significant problems in this regard. Researchers have confronted these problems in a variety of ways. For example, Moss (1983) included both habitat and season in one category. Bowser (1993) took a similar approach but increased the number of such categories, and Glenn (1990) differentiated between possible and probable habitat zones. Our habitat information is most consistent with the approach taken by Glenn (1990).

Table 3 presents the importance of each habitat zone fished by the prehistoric occupants of CA-SBA-53. A fraction of the total meat weight for a fish taxon occupying more than one habitat zone

Table 4
NISP, MNI,[a] AND ESTIMATED MEAT WEIGHT AT CA-SBA-53

		Unit 1			Unit 2			Unit 3		
Taxa	Live Wt.[b]	NISP	MNI	Est. Wt.	NISP	MNI	Est. Wt.	NISP	MNI	Est. Wt.
Teleost										
Atherinidae (silversides)	0.26	39	1	0.26	48	1	0.26	40	1	0.26
Clupeidae (herring, sardine)	0.14	163	3	0.42	89	2	0.28	90	2	0.28
Embiotocidae (surfperches)	0.30	91	2	0.60	69	2	0.60	119	3	0.90
Heterostichus rostratus (giant kelpfish)	0.19	1	1	0.19	1	1	0.19	1	1	0.19
mackerel undifferentiated	1.31	18	1	1.31	20	1	1.31	59	2	2.62
Merluccius productus? (Pacific hake)	0.90	0	0	0.00	0	0	0	3	1	0.90
Ophiodon elongatus? (lingcod)	0.90	0	0	0.00	1	1	0.90	0	0	0.00
Paralabrax clathratus (kelp bass)	0.50	0	0	0.00	1	1	0.50	0	0	0.00
Paralichthys californicus (California halibut)	3.60	12	1	3.60	1	1	3.60	0	0	0.00
Platichthus stellatus (starry flounder)	0.90	0	0	0.00	0	0	0	1	1	0.90
Pleuronichthiformes (flatfish)	1.80	0	0	0.00	0	0	0	1	1	1.80
Pleuronichthys sp. (turbot)	0.45	8	1	0.45	1	1	0.45	2	1	0.45
Porichthys sp. (midshipman)	0.40	5	1	0.40	5	1	0.40	7	1	0.40
Salmo gairdnerii? (steelhead trout)	0.28	5	1	0.28	2	1	0.28	1	1	0.28
Sciaenidae (croakers)	0.27	37	2	0.54	10	1	0.27	2	1	0.27
Scomber japonicus (Pacific mackerel)	0.35	12	1	0.35	5	1	0.35	2	1	0.35
Scombridae? (mackerel/tunas)	3.57	6	1	3.57	0	0	0	1	1	3.57
Sebastes sp.? (rockfish)	0.50	0	0	0.00	1	1	0.50	0	0	0.00
Semicossyphus pulcher (California sheephead)	1.40	0	0	0.00	1	1	1.40	0	0	0.00
Trachurus symmetricus (jack mackerel)	1.31	8	1	1.31	0	0	0	2	1	1.31
Elasmobranch										
Myliobatus californica (bat ray)	8.50	14	0	0.00	16	0	0	41	0	0.00
Platyrhinoidis triseriata (thornback)	1.80	7	0	0.00	10	0	0	11	0	0.00
Rhinobatus productus (shovelnose)	6.50	42	0	0.00	52	0	0	38	0	0.00
Triakididae (smoothhound, leopard, soupfin)	4.40	11	0	0.00	3	0	0	5	0	0.00
Urolophus halleri (stingray)	0.32	33	0	0.00	48	0	0	41	0	0.00
Total	–	512	17	13.28	384	17	11.29	467	19	14.48

[a] NISP = number of identified specimens; MNI = minimum number of individuals.
[b] Compiled from Moss (1983), Glenn (1990), Bowser (1993), Johnson (1982), and sources cited therein. Weights are in kg.

