EXTENT OF FISHING AND FISH CONSUMPTON BY FISHERS IN VENTURA AND LOS ANGELES COUNTY WATERSHEDS IN 2005

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Technical Report 574 - September 2008

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September 15, 2008

Cover Images (Clockwise from the Lower Left): San Gabriel River Estuary, Upper Calleguas Creek (Coastal Terrace Stream), Lake Casitas (Mountain Reservoir), Big Tujunga Creek (Mountain Stream), Peck Road Park Lake (Urban Lake), and Lower San Gabriel River (Coastal Terrace Stream).

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ABSTRACT

Although fishing is an important recreational activity in southern California, there is no recent description of its distribution in the watersheds. With increased focus on pollution control, there is a need for understanding the extent of fishing and fish consumption as a beneficial use in these watersheds. This study describes the general extent of fishing and fish consumption in six watersheds of Ventura and Los Angeles Counties: Ventura River, Santa Clara River, Calleguas Creek, Malibu Creek, Los Angeles River, and San Gabriel River. Of about 41 freshwater and anadromous fish species in these watersheds, 83% are introduced species. In addition, there are about 36 species of estuarine and surf zone fishes just seaward of the mouths of these rivers and creeks. We conducted a field survey during January-December 2005 to census fishers by fishing areas (estuary/river mouth, coastal terrace streams, urban lakes, mountain reservoirs, and mountain streams) in the watersheds. Fishers were interviewed to obtain information on their fishing habits and consumption of fish in these watersheds. Teams of two interviewers conducted surveys on four week days and five weekend days per month during this period. Sites were selected from a stratified random sampling design. In all, 273 site visits were conducted at 82 of 86 targeted sites. We observed 1,243 fishers and 495 were interviewed; of these, 238 consumed fish they caught, and 140 provided sufficient information to calculate consumption rates. Most fishers and consumers occurred at urban lakes and mountain reservoirs, fewer at mountain streams and estuary/river mouths, and least at coastal terrace streams. Stocked rainbow trout (*Oncorhynchus mykiss*), channel catfish (*Ictalurus punctatus*), bluegill (*Lepomis macrochirus*), and common carp (*Cyprinus carpio*) were the most frequently consumed species. The overall mean, median, and upper decile consumption rates were 34.9, 16.2, and 70.6 g/day, respectively, for fish caught in the Ventura and Los Angeles County watersheds in 2005. In contrast, the Santa Monica Bay fish consumption study of recreational anglers in 1990-1991 obtained overall mean, median, and upper decile consumption rates of 50, 21, and 107 g/day for marine fish caught in the Bay. Consumption rates in the present study varied by ethnicity of fishers, species of fish consumed, watershed, and fishing area. Consumption rates and other information collected during this study may be used in Total Maximum Daily Load (TMDL) assessments of these watersheds to determine beneficial use and potential health risks of these watersheds.

INTRODUCTION

Coastal southern California is one of the most populated coastal regions in the United States, with a population of more than 18 million people (USCB 2003). A consequence of this high population density is that rivers and streams in the area have been impacted by human activity. The Federal Clean Water Act (CWA) Section 101(a)(2) states that all waters of the United States are to be protected for recreation and the propagation of fish and wildlife. Hence, a goal of the CWA is to ensure that all water bodies are 'fishable.' To protect the human population living in this area and organisms living in or utilizing these waterways from detrimental effects of this contamination, the State Water Resources Control Board has implemented assessments of stream pollution in a number of southern California streams and rivers.

Coastal watersheds in southern California are frequently altered and impacted by human activities. Many streams, rivers, and lakes in southern California have been modified from natural conditions by stream bed alteration, flow alteration, and discharge of contaminants (Gumprecht 1999, Stein *et al*. 2007). Some stream beds have been straightened and lined with concrete, and some receive a variety of discharges regulated by the state or Federal government. These alterations may affect the beneficial use of many southern California streams and rivers, particularly with regard to fishing. For instance, altered stream habitat may affect the species and number of fish caught, with more or less desirable species occurring following the alteration. In addition, fish in these streams may pose health risks to human consumers. While fishing in these streams is not ideal (and is in fact illegal in some portions of these water bodies), fishing may occur downstream, and fish caught there may have periods of residency upstream. It is possible that fish caught and consumed in these water bodies provide a vital food supply for low-income families or particular ethnic groups. There is currently no broad summary of fishing activity or the amounts of fish consumed in southern California watersheds.

Although in southern California, studies of fish consumption by Santa Monica Bay anglers have been conducted (Puffer *et al*. 1981, 1982; SCCWRP and MBC 1994; Allen *et al*. 1996), similar studies of fish consumption by freshwater fishers in southern California (or elsewhere in California) have not been conducted (OEHHA 2001), although creel studies have been conducted elsewhere in California (some of which are listed in CDHS,EHIB 2007). OEHHA (2001) noted that consumption rates among anglers fishing in Santa Monica Bay (SCCWRP and MBC 1994; Allen *et al*. 1996) were similar to those of anglers fishing in fresh water bodies in Michigan, including the Great Lakes (Murray and Burmaster 1994). Based on this, OEHHA (2001) recommended that until reliable California freshwater fish consumption data become available, rounded unadjusted values in the most recent Santa Monica Bay study (SCCWRP and MBC 1994; Allen *et al*. 1996) be used as default median, mean, and 90th and 95th percentile consumption rates for both freshwater and marine waters of California. However, as consumption rates of anglers fishing in fresh water bodies in southern California may differ from those of freshwater anglers fishing in Michigan and elsewhere, there is a need to determine what fish consumption rates actually occur among anglers fishing fresh water bodies in southern California.

As there has been no regionwide study of fishing and fish consumption in freshwater bodies of southern California, the extent to which fishing and fish consumption occurs in most of these water bodies is currently unknown. This information is needed by environmental regulators to assess potential effects of contamination on beneficial use of these watersheds for fishing and fish consumption. There is a need to determine the amount of fishing and fish consumption in these watersheds for regulatory use, in risk-assessments, and for determining beneficial use of these watersheds for watershed CWA mandated Basin Plans. Further, there is a need to develop a survey instrument and survey protocol that can be used throughout California to standardize estimates of fish consumption rates by freshwater anglers in the State.

The objectives of this study are 1) to develop a survey instrument and survey protocol that may provide a standard methodology for assessing fish consumption rates throughout California; 2) to determine the extent of fishing and fish consumption as a beneficial use in these watersheds; and 3) to assess fish consumption rates by fishers at different sites for potential use in human health-risk assessments related to consumption of contaminated fish. For the latter purpose, the objectives are to determine from what fishing habitats and sites are fish most frequently consumed by fishers and what species at each site are most frequently consumed by fishers.

METHODS

Field Survey

Overview of Study

The survey design and survey instrument used in this study was based on and modified from those used in the Santa Monica Bay Seafood Consumption Survey of 1991-1992 (MBC 1991, MBC 1993, SCCWRP and MBC 1994, Allen *et al*. 1996). Because the Santa Monica Bay study was a survey of marine anglers, fishing modes, and fishes, the survey design and survey instrument of the present study were modified to make them appropriate for surveying fishing and fish consumption in selected coastal watersheds of Ventura and Los Angeles Counties in southern California. A survey instrument was developed consisting of census forms and questionnaires (Appendix A: Sections A1, A2, A3, A4); site lists by watershed and fishing areas and site maps (Appendix B: Sections B1, B2, B3); a list of fish species in the survey area and field guide for identification of the most important species (Appendix C: C1, C2); and other pertinent information (Appendix D). This information provided the material needed for conducting the survey. The fish consumption survey was conducted using the survey instrument to census and interview persons observed fishing in the water bodies in the study area. The field survey was conducted from January to December, 2005.

Data Needs

The objective of this study was to determine the extent of fishing and fish consumption in six Ventura and Los Angeles County watersheds. Data on extent of fishing were collected by censusing anglers at sites within different fishing areas (habitats) for each watershed. Data for estimating fish consumption rates of fishers consuming fish caught in the watersheds were collected by interviewing the anglers. These data were collected to characterize the extent of fishing and fish consumption by watershed and fishing areas for potential use for defining beneficial uses by watershed and for potential human health-risk assessments of consumption of contaminated fish. These data included the number of fishers using different fishing habitats within the watersheds, frequency and seasonality of fishing, demographics of fishers, fish species caught, and fish consumption rates (grams per day) for fish as a group and by species.

Targeted fish consumption data for each fisher interviewed were the estimated weight (in grams) consumed in a meal and the frequency of consumption per month, specifically, four weeks (defined as 28 days for consumption rate calculation purposes). Consumption rates were determined by fish (or invertebrate) species, and by user group. User groups were characterized by gender, age, ethnicity, income, and other demographic characteristics. Data on frequency of consumption and fishing by components of the fishing population are presented as percentages of total subpopulation categories (e.g., percentage of an ethnic or demographic category that consumed fish from the six Ventura and Los Angeles County watersheds at a given frequency).

Type of Survey

The relatively large study area includes fishing areas where fishers are likely to be encountered (e.g., river mouths and estuaries, urban lakes, mountain reservoirs) and fishing areas where fishers may be less likely to be encountered (e.g., coastal terrace streams, mountain streams). Nevertheless, information on extent of fishing and fish consumption were needed from both types of areas to fully describe beneficial uses of a watershed. Of particular interest was the extent of fishing and fish consumption (particularly for subsistence fishing by low income fishers) in coastal terrace rivers subject to water quality assessments. The study therefore, aimed to census numbers of fishers and the amount of fish consumption in different fishing habitats within a watershed.

The field survey consisted of two parts: 1) a census survey to describe the site and to census observed fishers at a site, and 2) a questionnaire survey conducted where fishers could be interviewed. Fishers were considered as persons with fishing gear or those actively fishing. The field survey was conducted by survey teams consisting of two persons using census forms and questionnaires in English (Appendix A: Sections A1, A2) or Spanish (Appendix A: Section A3, A4). Interviews were conducted following survey protocol given below (see Conduct of Survey). Spanish-speaking fishers were either interviewed in Spanish (if the interviewer was fluent in Spanish) or shown the Spanish census forms and questionnaires if the interviewer was not fluent in Spanish. In the latter case, the interviewee pointed to appropriate answers if these were listed, or communication between the interviewer and interviewee was conducted in mixed English and Spanish. Most Spanish speakers encountered could speak at least a little English. Although a large number of other languages are spoken in the Los Angeles Metropolitan area, these are not so widespread in the study area as English and Spanish, and were more variable in their occurrence. Where fishers were encountered that spoke other languages, these were noted on the questionnaire if they could be determined by the interviewer or were indicated by the speaker. This information may be of value for planning future fish consumption studies in the area and for posting health-risk advisories in appropriate languages.

The census survey was conducted at all sites visited on a given day whereas the fish questionnaire survey could only be conducted where fishers were present and willing to be interviewed. A site description and visual census of the number and demographic characteristics of all fishers at the site was performed by the field survey team when it reached a site. The site description also included information on time of day, public access, and water body conditions (e.g., water level, extent of water) and weather (e.g., sunny, rainy, windy). This information (Table 1) was recorded on a census form (Appendix A: Section A1).

Where fishers were present, they were interviewed in person as they fished (i.e., a roving survey) or at the end of a fishing trip (exit or fixed point survey), depending on access to the site, to obtain information on their fishing and fish consumption habits (Table 2). Interviewers asked fishers a series of questions from the questionnaire (Appendix A: Section A2) and recorded their responses. Two types of fishers were interviewed -- those

with fish and those without fish. A general interview questionnaire was administered to both types of fishers. The focus of this questionnaire was on collecting information on frequency of fishing, and frequency and amount of fish consumption and invertebrates caught at a site. For fishers with a catch of fish, the number of fish caught by species was recorded as well as the fate of the catch. Fishers were shown a balsa wood fish fillet model of a standard United States Environmental Protection Agency (USEPA) fish meal of 227 g (8 oz) (USEPA 2000) and asked how much (relative to the model) of a species they consumed when they ate it. They were also asked how frequently they consumed the species from the site during the past four weeks (28 days). Fishers with or without fish were shown pictures of fish likely found in the fishing area (Appendix C: Section C2), and asked if they had caught and consumed each species from the site. If they had consumed any of the species shown, they were asked how frequently the species was consumed during the past four weeks (28 days), and how much they consumed (relative to the fillet model) in a meal when they consumed it. In addition to fish consumption information, demographic information was also collected from the fisher, such as gender, age, ethnicity, and language (Table 2).

Table 1. Information collected by field survey team on a census form (Appendix A: Section A1) for each site visit during the 2005 freshwater fish consumption survey of Ventura and Los Angeles County watersheds.

No.	Information
1	Location/access point
2	Interview team members
3	Interviewer conducting census
4	Date
5	Day of week
6	Arrival and departure times
7	Estimated air temperature
8	Weather conditions (sunny, partly cloudy/overcast, foggy, windy, rainy/cloudy, Santa Ana conditions)
9	Hydrographic type (river mouth, estuary, cement-lined or earthen bed coastal terrace stream, urban lake, mountain stream, reservoir; anadromous or nonanadromous region)[1]
10	Tide height and time (for river mouth and estuary sites)
11	River or stream conditions
	a Flow (high, moderate, low, intermittent)
	b Pools (large, small, clear, stagnant)
12	Reservoir level (high, medium, low)
13	Fishing mode of all fishers observed (shore, bridge, boat)
14	Fishing method of all fishers observed (hook/line, trap, net, other)
15	Number of fishers observed by gender and age in ethnic groups (Asian, Black, Hispanic, White, Other)
16	Interviewer comments
17	Watershed map (to mark census location)
18	Approximate number of nonfishers observed in the area
19	Anecdotal information from nonfishers
	a How often does the respondent observe fishers in the area and what fish are caught?
	b What season are fishers observed in the area?
	c How often does the respondent visit the area?

[1]Anadromous region is between the river mouth and the first barrier to steelhead (rainbow trout, *Oncorhynchus mykiss*) migration.

Table 2. Information collected by a questionnaire (Appendix A: Section A2) administered to fishers during the 2005 freshwater fish consumption survey of Ventura and Los Angeles County watersheds.

