

Seafood Consumption Habits of Recreational Anglers in Santa Monica Bay

Chemical contamination in seafood organisms in Santa Monica Bay (Young *et al.* 1978, Gossett *et al.* 1983, Risebrough 1987, Pollock *et al.* 1991, SCCWRP *et al.* 1992, SCCWRP 1994) has raised public concern about whether the seafood organisms are safe to eat. Based on contaminant levels in fish collected in 1987, and using national consumption rates, Pollock *et al.* (1991) recommended limiting consumption of some species caught off Southern California (including Santa Monica Bay). In anticipation of an updated risk analysis for the area, the Santa Monica Bay Restoration Project (US Environmental Protection Agency Natural Estuary Program) funded two studies: one to measure contamination in seafood organisms in Santa Monica Bay (SCCWRP 1994) and one to determine the seafood consumption habits of recreational anglers in Santa Monica Bay.

This study describes the demographic and consumption characteristics of recreational anglers in and around Santa Monica Bay, identifies groups with high consumption rates, and reports the species most abundantly caught and consumed in the early 1990s. A detailed account of sampling protocols, analytical methods, and results are presented elsewhere (SCCWRP and MBC 1994).

MATERIALS AND METHODS

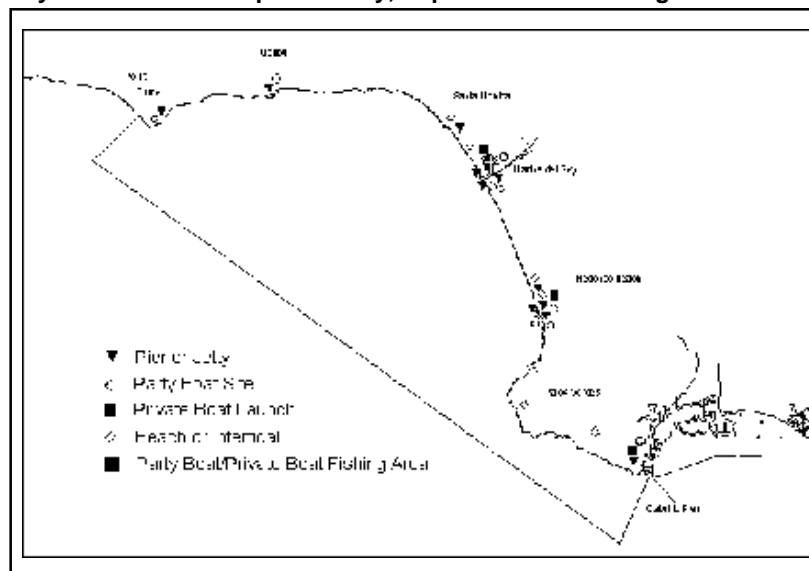
The Santa Monica Bay study area extended from Point Dume to Cabrillo Pier (Figure 1). The field study lasted from September 1991 to August 1992, and consisted of a survey of recreational anglers in four fishing modes: piers and jetties; party boats; private boats; and beach and intertidal zone. Surveys were conducted at 11 piers and

jetties, five party-boat landings, three private-boat launches and hoists, and 11 beach and intertidal sites (Figure 1).

Interviewers censused anglers at each site and asked them questions from a questionnaire prepared specifically for the study. In addition to English, interviewers spoke

Spanish, Vietnamese, Chinese, or Filipino. Each angler was asked questions about their background, fishing history, types of fish eaten, consumption habits, and methods of preparing fish. Answers to the questions were numerically coded, entered into a computer database, and analyzed. Ethnic group names were derived from the most recent US

FIGURE 1. Recreational angler fishing sites sampled in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.



census report (USBC 1990).

Consumption rates were calculated based on the angler's estimates of meal size relative to a model fish fillet that represented a 150 g meal. The amount consumed per meal was multiplied by the frequency of consumption of the species during the previous four weeks to get monthly consumption rates (kg/individual/month). This was divided by 28 days to get daily consumption rates (g/individual/day). Consumption rate data were summarized by parametric statistics (means, standard deviations, and 95% confidence limits) and nonparametric statistics (medians, and upper deciles or 90th percentiles).

RESULTS

In 113 separate surveys, 2376 anglers were censused, 1244 were successfully interviewed, and 555 provided sufficient information for calculation of consumption rates.

The majority of Santa Monica Bay anglers were male (93%), 21 to 40 years old (54%), white (43%), with an annual household income of \$25,000 to \$50,000 (39%) (Figures 2-4). The next most abundant ethnic groups were Hispanics, Asians (Japanese, Koreans, Chinese, Filipinos, Vietnamese, and Cambodians), blacks, and others (Figure 3). Hispanics were the most abundant ethnic group on piers and jetties, while whites were the most abundant group on party boats and private boats (Figure 5). Pier and jetty anglers had lower household incomes than party boat and private boat anglers (Table 1). Most anglers fished year-round but 19% fished only during the summer; about a third did not fish during the month (28 days) prior to the interview, but of those that had, most fished 3-5 times per month and for 2-5 h at a time.