Table 5
DIETARY SIGNIFICANCE OF TELEOST AND ELASMOBRANCH FISH[a]

		Unit 1		Unit 2		Unit 3		Total	
	Multiplier[b]	Wt.	Meat Yield	Wt.	Meat Yield	Wt.	Meat Yield	Wt.	% Meat
Teleost	27.7	46.9	1,299.13	35.2	975.0	65.5	1,814.35	4,088.48	60.0
Elasmobranch	80.5	10.1	813.05	8.2	660.1	15.5	1,247.75	2,720.9	40.0
Total		57.0	2,112.18	43.4	1,635.1	81.0	3,062.1	6,809.38	100.0

[a] All weights in g. for each unit, at levels 0 to 90 cm.
[b] The teleost multiplier was obtained from Glassow and Wilcoxon (1988). The elasmobranch multiplier is an average of brown smoothhound and California thornback (Rick et al. n.d.).

was distributed evenly across each one. For example, surfperches occupy the surf zone, kelp beds, bay/estuaries, and rocky shores, and their estimated meat weight for Unit 1 was 0.6 kg. Each habitat zone would therefore receive 0.15 kg., or one-quarter of the total weight. Elasmobranchs were not assigned to the habitat zones.

Season and habitat characteristics are assumed to have been the same during the Middle Holocene as they are now. Wheeler and Jones (1989) suggested that this assumption is justified, especially when more in-depth studies such as otolith or vertebral growth ring studies are not possible. Gobalet (1997:57-58) suggested that otolith season of capture identifications are problematical and should be used cautiously. Otolith or vertebral annuli growth studies, however, would be an appropriate way to confirm or correct some of the ideas presented in this article, although only a small number of otoliths were recovered from CA-SBA-53. Table 3 presents the optimal season to capture a given species. Virtually all of the species represented in the collection could be captured at any time during the year, but would be rare during seasons other than that of optimal availability.

RESULTS

To determine the dietary significance of teleost and elasmobranch fish, two methods producing vastly different results were used. Table 5 presents yields based upon bone-to-meat weight ratios, while Table 4 presents yields for teleost fish based upon MNI and individual live weights. The yields produced using MNI are substantially higher than the yields produced using bone to meat weight ratios (about 10 times greater). Both methods have been widely criticized by zooarchaeologists (see Grayson 1984), and a critique of these two methods is beyond the scope of this article. The results produced by both methods may be useful for different types of questions. The MNI results may be most appropriate for comparison between fish assemblages at a single site or between sites, whereas the more conservative values based on the weight method may be most appropriate for regional comparison of general categories of fauna (e.g., mammal, bird, teleost, elasmobranch).

The bone-to-meat weight conversions for the CA-SBA-53 fish remains indicate that teleosts contribute roughly 60% of the overall contribution of fish to the diet, while elasmobranchs contribute the other 40% (Table 5). Though teleost fish provided more food value than elasmobranchs, the importance of sharks and rays is significant and is another indication of the intensity to which fish were pursued by the occupants of CA-SBA-53. The elasmobranchs identified in the CA-SBA-53 assemblage are from four different species and one family. These include bat ray, shovelnose guitarfish, round stingray, and members of the smoothhound family (such as leopard sharks and small soupfin sharks) (see Table 3).

Twenty-five taxa at the species, genus, or family levels were identified among the teleost fish remains. Of these 25 taxa, mackerel, surfperch, halibut, flatfish, and clupeids are the most important with respect to estimated meat weight (Table 4). These five categories comprise approximately 55% of the total estimated weight of meat from teleost fishes and therefore contributed the most meat to the diet of the identified teleost fishes.

It is important to note that numerous researchers have suggested the possibility that clupeids and other smaller fish may have come to a site as the stomach contents of large fish and sea mammals rather than as actual pursued resources. However, as Johnson (1980c:11-9) and Moss (1983:94) have suggested, one would expect at least some of the vertebrae turning up as stomach contents to be distorted by digestive processes, yet the vast majority of these vertebrae exhibit no signs of digestion. Ethnohistoric accounts suggest that small fish were regularly consumed, and numerous sardines have been identified at interior sites as subsistence resources (Johnson 1980c:11-9, 1982; Gobalet 1992). The high proportion of clupeid and atherinid vertebrae with respect to both MNI and estimated meat weight therefore most likely represents fish harvested for subsistence uses or bait rather than sea mammal stomach contents.

The taxonomic identification and dietary contribution of the fish taxa indicate that a variety of habitat zones were exploited by the occupants of CA-SBA-53. These include bay/estuary, surf zone, nearshore sandy bottom, nearshore rocky substrate, kelp beds, nearshore/summer (migratory fish that come nearshore in the summer), and midwater (nearshore pelagic). The same migratory taxa (clupeids, tuna, Pacific mackerel, and jack mackerel are known to inhabit both the nearshore/summer, and midwater zones at varying times of the year. Given the fishing technology of Middle Holocene peoples (nets, gorges, composite fishhooks, spears, and probably tule rafts), the fish occurring in these two zones were probably obtained largely or exclusively from the nearshore/summer rather than the midwater zone. A similar pattern is also suggested by ethnohistoric records, which indicate an emphasis on taking sardines and other pelagic fish during the summer months when they are found nearshore, often around kelp beds (Landberg 1975; Moss 1983).

