Fish Remains from CA-MRN-44/H, Angel Island, Marin County, California

Dwight D. Simons and Tim Carpenter

Analysis of fish remains from site CA-MRN-44/H on Angel Island in San Francisco Bay has included a quantitatively-based examination of prehistoric dietary composition and resource selectivity, seasonality, exploitative strategies, and procurement practices of the island's prehistoric populations. This paper summarizes these analyses and compares the results with other faunal assemblages derived from prehistoric San Francisco Bay island sites and other sites in southeastern Marin County .

Introduction

Excavations at site CA-MRN-44/H in Angel Island State Park recovered a large assemblage of fish remains, allowing detailed quantitatively based analyses and interpretations directed at prehistoric central California zooarchaeological research themes. These include dietary composition and resource selectivity of fish, seasonality of fish exploitation, fish exploitative strategies, and fish procurement practices. Of particular interest is how these themes/questions characterize prehistoric fish faunas occurring at island sites in central San Francisco Bay, and sites located in southeastern Marin County, California.

The Site

The excavation focus at CA-MRN-44/H was on the recovery of cultural materials present in three loci, designated A, B, and C. Similar techniques were used to recover fish remains from Locus A and Locus B, including passage of recovered soil through 1/8-in. mesh hardware cloth (DeGeorgey 2006). Approximately 30 liters of soil from 25 x 25 x 10 cm floatation samples recovered each of the three loci were passed through ¼-in., 1/8-in., and 1/16-in. mesh hardware cloth to sample smaller fish bones.

Radiocarbon dating, obsidian hydration analysis, and artifact cross-dating revealed that Locus A strongly represents the Terminal Late Phase of the Middle Period, ca. 1500-500 B.P. (DeGeorgey 2006:195). Locus B is tentatively ascribed to an indeterminate phase of the Late Period, ca. 500 B.P. Locus C is tentatively placed within the Middle Late Transition Period, ca. 800 B.P. The site probably was a residential village, whose inhabitants were focused on fishing and gathering shellfish (DeGeorgey 2006:197).

Materials and Techniques

Fish remains from CA-MRN-44/H initially were segregated into those elements potentially identifiable to family-genus-species level, and those that were not. Those that were not so identified were assigned to the categories Cartilaginous Fishes and Ray-Finned (i.e., "bony") Fishes. Tim Carpenter, using comparative osteological collections at the Department of Anthropology, University of California, Davis, identified the fish bones, in consultation with Dr. Kenneth W. Gobalet, Department of Biology, California State University, Bakersfield

Recorded data included taxonomic identity; skeletal element; side of the body or body segment represented; and configuration (that is, whole element, proximal portion, distal portion, and so forth). Additional observations included signs of cultural modification: intentional breakage; presence of butchering marks; burning; polishing; striations; modification into an artifact; and so forth. Non-cultural modifications included animal gnaw marks; weathering; and post-depositional breakage. Skeletal element counts or Numbers of Identified Species (NISP) were determined for each identified fish taxon by tallying total numbers of identified skeletal elements assigned to each.

Results

A total of 3,940 identified fish elements, representing 25 taxa, was recovered at CA-MRN-44/H. The array of identified species is presented in Table 1. All of the fish taxa are/were native to the vicinity of MRN-44/H, and all were economically significant to prehistoric people. Fish remains assigned to the categories Cartilaginous Fishes and Ray-Finned Fishes together total 11,268 bones. Bony Fishes (N = 11,238; 99.7 percent) overwhelmingly outnumber Cartilaginous Fishes (N = 30; 0.3 percent).