During the study, interviewers identified at least 67 species of fish, two species of crustaceans, two species of mollusks, and one species of echinoderm taken from the study area by recreational anglers and foragers. The most abundant species were chub (=Pacific) mackerel (*Scomber japonicus*), barred sand bass (*Paralabrax nebulifer*), kelp bass (*Paralabrax clathratus*), white croaker (*Genyonemus lineatus*), Pacific barracuda (*Sphyrna argentea*), and Pacific bonito (*Sarda chiliensis*) (Table 2). Most of the anglers were unable to give the correct common name for the fish in their possession, but they were able to give correct generic common name (e.g., barracuda, mackerel, etc.).

Thirty-nine percent of the respondents had eaten fish from the study area in the four weeks prior to the interview, and most anglers had caught fish on the day of the interview. The percentage of party boat (76%) and private

FIGURE 2. Age distribution of recreational anglers of 21 years or older interviewed in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992. Age classes are 21-30, 31-40, etc.

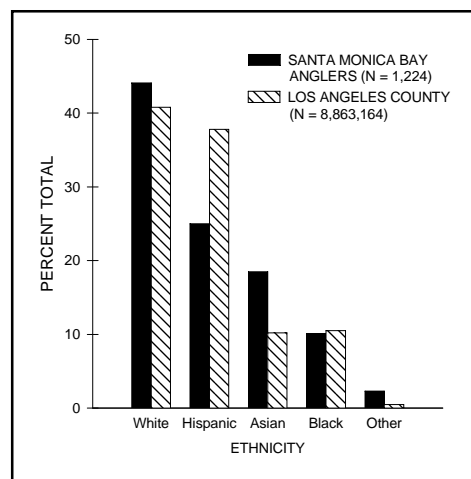
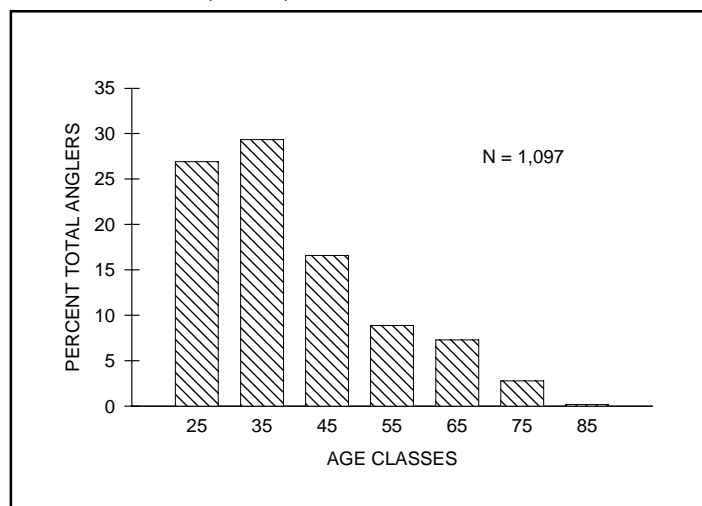
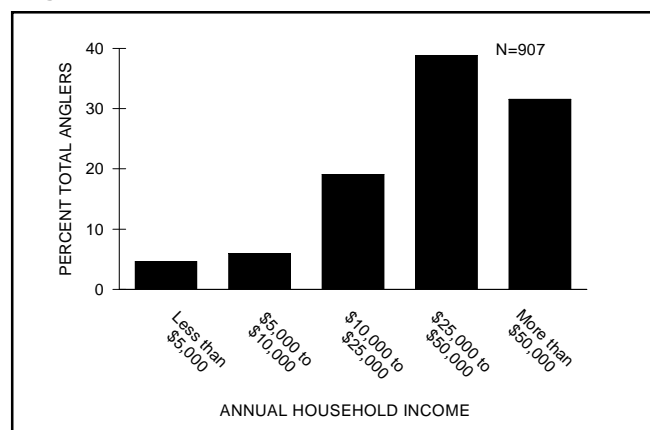


FIGURE 3. Ethnic distribution of recreational anglers interviewed in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.

FIGURE 4. Annual household income distribution of recreational anglers interviewed in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.