Fish from the bay/estuary and nearshore sandy bottom zones composed the largest proportion (approximately 65% combined) of the total estimated meat weight (see Fig. 2). These two zones contain many of the species that are known to frequent both habitats (Eschmeyer et al. 1983). However, the environmental setting of CA-SBA-53 suggests that the vast majority of these fish probably were obtained from the enclosed bay that is now the Goleta Slough. Many of these fish could easily have been taken in the shallow mudflats and deeper waters characteristic of this embayment (Johnson 1980a). Fish from the bay/estuary and nearshore sandy bottom zones would probably be much more abundant if the frequencies of elasmobranch taxa were also converted into the habitat zone ratios. The large meat yields of elasmobranchs and their common occurrence in both of these calm water habitats again suggest that the enclosed bay probably was substantially more important than these data imply.

Fish from the surf zone and nearshore rocky substrate represent a mere 7% of the total estimated meat yields of fish from CA-SBA-53. The dearth of fish from the nearshore rocky substrate is understandable as this habitat zone is minimally represented along the coastline adjacent to the Goleta Slough (Glenn 1990:17-5). However, the low proportion of fishes that occupy the surf zone is somewhat surprising. An absence of surf zone species may reflect the bounty from other habitat zones that were more easily exploited and yielded a higher rate of return. The importance of the kelp bed, nearshore/summer, and midwater zones (approximately 30% combined), corroborates the importance of the migratory clupeid and mackerels identified in the CA-SBA-53 assemblages (Fig. 2). Again, the ma-

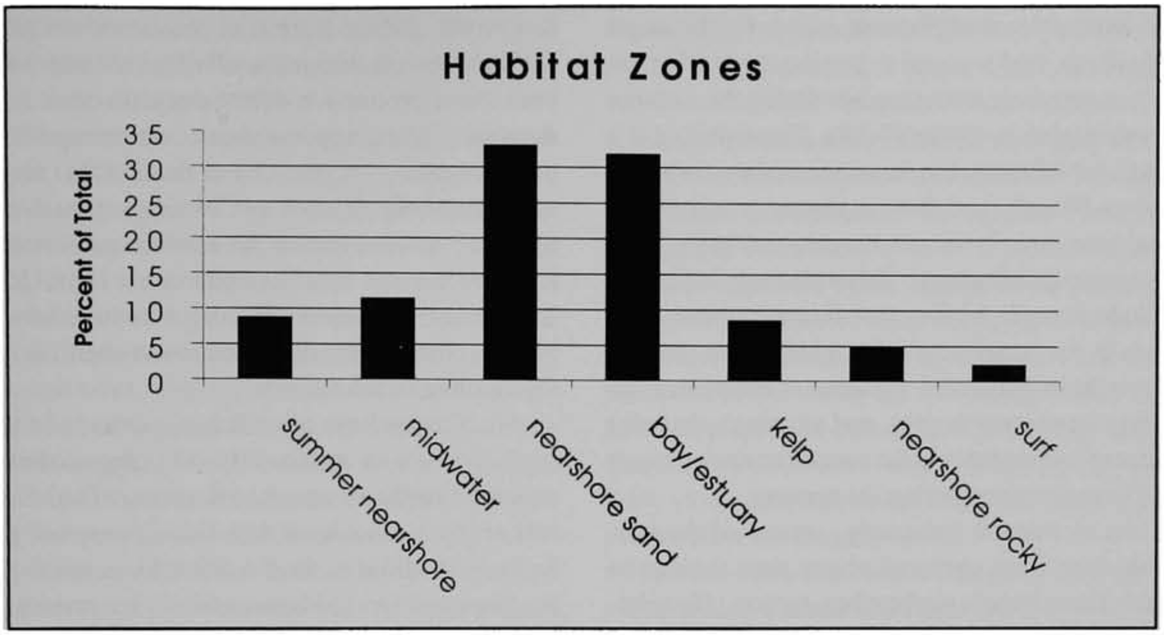

Fig. 2. The relative dietary importance of habitat zones to the inhabitants of CA-SBA-53.

jority of these fish probably were taken in the nearshore/summer and kelp bed zones rather than in the midwater zone.