Dwight D. Simons, Consulting Archaeologist, 5131 Dredger Way, Orangevale, CA 95662 and Tim Carpenter, ArchaeoMetrics, 414 Buena Terra, Woodland, CA 95695
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Table 1. Fish Taxa from CA-MRN-44/H

Fish	Vertebrate Taxa	Number of Specimens
Leopard Shark	*(Triakis semifasciata)*	1
Bat Ray	*(Myliobatis californica)*	18
Sturgeon	*(Acipenser* sp.*)*	60
White Sturgeon	*(Acipenser transmontanus)*	24
Herring	(Clupeidae)	75
Northern Anchovy	*(Engroulis mordax)*	665
Pacific Herring	*(Clupea pallasi)*	37
Pacific Sardine	*(Sardinops sagax)*	74
Smelt	(Osmeridae)	1
Salmon	*(Oncornynchus* sp.*)*	2,490
Chinook Salmon	*(Oncorhynchus tshawytscha)*	37
Pacific Tomcod	*(Microgadus proximus)*	4
Plainfin Midshipman	*(Porichthys notatus)*	7
Silversides	(Atherinopsidae)	20
Jacksmelt	*(Atherinopsis californiensis)*	45
Rockfish	*(Sebastes* sp.*)*	19
Brown Rockfish	*(Sebastes auriculatus)*	8
Kelp Greenling	*(Hexagrammos decagrammus)*	3
Ling Cod	*(Ophiodon elongatus)*	2
Cabezon	*(Scorpaenichthys marmoratus)*	6
Surfperch	(Embiotocidae)	301
Shiner Surfperch	*(Cymatogaster aggregatae)*	4
Striped Surfperch	*(Embiotoca lateralis)*	28
Rubberlip Surfperch	*(Rhacochilus toxotes)*	1
Pile Surfperch	*(Rhacochilus vecca)*	10
Total Fish		3,940

Notes: Nomenclature follows Nelson et al. (2004).

Dietary Composition and Resource Selectivity

Table 2 presents numbers and percentages of principal fish taxa present in the three loci at MRN-44/H. In all loci, salmon dominate. Herrings/sardines/anchovies are abundant in Locus A and B, and not present in Locus C. Surfperch (Embiotocidae) are relatively abundant in all loci. Other fish (i.e., sharks, rays, sturgeon, plainfin midshipman, jacksmelt, and rockfish) occur in generally small numbers. Locus C, with a much smaller sample of site deposit, has a depauperate assemblage of fish remains, with only four of the nine taxa represented.

Changes through time in fish procurement at MRN-44/H are evident when the fish assemblage from Locus A, dated to the Terminal Late Phase of the Middle Period, is compared to that from Locus B, assigned to Phase 2 of the Late Period. Salmon comprise the majority of fish in both loci; herrings/sardines/anchovies are common; surfperch are relatively abundant; and all other fish taxa occur in low ratios. Through time, percentages of salmon and herrings/sardines/anchovies declined slightly. The ratio of surfperch increased, and that of sturgeon slightly increased. There appears to have been a slightly lessened emphasis upon migrating anadromous salmon, and inshore/intertidal spawning herrings/anchovies; and a greater focus upon resident inshore/open water fishes.

Tables 3 and 4 present NISP of sharks/rays and bony fish from MRN-44/H and five mainland southeast Marin sites/components. A variety of fish occur at all sites, but NISP values for fish taxa vary highly. Sharks, bat rays, sturgeon, salmon, jacksmelt, and surfperch are the most commonly represented fish at mainland Marin sites.

Table 5 has numbers and percentages of principal fish taxa occurring at MRN-44/H and those southeast Marin sites/components with fish remains totaling at least 100 specimens. In contrast to MRN-44/H:

- Sharks are abundant at MRN-14 and MRN-20.
- Bat rays dominate at MRN-14, and are relatively common at MRN-17, MRN-20, and the Middle-Late Middle component at MRN-254.
- Sturgeon dominate the three Middle Period components at MRN-254, and are somewhat common at MRN-20.
- Salmon are relatively uncommon or rare at all Marin mainland sites.
- At MRN-17, jacksmelt comprise the majority of the fish assemblage.
- Starry flounder is somewhat common at MRN-20.