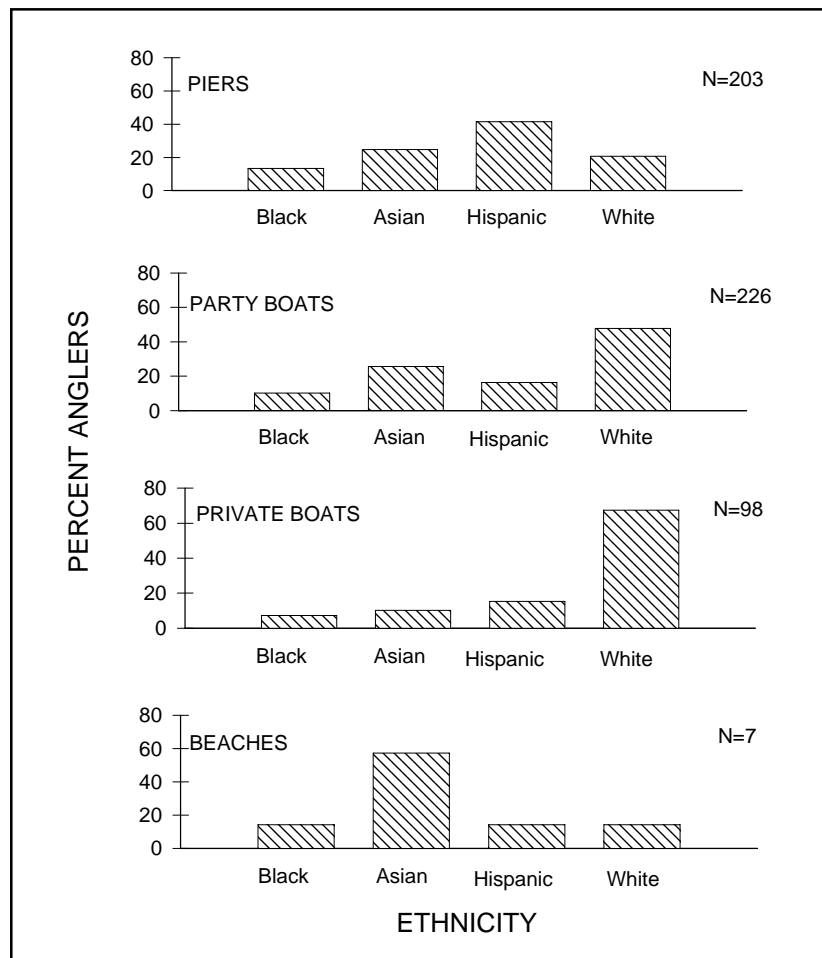
boat (74%) anglers who caught fish on the day of the interview was much greater than that of the pier and jetty anglers (47%).

Santa Monica Bay anglers had a median consumption rate of 21 g/ind/day. Although the median consumption rate was relatively low, the upper decile (90th percentile) consumption rate was about five times higher (107 g/ind/day) (Figure 6).

Of the identifiable ethnic groups, consumption rates were highest for blacks, who had a median consumption rate of 24 g/ind/day. Upper decile consumption rates were highest for Asians, who had a median consumption rate of 137 g/ind/day (Figure 7). Anglers with annual household incomes less than \$5,000 had the highest median consumption rates (32 g/ind/day), but those with incomes greater than \$50,000 had the highest upper decile rates (129 g/ind/day) (Figure 8).

Median consumption rates of the most commonly caught species were similar, but upper decile rates were more variable. Some individuals had much higher con-

FIGURE 5. Ethnic distribution of recreational anglers by fishing mode, Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.



sumption rates (particularly for chub mackerel) than the average consumer (Figure 9). Median consumption rates were highest for barred sand bass, Pacific barracuda, kelp bass, rockfish species (*Sebastes* spp.), Pacific bonito, and California halibut (*Paralichthys californicus*). Upper decile consumption rates were highest for kelp bass, barred sand bass, and rockfish species.

Anglers who consumed white croaker were mostly male (92%), Hispanic (57%), 21 to 30 years old (26%), with a household income of \$10,000 to \$25,000 (17%) (Figure 10). Blacks had the highest median consumption rate (13 g/ind/day), and Asians had the highest upper decile consumption rate (51 g/ind/day), of this species. Most anglers caught white croaker at piers (particularly Cabrillo Pier), fished year-round, had fished less than six years, and had eaten this species at least once in the four weeks preceding the interview. They generally ate the fish whole but gutted, ate about 150 g at a time, and fried their catch.

About 77% of the anglers were aware of health warnings about consumption of fish from Santa Monica Bay; most of the respondents cited television and newspaper or magazine articles as the major source of information (Table 3). Of the aware anglers, 50% had been affected by the warnings and had altered their seafood consumption habits. Of these, 46% stopped consuming some species, 25% ate less of all species, 19% stopped consuming all fish, and 10% ate less of some species (Table 3).

Most anglers of all ethnic groups were aware of the health-risk warnings. Television was the major source of information on warnings for black, Hispanic, and "other" anglers, while newspapers and magazines were the major source for Asian and white anglers. Most black,

Hispanic, and "other" anglers were not affected by the warnings, but most Asian and white anglers altered their consumption behavior. Of the anglers who altered their behavior, the pattern was similar for all ethnic groups: most stopped eating some species and somewhat fewer ate less of all species. White croaker consumers were gener-

TABLE 1. Distribution of recreational anglers by annual household income and fishing mode, Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.