No.	Information
1	Interviewer(s)
2	Date
3	Location/access point
4	Interview time (begin and end)
5	Observed fishing method (hook/line, trap, net, other)
6	Observed gender
7	Permission to conduct interview
	If interview was not conducted:
	a Reason (no time, language barrier, appeared threatening, not eligible, other, unknown)
	b Observed ethnic group (Asian, Black, Hispanic, White, Other, Unknown)
	c Language (Spanish, Pilipino, Vietnamese, Korean, Cambodian, Chinese, other, undetermined)
	d Estimated age
	e Observed catch (estimated number by species)
8	Fisher previously or not interviewed for this survey
9	Number of years or months fisher has fished at this location
10	Seasons fished at this location (spring, summer, fall, winter)
11	Number of times fisher has fished at this location during the past four weeks
12	Number of times fisher has caught and consumed fish during the past four weeks from southern California freshwater fishing areas (river mouths/estuaries, coastal streams, urban lakes, mountain streams, reservoirs)
13	Fisher's three favorite freshwater fishing locations in southern California
14	Fish caught during day of interview (yes or no)
15	Permission to examine catch
	a If no, estimated number by observed or reported species
	b If yes, actual number by species
16	Species caught during day of interview:
	a Correct species name
	b Fisher's name for species
	c Number of times species consumed by fisher during the past four weeks
	d Fate of fish caught (eat, throw back, give away, other)
	e Amount of fish consumed relative to fillet model
	f Parts of fish consumed (fillet/steak, whole gutted, whole with intestines, other)
	g Preparation method (fry, broil/bbq, bake/boil/steam, raw/smoked/ceviche, soup, other)
17	Species caught previously at this location (shown in photos): (a-g, as in question 16)
18	Fisher's hometown and zip code
19	Fisher's age
20	Fisher's ethnic background (Black, Hispanic, Vietnamese, Cambodian, Chinese, Japanese, White, Other)
21	Fisher's annual household income category, in thousands (<5, 5-10, 10-25, 25-50, >50, no response)
22	Number and ages of other household members that consume fish caught by fisher
23	Interviewer observations (quality of interview, survey type, comments, language used in interview)

Study Area

Watersheds

The study was conducted in six Ventura and Los Angeles County watersheds: Ventura River, Santa Clara River, Calleguas Creek, Malibu Creek, Los Angeles River, and San Gabriel River (Figure 1). Sites sampled by watersheds are listed in Appendix B: Section B1 and shown on maps in Appendix B: Section B2. Certain portions of these watersheds were not sampled due to public access limitations, safety concerns, and/or areas with little or no water to allow for fishing. In addition, sections of these watersheds were

closed to fishing by California Department of Fish and Game (CDFG) to protect steelhead rainbow trout (*Oncorhynchus mykiss*; Figure 2). The areas included the anadromous reaches of the watersheds from the river mouth to the first barrier to steelhead migration. Sections of all watersheds except Calleguas Creek fell into this category because of known historic occurrences of steelhead in these watersheds (Mary Larson, CDFG Los Alamitos, personal communication, 2004). These closures included large sections of the Ventura, Santa Clara, Los Angeles, and San Gabriel Rivers and a small section of lower Malibu Creek (to Rindge Dam; Figure 2). In spite of these closures, the advisory committee for this project recommended that surveys be conducted in these areas to provide information of the extent of fishing there.

Generalized Fishing Areas

Generalized fishing areas are watershed habitats with characteristic fish assemblages that may require different types of fishing. Fishers at different fishing areas often target species specific to that fishing area and use different fishing methods. Some of these fishing areas have been listed as "impaired" by the Regional Water Quality Control

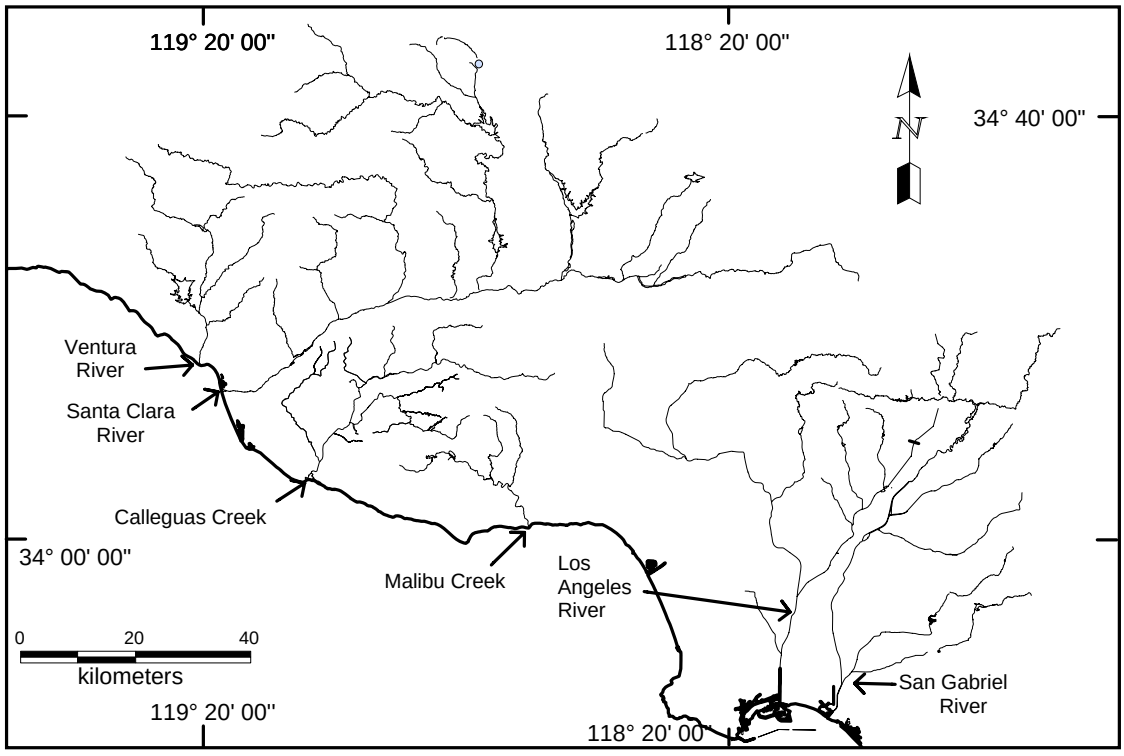


Figure 1. Map of six watersheds of Ventura and Los Angeles Counties, California, surveyed for extent of fishing and fish consumption in 2005.

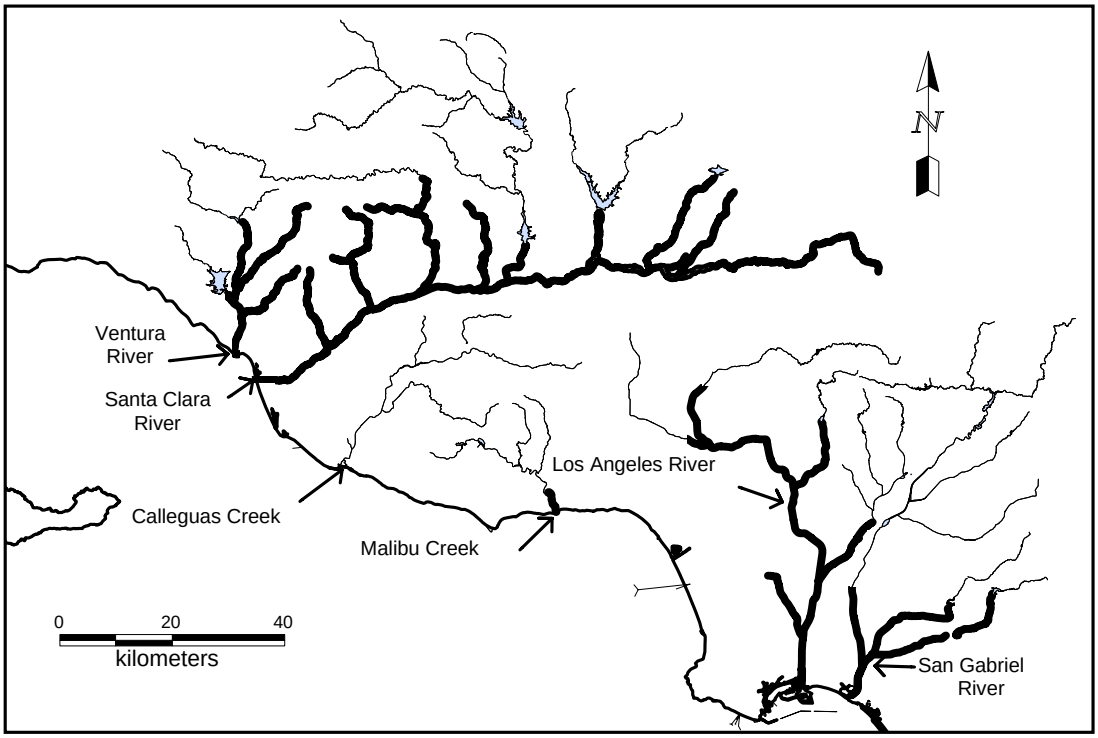


Figure 2. Areas in Ventura and Los Angeles Counties closed to fishing in 2005 to protect steelhead rainbow trout (*Oncorhynchus mykiss*).

Board (Appendix B: Section B3). Five different fishing areas were sampled in this survey: 1) river mouth/estuaries; 2) coastal terrace rivers/creeks; 3) urban lakes; 4) mountain reservoirs; and 5) mountain streams. River mouth/estuaries included the freshwater river mouth and the brackish water estuary (if present) into which the river or stream flows. Coastal terrace streams/rivers are defined here as those of the coastal terrace and, if in the lower foothills, inhabited by a lowland native fish fauna (see Swift *et al*. 1993) Urban lakes were added at the request of the advisory committee, as they were generally within the area of a watershed but often did not connect directly to the rivers or streams of the watershed. Mountain reservoirs were dammed portions of rivers and streams in foothill and mountain areas. Mountain streams were generally above the first major foothill or mountain reservoir and typically with a highland native fish fauna (Swift *et al*. 1993). All five of these fishing areas were not necessarily found within each of the six watersheds (Appendix B: Sections B1, B2, B3). Sampling priority of sites within each fishing area was given to sites on the California CWA Section 303(d) List for fish tissue impairments (Appendix B: Sections B1, B3), or which were of particular interest to funding agencies. Some reaches of rivers and streams were dry at the time of the survey or did not allow access. General locations of the sampling sites within these fishing areas (Figures 3 - 7) are given below, with additional information in Appendix B: Section B3.

River Mouth and Estuaries

River mouths and adjacent estuaries of the six watersheds were targeted for survey visits. These include the following seven sites (Figure 3; Appendix B: Section B3):

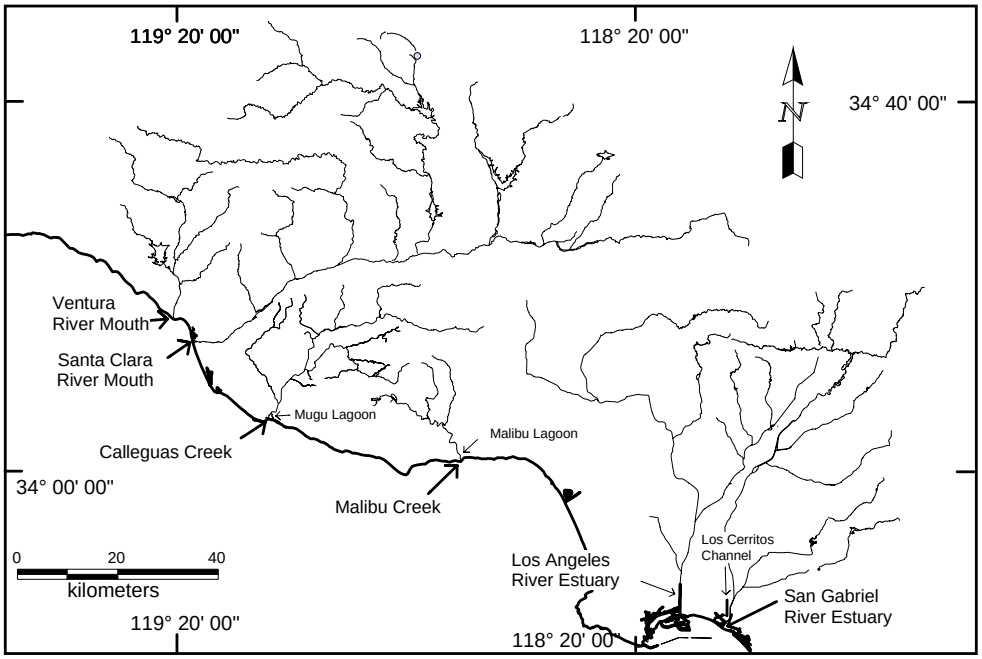


Figure 3. Map of river mouth/estuary sites to be censused and sampled for fishing and fish consumption information in 2005.

1) Ventura River mouth (seaward of Highway 101);

2) Santa Clara River mouth (seaward of Highway 101);

3) Mugu Lagoon/Calleguas Creek mouth -- (seaward of Highway 1; Note: Mugu Lagoon is listed on the 303d List for fish tissue impairment but fishing is not allowed except at the beach – accessibility was determined by contacting the U.S. Naval Air Weapons Station prior to visiting the site);

4) Malibu Lagoon/Malibu Creek mouth (seaward of Highway 1);

5) Los Angeles River mouth and estuary (303d fish tissue listed; seaward of Highway 405 to Shoreline Village Aquatic Park);

6) San Gabriel River mouth/estuary complex (2 sites): a) San Gabriel River mouth/ estuary proper, extending just inland of Highway 405, with high tides going up into the concrete lined channels of the San Gabriel River and Coyote Creek; and b) Los Cerritos Channel (Highway 1 to Highway 405). Los Cerritos Channel is currently not connected to San Gabriel River proper but lies in close proximity to the estuarine part of San Gabriel River and would have been a part of the predevelopment part of the San Gabriel estuary (including Alamitos Bay). Tides go upstream in Cerritos Channel to the cement-lined portion south of Atherton Street. Cerritos Channel was included here because many persons fishing along this Channel may also fish in the San Gabriel River mouth/estuary channel.

Coastal Terrace Rivers and Creeks

The following 34 reaches and tributaries of coastal terrace rivers and creeks were targeted for survey visits (Figure 4; Appendix B: Section B3):

1) Ventura River Watershed (4 sites): a) Lower Reach Ventura River (Highway 101 to San Antonio Creek), b) Upper Reach Ventura River (San Antonio Creek to Matilija Creek), c) San Antonio Creek, and d) Cañada Larga;

2) Santa Clara River Watershed (5 sites): a) Lower Reach Santa Clara River -- Highway 101 to confluence with Sespe Creek, including lower Wheeler Canyon/Todd Barranca; b) Middle Reach -- includes lower Sespe Creek and lower Piru Creek; c) USEPA Reach 7 -- Barranca Drive to Interstate 5; d) USEPA Reach 8 -- Interstate 5 to Bouquet Canyon Road (Note: USEPA Reaches 7 and 8 of Santa Clara River are the same as Los Angeles Regional Water Quality Control Board (LARWQCB) Reaches 5 and 6, and were contract requested); and e) Upper Reach Santa Clara River -- Bouquet Canyon Road to end.