In summary, the bay/estuary, possibly the nearshore sandy bottom zone, and the nearshore/summer zone were the habitats exploited most intensively. This is probably due to the high productivity within these zones, as well as the potential to catch a variety of different fishes. Considering both teleost and elasmobranch meat weights, the bay/estuary environment was probably the most heavily exploited zone. This is due to its high productivity, ease of procurement, and proximity to the site (Johnson 1980a). Fish from the nearshore/summer zone also yielded an important dietary contribution. This zone became especially important during the Late Period (Moss 1983; Glenn 1990).

Of the 25 fish taxa identified in this analysis, 12 are indicative of a summer optimum for harvest, with five of these also fairly abundant in the late spring and early fall (Table 3). A few of the identified taxa, such as steelhead trout, turbots, and croakers, indicate a possible year-round exploitation, or winter harvest in the case of steelhead. However, their estimated meat weights are substantially lower than the other fish taxa and reflect a smaller dietary contribution than the summer indicators.

Of particular importance are the mackerel and clupeid species that move nearshore during the summer months and could easily be exploited using a variety of nets and possibly hook and line in the waters just off the coast of Goleta. As stated earlier, the fish from the nearshore summer habitat compose approximately 10% of the total percentage of meat weight (Fig. 2). This is a small percentage, but ranks fourth among the seven habitat zones. Moreover, due to disturbances to the deposits at this site and the small size of clupeid vertebrae, the quantities of these fish taxa in the deposits actually may be higher than the data imply. Migratory mackerel and clupeids clearly were important subsistence resources, representing significant summer harvesting.

The importance of elasmobranchs in this sample (40% of all fish) lends further support to the extensive intake of fish during the summer months (Table 5). Bat rays, shovelnose guitarfish, stingrays, and most of the smoothhounds, especially the larger individuals, tend to move to bay/estuary and sandy bottom nearshore environments during the summer months (Johnson 1980a:17-23). These individuals could have been taken in large numbers from the Goleta Slough, and they represent a substantial food resource that could be obtained using relatively simple technology. Other summer indicators include juvenile halibut that frequents bays/estuaries in the summer months, midshipmen that are known to increase their presence in bays/estuaries during the summer months, and atherinids that also increase in abundance in the nearshore environment and bays/estuaries during the summer.

As mentioned previously, several of the taxa could have been captured at any time during the year. These include surfperches, turbots, flounder, and kelp bass. Several tentatively identified vertebrae are probably steelhead rainbow trout, a member of the anadromous salmonid family that typically runs in the winter but could also be caught at other times of the year. Craig and Johnson (1978: 4.0-12) also tentatively identified a single steelhead trout vertebra during test excavations at CA-SBA-53. This find lends further support to a potential winter harvest of trout. Vertebrae of steelhead rainbow trout have also come from the Early Holocene site of CA-SBA-1807 (Erlandson 1994:102). However, this identification is also tentative, as it may represent another member of the salmonid family. Winter exploitation of steelhead trout may have occurred during the Middle Holocene and possibly the Early Holocene, but further documentation is needed to support this contention. The winter harvest of steelhead and year-round exploitation of surfperches, croakers, and other fishes may have occurred at CA-SBA-53. However, the year-round fishes contribute only approximately 10% of the estimated meat weight, a figure that is substantially lower than that of the summer fishes.

In light of these data, it seems clear that the summer months were the most productive, or most popular, time for fishing. During other seasons, the site occupants may have exploited other food resources, such as terrestrial plants and animals, shellfish, and sea mammals, all of which may have been more productive during seasons other than summer. Fishing may have been concentrated during the summer months due to the fact that many species of shellfish, such as California mussel, are frequently inedible during the summer months as a result of the red tide (Ricketts et al. 1968:185). Summer intensification of fishing may have been a viable substitute for the collection of shellfish for the duration of the red tide.