	NUMBER OF ANGLERS BY FISHING MODE				TOTAL
	Pier/ Jetty	Party Boat	Private Boat	Beach/ Intertidal	
ANNUAL HOUSEHOLD INCOME					
Less than \$5,000	26	7	7	2	42
\$5,000 to \$10,000	32	18	3	1	54
\$10,000 to \$25,000	93	55	25	0	173
\$25,000 to \$50,000	129	138	82	3	352
More than \$50,000	49	150	86	1	286
TOTAL	329	368	203	7	907

TABLE 2. Abundance of seafood species caught by recreational anglers using different fishing modes, Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.

COMMON NAME	SCIENTIFIC NAME	NUMBER OF ORGANISMS BY FISHING MODE				
		Pier	Party Boat	Private Boat	Beach/Intertidal	Total
chub mackerel	<i>Scomber japonicus</i>	476	356	215	0	1047
barred sand bass	<i>Paralabrax nebulifer</i>	1	308	79	0	388
kelp bass	<i>Paralabrax clathratus</i>	1	250	76	0	327
white croaker	<i>Genyonemus lineatus</i>	167	3	149	0	319
Pacific barracuda	<i>Sphyræna argentea</i>	4	202	53	0	259
Pacific bonito	<i>Sarda chiliensis</i>	25	124	101	0	250
sea mussel, unidentified	<i>Mytilus</i> spp.	0	0	0	100	100
Pacific purple urchin	<i>Strongylocentrotus purpuratus</i>	0	0	0	90	90
jacksmelt	<i>Atherinopsis californiensis</i>	64	2	8	0	74
California scorpionfish	<i>Scorpaena guttata</i>	3	34	28	0	65
bocaccio	<i>Sebastes paucispinus</i>	0	46	16	0	62
California halibut	<i>Paralichthys californicus</i>	12	23	27	0	62
halfmoon	<i>Medialuna californiensis</i>	0	32	24	0	56
opaleye	<i>Girella nigricans</i>	31	0	12	9	52
rockfish, unidentified	<i>Sebastes</i> spp.	0	34	3	0	37
squarespot rockfish	<i>Sebastes hopkinsi</i>	0	29	0	0	29
surfperches, unidentified	<i>Embiotocidae</i> spp.	18	0	9	0	27
black perch	<i>Embiotoca jacksoni</i>	5	0	21	0	26
starry rockfish	<i>Sebastes constellatus</i>	0	18	6	0	24
yellowfin croaker	<i>Umbrina roncadore</i>	16	0	1	3	20
other species combined		94	76	68	11	249
TOTAL		917	1537	896	213	3563
rockfishes, combined ^a	<i>Sebastes</i> spp., combined	4	171	28	0	203

^aRockfishes combined included 15 identified and one unidentified species, some of which (i.e., bocaccio, squarespot rockfish, rockfish unidentified, and starry rockfish) are included in this table.

ally aware of health warnings for this species from a variety of media sources. Although most thought the warnings were very important, half did not alter their consumption habits (Figure 11).

DISCUSSION

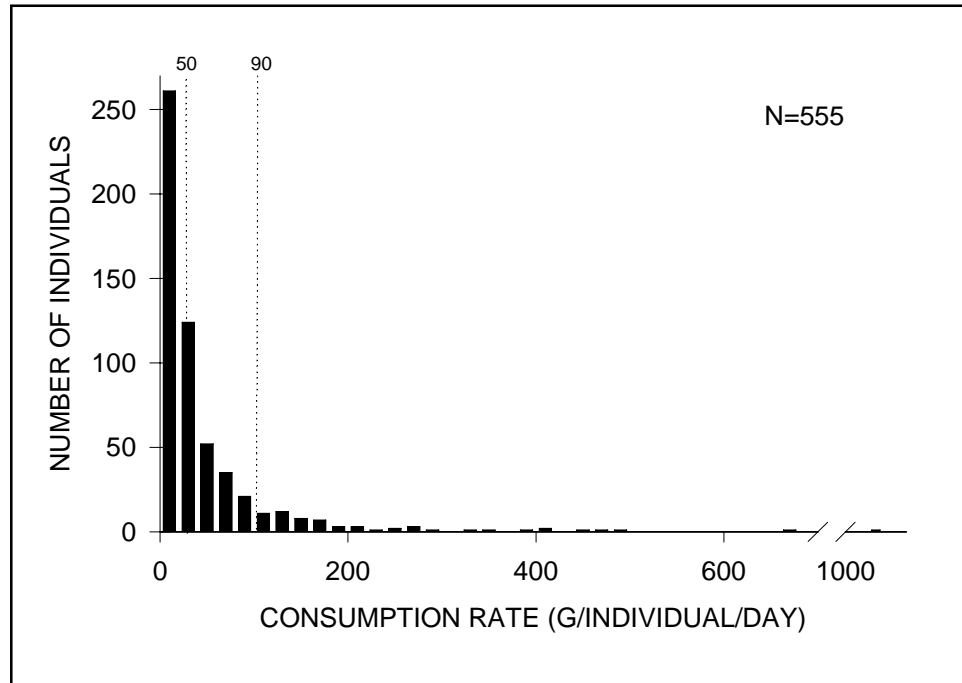
There were more whites and Asians and fewer Hispanics in the recreational fishing population of Santa Monica Bay relative to the ethnic composition of Los Angeles County (Figure 3) (USBC 1990, SCCWRP and MBC 1994). The gender, age, and ethnic characteristics of the anglers in 1991-1992 were similar to those obtained in a seafood study conducted in Santa Monica Bay in 1980 (Puffer *et al.* 1981, 1982). The most abundant species caught by recreational anglers in 1991-92 were similar to those caught by recreational anglers in 1980, except that white croaker was more abundant in 1980 than in 1991-92.