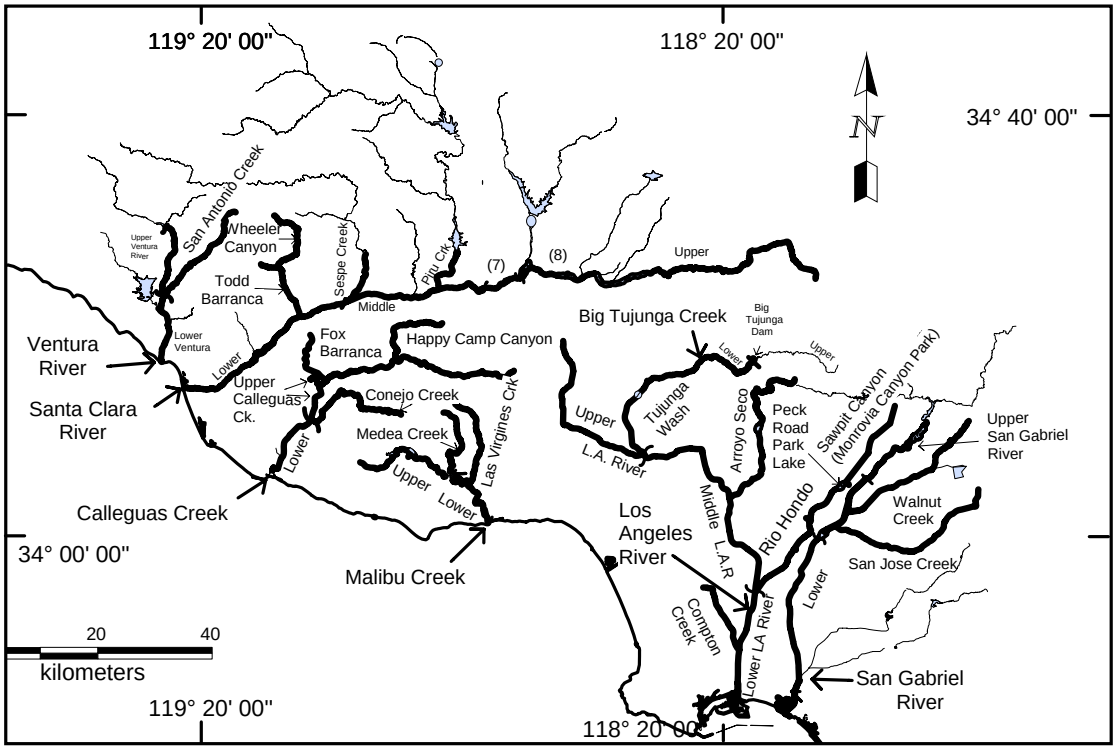


Figure 4. Map of coastal terrace rivers/creeks sites to be censused and sampled for fishing and fish consumption information in 2005.

3) Calleguas Creek Watershed (7 sites): a) Lower Reach Calleguas Creek -- Highway 1 to confluence with Conejo Creek; b) Revlon Slough; c) Conejo Creek; d) Upper Reach Calleguas Creek (Conejo Creek confluence to end); e) Arroyo Simi; f) Fox Barranca; and g) Happy Camp Canyon. Certain portions of Lower Calleguas Creek, Arroyo Simi, and Happy Camp Canyon are 303d fish tissue listed (Appendix B: Sections B1, B3).

4) Malibu Creek Watershed (4 sites): a) Lower Reach Malibu Creek -- Malibu Lagoon to confluence with Medea Creek; b) Los Virgenes Creek; c) Medea Creek; and d) Upper Reach Malibu Creek -- from confluence with Medea Creek to end;

5) Los Angeles River Watershed (9 sites): a) Lower Reach Los Angeles River -- Highway 405 to confluence with Rio Hondo; b) Compton Creek; c) Rio Hondo (upper reach contract requested); d) Monrovia (Sawpit) Canyon; e) Middle Reach Los Angeles River (Rio Hondo to confluence with Tujunga Wash, including Glendale Narrows); f) Arroyo Seco; g) Upper Reach Los Angeles River -- above confluence with Tujunga Wash; h) Tujunga Wash; and i) Lower Big Tujunga Creek -- Hanson Dam to Big Tujunga Creek Dam;

6) San Gabriel River Watershed (5 sites): a) Lower Reach San Gabriel River -- from confluence with Coyote Creek to Whittier Narrows Dam; b) Coyote Creek (contract requested); c) Upper Reach San Gabriel River -- Whittier Narrows Dam to Morris Reservoir; d) San Jose Creek Reach 1 (contract requested) -- confluence with San Gabriel River to confluence with Puente Creek; and e) Walnut Creek Wash.

Urban Lakes

A total of 25 urban lakes were targeted in the survey (Figure 5; Appendix B: Section B3). Many of these were not directly connected to the watersheds but were within the area of specific watersheds.

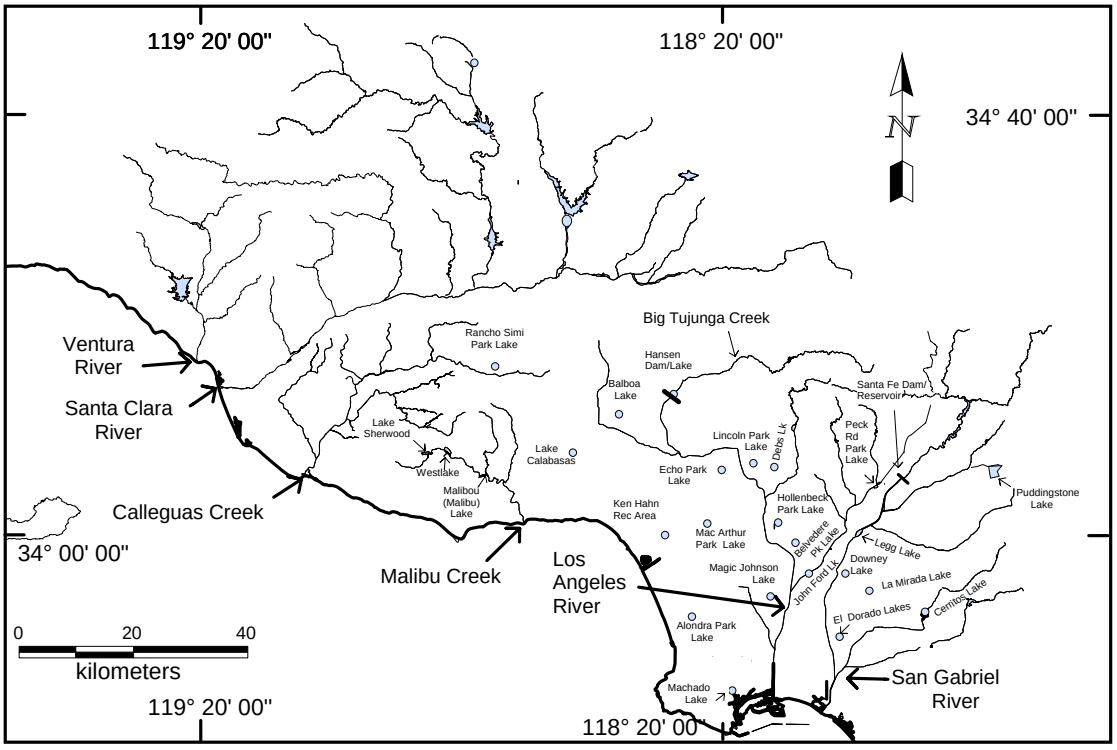


Figure 5. Map of urban lake sites to be censused and sampled for fishing and fish consumption information in 2005.

1) Ventura River and Santa Clara River Watersheds -- no urban lakes.
2) Calleguas Creek Watershed -- Rancho Simi Park Lake;
3) Malibu Creek Watershed: a) Malibou (Malibu) Lake; b) Westlake; and c) Lake Sherwood (303d fish tissue listed). (All of these lakes are privately owned. Westlake and Lake Sherwood are closed to the public. Malibou Lake gives limited access);
4) Los Angeles River Watershed: a) Machado Lake; b) Alondra Park Lake (Machado Lake, and Alondra Park Lake are in Dominguez Channel/Los Angeles Harbor Watershed); c) John Ford Park Lake; d) Peck Road Conservation Park; e) Belvedere Park Lake; f) Ken Hahn State Recreation Area (in Ballona Creek watershed); g) Hollenbeck Park Lake; h) Debs Lake; i) Lincoln Park Lake; j) Echo Park Lake; k) Hansen Dam Aquatic Center; l) Balboa Lake; and m) Lake Calabasas. Of these, four (Machado Lake, Echo Park Lake, Peck Road Water Conservation Park, and Lake Calabasas) were 303d listed for fish tissue. Two urban lakes in this watershed (MacArthur Lake and Earvin "Magic" Johnson Lake) were not included due to safety concerns raised by the study's advisory committee.
5) San Gabriel Watershed: a) Milton Arthur Lakes (El Dorado Lakes); b) Cerritos Lake; c) La Mirada Lake; d) Downey Lake; e) Legg Lakes; f) Puddingstone Lake; and g) Santa Fe Reservoir. (Puddingstone Lake and Milton Arthur Lakes are 303d listed for fish tissue).

Mountain Reservoirs

The following eight mountain reservoirs were targeted for survey visits (Figure 6; Appendix B: Section B3):

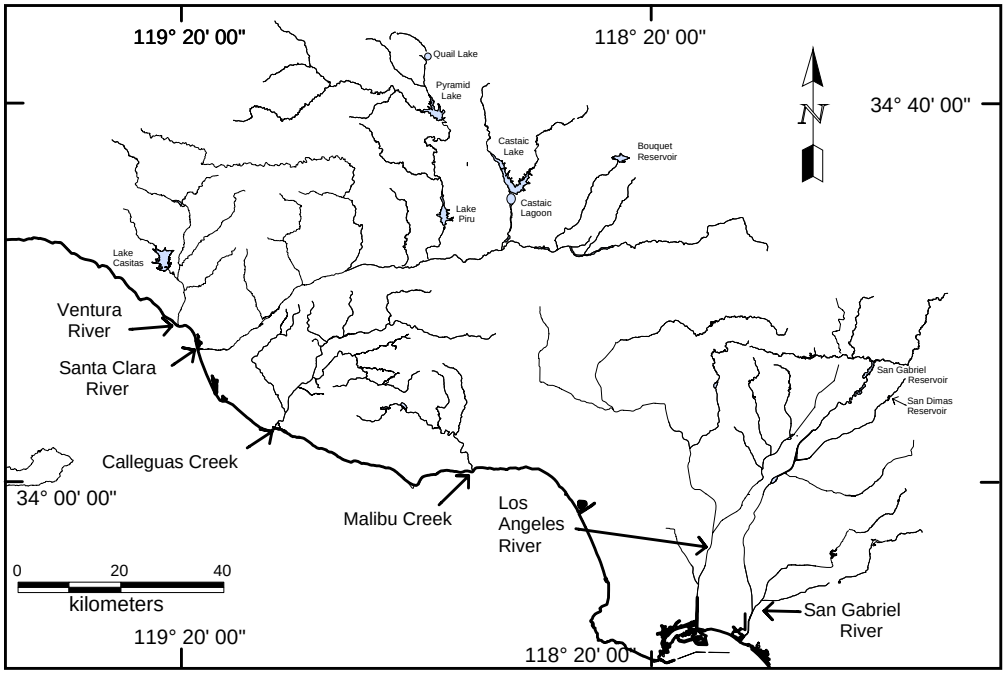


Figure 6. Map of mountain reservoir sites to be censused and sampled for fishing and fish consumption information in 2005.

1) Ventura River Watershed -- Lake Casitas.
2) Santa Clara Watershed: a) Lake Piru; b) Pyramid Lake; c) Castaic Lagoon; d) Castaic Lake; and e) Quail Lake.
3) Calleguas Creek, Malibu Creek, and Los Angeles River Watersheds had no mountain reservoirs. Note that fishing is not allowed in Big Tujunga Reservoir in the Los Angeles River watershed (USDA 2004); hence it is not included as a sampling site.
4) San Gabriel River Watershed: a) San Gabriel Reservoir; and b) San Dimas Reservoir.

Mountain Streams

The following 11 mountain streams were targeted for survey visits (Figure 7; Appendix B: Section B3):

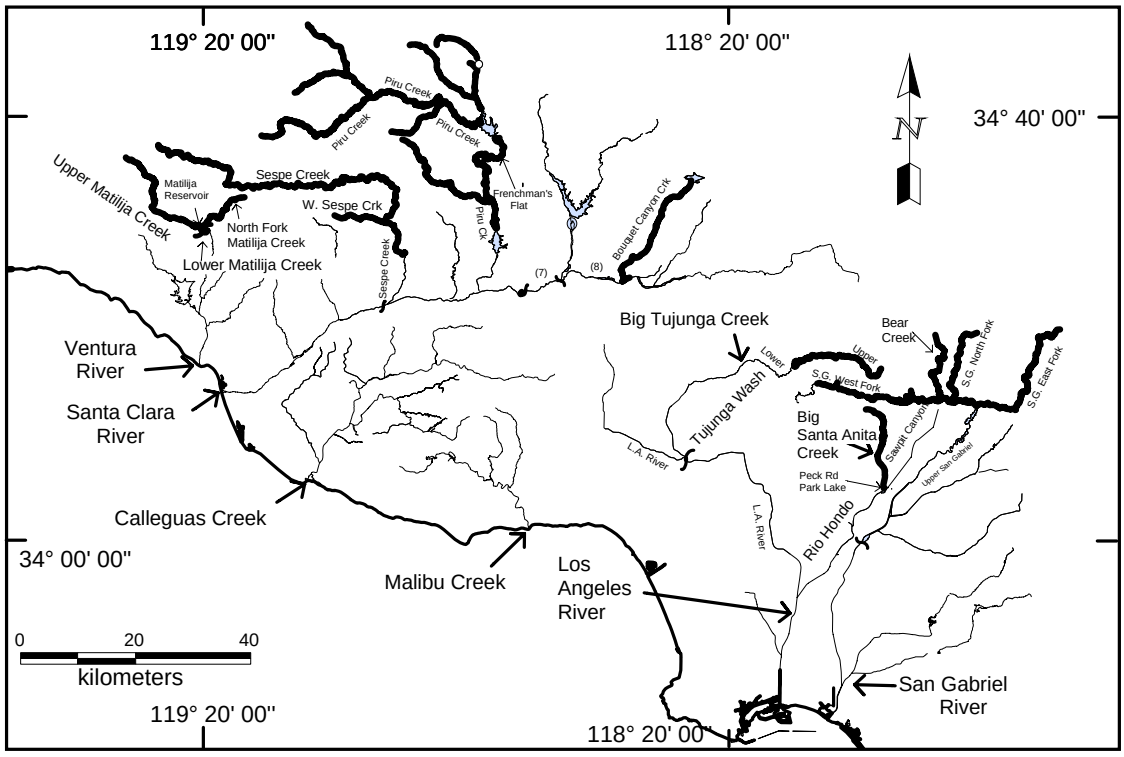


Figure 7. Map of mountain stream sites to be censused and sampled for fishing and fish consumption information in 2005.

1) Ventura River Watershed: a) Lower Reach Matilija Creek (below Matilija Dam to confluence with Ventura River); b) Upper Reach Matilija Creek (above the dam); and c) North Fork Matilija Creek.
2) Santa Clara River Watershed: a) Sespe Creek; b) Frenchman's Flat (Piru Creek); and c) Bouquet Canyon Creek;
3) Calleguas Creek and Malibu Creek watersheds – these watersheds were classified as coastal terrace in this study and not mountain streams;

4) Los Angeles River Watershed: a) Big Santa Anita Creek; and b) Upper Big Tujunga Creek
5) San Gabriel River Watershed: a) East Fork San Gabriel River; b) North Fork San Gabriel river; and c) West Fork San Gabriel River and Bear Creek.