All of these lines of evidence, particularly the exploited species at CA-SBA-53, suggest that a variety of methods was used to procure fish. Formal artifacts associated with fishing were not definitively identified in the CA-SBA-53 assemblage. Fragments of worked bone artifacts are present in the collection, but these could represent a variety of tools not necessarily associated with fishing. Because of the ambiguity of artifacts associated with fishing, probable methods of capture must be inferred from size, habitat, and behavioral characteristics of the taxa present in the collection. The inhabitants of CA-SBA-53 may have used spears, nets, seines, hooks or gorges and line, and possibly weirs to catch fish. It is also possible that shovelnose guitarfish may have been captured by hand in shallow mudflats (Johnson 1980a:65). Tule rafts or some other form of watercraft were probably used to catch the mackerel, clupeids, halibut, and other deeper water species from both the open coast and the Goleta Slough (Hudson and Blackburn 1982:331).

The most probable method of capturing fish and the one most capable of yielding a large number of small fish of the schooling taxa is the use of nets. Seine and dip nets are both documented to have been used by the Chumash for capturing small fish such as sardines and surfperch (Hudson and Blackburn 1982:153, 164). Seines could easily have caught smaller mackerel, atherinids, surfperches, croakers, and small smoothhound sharks. Gill nets may have been used to capture some of the larger mackerel, halibut, larger croakers, and surfperches.

Drag nets may also have been employed to catch some of the bottom-dwelling flatfishes, midshipmen, rays, and guitarfish.

Some of the larger mackerel, flatfish, surfperch, and others may have been caught using hooks or gorges and line. Compound fishhooks, which King (1990:80) documented to be from Middle Holocene sites, may have been used by the inhabitants of CA-SBA-53 to catch the larger fish in the deeper water of the Goleta Slough or along the open coast. Finally, spears would have provided an easy and productive way to obtain nearshore bottom-dwelling elasmobranchs such as rays and guitarfish in the shallow, muddy waters of the Goleta Slough (Johnson 1980a:19-21).

In the remains from CA-SBA-53 reported by Harrison and Harrison (1966), 13 centra from sharks, 46 vertebrae from unknown taxa, and five swordfish vertebrae were noted. Due to the distinctive nature of swordfish vertebrae, it can be fairly confidently presumed that these were, in fact, swordfish.[2] The presence of this pelagic fish, which represents a significant labor investment for procurement, contrasts with the fish remains reported in this analysis. It is possible that groups at this time may have opportunistically acquired swordfish on their way to and from the Channel Islands or possibly may have engaged in low-level, systematic exploitation of swordfish. The results presented in this article, which indicate a relatively simple fishery, are more consistent with opportunistic exploitation of swordfish.

COMPARATIVE ANALYSIS

The information on habitat, season of availability, and method of capture reveal several interesting patterns which both contrast and agree with earlier, contemporary, and later fishing practices in the Santa Barbara Channel. King (1990) argued that during the Early Period (5,500 to 600 B.C.) fishing became an increasingly important activity. He posited a gradual increase in the importance of fish due to an increase in the diversity of fish taxa and the habitat zones exploited during the Early Period. King's argument was based largely on sites from San Luis Obispo, Ventura, and Los Angeles counties. His observation that Santa Barbara fisheries may exhibit a diversification of fishing strategies similar to those seen to the north and south is provocative, but lacks empirical support. However, the fact that a diverse array of habitats and fish species were exploited by the occupants of CA-SBA-53 in part substantiates King's argument. Whether this diversity increases through time remains to be seen. In many ways, the assemblage from CA-SBA-53 is quite similar to the fish remains identified at CA-SBA-1807 and CA-SBA-2057, two Early Holocene estuarine sites occupied some 3,000 years earlier (Erlandson 1994).

The CA-SBA-1807 site is a large midden located on a high coastal bluff approximately 55 km. west of the Goleta Slough. Similar to CA-SBA-53, the vast majority of the fish at CA-SBA-1807 could easily have been obtained from a nearby bay/estuary environment (Erlandson 1994:102). The methods used to obtain fish at CA-SBA-1807 would probably have been quite similar to those employed by the occupants of CA-SBA-53. Most fish at CA-SBA-1807 were probably taken with nets, hooks or gorges and line, and spears. It seems probable that tule rafts or some other form of watercraft was probably used at CA-SBA-1807 to obtain clupeids and tunas from the nearshore environment during the summer. CA-SBA-2057 is a small site located one km. from the present shoreline and approximately 55 km. west of CA-SBA-53. Though many of the fish remains from CA-SBA-2057 have not yet been identified, preliminary results suggest that many of the fish caught at this site are from a bay/estuary environment using technology similar to that used by the occupants of CA-SBA-1807 (Erlandson 1994:154).