The consumption rate distributions were skewed to the right and hence medians and upper deciles (90th percentiles) provided a better description than means and 95% confidence limits. The skewness of the consumption rate

distributions indicates that there were relatively few anglers with high consumption rates and many anglers with low consumption rates. This was true for all angler groups examined (i.e., overall, ethnic groups, age groups, income groups) and for all species.

The median consumption rate for Santa Monica Bay anglers (21 g/ind/day) was 70% of the national median (30 g/ind/day) (USEPA 1990). This may indicate that while many anglers fish in Santa Monica Bay, relatively few rely on their catch as a major source of food. Only 39% of the anglers had caught and consumed fish from the bay during the four weeks before the interview. No attempt was made to adjust for differences in the number of anglers that use each mode. The size of the fishing population in each mode was unknown and could not have been estimated without doing a special study. However, some weighting occurred naturally due to the different numbers of anglers fishing (and hence interviewed) in each mode. This natural weighting provided the best estimate of the size of the fishing population in each mode within the limitations and resources available in this study.

FIGURE 6. Distribution of seafood consumption rates of all seafood species combined by recreational anglers interviewed in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992. Median (50th percentile) and upper decile (90th percentile) are noted with vertical dotted lines.

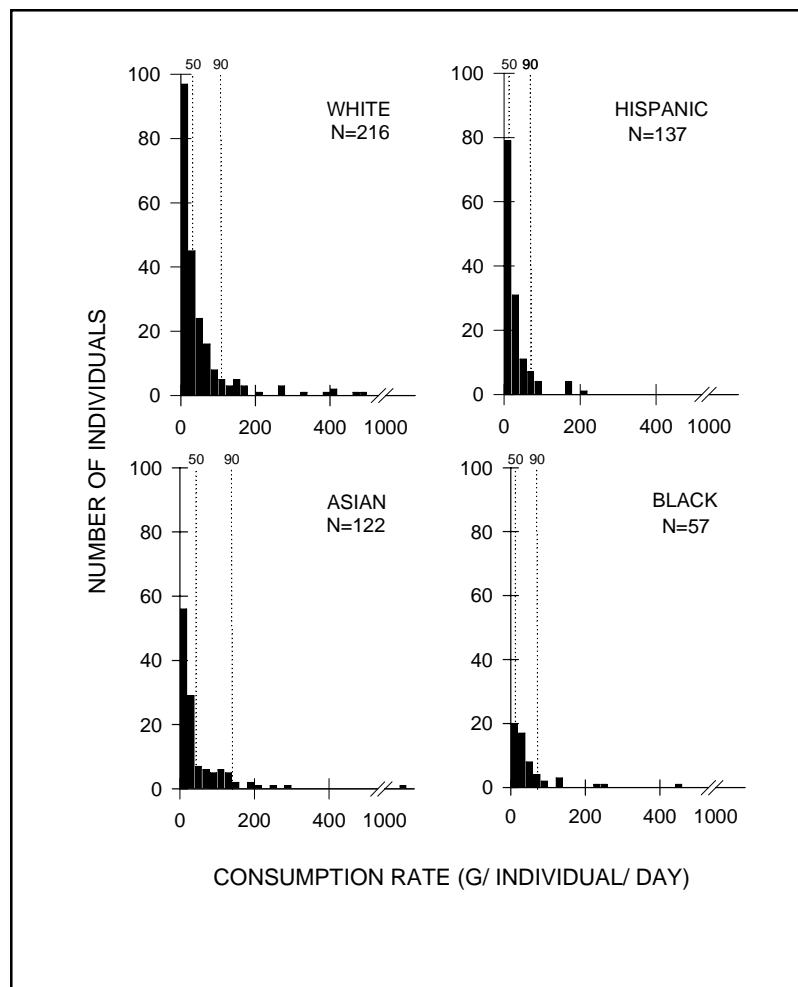


In general the most abundant species caught by recreational anglers in 1991-92 were consumed at the highest rates. These included barred sand bass, Pacific barracuda, kelp bass, rockfish species, and California halibut — all of which have low PCB and DDT levels (Pollock *et al.* 1991, SCCWRP *et al.* 1992). However, white croaker was consumed at relatively high rates and this species has high levels of PCBs and DDTs on the Palos Verdes Shelf and in Los Angeles Harbor (Pollock *et al.* 1991, SCCWRP *et al.* 1992, SCCWRP 1994). White croaker was consumed predominantly by Hispanic anglers fishing on Cabrillo Pier, a site where this species is contaminated (Pollock *et al.* 1991). Although there were more Hispanics that consumed white croaker, blacks and Asians were

more likely to consume larger quantities of this species.