In all, 85 sites were targeted for sampling in this survey (Table 3). By watershed, the most sites were targeted in the Los Angeles, San Gabriel, and Santa Clara River watersheds (26, 19, and 14, respectively). Nine sites each were targeted in the Ventura River and Calleguas Creek watersheds and eight were targeted in the Malibu Creek watershed. By fishing area, the most sites were targeted in coastal terrace streams, urban lakes, and mountain streams (34, 25, and 11, respectively), and least in mountain reservoirs and river mouth/estuaries (8 and 7, respectively). By fishing area within watershed, the most sites were targeted in urban lakes (14) and coastal terrace streams (9) of the Los Angeles River watershed.

Table 3. Number of sites targeted by watershed and fishing area in the 2005 Fish Consumption Survey of Watersheds of Ventura and Los Angeles Counties.

	Number of Sites Targeted					
	Fishing Area					
Watershed	**Mouth/Estuary**	**C Terr Stream**	**Urban Lakes**	**Mtn. Reservoirs**	**Mtn. Streams**	**Total**
Ventura River	1	4	--	1	3	**9**
Santa Clara River	1	5	--	5	3	**14**
Calleguas Creek	1	7	1	--	--	**9**
Malibu Creek	1	4	3	--	--	**8**
Los Angeles River	1	9	14	--	2	**26**
San Gabriel River	2	5	7	2	3	**19**
Total	7	34	25	8	11	**85**

Sampling Methods

Survey Design

The stratified sampling design used in this survey distributed sampling effort by watershed, fishing area, day of week (weekday or weekend day), time of day (morning or afternoon), and season. This design was based on that used in the Santa Monica Bay Seafood Consumption Survey of 1991-1992 (MBC 1991, MBC 1993, SCCWRP and MBC 1994, Allen *et al.* 1996). The present survey was designed so that all of the watersheds of interest were similarly characterized by fishing area. The field study had a balanced survey design that minimized bias among sites within fishing areas. However, as noted above, sampling priority of sites within each fishing area were given to sites on the California 303d List for fish tissue impairments (Appendix B: Sections B1, B3), or which were of particular interest to funding agencies. Each of these priority sites were categorized within an appropriate fishing area and randomly selected as described below.

The major stratification of the study focused on comparing fishing and fish consumption in generalized fishing areas and seasons across the watersheds.

Strata

Seasons. The field study was conducted from January through December 2005, a period of 12 months. Months were divided into two seasons of which six months were sampled in the nonsummer (January through March and October through December) and six months in the summer (April through September). There were nine sampling days per month (five weekend/holiday days and four week days) with at least two sites sampled per day. Due to contract limitations, surveys were conducted only during a normal 8-hr day.

Fishing Area. Four sample sites per fishing area across the watersheds were sampled each month, totaling 20 sites. These 20 sites were sampled over nine days (five weekend/holiday days and four week days). At the start of the survey, a sampling site sequence within each fishing area was determined for the entire sampling period using a random number table. Sites were sampled systematically each month following this order until all sites were sampled, at which point, the sampling site sequence was again randomly determined. Where priority sites existed within a fishing area, one of the four sample sites was selected from a previously determined random sequence of priority sites. After priority site replacement, the other three sites were randomly selected from the remaining sites that had not yet been sampled in that fishing area. In this way, priority sites within a fishing area had an additional opportunity to be sampled each month. At least one priority site per month was sampled. However, depending on the number of priority of sites within a fishing area, as many as four priority sites were potentially selected by random draw. Priority sites were sampled in order through the random sequence so that all priority sites had an equal minimum sampling effort. After site selection for each fishing area, sites were grouped in pairs or in groups of three according to geographic area. This was done to minimize the overall driving distance during the day, which could otherwise be very great, considering the size of the overall region sampled. Distance traveled between sites could be costly in terms of staff time (limited by contract to 8-hr days, with transit time often during high traffic periods) and expenses. Site groups were then randomly assigned among the nine sample days randomly selected for the month.

- *River Mouths/Estuaries.* There were seven river mouth/estuary sites with two of these (Mugu Lagoon, Los Angeles River Estuary) being priority sites due to 303d listing. Each month, either Mugu Lagoon or Los Angeles River Estuary was sampled according to the previously determined random sequence. The remaining priority site was placed into the random draw with the remaining river mouth sites not yet sampled, to determine the other three sites to be sampled for the month. In each month, three nonpriority sites were potentially sampled. With 12 sampling months, a total of 36 nonpriority sampling events might occur. Therefore, given there were five nonpriority river mouth/estuary sites, each had the potential for being sampled at least seven times throughout the sampling period. In the same regard, both of the priority sites had the potential of being sampled at least once a

month. With 12 sampling months, a total of at least 12 priority sampling events would have occurred. Given there were two priority river mouth sites, each priority site had the potential for being sampled at least six times throughout the sampling period.

- *Coastal Terrace River/Creeks.* There were 34 coastal terrace river/creek sites with five of these being priority sites (Santa Clara River Reach 7, Santa Clara River Reach 8 (USEPA Reach 8 is now RWQCB Reach 6), Lower Reach Calleguas Creek, Upper Reach Calleguas Creek, and San Jose Creek Reach 1). At least one of these priority sites could be sampled each month according to the previously determined random sequence. The remaining three priority sites were reentered into the random draw with the remaining sites not yet sampled, to determine the other three sites to be sampled for the month. In each month there was the potential for three nonpriority sites to be sampled. With 12 sampling months, a total of 36 nonpriority sampling events could occur. Therefore, given that there were 30 nonpriority coastal terrace river/creek sites, each had the potential for being sampled at least 10 times throughout the sampling period. In the same regard, each of the four priority sites had the potential of being sampled at least once a month. With 12 sampling months, a total of at least 12 priority sampling events could occur. Given there were four priority coastal terrace river/creek sites, each had the potential for being sampled at least three times throughout the sampling period.

- *Urban Lakes.* There were 26 urban lake sites with seven of these being priority sites (Lake Sherwood, Machado Lake, Echo Park Lake, Peck Road Water Conservation Park, Lake Calabasas, Puddingstone Lake, and Milton Arthur Lakes [El Dorado Lakes]). At least one of these priority sites could be sampled each month according to the previously determined random sequence. The remaining six priority sites were reentered into the random draw with the remaining sites not yet sampled, to determine the other three sites to be sampled for the month. In each month there existed the potential for three nonpriority sites to be sampled. With 12 sampling months, a total of 36 nonpriority sampling events might occur. Therefore, given there were 18 nonpriority urban lake sites, each one having the potential for being sampled at least six times throughout the sampling period. In the same regard, each of the seven priority sites had the potential of being sampled at least once a month. With 12 sampling months, a total of at least 12 priority sampling events would occur.

- *Mountain Reservoirs.* There were eight reservoirs and no priority sites within this fishing area. Each month four reservoir sites were selected from the previously determined random sample site sequence. Once all of the reservoirs have been sampled, another random sampling site sequence was determined and site selection for following months will continue with that sequence. With 12 sampling months, a total of 48 reservoir sampling events would occur. Given there were eight reservoir sites, each reservoir would be sampled at least six times throughout the sampling period.

- *Mountain Streams.* There are 11 mountain streams and no priority sites within this fishing area. Each month four mountain stream sites were selected from the previously determined random sample site sequence. Once all of the mountain streams had been sampled, another random sampling site sequence was determined and site selection for subsequent months continued with that sequence. With 12 sampling months, a total of 48 mountain stream sampling events could occur. Given there are 11 mountain stream sites, each mountain stream could be sampled at least four times throughout the sampling period.

Sampling Period. A random number table was used to select days to survey during a given month. Surveys were conducted on four weekdays and five weekend/holiday days each month. Weekends are therefore weighted to increase the probability of encountering fishers at a site. At least two sites were sampled per day with at least two hours of sampling conducted at each fishing area site. The remaining time (2 hr) were used for driving time and censusing. Occasionally, three sites were assigned on a given sample day. In most cases this included sites expected to have few fishers and therefore sampling time at each site (likely spent censusing) were divided equally. However, if an urban lake or reservoir site was included on a three-site sampling day, sample time priority (3 hr) was given to the urban lake or reservoir and the rest of the time was split accordingly between the other two sites. Because fishing can occur at different times during the day, the 3 hr sampling period was scheduled in the morning or afternoon. River mouth sampling times were scheduled during the morning and afternoon on the ebb of the highest tide if possible. As noted above, contract constraints limited sampling to an eight-hour period during daylight hours.

Sampling Frequency and Periodicity. Nine days were sampled per month during the 12 month period. Thus, a total of 54 days were scheduled for sampling during nonsummer and summer periods for a total of 108 sampling days for the year. Four sites were sampled per fishing area per month for a total of 48 sample sites surveyed per fishing area throughout the study period (24 nonsummer, 24 summer). Given there are five fishing area categories and four sites sampled per month per fishing area (a total of 20 sites sampled per month), a goal of 240 sites were targeted for sampling among 108 sampling days (54 nonsummer, 54 summer) throughout the 12-month survey period.

Field Survey Preparation

Composition of the Survey Team

The survey team consisted of two persons – in most cases, two males or a male and female. The advantages of using two interviewers included partitioning of labor (conducting interview, identifying fish), and safety.

If possible, an attempt was made to assign a bilingual interviewer to sample sites where non-English speaking fishers were expected to fish. Spanish was anticipated to be the most commonly encountered non-English language. Although other languages (i.e., Vietnamese, Cambodian, Chinese, Korean, Pilipino, and Japanese) might also be

encountered, it was not known where non-English speakers of these languages might be encountered. Only one survey team member was fluent in Spanish and several were able to speak some Spanish and/or other languages. For this reason, we had the census forms and questionnaires translated to Spanish. An interviewer would either read the information or questions from these forms or let the Spanish-speaking fisher read the forms and answer the questions.

Ideally, members of the survey team were selected for their ability to gather information from a wide variety of persons, and the ability to identify local fishes. Several members of the survey team had recent experience conducting creel surveys for the California Department of Fish and Game (CDFG), although this experience was primarily with marine fishes

The field team was instructed on protocol for conducting the field surveys at a meeting at the Southern California Coastal Water Research Project, and given written information (Appendices A, B, C, and D, as well as a survey design document) to review before going into the field. If possible, interviewers not experienced in conducting interviews, were assigned to team with persons experienced in conducting field surveys (CDFG) of anglers and familiar with general interview techniques.

Survey Equipment

Each interview team took the following items on the survey trip (see also Appendix D):

1) Study description cards with phone number of person responsible for the project;
2) Data forms (census forms, questionnaires) and a survey design document (similar to this methods section) and protocol document (Appendix D);
3) Detailed watershed maps (Appendix B: Section B2);
4) Driver's license and survey card with picture identification;
5) Fish identification aids and large laminated color fish pictures for each type of fishing area with scientific names and English and Spanish common names (Appendix C: Section C2).
6) Balsa wood model of a fish fillet of 227g wet weight (8 oz. ww, the standard size of a fish meal, USEPA 2000);
7) Tide chart;
8) Pencils and pens, and clipboards.
9) Ziploc plastic freezer bags (quart), small ice chest with ice – to hold confusing specimens for final ID at the lab.
10) Optional -- digital or expendable camera for taking photos of sites and side views of fish specimens for later identification.
11) Cell phone (personal) for contact with SCCWRP with questions or checking in or out of sites, and for safety (emergency calls, car towing)
12) Additional safety equipment – air horns, pepper spray, mosquito repellent (with DEET), first aid kit.

Notification of Authorities

Prior to the survey day, the study director contacted (by phone or a courtesy letter) appropriate persons with jurisdiction of the areas to be sampled. This call or letter described the nature of the study and alerted these entities of the intent to conduct a survey at a given location, the purpose and duration of the survey, and how the survey team could be identified. Upon arrival at a site, the survey team introduced themselves to any on-site authorities. In U. S. National Forest areas, the team bought an Adventure Pass to enable them to park as needed. The survey team also asked authorities about possible problems or safety issues occurring at the site (or sites). Interviews were not conducted in areas that authorities indicated were unsafe for conducting such surveys.

Safety Measures

Field teams were instructed to follow SCCWRP Health and Safety Plan for Watershed Field Safety. Interviewers were instructed to use their best judgment in assessing potential safety problems in an area and take appropriate steps to ensure safety. Some survey sites were in remote areas and some in potentially unsafe areas. Survey teams checked in with the SCCWRP field coordinator when they arrived at a site and checked-in with an update of the survey success and/or problems at the end of the day. The SCCWRP coordinator was called as necessary to get information, get help on decisions, or to notify of problems. Although none occurred, had a critical emergency occurred, the field team was instructed to call 911 first, and then notify the SCCWRP field coordinator.

If weather or road conditions were known to be particularly bad prior to or on a survey day, the survey team was required to check specific internet websites that gave up-to-date information on storm and road conditions. If these sources advised of probable safety risks, the survey team notified the SCCWRP field coordinator of the problem, and the survey to be conducted on that day was rescheduled for a future date.

Conduct of the Survey

Respondents

Persons with fishing gear were interviewed in this study and regarded as fishers, whether they had fish or not. Both genders, and all ethnic groups and ages were interviewed if they had been fishing. However, if family groups with children occurred, the head of the household was the primary respondent. If either a father or mother was present, either were considered the head of household. If both were present, the questionnaire was administered to both at the same time. For safety, interviews were not conducted if a person, group, or situation appeared threatening.

Roving Census

When the survey team arrived at a site, they recorded basic information for the site (e.g., location, date, day, fishing area, time, weather conditions, public accessibility to site, and hydrographic conditions) on the census form. The survey team then censused the fishers at the site at the beginning of the survey. The team counted the number of fishers with

fishing gear (poles, nets, traps) and assessed their gender, age (in broad categories), and ethnicity (White/non-Hispanic, African-American/Black, Hispanic, Asian, other). If no fishers were present, the roving census continued at access points upstream or downstream of the first access point of the target site until the entire area had been censused. The roving census was not conducted in areas without a clearly defined trail or access point, or in areas deemed unsafe by the survey team.

Fish Consumption Interviews

If fishers were present, the survey team attempted fish consumption interviews. The interviewer first noted the group type (single fisher, family, nonfamily group) and size, and fishing technique. In general, the team initiated the contact in an informal way, such as asking "How's the fishing?" Then the interviewer briefly described why he or she was there (e.g., "We are doing a survey for the State Water Board. We are gathering information on how often people fish, what types of fish they catch, and what they keep and eat") and asked permission to conduct an interview (e.g., "May we talk with you for a few minutes about your fishing experience?"). If permission to interview was not granted, then only the ethnic group, gender, estimated age, observed species caught, and number of organisms caught was noted. If permission to interview was given, then information on whether the respondent was previously interviewed, length of fishing time, and permission to examine catch was obtained.

If the fisher had fish, the interviewers asked permission to identify and count the species. While one interviewer examined the catch, the other interviewer continued to ask questions. These questions include type and number of usual catch, the fate of each species caught, frequency of consumption of fish caught in the watershed, and where the fisher had caught and consumed fish during the past month. The fisher was then asked how frequently he or she had eaten the species caught during the past four weeks (four weeks or 28 days) and method of preparation.