The similarities between CA-SBA-53, -1807, and -2057 indicate a great deal of continuity between Middle and Early Holocene fishing practices of the Santa Barbara Channel mainland coast. As a result, King's (1990) assertion of intensification from Early to Middle Holocene times may have to be reassessed. These continuities are largely due to the close proximity of all three of these sites to bay/estuary environments. Although differences in the sample size of the CA-SBA-53 assemblage in comparison to those from CA-SBA-1807 and -2057 prevent exact comparison, the data presented here indicate that fishing during the Early and Middle Holocene was a supplemental subsistence strategy. In the case of CA-SBA-53, shellfish, including both estuarine and open coast species, were still contributing significantly to the diet (over 180 kg. of shellfish per $m.^3$). Nonetheless, the ability to catch a wide variety of fish from a diverse array of habitats was present at these early stages of Santa Barbara Channel prehistory.

One discrepancy between CA-SBA-53 and -1807 concerns the exploitation of migratory fish taxa (clupeids, mackerel) that move nearshore during the summer. While clupeid, barracuda, and yellowtail were identified in the CA-SBA-1807 assemblage (Erlandson 1994:102), their proportions are quite low when compared to those of CA-SBA-53. At CA-SBA-2057, NISP (number of identified specimens) and raw weight values for clupeids were high; however, their precise dietary significance has not yet been determined (Erlandson 1994:155).[3] This suggests that mackerels and clupeids, which together contribute approximately 25% of the total meat yield for teleost fishes at CA-SBA-53, were potentially more important resources for the occupants of this Middle Holocene site. This may be the result of microhabitat variation between CA-SBA-53 and these two Early Holocene sites. Future studies of both Middle and Early Holocene fisheries are necessary to determine whether this is a localized or regional phenomenon.

Two Middle Holocene fish assemblages have been analyzed, one from a site on the San Luis Obispo County coast (CA-SLO-175) and the other from the Santa Barbara Channel (CA-SBA-1). Radiocarbon dates from CA-SLO-175 range from 5,020 ± 80 to 690 ± 80 RCYBP, with the lower component dating around 5,000 RCYBP, making it roughly contemporary with CA-SBA-53 (Jones and Waugh 1995:34). CA-SLO-175 is located on a marine terrace along a heavily surf-swept portion of the central California coast just north of the modern city of San Simeon. Dietary reconstruction of the CA-SLO-175 assemblage indicates that during the Early Period, fish contributed the most meat to the diet of any faunal class (80.8%). In part, this may be the result of stratigraphic mixing or discrepancies in the methods used to quantify faunal remains. However, data from Middle Holocene deposits on San Nicolas (Vellanoweth and Erlandson 1999) and San Miguel islands (Vellanoweth et al. 1999) also suggest that fish were extremely important at some sites during the Middle Holocene. Although the Middle Period assemblage at CA-SLO-175 indicates greater taxonomic richness, there was virtually no increase through time in the diet breadth or in the dietary importance of fish (Jones and Waugh 1995:115). This supports the idea that many of the fishing strategies observed later in time at CA-SLO-175 were in place by 5,000 RCYBP.

Early Period fish at CA-SLO-175 were taken from a variety of habitats, predominantly in the nearshore environment of kelp beds, rocky substrate, and sand beaches (Jones and Waugh 1995). Many of the same fish represented in the CA-SLO-175 assemblage were also present at CA-SBA-53, but a greater abundance of open coast species was present at CA-SLO-175 as opposed to a greater proportion of calm water species at CA-SBA-53. This suggests that the inhabitants of both sites were harvesting fish in the waters immediately adjacent to the sites. The dietary importance of fish from CA-SLO-175 indicates that by at least the Early Period, fishing was quite important to some central California populations. Furthermore, the data from CA-SLO-175 suggest that in certain environmental contexts, Middle Holocene fishing was just as important as it was later in time.