The study suggests that health risks from eating contaminated fish at different sites might best be communicated to the public via a variety of media (posting warnings, television, newspapers, etc.). Nevertheless, many anglers who were aware of the warnings did not alter

FIGURE 7. Distribution of consumption rates of all seafood species combined by ethnic groups of recreational anglers interviewed in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992. Median (50th percentile) and upper decile (90th percentile) are noted with vertical dotted lines.



their consumption rates. They reasoned that if there were a health risk, they would experience ill effects within a day of eating a fish.

CONCLUSIONS

Most of the recreational anglers from Santa Monica Bay in 1991-1992 were male (93%), 21-40 years old (54%), white (43%), and had annual household incomes of \$25,000 to \$50,000 (39%). Chub mackerel, barred sand bass, and kelp bass were the dominant species caught, while barred sand bass, kelp bass, combined rockfish species, Pacific barracuda, and California halibut were consumed at the highest rates. The median con-

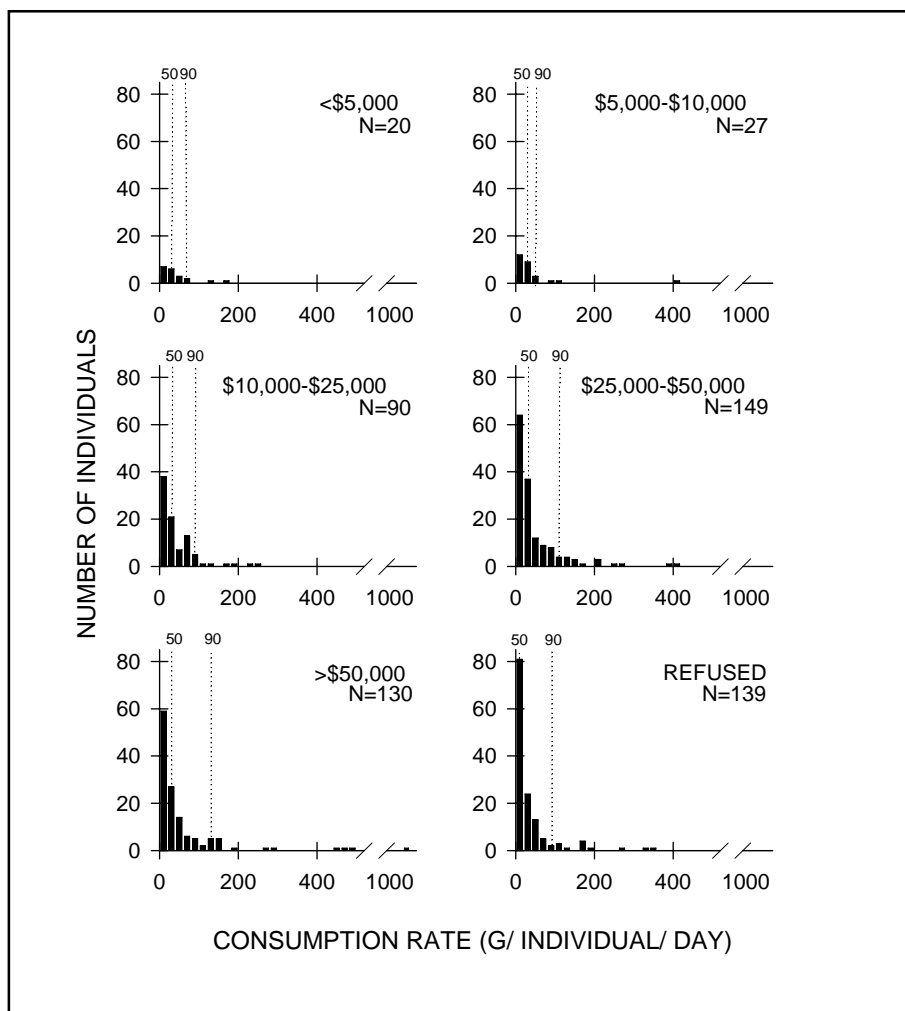
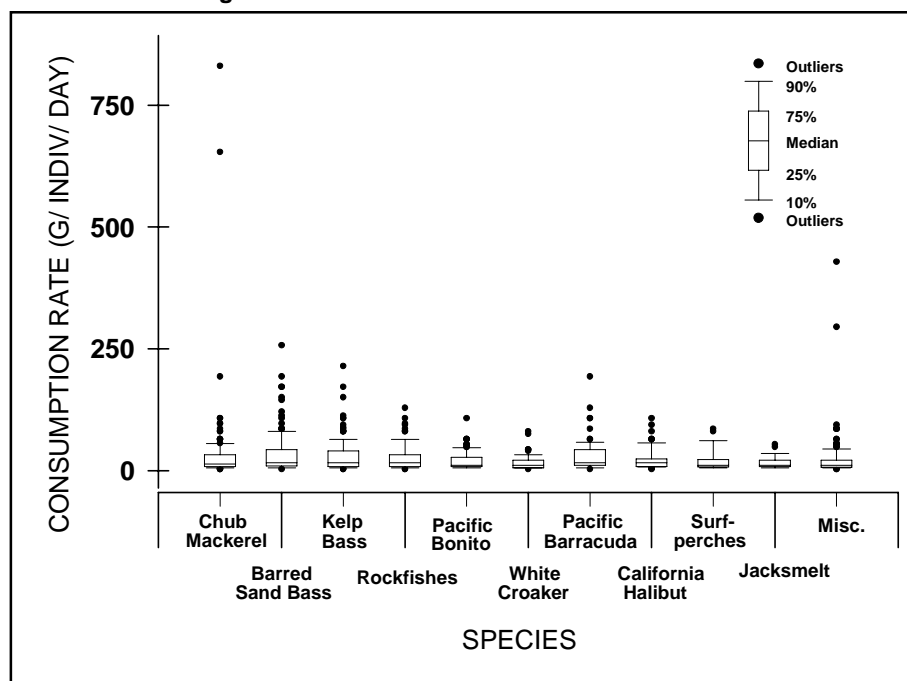