The fisher was shown the model of a fish fillet (estimated to be the size of a typical USEPA standard fish meal of 227 g [8 oz.] wet weight; USEPA 2000) and was asked when he or she eats this species, how much is eaten relative to the fillet model (the same amount, more or less); if more or less, the person was asked how much more or how much less (e.g., twice as much, half as much, two-thirds as much, etc.). This information was very important because multiplying the amount consumed relative to the fillet model by the number of times it was consumed in the past month provided the basis for estimating consumption rates.

The fisher was then shown pictures of other species likely found in the fishing area (Appendix C: Section C2), and was asked if he or she had caught any of those shown. If so, the fisher was asked the same questions above, including how frequently it was consumed in the past four weeks and when consumed, how much relative to the fillet model was consumed.

The fisher also was asked what he or she called each of the species. Most fishers do not know the standard common names of local fishes (Nelson *et al*. 2004). This information

may be particularly valuable for fishers from generally non-English-speaking ethnic groups which may have very different names for the species. Knowing what the fishers call a fish already identified by an interviewer will aid in the interpretation of anecdotal information on past fish catches and consumption, and for any future fish consumption advisory postings.

The respondent was asked the size of his or her living group and whether individuals of specific ages or those that are pregnant eat fish caught by the fisher. If the respondent was willing, he or she was also asked some general personal information including the town and zip code of home, age, ethnic background, number and age of family members, and how much they consume of fish caught in watershed.

Fish Identification

There are at least 41 freshwater and anadromous species of fish reported in the Ventura and Los Angeles County Watersheds (Swift *et al*. 1993, Moyle 2002), as well as at least 36 species of estuarine and/or surf zone fishes found just seaward of the freshwater mouth of the river or creek (Appendix C: Section C1). Most of the freshwater fishes are introduced, with only seven freshwater or anadromous species being native to one or more these watersheds. These include Pacific lamprey (*Lampetra tridentata*), arroyo chub (*Gila orcuttii*), speckled dace (*Rhinichthys osculus*), Santa Ana sucker (*Catostomus santaanae*), rainbow trout (*Oncorhynchus mykiss*), threespine stickleback (*Gasterosteus aculeatus*), and prickly sculpin (*Cottus asper*). Of these, only rainbow trout was likely caught for consumption by fishers. Whereas native species can be easily identified from field guides of the area, introduced species may come from anywhere in the United States or from other countries. Hence, to aid in field identification of the freshwater fishes in these watersheds, as well as estuarine and surf zone fishes, a field guide to the fishes (and two invertebrates) reported from these watersheds was developed (Appendix C: Section C2) and included with the survey instrument to help interviewers identify fish that fishers had caught. The English and Spanish common name (Nelson *et al*. 2004), as well as the scientific name of each species were included in this guide. Pictures of these fishes were organized by fishing areas where the species would likely be found. In addition to fish species, at least two species of introduced invertebrates (red swamp crayfish, *Procambarus clarkia*, and Asian clam, *Corbicula fluminea*) have been observed being caught for consumption in some of these watersheds prior to this survey (C.C. Swift, Entrix, pers. comm., 2005).

During interviews, pictures of fishes likely to be caught at the fishing area of the site (e.g., mountain stream, urban lake) were shown to fishers. The fishers were then asked if they had caught and consumed any of these species from the site in the last four weeks, and if so, how frequently had they been caught and consumed, and how much (relative to the fillet model) did they consume in a meal.

If fishes had been caught that were not on these pages, the interviewer compared the species caught to those in other fishing areas illustrated. The interviewer determined the species most similar, and how the specimen differed from the one pictured. If the fisher was willing to give up the specimen, the interviewers were instructed to place it in a

Ziploc freezer bag labeled with the date, site, and collector's name. When returning to the car, the interviewer would put the specimen on ice in a cooler, and returned to SCCWRP. At SCCWRP these were fixed immediately in 10% formalin solution, and later preserved in 50% isopropyl alcohol. This occurred on a single occasion, where an arroyo chub was returned to the lab for identification.

Data Analysis

Database Development

Field survey teams checked their census forms and questionnaires before leaving a site to make sure that data were entered appropriately. Data forms for each survey day were put in a different manila folder labeled with date of survey, site of survey, and survey team. All data forms collected during the week were returned to SCCWRP by the first Monday following the surveys. These were checked to see if data had been entered appropriately. Data from census and questionnaire forms were then entered into a relational database (Microsoft ACCESS). A user-friendly data entry tool with constrained look-up lists was used to make sure values were entered in a consistent manner (Appendix E).

Data Summarization and Analysis

Data collected in the survey were summarized in tables (using MS Excel), graphed using SigmaPlot (Systat Software, Inc.), or mapped using MapInfo, as appropriate. Summaries of survey success (e.g., number of visits, fishers observed, interviews attempted, and consumers) were graphed or summarized in tables. Summaries of fisher characteristics (e.g., gender, ethnicity, age, income, years fished, seasons fished, etc.) were presented in tables, graphs, or pie charts. Fishing and numbers of consumers were summarized overall, by watershed, by fishing area, and by sites.

Fish consumption rates of fishers interviewed in the survey were based on a fisher's estimate of the amount he or she consumed of a species in meal relative to a balsa wood model of a fish fillet which represented a fish fillet of 227 g (8 oz.), the standard USEPA meal size for estimating fish consumption (USEPA 2000). As in Allen *et al*. (1996), the amount a fisher consumed in a single meal of a species was multiplied times the number of times the fisher consumed that species during the previous four weeks. This gave a monthly consumption rate (grams per month). This amount was divided by 28 days to get a daily consumption rate (in grams per day). Hence if the fish was consumed four times in four weeks (28 days) and the amount eaten per meal was half of that represented, then the total amount consumed in four weeks would be (4 x 227g x 0.5))/28 = 16 g/day. This rate was an estimate of the fisher's consumption rate, and not of other members of the household.

Consumption rate data were summarized statistically by parametric statistics (e.g., means, standard deviations, and 95% confidence limits) and nonparametric statistics (e.g., medians and upper deciles, i.e., 90th percentiles). These were summarized in tables or graphs. Consumption rates were summarized overall (all species and fishers lumped), by species of fish, and by various types of fishers.

RESULTS

Survey Success

Number of Site Visits

During the survey, conducted in January-December 2005, 276 site visits (Table 4) were conducted at 82 of 86 targeted sites (Appendix F; Table 3), across all watersheds and fishing areas. By watershed (Table 4), the most site visits (85) occurred in the San Gabriel River watershed, followed by the Santa Clara River (64), Los Angeles River (55), Ventura River (31), Calleguas Creek (22), and Malibu Creek (19) watersheds. By fishing areas, most site visits (74) occurred at coastal terrace streams, followed by river mouth/estuaries (56), urban lakes (54), mountain streams (47), and mountain reservoirs (45). By fishing area within a watershed, the most visits (32) occurred in urban lakes of the Los Angeles River watershed, followed by mountain reservoirs Santa Clara River watershed (29), and coastal terrace streams San Gabriel River watershed (22).

Table 4. Number of site visits by watershed and fishing area in the 2005 Fish Consumption Survey of Watersheds of Ventura and Los Angeles Counties.

	Number of Site Visits					
	Fishing Area					
Watershed	**Mouth/Estuary**	**C Terr Stream**	**Urban Lakes**	**Mtn. Reservoirs**	**Mtn. Streams**	**Total**
Ventura River	10	3	--	6	12	31
Santa Clara River	7	18	--	29	10	64
Calleguas Creek	8	14	--	--	--	22
Malibu Creek	8	7	4	--	--	19
Los Angeles River	7	10	32	--	6	55
San Gabriel River	16	22	18	10	19	85
Total	56	74	54	45	47	276

-- = not applicable

Observed Fishers

Fishers were generally not observed at most reaches of coastal terrace and mountain stream sites and at most river mouth/estuaries (Figure 8). Exceptions in coastal terrace streams included San Jose Creek Reach 1 (a coastal terrace stream in the San Gabriel River watershed), and parts of Malibu and Calleguas Creeks (Table 5). Exceptions for mountain streams include the East and West Forks of the San Gabriel River (both mountain streams) and Piru and Bouquet Canyon Creeks of the Santa Clara River (Figure 8, Table 5). Exceptions for river/mouth estuaries were the Los Angeles and San Gabriel River estuaries. In contrast, fishers were generally observed in most of the urban lakes and mountain reservoirs surveyed. By watershed (Figure 9a), fishers were mostly likely observed (percent site visits) in the San Gabriel and Santa Clara River watersheds, followed by the Los Angeles and Ventura River watersheds, then Malibu Creek, and were least likely observed in the Calleguas Creek watershed. By fishing area (Figure 9b), fishers were most likely observed at mountain reservoirs and urban lakes, followed by mountain streams and river mouth/estuaries, and least likely observed at coastal terrace streams.

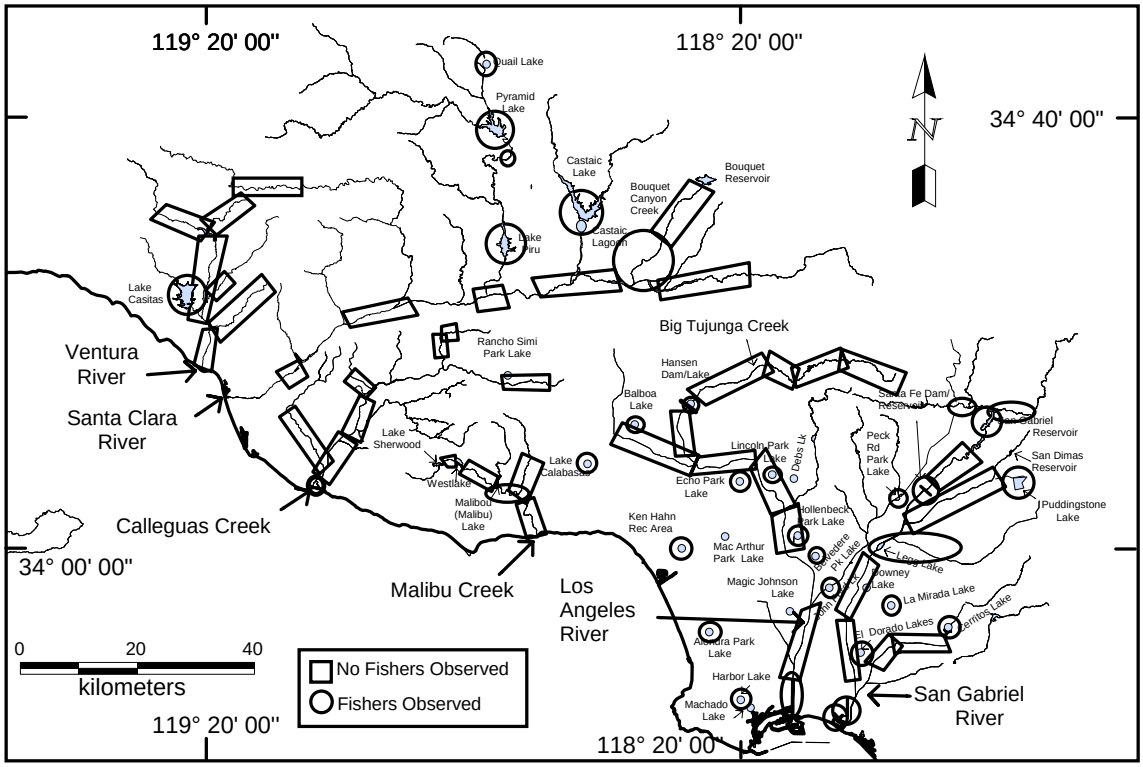


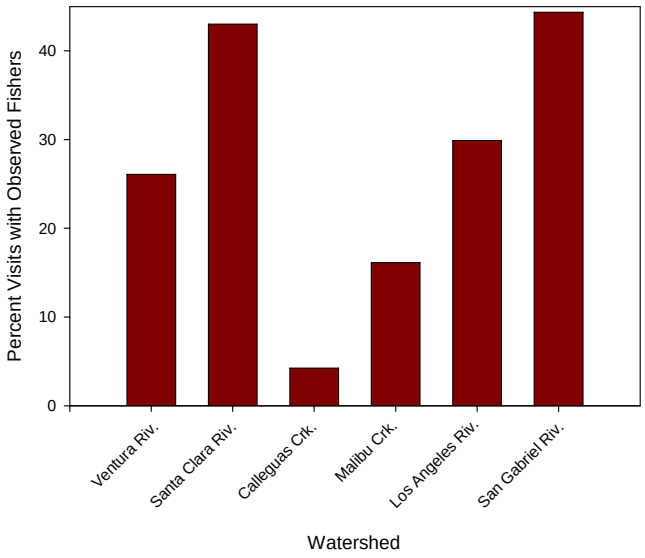
Figure 8. Extent of fishers observed in watersheds of Ventura and Los Angeles Counties in 2005.

Table 5. Number of fishers observed by watershed and fishing area in 2005 fish consumption survey of watersheds of Ventura and Los Angeles Counties.

	Number of Fishers Observed					
	Fishing Areas					
Watershed	**Mouth/Estuary**	**C Terr Stream**	**Urban Lakes**	**Mtn. Reservoirs**	**Mtn. Streams**	**Total**
Ventura River	0	0	--	134	0	134
Santa Clara River	0	0	--	250	22	272
Calleguas Creek	0	7	--	--	--	7
Malibu Creek	0	10	12	--	--	22
Los Angeles River	88	0	215	--	0	303
San Gabriel River	55	37	282	4	127	505
Total	143	54	509	388	149	1243

-- = not applicable

a)



b)

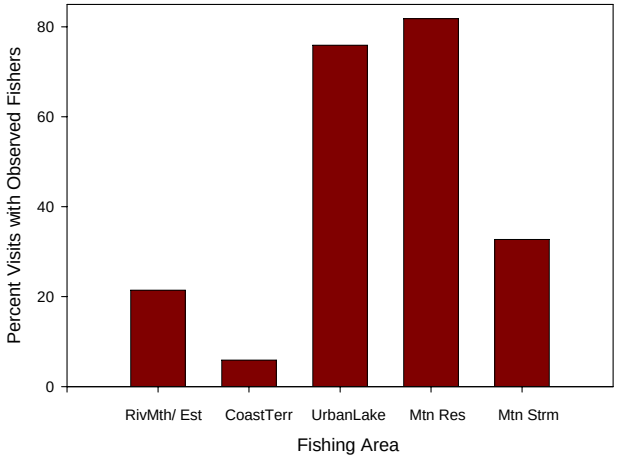
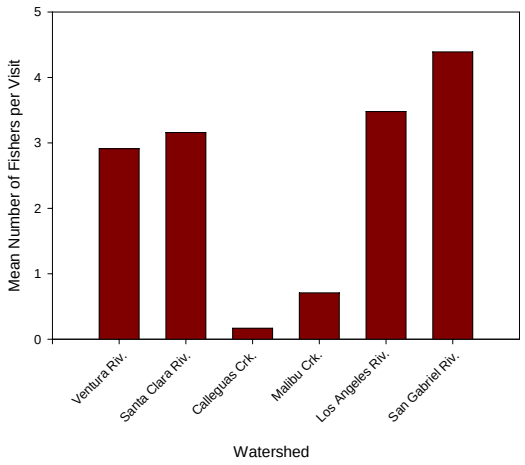


Figure 9. Percent site visits with observed fishers by watershed (a) and fishing area (b) in 2005 fish consumption survey of Ventura and Los Angeles County watersheds.