Other evidence of the significance of fishing during the Middle Holocene comes from CA-SBA-1 (5,830 ± 80 to 2,820 ± 100 RCYBP), located at Rincon Point southeast of the modern city of Carpinteria (Erlandson 1991). A comprehensive analysis of the CA-SBA-1 fish remains was performed by Johnson (1980c). At the time of Johnson's analysis, no radiocarbon dates were available for the CA-SBA-1 assemblage. However, on the basis of time-sensitive artifacts, Johnson (1980c) grouped the fish remains into two temporal components, a lower component dating to the Early Period (3,000 B.C.), and a later component dating to 1,000 B.C. In general, the radiocarbon dates reported by Erlandson (1991) support the temporal distinctions used in earlier studies. However, one of these dates, 4,480 ± 70 RCYBP from the 43 to 53 cm. level, indicates that the proposed stratigraphic break at 103 cm. is not a clear distinction between the Early and Middle period components at the site (Erlandson 1991:114). In other words, the timing of changes in fishing at CA-SBA-1 should be interpreted with caution.

The CA-SBA-1 assemblage was dominated by fish remains from sandy beaches, with lesser amounts from kelp beds, rocky shores, and offshore habitats (Johnson 1980c:11-17). Many of the species noted in the lower component of CA-SBA-1 were similar to those in the CA-SBA-53 assemblage, such as the importance of clupeids, Pacific mackerel, croakers, and surfperch. It appears that during this period of time, groups inhabiting CA-SBA-53 and -1 were exploiting the nearshore environment adjacent to the sites and perhaps using similar technologies. In the upper component of CA-SBA-1, a shift takes place in which the importance of clupeid vertebrae increases (Johnson 1980c:11-16). Johnson (1980c) suggested that this increase in the importance of clupeids reflects the increasing importance of this resource through time, a process King (1990:83) assumed to be correlated with a general increase in the significance of fishing through time. In light of the radiocarbon dates, it is possible that some of this shift may have occurred during the latter part of the Early Period (i.e., Middle Holocene).

The late Middle Period (A.D. 660-1050) site CA-VEN-110 offers an interesting comparison with CA-SBA-53 due to its location along the lower portion of Calleguas Creek near its outlet into the estuarine environment of the Mugu Lagoon (Roeder 1987:8). As was the case at CA-SBA-53, the bay/estuary environment was utilized by the inhabitants of CA-VEN-110, as indicated by the presence of flatfish, small elasmobranchs, shiner perch, topsmelt, and others (Roeder 1987). Otolith growth ring analysis indicated that, similar to CA-SBA-53, fishing at CA-VEN-110 occurred primarily during the summer months (Roeder 1987). In contrast with CA-SBA-53, fish identified from CA-VEN-110 were taken from offshore pelagic environments and from the nearshore habitat adjacent to the Malibu submarine canyon (Roeder 1987:2-3, 23). The presence of offshore fish such as tuna, barracuda, and bonito, along with large elasmobranchs such as mako and blue sharks, is similar to other Late Holocene assemblages along the California coast.

The Late Period (A.D. 1300-1782) site CA-SBA-46 (Mescalitan Island) is also quite distinct from CA-SBA-53 with regard to fish remains. CA-SBA-46 is located near the mouth of the Goleta Slough, on the opposite side of the estuary from CA-SBA-53. The fish remains from CA-SBA-46 indicate that pelagic schooling fish from the midwater region contributed approximately 90% to the total fish meat weight (Glenn 1990). These pelagic schooling fish, including clupeids, tunas, and mackerels, most probably were obtained during the summer months when they are most abundant. In contrast, these fishes were a relatively minor resource to the inhabitants of CA-SBA-53. The much greater dependence on pelagic schooling fish by the inhabitants of CA-SBA-46 and CA-VEN-110 is probably related to higher regional population densities, use of the more efficient plank canoe, and possibly diminished availability of shellfish and fishes from the adjacent bay/estuary environment during the Late Period (Roeder 1987:23; Glenn 1990:17-10).

The fish remains from other Late Holocene sites such as CA-VEN-87 (3,550 ± 90 RCYBP to the historical era) (Greenwood 1975), CA-VEN-3

(A.D. 1,000 to the Mission Period) (Greenwood and Browne 1969:1), and CA-SBA-1731 (1,720 ± 70 to 190 ± 50 RCYBP) (Gerber et al. 1993:63) also differed significantly from those of CA-SBA-53. The most striking difference was the presence of offshore fisheries during the occupations of each of these sites. For CA-VEN-87 (Fitch 1975:458; Roeder 1976:569-571) and CA-VEN-3 (Fitch 1969:64-65), offshore fish such as barracuda, rock cod, sea bass, bonito, and mackerel were present in the assemblages. Unfortunately, no dietary or quantitative data were presented for either of these two sites. However, it appears that the majority of offshore fish taken from CA-VEN-87 date to the later Mission Period component and were not identified in the earlier levels of the site (Roeder 1976:570-571). At both sites, a significant number of fish also were taken from the nearshore environment adjacent to the sites (Fitch 1969:68, 1975; Roeder 1976:570). This indicates that like most other southern California fisheries, fishing was concentrated in the areas closest to the site. However, the evidence for an offshore fishery used by the occupants of CA-VEN-87 and -3 is consistent with evidence from other Late Holocene sites, such as CA-SBA-46, CA-VEN-110, and CA-SBA-1731 (Moss 1983:86-88; Bowser 1993:155-157). The minimal importance of offshore fishes to the occupants of CA-SBA-53 stands in sharp contrast.