Differences between MRN-44/H and Marin mainland sites probably result largely from our site's location on Angel Island, surrounded by relatively deep water and fringed by a rocky shoreline. In contrast, all the Marin mainland sites are situated in close proximity to sandy beaches, relatively shallow waters with sandy/muddy bottoms, and tidal flats.

Most Marin mainland sites/components date to the Middle Period and/or the Middle-Late Transition (Table 6). At MRN-254, the bat ray ratio decreased between these two periods. That of sturgeon increased slightly, and that of salmon approximately 1.5 times. Differences between Middle Period and Middle-Late Transition fish assemblages at MRN-17/MRN-254, and MRN-20/MRN-254 probably are due mainly to differing access to different fishes.

Table 2. Numbers and Percentages of Principal Fish Taxa Recovered from Loci A, B, and C at CA-MRN-44

Fish Taxa	Locus A	Locus B	Locus C
Sharks			1 (0.1)
Rays	12 (0.5)	5 (1.1)	1 (0.1)
Sturgeon	60 (2.4)	24 (5.4)	
Herrings/Sardines/Anchovies	739 (29.6)	109 (24.8)	
Salmon	1,356 (54.3)	226 (51.5)	847 (96.3)
Plainfin Midshipman	7 (0.3)		
Jacksmelt	60 (2.4)	5 (1.1)	
Rockfish	22 (0.9)	5 (1.1)	
Surfperch	239 (9.6)	65 (14.8)	40 (4.5)
TOTALS	2,495	439	889

Table 3. Sharks and Rays from Southeast Marin County Sites

	MRN-44	MRN-14[1]	MRN-17[2]	MRN-20[3]	MRN-254 (Late)[4]	MRN-254 (Middle/Late Transition)[4]	MRN-254 Intermediate Middle)[4]	MRN-254 (Mid-Late Phase Middle)[4]	MRN-255[5]
	30		7						
Leopard Shark	1	15	289	45			1	2	
Smooth Hounds		30							
Requim Shark									4
Rajiformes									7
Bat Ray	18	57	813	17	2	15	3	88	11
TOTALS	49	102	1109	62	2	15	4	90	22

1 Follett (1974:146-149)
2 Scott and Millerstrom (2003:6-16 to 6-54).
3 Follett (1957:69-70)
4 Scott (1998:181-183, Table 33)
5 Gobalet and Miller (2000:12.2, Table 12.1)

Table 4. Boney Fishes from Southeast Marin County Sites

	MRN-44	MRN-14[1]	MRN-17[2]	MRN-20[3]	MRN-254 (Late)[4]	MRN-254 (Late-Middle Transition)[4]	MRN-254 (Intermediate Middle)[4]	MRN-254 (Mid-Late Middle)[4]	MRN-255[5]
Sturgeon-Acipenser	84	4	300	12	29	233	85	349	16
Ray-Finned Fish	11,238		3,135						
Herrings-Clupeidae	75								
Pacific Herring	37								
Pacific Sardine	74								
Northern Anthovy	665								
Smelts-Osmeridae	1								
Salmon	2,490		53		3	51	11	58	7
Chinook Salmon	37	1	239						
Steelhead		4							
Plainfin Midshipman	7		12		7			16	
Pacific Tomood	4								
Silversides – Athernidae	20		158						
Jacksmelt	45	8	2,420			1	1		
Rockfish - *Sebastes*	27	1	3						
Lingcod	2								
Kelp Greening	3								
Cabezon	6								
White Sea Bass		1	7	19				12	
Surfperch - Embiotocidae	301	5	456		1			3	
Rubber Lip Surf Perch	1			6					
Black Surf Perch		5	245	1					
Redtail Surf Perch		3		2					
Shiner Surf Perch	4								
Striped Surf Perch	28								
Pile Perch	10		53	8					
Starry Flounder				16					
TOTALS	15,159	28	7,081	64	40	285	97	438	23