The total numbers of fishers observed during the survey were highest in the San Gabriel River (505), followed by the Los Angeles River (303), Santa Clara River (272), Ventura River, and least in Malibu Creek and Calleguas Creek (Table 5) watersheds. By fishing area, the total number of fishers observed were highest in urban lakes (509), mountain reservoirs (388), in mountain streams (149) and river mouth/estuaries (143) much lower, and coastal terrace streams the least (54). By fishing area within a watershed, the most fishers observed (282) were in urban lakes of the San Gabriel River watershed, followed by mountain reservoirs of the Santa Clara River watershed (250), and urban lakes in the Los Angeles River watershed (215; Table 5).

The mean number of fishers per visit by watershed and fishing area (Figures 10a, 10b) followed the same order as total numbers (Table 5). However, relative to total fishers observed, the mean number of fishers in the Ventura River watershed was more similar to that of the Santa Clara River, and the mean number for fishers in Malibu Creek was noticeably higher than in Calleguas Creek.

a)



b)

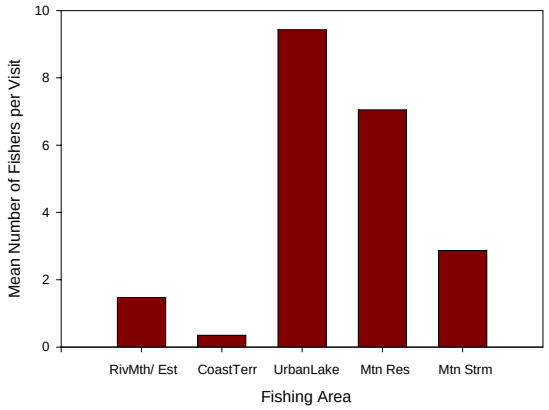


Figure 10. Mean number of observed fishers by watershed (a) and fishing area (b) in 2005 fish consumption survey of Ventura and Los Angeles County watersheds.

Consumers Interviewed

Of the 1,243 fishers observed, 495 (40%) were interviewed to get fish consumption information (Appendix F). Of those interviewed, 238 (48%) consumed fish that they caught at the sites (Table 6). Consumers were not encountered in Calleguas Creek and Malibu Creek watersheds (Table 6; Figure 11). By watershed, the number of consumers encountered was highest (83) in the San Gabriel River, followed by Los Angeles River (67), Santa Clara River (64), and Ventura River (24). Fish consumers were encountered at most urban lakes and mountain reservoirs surveyed, at some estuaries, and mountain streams, and at one coastal terrace stream (Figure11). By fishing area, the number of consumers encountered was highest (95) in urban lakes, followed by mountain reservoirs

(83), estuaries (30), mountain streams (29), and coastal terrace streams (1; Table 6). By fishing area within watersheds, the highest number of consumers (58) was encountered in Santa Clara River mountain reservoirs, followed by urban lakes in the San Gabriel River watershed (49) and the Los Angeles River watershed (46).

Table 6. Number of fish consumers interviewed by watershed and fishing area in the 2005 fish consumption survey of watersheds of Ventura and Los Angeles Counties.

	Number of Fish Consumers Interviewed					
	Fishing Areas					
Watershed	**Mouth/Estuary**	**C Terr Stream**	**Urban Lakes**	**Mtn. Reservoirs**	**Mtn. Streams**	**Total**
Ventura River	--	--	--	24	--	24
Santa Clara River	--	--	--	58	6	64
Calleguas Creek	--	0	--	--	--	0
Malibu Creek	--	--	0	--	--	0
Los Angeles River	21	--	46	--	0	67
San Gabriel River	9	1	49	1	23	83
Total	30	1	95	83	29	238

-- = not applicable

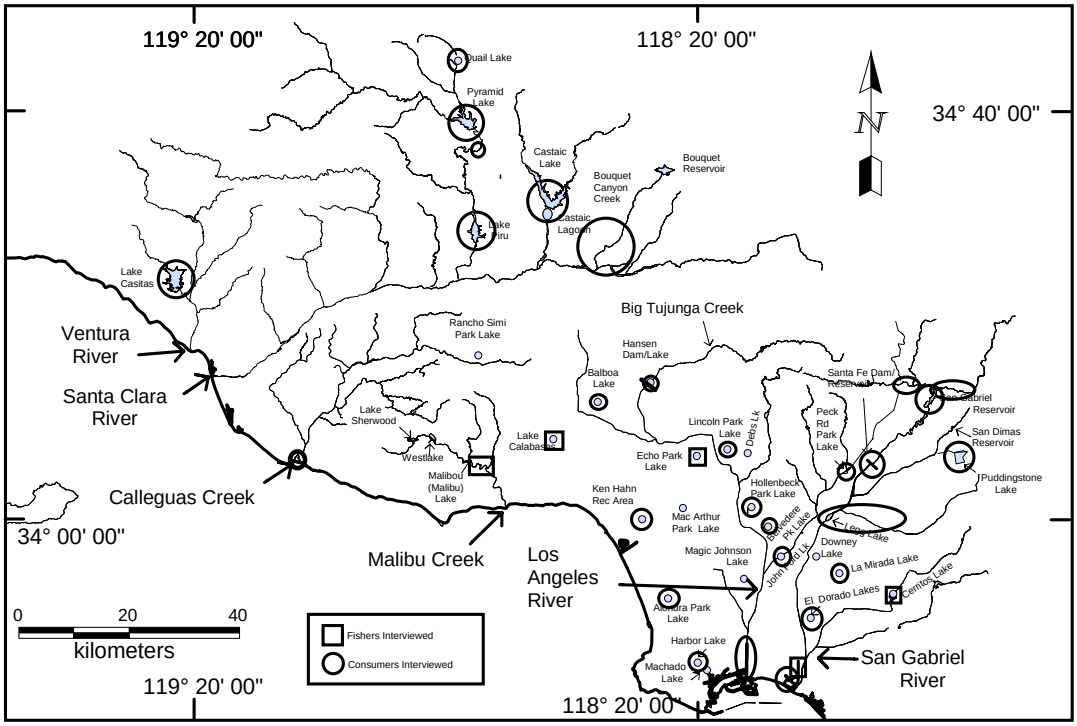


Figure 11. Areas where fishers interviewed provided fish consumption information (circles) or did not provide this information (boxes) in 2005.

Survey Success by Sites within Watersheds

The number of site visits, observed fishers, fishers interviewed, and fish consumers also varied by sites within fishing areas in watersheds (Tables 7 - 11; Appendix F).

Ventura River Watershed. In the Ventura River watershed, nine sites were targeted, including one river mouth/estuary site, four coastal terrace stream sites, one mountain reservoir site, and three mountain stream sites (Table 7). A total of 31 site visits were conducted in this watershed, with the Ventura River Mouth being visited the most times (7), followed by Lake Casitas (6), and Upper Matilija Creek (5). However, fishers were observed only at Lake Casitas, where 134 were observed (mean =22 per visit). Of these, 48 (36%) were interviewed, and of these, 24 (50%) were consumers.

Table 7. Survey success at Ventura River sites in 2005 fish consumption survey of watersheds in Ventura and Los Angeles Counties.

			Fishers		Consumers	
Fishing Area	**Sampling Sites**	**Visits**	**Observed**	**Interviewed**	**No.**	**%**
Ventura River (n=9)						
River Mouth/Estuary	Ventura River Mouth	**7**	**0**	**-**	**-**	**-**
Coastal Terrace	Ventura River Lower	**3**	**0**	**-**	**-**	**-**
Coastal Terrace	Cañada Larga	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	San Antonio Creek	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Ventura River Upper	**1**	**0**	**-**	**-**	**-**
Mountain Reservoir	Lake Casitas	**6**	**134**	**48**	**24**	**50**
Mountain Stream	Matilija Creek Lower	**4**	**0**	**-**	**-**	**-**
Mountain Stream	Matilija Creek Upper	**5**	**0**	**-**	**-**	**-**
Mountain Stream	Matilija Creek North Fork	**3**	**0**	**-**	**-**	**-**
Total		**31**	**134**	**48**	**24**	**-**
Mean		**3**	**15**	**48**	**24**	**50**
Median		**3**	**0**	**48**	**24**	**50**

Santa Clara River Watershed. In the Santa Clara River watershed, 14 sites were targeted, including one river mouth/estuary site, five coastal terrace stream sites, five mountain reservoir sites, and three mountain stream sites (Table 8). A total of 64 site visits were conducted in this watershed, with Santa Clara River Reach 8 (a contract requested site) being visited the most times (11), followed by Castaic Lagoon (8), and the Santa Clara River Mouth (5). The upper reach of the Santa Clara River (i.e., upstream of Bouquet Canyon Road) was not successfully visited due to an extremely steep slope between the highway and the river channel along this reach, making the river channel inaccessible. A total of 272 fishers were observed in the Santa Clara River watershed during this survey. The number of fishers observed was highest at Castaic Lagoon (87; mean =11 per visit), followed by Lake Piru (51; mean = 10), Pyramid Lake (47; mean = 9), and Quail Lake (47; mean = 8). Fishers were not observed at the Santa Clara River mouth, any of the coastal terrace streams, or Sespe Creek. Of the total fishers observed (272), 126 (46%) were interviewed. Of those interviewed, 64 (51%) were consumers. The most consumers were encountered at Castaic Lagoon (19; 45% of fishers interviewed at site), followed by Lake Piru (18; 64 %), and Pyramid Lake (11; 61%).

Table 8. Survey success at Santa Clara River sites in 2005 fish consumption survey of watersheds in Ventura and Los Angeles Counties.

			Fishers		Consumers	
Fishing Area	**Sampling Sites**	**Visits**	**Observed**	**Interviewed**	**No.**	**%**
Santa Clara River (n=14)						
River Mouth/Estuary	Santa Clara River Mouth	**7**	**0**	**-**	**-**	**-**
Coastal Terrace	Santa Clara River Lower	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Santa Clara River Middle	**3**	**0**	**-**	**-**	**-**
Coastal Terrace	Santa Clara River Reach 7	**3**	**0**	**-**	**-**	**-**
Coastal Terrace	Santa Clara River Reach 8	**11**	**0**	**-**	**-**	**-**
Coastal Terrace	Santa Clara River Upper[1]	**0**	**-**	**-**	**-**	**-**
Mountain Reservoir	Lake Piru	**5**	**51**	**28**	**18**	**64**
Mountain Reservoir	Pyramid Lake	**5**	**47**	**18**	**11**	**61**
Mountain Reservoir	Castaic Lagoon	**8**	**87**	**42**	**19**	**45**
Mountain Reservoir	Castaic Lake	**5**	**18**	**12**	**1**	**8**
Mountain Reservoir	Quail Lake	**6**	**47**	**16**	**9**	**56**
Mountain Stream	Sespe Creek	**1**	**0**	**-**	**-**	**-**
Mountain Stream	Upper Piru Creek (Frenchman's Flat)	**5**	**19**	**8**	**4**	**50**
Mountain Stream	Boquet Canyon Creek	**4**	**3**	**2**	**2**	**100**
Total		**64**	**272**	**126**	**64**	
Mean		**5**	**21**	**18**	**9**	**55**
Median		**5**	**3**	**15**	**9**	**56**

[1] No access

Calleguas Creek Watershed. In the Calleguas Creek watershed, nine sites were targeted, including one estuary site, seven coastal terrace stream sites, and one urban lake site (Table 9). A total of 22 site visits were conducted in this watershed, with Mugu Lagoon being visited the most times (8), followed by upper Calleguas Creek (4), Lower Calleguas Creek (3), and Arroyo Simi (3). Rancho Simi Park Lake was not visited due to not being selected by chance in the random site selection process. However, fishers were observed only at Arroyo Simi (7). None of these were interviewed and no person consuming fish from the watershed was encountered.

Malibu Creek Watershed. In the Malibu Creek watershed, eight sites were targeted, including one estuary site, four coastal terrace stream sites, and three urban lake sites (Table 9). A total of 19 site visits were conducted in this watershed, with Malibu Lagoon being visited the most times (8), followed by Lower Malibu Creek and Lake Sherwood with 3 visits each. Malibou Lake was not visited as it is a private lake with no public access. The number of fishers observed was highest at Lower Malibu Creek (10; mean = 3 per visit), followed by Westlake (6; mean = 6 per visit), and Lake Sherwood (6; mean = 2 per visit). Both Westlake and Lake Sherwood are private lakes with limited access (e.g., the number of persons fishing could be observed from the road). Of the 22 persons observed fishing, two (9%) were interviewed (both at Lower Malibu Creek). The two persons interviewed did not consume fish from the site and no person consuming fish from the watershed was encountered.

Table 9. Survey success at Calleguas Creek and Malibu Creek sites in 2005 fish consumption survey of watersheds in Ventura and Los Angeles Counties.

Fishing Area	Sampling Sites	Visits	Fishers		Consumers	
			Observed	Interviewed	No.	%
Calleguas Creek (n =9)						
River Mouth/Estuary	Mugu Lagoon	**8**	**0**	**-**	**-**	**-**
Coastal Terrace	Calleguas Creek Lower	**3**	**0**	**-**	**-**	**-**
Coastal Terrace	Revlon Slough	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Conejo Creek	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Calleguas Creek Upper	**4**	**0**	**-**	**-**	**-**
Coastal Terrace	Arroyo Simi	**3**	**7**	**0**	**-**	**-**
Coastal Terrace	Fox Barranca	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Happy Camp Canyon	**1**	**0**	**-**	**-**	**-**
Urban Lake	Rancho Simi Park Lake[1]	**0**	**-**	**-**	**-**	**-**
Total		**22**	**7**	**0**	**-**	**-**
Mean		**2**	**1**	**0**	**-**	**-**
Median		**1**	**0**	**0**	**-**	**-**
Malibu Creek (n=8)						
River Mouth/Estuary	Malibu Lagoon	**8**	**0**	**-**	**-**	**-**
Coastal Terrace	Malibu Creek Lower	**3**	**10**	**2**	**0**	**0**
Coastal Terrace	Los Virgenes Creek	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Medea Creek	**2**	**0**	**-**	**-**	**-**
Coastal Terrace	Malibu Creek Upper	**1**	**0**	**-**	**-**	**-**
Urban Lake	Malibou (Malibu) Lake[2]	**0**	**-**	**-**	**-**	**-**
Urban Lake	Westlake[3]	**1**	**6**	**0**	**-**	**-**
Urban Lake	Lake Sherwood[3]	**3**	**6**	**0**	**-**	**-**
Total		**19**	**22**	**2**	**0**	
Mean		**2**	**3**	**0**	**0**	**0**
Median		**4**	**0**	**0**	**0**	**0**

[1] Site not surveyed due to random site selection error

[2] Private lake, no access

[3] Private lake, limited access

Los Angeles River Watershed. In the Los Angeles River watershed, 28 sites were targeted, including one river mouth/estuary site, nine coastal terrace stream sites, 16 urban lakes, and two mountain stream sites (Table 10). A total of 55 site visits were conducted in this watershed, with the Los Angeles River Mouth/Estuary being visited the most times (7), followed by Upper Big Tujunga Creek (5), and Alondra Park Lake (4). The lower reach of the Los Angeles River, Earvin "Magic Johnson" Lake, and MacArthur Lake were not visited due to safety concerns. A total of 303 fishers were observed in the Los Angeles River watershed during this survey. The number of fishers observed was highest at Los Angeles River Estuary (88), followed by Ken Hahn State Recreation Area (55); Balboa Lake (45); and Alondra Park Lake (43). The mean number of fishers per visit was highest at Balboa Lake (22), Ken Hahn State Recreation Area (18), Peck Road Water Conservation Park (17), Los Angeles River Estuary (13), and Alondra Park Lake (17). Fishers were not observed at any of the nine coastal terrace stream sites, at the two

mountain stream sites, or at Debs Lake. Of the fishers observed, 118 (39%) were interviewed. Of those interviewed, 67 (57%) were consumers. The most consumers were encountered at Ken Hahn State Recreation Area (14; 93% of fishers interviewed at site), followed by Alondra Park Lake (14; 70%), and Peck Road Water Conservation Park (4; 29%).