SUMMARY AND CONCLUSIONS

Fishing during the Middle Holocene of Santa Barbara Channel prehistory was a complex phenomenon that probably was highly variable from one part of the region to another. The data presented in this article represent one subsistence response to localized environmental conditions around 5,000 B.P. along the central Santa Barbara Channel. The proximity of CA-SBA-53 to surrounding terrestrial and marine environments, the importance of fishing, and the diversity of faunal materials and other nonfaunal cultural constituents attest to the likelihood of this site being a principal residential base (Glassow 1997:80).

The predominant habitat zones exploited by the occupants of CA-SBA-53 were the bay/estuary, the nearshore sandy bottom, and the nearshore kelp bed habitats. Although the summer months were the principal fishing season, some indicators of year-round fishing were also present. Definitive summer indicators include the remains of mackerels and clupeids, which tend to move nearshore in the summer, and elasmobranchs, which increase substantially in the bay/estuary environment during the summer. Most of the fish probably were captured using gill nets, seines, spears, and possibly hook or gorge and line. The use of the tule raft or other simple watercraft is also probable at this time, as indicated by the presence of fishes such as mackerels, whose capture would have required the use of a boat.

Along the Santa Barbara coast, there is a great deal of continuity between Early and Middle Holocene fishing methods and exploited habitats. The exploitation of schooling fish and elasmobranchs at CA-SBA-53 suggests an increase in the importance of these resources during this time period, although currently this cannot be verified. In terms of dietary contributions, these resources were still quite unimportant, suggesting that the same subsistence strategies employed during the Early Holocene were still viable. The Middle Holocene components at CA-SBA-1 and CA-SLO-175 exhibit exploitation of the nearshore environment similar to that of CA-SBA-53. In particular, the relative importance of different taxa in the assemblages from these sites is consistent with the environment adjacent to the respective sites. In contrast, the CA-SBA-53 assemblage differs greatly from those of the nearby Late Period site CA-SBA-46, where fish from the midwater zone are by far the most important. This lends support to the idea that Middle Holocene populations around the Goleta Slough region were still relatively low in comparison with Late Period populations and could still turn with relative ease to shellfish and other easier-to-procure resources.

This article represents an initial attempt at developing an understanding of fisheries during the

Middle Holocene of Santa Barbara Channel prehistory. Studies of fish remains from other sites in diverse environmental settings will be needed before the full range of Middle Holocene fishing practices can be understood.

NOTES

1. For a few species, atlas vertebrae indicated MNI substantially higher than inferred by the actual number of vertebrae present. For example, in Unit 2, 89 clupeid vertebrae were identified from the five levels. Using the frequency of vertebrae to calculate MNI, the presence of two individuals was determined. However, if atlas vertebrae were used to determine MNI, 36 individuals would have been identified in the assemblages. Using atlas vertebrae in this context has the potential to greatly overestimate the dietary importance of specific taxa, especially since differential processing methods, such as the removal of fish heads, may influence the presence or abundance of atlas vertebrae within a site.

2. The authors were not able to check Harrison and Harrison's (1966) collection to confirm the swordfish identification. Swordfish vertebrae have not been noted elsewhere in southern California assemblages predating 2,000 B.P. (Davenport et al. 1993). However, it is possible that the CA-SBA-53 vertebrae identified by Harrison and Harrison (1966) are, in fact, swordfish and that swordfish may have been obtained during the Middle Holocene by scavenging or by intermittent capture on cross-channel voyages.

3. A more comprehensive analysis of fish remains from CA-SBA-2057 is currently being performed by Rick and Erlandson (n.d.). Their preliminary research indicates that clupeids may actually be quite important at some Early Holocene sites. Further research is needed to determine the extent of this phenomenon.

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