1 Follett(1974:146-147); 2 Scott and Millerstrom (2003:6.16 to 6.54); 3 Follett (1957:69-70); 4 Scott (1998:181-183, Table 33); 5 Gobalet and Miller (2000:12.2, Table 12.1)

Table 5. Numbers and Percentages of Principal Fish Taxa Present at Southeast Marin County Sites

Fish Taxa	MRN-44	MRN-14	MRN-17	MRN-20	MRN-254 Middle-Late Transition	MRN-254 Middle-Late Middle	MRN-254 Intermediate Middle
Sharks	1 (<0.1)	45 (33.6)	289 (5.7)	45 (35.7)		2 (0.4)	1 (1.0)
Rays	18 (0.5)	57 (42.5)	813 (16.1)	17 (13.5)	15 (4.7)	88 (16.7)	3 (3.0)
Sturgeon	84 (2.1)	4 (3.0)	300 (5.9)	12 (9.5)	233 (72.8)	349 (66.1)	85 (85.0)
Herrings/ Sardines/ Anchovies	851 (21.7)						
Salmon	2,527 (64.4)	5 (3.7)	292 (5.8)		51 (15.9)	58 (11.0)	11 (11.0)
Plainfin Midshipman	7 (0.2)		12 (0.2)			16 (3.0)	
Jack Smelt	65 (1.7)	8 (6.0)	2,578 (51.1)		1 (0.3)		1 (1.0)
Rockfish	27 (0.7)	1 (0.7)	3 (0.1)				
White Seabass		1 (0.7)	7 (0.1)	19 (15.1)		12 (2.3)	
Surf Perch	344 (8.8)	13 (9.7)	754 (14.9)	17 (13.4)		3 (0.6)	
Starry Flounder				16 (12.7)			
TOTALS	3,924	134	5,048	126	320	528	101

Sources: see Tables 3 and 4

Table 6. Temporal Assignment of Southeast Marin County Sites

Site	Temporal Assignment	Source(s)
MRN-14	Middle and Late Periods, ca. 2000 – 600 B.P.	Moratto (1974:85; 1984:275).
MRN-17	Middle Period, appears contemporaneous with MRN-27	Pahl (2003)
MRN-20	Middle-Late Transition and Phase 1 of Late Period	McGeein and Meuller (1955:62); Moratto (1984:272-273)
MRN-254	Middle Period, Middle Late Transition, and Late Period	Bieling (1998:137-146)
MRN-255	Middle Period	Bieling (2000:9.1-9.14)

CA-MRN-44/H and CA-SFR-04/H on Yerba Buena Island offer an opportunity to compare fish assemblages from San Francisco Bay island sites. The sites date to roughly equivalent time periods (C. Arrington, personal communication, 2004). Table 7 presents numbers and percentages of principal fish taxa from the two sites. At MRN-44/H, salmon dominate, herrings/sardines/anchovies are common, surfperch are somewhat common, and other fishes (i.e., sharks, rays, sturgeon, plainfin midshipman, jacksmelt, rockfish) are rare. Surfperch, jacksmelt, and rockfish co-dominate at SFR-04/H. Herrings/sardines/anchovies are somewhat common, and salmon, along with sharks, rays, sturgeon, and plainfin midshipman, are relatively rare. Differences in the fish assemblages from these two San Francisco Bay Island sites are best explained by their locations. Angel Island is surrounded by relatively deep water, athwart the main Chinook salmon migration route through San Francisco Bay (Skinner 1962:Plate IV). Its rocky shores and inshore waters provide spawning grounds for Pacific herring and possibly northern anchovies. Yerba Buena Island is situated within an expanse of open water with deep water, tidal flats, and sandy/muddy and rocky bottoms, favored habitat for surfperch, rockfish, and jacksmelt (Gobalet 1990:240; Skinner 1962:Plate I).