Table 10. Survey success at Los Angeles River sites in 2005 fish consumption survey of watersheds in Ventura and Los Angeles Counties.

			Fishers		Consumers	
Fishing Area	**Sampling Sites (n=28)**	**Visits**	**Observed**	**Interviewed**	**No.**	**%**
River Mouth/Estuary	Los Angeles River Estuary	**7**	**88**	**36**	**21**	**58**
Coastal Terrace	Los Angeles River, Lower[1]	**0**	**-**	**-**	**-**	**-**
Coastal Terrace	Compton Creek	**2**	**0**	**-**	**-**	**-**
Coastal Terrace	Rio Hondo	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Monrovia (Sawpit) Canyon	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Los Angeles River, Middle	**2**	**0**	**-**	**-**	**-**
Coastal Terrace	Arroyo Seco Creek	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Los Angeles River, Upper	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Tujunga Wash	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	Big Tujunga Creek (lower)	**1**	**0**	**-**	**-**	**-**
Urban Lake	Machado Lake[2]	**3**	**3**	**3**	**1**	**33**
Urban Lake	Alondra Park Lake[2]	**4**	**43**	**20**	**14**	**70**
Urban Lake	Earvin "Magic" Johnson Lake[1]	**0**	**-**	**-**	**-**	**-**
Urban Lake	John Ford Park Lake	**3**	**3**	**1**	**1**	**100**
Urban Lake	Peck Road Water Conservation Park	**2**	**34**	**14**	**4**	**29**
Urban Lake	Belvedere Park Lake	**1**	**9**	**4**	**3**	**75**
Urban Lake	Ken Hahn State Recreation Area[3]	**3**	**55**	**15**	**14**	**93**
Urban Lake	MacArthur Lake[1]	**0**	**-**	**-**	**-**	**-**
Urban Lake	Hollenbeck Park Lake	**2**	**5**	**2**	**2**	**100**
Urban Lake	Debs Lake	**2**	**0**	**-**	**-**	**-**
Urban Lake	Lincoln Park Lake	**2**	**2**	**3**	**3**	**100**
Urban Lake	Echo Park Lake	**3**	**5**	**4**	**0**	**0**
Urban Lake	Hansen Dam Aquatic Center	**2**	**5**	**5**	**1**	**20**
Urban Lake	Balboa Lake	**2**	**45**	**10**	**3**	**30**
Urban Lake	Lake Calabasas	**3**	**6**	**1**	**0**	**0**
Mountain Stream	Big Santa Anita Creek	**1**	**0**	**-**	**-**	**-**
Mountain Stream	Big Tujunga Creek (upper)	**5**	**0**	**-**	**-**	**-**
Total		**55**	**303**	**118**	**67**	**-**
Mean		**2**	**12**	**9**	**5**	**54**
Median		**2**	**1**	**4**	**2**	**46**

[1] Site not surveyed due to safety concerns.

[2] Although bordering Los Angeles River watershed, these lakes are in Dominguez Channel/Los Angeles Harbor watershed; however, they may have originally been in the Los Angeles River drainage (Gumprecht 1999).

[3] Although bordering Los Angeles Rive watershed, Ken Hahn Recreation Area is in Ballona Creek watershed

San Gabriel River Watershed. In the San Gabriel River watershed, 19 sites were targeted, including two river mouth/estuary sites, five coastal terrace stream sites, seven urban lakes, two mountain reservoir, and three mountain stream sites (Table 11). A total of 85 site visits were conducted in this watershed, with San Jose Creek Reach 1 (a contract requested site) being visited the most times (15), followed by West Fork San

Gabriel River/Bear Creek (10), San Gabriel River Mouth/Estuary (8), and Los Cerritos Channel (8). A total of 505 fishers were observed in the San Gabriel River watershed during this survey. The number of fishers observed was highest at West Fork San Gabriel River/Bear Creek (124; mean = 12), followed by Puddingstone Lake (95; mean = 19), and La Mirada Lake (55; mean = 18). Fishers were not observed at Lower San Gabriel River, Coyote Creek, Upper San Gabriel River, and Walnut Creek Wash, or at Downey Lake, San Dimas Reservoir, and North Fork San Gabriel River. Of the fishers observed, 201(40%) were interviewed. Of those interviewed, 83 (41%) were consumers. The most consumers were encountered at Puddingstone Lake (22; 55% of fishers interviewed at site), followed by West Fork San Gabriel River/Bear Creek (22; 43%), and La Mirada Lake (19; 73%).

Table 11. Survey success at San Gabriel River sites in 2005 Fish Consumption Survey of Ventura and Los Angeles County Watersheds.

			Fishers		Consumers	
Fishing Area	**Sampling Sites (n = 19)**	**Visits**	**Observed**	**Interviewed**	**No.**	**%**
River Mouth/Estuary	San Gabriel River Estuary	**8**	**54**	**26**	**9**	**35**
River Mouth/Estuary	Los Cerritos Channel	**8**	**1**	**1**	**0**	**0**
Coastal Terrace	San Gabriel River Lower	**3**	**0**	**-**	**-**	**-**
Coastal Terrace	Coyote Creek	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	San Gabriel River Upper	**1**	**0**	**-**	**-**	**-**
Coastal Terrace	San Jose Creek Reach 1	**15**	**37**	**9**	**1**	**11**
Coastal Terrace	Walnut Creek Wash	**2**	**0**	**-**	**-**	**-**
Urban Lake	Milton Arthur Lakes (El Dorado Lakes)	**3**	**45**	**18**	**2**	**11**
Urban Lake	Cerritos Lake	**1**	**2**	**2**	**0**	**0**
Urban Lake	La Mirada Lake	**3**	**55**	**26**	**19**	**73**
Urban Lake	Downey Lake	**1**	**0**	**-**	**-**	**-**
Urban Lake	Legg Lakes	**2**	**50**	**11**	**3**	**27**
Urban Lake	Puddingston Lake	**5**	**95**	**40**	**22**	**55**
Urban Lake	Santa Fe Reservoir	**3**	**35**	**12**	**3**	**25**
Mountain Reservoir	San Gabriel Reservoir[1]	**7**	**4**	**2**	**1**	**50**
Mountain Reservoir	San Dimas Reservoir	**3**	**0**	**-**	**-**	**-**
Mountain Stream	East Fork San Gabriel River	**6**	**3**	**3**	**1**	**33**
Mountain Stream	North Fork San Gabriel River	**3**	**0**	**-**	**-**	**-**
Mountain Stream	West Fork/Bear Creek San Gabriel River	**10**	**124**	**51**	**22**	**43**
Total		**85**	**505**	**201**	**83**	
Mean		**4**	**27**	**17**	**7**	**30**
Median		**3**	**3**	**12**	**3**	**30**

[1] Fishing is permitted in the San Gabriel Reservoir ONLY from the shoreline on the North side of the reservoir. In 2005, the shoreline was down to the East Fork.

Sites with Highest Mean Number of Consumers

The sites in this study with the highest mean number of consumers were La Mirada Lake (San Gabriel River Watershed) with six consumers per visit and Ken Hahn Recreation Area (classed here as Los Angeles River Watershed) with five consumers per visit. A mean of four consumers per visit occurred at Puddingstone Lake (San Gabriel River Watershed), Lake Casitas (Ventura River Watershed), Lake Piru (Santa Clara River Watershed), and Alondra Park Lake (classed here as Los Angeles River Watershed).

Characteristics of Fishers and Fish Consumers Interviewed

Characteristics of Fishers

As noted above, 495 of the 1,243 fishers observed (i.e., censused) at the sampling sites were interviewed by the survey team. Fishers interviewed in this survey varied by a variety of demographic and ethnic characteristics, and preferred fishing locations (Figure 12). By age, fishers interviewed ranged in age from less than 11 to greater than 90 years, although 76% of the fishers ranged in age from 21 to 60 years (Figure 12a). The highest percentage of fishers interviewed were in the 31-40 year class (25%), followed by the 41-50 year class (21%), the 21-30 year class (16%), and 51-60 year class (14%).

By ethnicity, fishers interviewed represented at least eight ethnic groups. Of these, the highest percentage of fishers were White/non-Hispanic (41%), followed by Latino/Hispanic (27%), African-American/Blacks (13%), Asians (6%), and other (including Pacific Islanders) (10%) (Figure 12b). The Asian category included fishers who were Japanese, Chinese, Cambodian, and Vietnamese.

When asked to estimate their household income, 35% of the fishers interviewed gave no response (Figure 12c). Of those that responded, 27% had household incomes greater than $50,000, 20% had incomes of $25,000-50,000, and 7% had $10,000-25,000. Of lower incomes, 2% had household incomes of $5,000-10,000, and 4% had incomes less than $5,000.

By watershed and fishing area, the percentage of fishers interviewed (Figures 12d, 12e) were generally similar to the distribution of the number of fishers observed (i.e., censused, but not necessarily interviewed) (Table 5). By watershed (Figure 12d), the highest percentage of fishers interviewed were in the San Gabriel River watershed, followed by the Los Angeles River and Santa Clara River watersheds, Ventura River watershed, and the least in the Malibu Creek and Calleguas Creek watersheds. By fishing area, the highest percentage of fishers interviewed occurred at urban lakes and mountain reservoirs, followed by mountain streams and river mouth/estuaries, and was lowest for coastal terrace streams.

Of fishers interviewed, 94% were male and 4% female, with no data on the remaining 2%. Of the 21 women interviewed, 10 were fishing in the Los Angeles River watershed, five in the San Gabriel River watershed, and 3 each in the Ventura River and Santa Clara River watersheds. None were interviewed in the Calleguas Creek and Malibu Creek watersheds. By fishing area, 11 were interviewed at urban lakes, six at mountain reservoirs, three at mountain streams, and one at a river mouth/estuary.

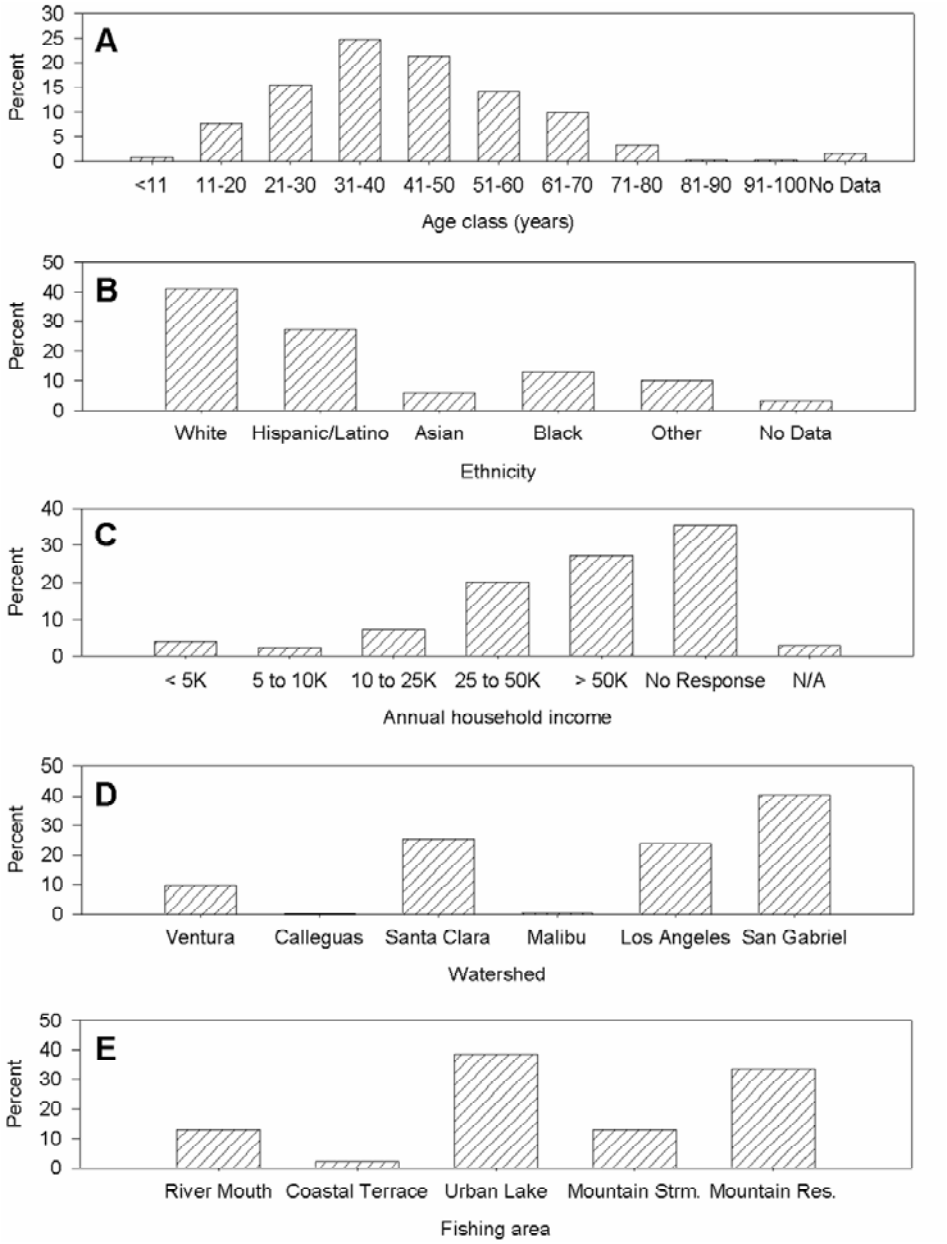


Figure 12. Percent fishers interviewed in the 2005 fish consumption survey of Ventura and Los Angeles County watersheds by age (A), ethnicity (B), annual household income (C), watershed (D), and fishing area (E).