FIGURE 8. Distribution of consumption rates of all seafood species combined by annual household income groups of recreational anglers interviewed in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992. Median (50th percentile) and upper decile (90th percentile) are noted with vertical dotted lines.

sumption rate for Santa Monica Bay anglers (21 g/ind/day) was 70% of the national median (30 g/ind/day). Of the identified ethnic groups, blacks had the highest median consumption rates, but Asians had the highest upper decile consumption rates. Anglers with annual household incomes less than \$5,000 had the highest median consumption rates, but those with incomes greater than \$50,000 had the highest upper decile consumption rates. Anglers who consumed white croaker were primarily Hispanic and most caught this species at Cabrillo Pier, a site where white croaker were known to be highly contaminated. Although more Hispanics consumed white croaker, blacks had the highest median and Asians had the highest upper decile consumption rates. About 77% of the anglers were aware of health warnings regarding consumption of seafood species from Santa Monica Bay; 50% of these said they altered their fish consumption behavior as a result of these warnings by eating less or no fish.

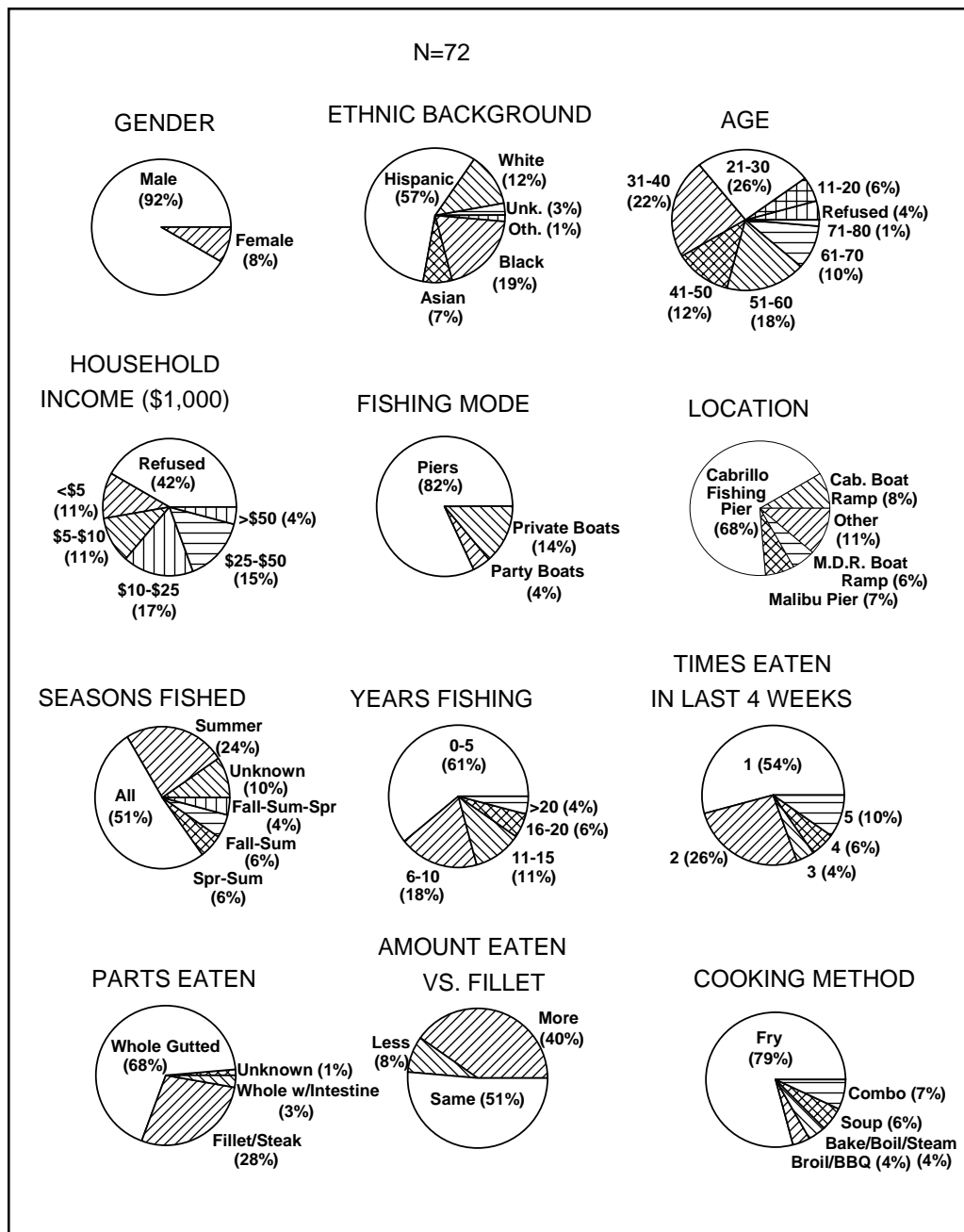
FIGURE 9. Seafood consumption rates by seafood species for recreational anglers interviewed in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.