Fish present at MRN-44/H probably came from portions of San Francisco Bay within the catchment surrounding the site. Angel Island may have been a "platform" from which prehistoric peoples fished, and hunted/harvested birds and mammals frequenting the shoreline, intertidal zone, tidal flats, and deeper waters around the island. Other islands in San Francisco Bay, including Yerba Buena, Brooks, Alcatraz, and the Marin islands, also may have been "platforms" for harvesting fish, birds, and marine mammals. Evidence of this comes from detailed analyses of fish (Gobalet et al. 2004) and bird and mammal (Simons 2004) remains from Yerba Buena Island; and preliminary analyses of bird and mammal remains from CCO-290 on Brooks Island (G. Coles, personal communication, 2001; Simons, unpublished data); MRN-42, -43, and -44 on Angel Island (Simons 1983; Simons, unpublished data); and MRN-611 on East Marin Island (Luby 1994).

These island sites probably initially were inhabited during the Late Middle Period/Middle-Late Transition, approximately 1,300 years B.P. (cf., C. Arrington, personal communication 2004; Banks and Orlins 1981:3.44-3.48; Hines 1983; Luby 1994). Through Late Period times, island site occupancy apparently increased in intensity. Use of

Table 7. Numbers and Percentages of Principal Fish Taxa Present at CA-MRN-44 and CA-SFR-04

Fish Taxa	MRN-44	SFR-04
Sharks	1 (<0.1)	401 (3.0)
Rays	18 (0.5)	141 (1.0)
Sturgeon	84 (2.1)	61 (0.5)
Herrings/Sardines/ Anchovies	851 (21.7)	1,186 (8.7)
Salmon	2,527 (64.4)	333 (2.5)
Plainfin Midshipman	7 (0.2)	408 (3.0)
Jack Smelt	65 (1.7)	3,776 (27.8)
Rockfish	27 (0.7)	3,318 (24.4)
Surf Perch	344 (8.8)	3,969 (29.2)
TOTALS	3,924	13,594

Source: Gobalet et al. (2004:821-814, Table 2)

island sites may have resulted from increasing marine resource intensification/depression also noted through time at mainland San Francisco Bayshore sites (cf., Broughton 1994, 1995, 1997, 1999, 2002a, 2002b, 2003, 2004; Lightfoot 1997; Simons 1992).

Fish Exploitative Strategies

Gobalet (1990:239, Table 3; 1994:126, Table 1) and Gobalet et al. (2004:812-814, Table 2) present fish assemblages from prehistoric sites located along the east shore of San Francisco Bay in Contra Costa and Alameda counties, at the north end of the San Francisco Peninsula, on Yerba Buena Island, and in southeast Marin County. Sharks, rays, sturgeon, herrings/sardines/anchovies, salmon, jacksmelt, and surfperch frequently are well-represented. Sites in the Richmond vicinity often have abundant sturgeon, salmon, bat ray, herring/sardine, and/or jacksmelt remains. Gobalet (1994:126-127) proposes that prehistoric peoples inhabiting some Richmond sites were "sturgeon eaters." The "sturgeon eaters" sobriquet also has been applied to prehistoric inhabitants of MRN-254 (Scott 1998:180).

Broughton (1997, 1999:42-48; 2002a, 2002b, 2003) analyzed fish remains from the Emeryville Shellmound, ALA-309, which has an abundant vertebrate faunal assemblage dated to sometime between 2,800 and 700 B.P. Sturgeon remains dominate the fish assemblage (Broughton 1997:852, Table 3). Bat rays, requiem sharks, and salmon also are abundant. Herring, jacksmelt, white sea bass, and surfperch bones occur in very small numbers. The low representation of these taxa probably results from coarse-grained recovery methods, preventing full recovery.

To measure fishing efficiency, Broughton computes a "sturgeon index" for each stratigraphic/temporal unit at ALA-309. Through time, the sturgeon index declined (cf., Broughton 1997:854, Figure 3; 1999:112, Figure 7.1; 2002a:67, Figure 3; 2002b:51, Figure 3.2; 2003:78, Figure 3). This suggests lower encounter rates for sturgeon, and decreasing efficiency of fish exploitation, probably resulting from human harvesting pressure. Sturgeon dentary widths also are plotted by stratum at Emeryville (cf., Broughton 1997:857, Figure 5; 1999:114, Figure 7.4; 2002a:72, Figure 7; 2002b:51, Figure 3.3; 2003 :81, Figure 6). Both mean and maximum dentary widths declined significantly through time. It is concluded that this indicates a significant decrease in sturgeon size, with ever-smaller fish being caught.

Simons (1992:84-88; 2007:375-382) argues that intensification upon various mammal species through time at prehistoric Bay Area sites was in large part a response to long- and short-term resource predictability, and attendant risk-avoidance. This is seen as profoundly affecting prehistoric resource procurement in California. As a consequence, fish present at MRN-44/H may have been taken using a "coharvesting/prey switching" strategy. Yesner (1976; 1981:162) defines "coharvesting" as follows:

> Another feature of the Aleut exploitational pattern is what I term a "coharvesting" strategy. Optimal foraging theory predicts that any prey encountered that has a low handling cost, or a handling cost/benefit ratio below a given level, will be harvested. "Coharvesting" is a type of optimal foraging when additional species are obtained as part of the same general hunting procedure….Ross (1978) has recently demonstrated that among Amazonian groups for which fishing is the major focus, mammals may be acquired when they are encountered during fishing trips.

As a corollary, Dwyer (1982) notes that hunters (and fishers) often switch their efforts from pursuing one prey species to pursuing another, making hunting (or fishing) episodes highly opportunistic events.

Seasonality of Exploitation

Table 8 presents the seasonality of occurrence of fish taxa present at MRN-44/H. All fish taxa occur to some extent throughout the year in the waters around Angel Island. With respect to the five most abundant fish taxa at MRN-44/H:

- Chinook salmon are in San Francisco Bay throughout the year, with migratory peaks in March, May-June, September-October, and December.
- Northern anchovies are available through the year. Inshore spawning happens during spring.
- Surfperch are present through the year. Inshore spawning occurs from March to May/June, and population aggregates form from August to November.
- Herrings/sardines are available throughout the year. Herring spawn intertidally along the shores of Angel Island from mid-December to mid-March.
- Jacksmelt are present throughout the year, and are most abundant from October to April.

At MRN-44/H, fish would have been available in a fairly consistent manner throughout the year. Their highest annual availability probably took place in early spring and early fall. Slightly lower fish availability would have occurred during late winter and in early to mid-summer. Therefore, MRN-44/H probably was occupied to some extent throughout the year, because fish taxa of some sort are available/abundant throughout the year in the catchment surrounding the site. Fishing probably was the principal economic activity at this site. In order to effectively harvest fish, the human population of the site may have been at a fairly constant level throughout the year. Fishing at MRN-44/H may have been done largely by a specialized task group.

Moratto (1974:85) concludes that nearby mainland site MRN-14 was a seasonal camp, inhabited mainly during spring, summer, and possibly early fall. Scott and Millerstrom (2003:6.7-6.8) and Zogg (2003:5-19) note that MRN-17 probably was occupied year-round, with possible seasonal shifts in numbers of people. McGeein and Mueller (1955:59-60, Table 1) note that MRN-20 probably was not a permanent village site, apparently occupied mainly during the winter. Year-round habitation of MRN-254 is postulated by Bieling (1998:218) and Valente (1998:160). This also was likely at MRN-255 (Bieling 2000:13.5; Valente 2000:11.11).