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FIGURE 10. Characteristics of recreational anglers who consumed white croaker (*Genyonemus lineatus*) in Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.



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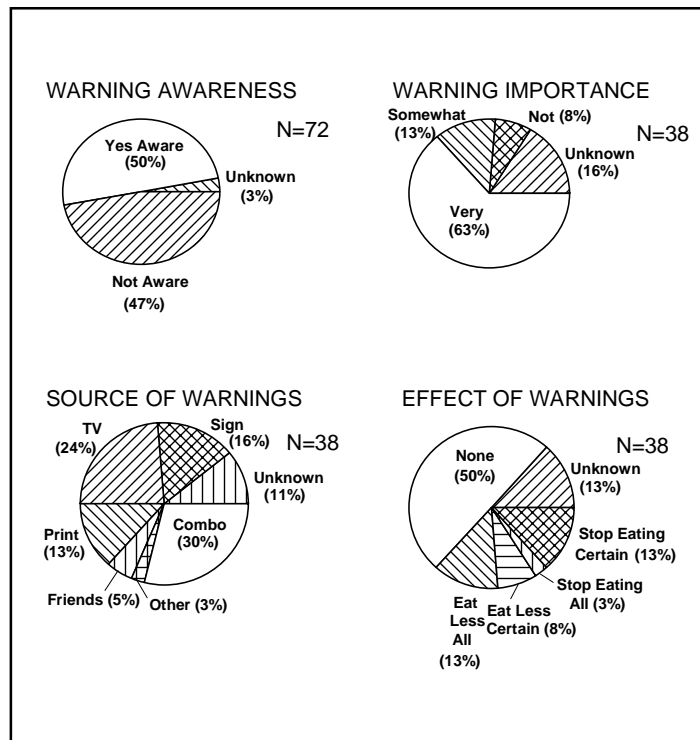
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FIGURE 11. Responses to health risk warnings by Santa Monica Bay anglers who consumed white croaker (*Genyonemus lineatus*), Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.



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TABLE 3. Response to health-risk awareness warnings by Santa Monica Bay anglers of different ethnic groups in the Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992.

	ETHNIC GROUP					
	Black	Asian	Hispanic	White	Other	TOTAL
<u>NUMBER OF RESPONDENTS</u>						
Total	124	224	305	533	28	1214
Aware of warnings	95	171	179	467	18	930
Affected by warnings	43	98	78	243	6	468
<u>AWARE OF WARNINGS? (% respondents)</u>						
Aware of warnings	77	76	59	88	64	77
Not aware of warnings	23	24	41	12	36	23
<u>SOURCE OF WARNINGS (% of aware)^a</u>						
Television	61	46	64	51	56	54
Newspaper and/or magazines	44	49	30	59	22	49
Posted signs	33	38	32	32	33	33
Anglers and/or friends	27	20	14	28	17	23
Other	6	9	7	12	11	10
<u>RESPONSE TO WARNING (% of aware)</u>						
Affected by warnings	45	57	44	52	33	50
Not affected	55	43	56	48	67	50
<u>TYPE OF RESPONSE (% of affected)</u>						
Stopped eating some species	37	51	44	47	67	46
Ate less of all species	37	27	28	21	17	25
Stopped eating all species	19	13	18	21	17	19
Ate less of some species	7	9	10	12	0	10

^aRespondents could say "yes" to more than one category.