King (1974:44-45) concludes that the prehistoric inhabitants of MRN-27 had access to plant and animal resources available during every season. Consequently, there was little need for people living at this site to move about during the year. Short trips away from the site may have been made by individuals/small groups to the outer Marin coast, or to interior localities, to obtain resources not immediately available. King notes that southeast Marin seasonal subsistence rounds may have included the following:

- Residence along the shore throughout the year.
- Winter gathering of shellfish and hunting of waterfowl.
- Spring taking of anadromous fish (i.e., salmon), gathering of upland plants, and hunting of upland animals.
- Summer expeditions by small task groups to upland hunting/gathering camps until the fall acorn harvest.
- Fall acorn harvest, gathering of shellfish, and hunting of waterfowl.

Postulation of year-round occupancy at MRN-44/H and many other southeast Marin sites supports inference of year-round annual occupancy of prehistoric San Francisco bayshore shellmounds in the Richmond-San Pablo region (cf. Banks and Orlins 1981, 1985; Broughton 1994:390-391; Lightfoot 1997:136; Simons 1981:12.8-12.15, 12.18-12.19; Simons et al. 2000:371-375). This pattern of prehistoric bayshore site use supports the seasonal subsistence model hypothesized for prehistoric Ohlone peoples living in the East Bay shore region (cf. King 1974:42-45, Table 1; Parkman 1980, 1994:47-50).

Fish Procurement

Use of Watercraft

Tule rush raft boats or "balsas" frequently were used on San Francisco Bay by the Ohlone and Coast Miwok (Follett 1975:80-81; Harrington 1942:11; Heizer and Massey 1953:291-293; Kelly 1978 :419, 1996:210; Kroeber 1925:468, 813; Levy 1978:492; Margolin 1978:37-38, 54-56; Slaymaker 1977:44; Switzer 1974:8). These watercraft often were seen on San Francisco Bay by early Spanish explorers (Milliken 1995:31-61). Balsas were about 10-15 ft. long and 3 ft. wide, made from several bundles of rushes and dried grass lashed together into rolls which were then tied together (Follett 1975:98, Plate 6; Heizer 1974:92, Figure 3, 103, Figure 13, 104, Figure 15; Heizer and Massey 1953:292, Figure 11; Levy 1978:492, Figure 3; Margolin 1978, Figure on pg. 55). They were powered by double-bladed paddles and anchored with stone anchors. The boats were used for

Table 8. Seasonality of Occurrence of Principal Fish Taxa Occurring at CA-MRN-44/H

FISH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Leopard Shark	----	----	--XX	XXXX	XXXX	XXXX	XXXX	xxxx	xx --	----	----	----
Bat Ray	----	----	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	----	----	----
Sturgeon	XXXX	XXxx	xxxx	xxxx	xxxx	xxXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Pacific Herring	XXXX	XXXX	XXxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxXX
Pacific Sardine	xxxx	----	....	....	....	....	xxxx	XXXX	XXXX	XXXX	xxxx	xxxx
Northern Anchovy	xxxx	xxxx	xxXX	XXXX	XXXX	XXxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Chinook Salmon	xxxx	xxxx	XXXX	xxxx	XXXX	XXXX	xxxx	xxxx	XXXX	XXXX	xxxx	XXXX
Plainfin Midshipman	xxxx	xxxx	xxxx	XXXX	XXXX	XXXX	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
Jacksmelt	XXXX	XXXX	XXXX	XXXX	xxxx	xxxx	xxxx	xxxx	xxxx	XXXX	XXXX	XXXX
Rockfish	XXXX	XXXX	XXXX	XXXX	XXXX	XXxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxXX
Surfperch	xxxx	xxxx	XXXX	XXXX	XXXX	xxxx	xxxx	XXXX	XXXX	XXXX	XXXX	xxxx

Fish Sources: Bane and Bane (1971); Baxter (1974) Feder; et al. (1974); Fisher (1994); Fitch and Lavenberg (1971, 1975); Frey (1971); Fukushima and Lesh (1998); Miller and Geibel (1973); Moyle (2002); Roedel (1948, 1953); Walford (1931).

XXXX: Population High.
xxxx: Moderate Population Numbers.
----: Population Decline.
....: Population Low.
XXXX: Annual Spawning Period

transport, fishing, gathering of bird eggs, and waterfowl hunting. They probably also were employed to hunt marine mammals.

Ethnographic Accounts of Fishing

Kelly (1978:415-416; 1996:139-143) comments on Coast Miwok fishing techniques. Good places for catching surf fish often were privately owned. Wooden fish clubs and two-pronged fish spears were used. Nets included framed round nets and dip nets, and various sizes and meshes of seine nets. Salmon mainly were taken during winter, with fish traps and various types of nets, including dip nets. A salmon "singer" often accompanied fisher folk. During spring, rockfish found inshore at low tide apparently were poisoned. Sturgeon, herring, and surf perch were caught in San Francisco Bay using a large seine net stretched between two tule balsas. These nets often belonged to two or three men. Mesh size varied, depending on what was being taken. Pieces of wood were used for floats, and beach rocks provided sinkers. Sometimes nets were tied to poles instead of sinkers.

Follett (1974:148-149) comments that sharks and bat rays from MRN-14 probably were caught using a seine net. A seine also may have been used to take sturgeon, white sea bass, surfperch, and possibly jacksmelt. Salmon passing through San Francisco Bay during spawning migrations were best caught from tule balsas. Rockfish probably were caught using hand lines cast from shore.

Follett (1975:80-86) notes that prehistoric inhabitants of the West Berkeley Shellmound, ALA-307, apparently preferred tule balsas and gill and seine nets for fishing. Fishhooks and spears do not appear to have been as important. Nets probably were weighed down with stone sinkers. Gill nets possibly were used to catch sturgeon and Chinook salmon. Leopard sharks, bat rays, sturgeon, jacksmelt, and plainfin midshipmen may have been taken with seines. Plainfin midshipmen, surfperch, and smaller leopard sharks, bat rays, sturgeon, and salmon could have been caught on fishhooks. Gorge hooks would have served to take leopard sharks, bat rays, sturgeon, and salmon. Sturgeon also could have been speared.

Following Follett (1974, 1975), Scott (1998:180) and Scott and Millerstrom (2003:6-11 to 6-12) conclude that prehistoric inhabitants of MRN-17 used several methods to catch fish. Shallow-water nets, spears, and seines appear to have been preferred. Watercraft would have facilitated fishing efforts. Thus, it is likely that a variety of fishing techniques were employed by prehistoric peoples living at MRN-44/H.

SUMMARY AND CONCLUSIONS

It is concluded that the fish assemblage from MRN-44/H supports the following inferences:

- Prehistoric inhabitants of MRN-44/H focused on fishing, with salmon particularly emphasized.
- Fishing probably used "coharvesting" and "prey switching," strategies as components of an overall emphasis on resource intensification; this resulted from resource depression produced by resource overexploitation and inter-annual unpredictability.
- Along with other islands, Angel Island probably was a prehistoric "platform" in San Francisco Bay from which specialized task groups fished and also hunted waterfowl and marine mammals.
- MRN-44/H/H was occupied throughout the year.
- Fish probably were procured in a number of ways, with watercraft and netting especially significant.

The MRN-44/H fish assemblage is from a prehistoric San Francisco Bay island site. Virtually all previous studies of faunal assemblages from sites in the San Francisco Bay Area have been conducted at mainland sites. The MRN-44/H faunal assemblage provides a unique opportunity to examine faunal materials from a permanent "platform" in the Bay. Comparable data exist at other San Francisco Bay island sites (i.e., Yerba Buena Island, Brooks Island, East Marin Island). Comparison of faunal data from these island sites has allowed examination of the dynamics of resource intensification/depression and unpredictability through time in the San Francisco Bay Area.

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