The ethnicity of fishers interviewed varied by fishing area (Figure 13). At river mouth/estuaries, 64 fishers were interviewed, and of these, 31% were Latino/Hispanic, 25% White/non-Hispanic, and 22% African-American/Blacks. At coastal terrace streams, 11 fishers were interviewed and of these, 82% were Latino/Hispanic and 18% were White/non-Hispanic. At urban lakes, 191 fishers were interviewed, and of these 32% were White/non-Hispanic, 29% were Latino/Hispanic, and 21% were African-American/Blacks.

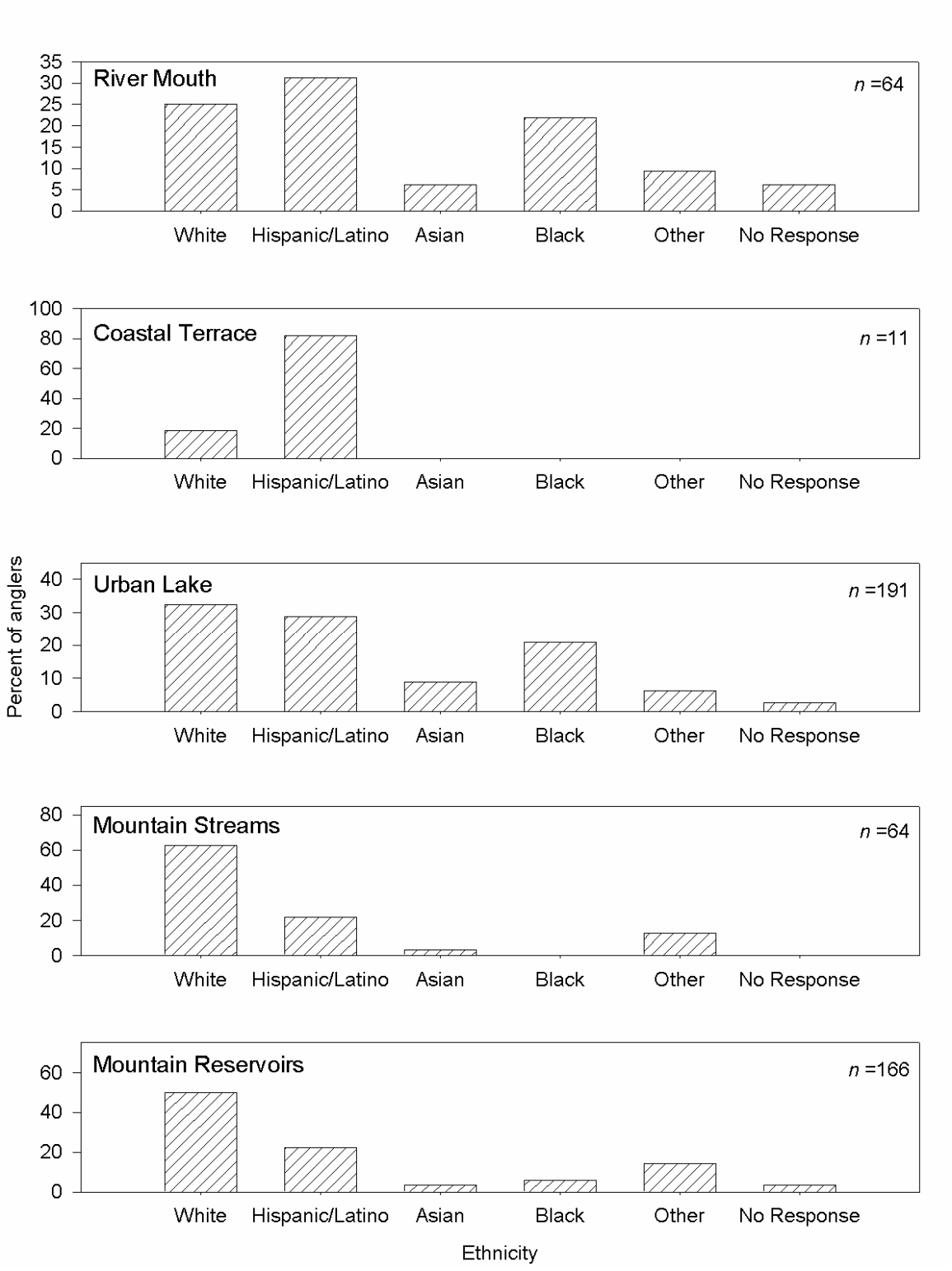


Figure 13. Distribution of ethnicity of fishers interviewed by fishing area in 2005 fish consumption survey of Ventura and Los Angeles County watersheds.

At mountain reservoirs, 166 fishers were interviewed and of these, 50% were White/non-Hispanic, 45% were Latino/Hispanic, 6% were African-American/Blacks, and 4% were Asian. Fishers at mountain streams were 62% White/non-Hispanic, 22% Latino/Hispanic, and 3% Asian.

Asians comprised 6% of the fishers interviewed at river mouth/estuaries, 9% of those at urban lakes, 4% at mountain reservoirs, and 3% at mountain streams. African-American/Blacks comprised 22% of the fishers at river mouth/estuaries, 21% at urban lakes, and 6% at mountain reservoirs. Latino/Hispanics comprised 31% of the fishers at river mouth/estuaries, 82% of fishers at coastal terrace streams, 29% of fishers at urban lakes, 23% of fishers at mountain reservoirs, and 22% of fishers at mountain streams. White/non-Hispanic fishers comprised 25% of the fishers at river mouth/estuaries, 18% at coastal terrace streams, 32% of fishers at urban lakes, 50% of fishers at mountain reservoirs, and 62% of fishers at mountain streams.

The number of fishers of different income classes also varied by watershed and fishing area (Table 12). The number of fishers not responding to the interview question regarding household income was 25-50% of those interviewed at a watershed. Of those that provided income information, high income fishers (>$50,000 per year or $25,000-$50,000 per year) comprised the highest percentage of fishers in the Ventura, Santa Clara River, and San Gabriel River watersheds (Table 12a). However, in the Los Angeles River watershed, the $25,000-50,000 income class comprised the highest percentage of fishers, followed by the $10,000-25,000 class, and then the >$50,000 class. The lowest income class (<$5,000) comprised 8% of the fishers interviewed in the Los Angeles River watershed, and 4% of the Ventura River watershed, and 2% of the fishers interviewed in the Santa Clara and San Gabriel River watersheds. Across all watersheds, 18 fishers (4% of 495 fishers interviewed) had household incomes less than $5,000. Across fishing areas (Table 12b), 27-70% of the fishers interviewed in a fishing area did not respond to the household income question during the field interview. Of those that responded, the highest income class (>$50,000) followed by the $25,000-50,000 class comprised the highest percentage of fishers interviewed at urban lakes, mountain reservoirs, and mountain streams. The highest income class comprised 47% of the fishers in the mountain streams. However, at river mouth/estuaries, the $25,000-50,000 class was highest income class. The lowest income class (<$5,000) comprised 13% of the fishers interviewed at the river mouth/estuary sites, and 3% each of those interviewed at urban lakes, mountain streams, and mountain reservoirs.

Characteristics of Fish Consumers

Of the 238 fishers interviewed that consumed fish that they caught at a site, most (93%) were male, white (37%), 41-50 years old (26%), and refused to state incomes (39%). However, of consumers providing income information, 24% had household incomes greater than $50,000 per year (Figure 14). Of these consumers, 40% fished in urban lakes and 35% in mountain reservoirs. By watershed, 35% fished in the San Gabriel River, 28% in the Los Angeles River, 27% in the Santa Clara River, and 10% in the Ventura River. By season, 39% preferred all seasons, 19% summer, 17% spring, 15% fall, and 9% winter. Of these consumers, 38% had not consumed any fish caught at the interview site

in the past four weeks, 24% had consumed or would consume fish once during the past 4 weeks (including the day of interview), and 16% had or would consume fish twice during the past month. About 50% of the fishers had been fishing these watersheds for 0-5 years, 18% for 6-10 years, and 12% for 16-20 years, and 12% for greater than 20 years. Of parts of fish consumed, 52% ate the fish as fillets or steaks, and 40% as whole, gutted fish. Regarding amount consumed in a meal, 45% ate about the same amount as the fillet model (representing 227g or 8 oz) of fish, whereas 44% consumed more in a meal. The predominant cooking methods of fish caught by these fishers were frying (46%), broiling or barbecue (24%), and steaming (18%).

Table 12. Percent of fishers interviewed by income category at watersheds (a) and fishing areas (b) sampled in 2005 fish consumption survey of watersheds of Ventura and Los Angeles Counties.

a) Watersheds

	Percent of Fishers Interviewed					
Income	Ventura River (n=48)	Santa Clara River (n=126)	Calleguas Creek (n=0)	Malibu Creek (n=2)	Los Angeles River (n=118)	San Gabriel River (n=201)
+50,000	40	30	--	50	12	32
25,000-50,000	23	21	--	--	17	21
10,000-25,000	2	6	--	--	14	6
5,000-10,000	2	2	--	--	4	2
Less than 5,000	4	2	--	--	8	2
N/A	4	2	--	--	4	3
No Response	25	38	--	50	41	33

b) Fishing Areas

	Percent of Fishers Interviewed				
Income	River Mouth/ Estuaries (n=64)	Coast Terr. Streams (n=10)	Urban Lakes (n=191)	Mountain Reservoirs (n=166)	Mountain Streams (n=64)
+50,000	13	10	21	34	47
25,000-50,000	22	10	20	20	19
10,000-25,000	13	--	10	4	3
5,000-10,000	2	--	4	2	2
Less than 5,000	13	--	3	3	3
N/A	6	10	3	2	--
No Response	33	70	39	34	27

n = number of fishers interviewed in watershed or fishing area

Fish Species Caught and Consumed

A total of 28 marine, estuarine, and freshwater fish species were caught and consumed during the past month by the 177 fishers interviewed during the survey (Table 13). The 28 species were 36% of the 77 species listed as potentially caught and consumed in the survey area (Appendix C: Section C1). The 28 species were variously distributed over the fishing areas and four watersheds (Ventura, Santa Clara, Los Angeles, and San Gabriel River). As noted above, fishers were not encountered that caught and consumed fish from the Calleguas and Malibu Creek watersheds.

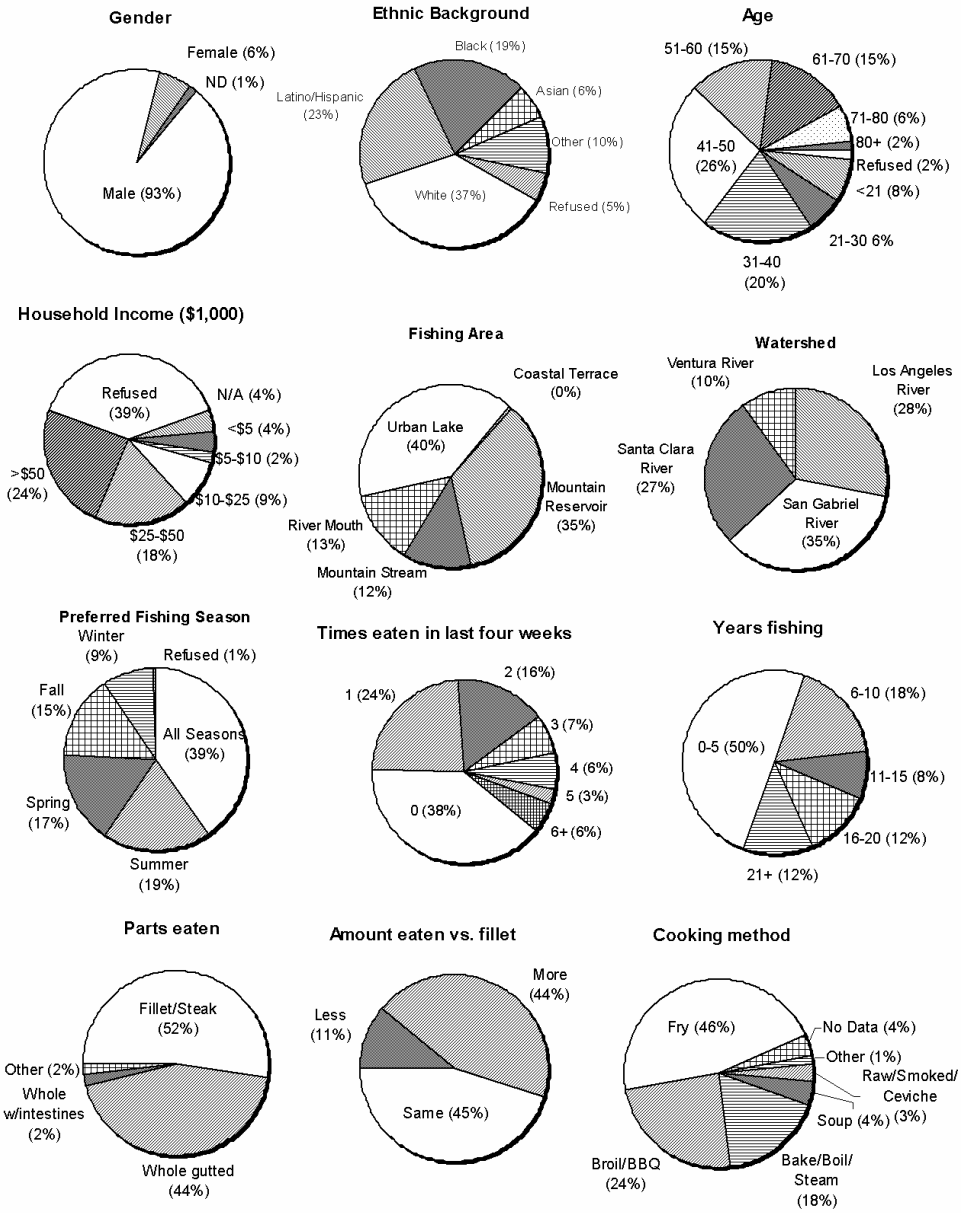


Figure 14. Characteristics of fishers who consumed their catch in the fish consumption survey of watersheds of Ventura and Los Angeles Counties, January-December 2005. Sample size = 495 fishers.

Table 13. Freshwater and estuarine fish species caught and consumed in fish consumption survey of watersheds of Ventura and Los Angeles Counties in January-December 2005.

Class / Order / Family / Species	Common Name	Fishing Area: Riv. Mouth Estuary	Coast. Terr. Stream	Urban Lake	Mountain Reservoir	Mountain Stream	No. Con.	Consumption Rate (g/day): Mean	Median
CHONDRICHTHYES									
CHARCHARHINIFORMES									
Triakidae									
Mustelus californicus	gray smoothhound	SGR	---	---	---	---	1	8.1	8.1
MYLIOBATIFORMES									
Urolophidae									
Urobatis halleri	round stingray	SGR	---	---	---	---	1	4.1	4.1
Myliobatidae									
Myliobatis californica	bat ray	SGR	---	---	---	---	1	12.2	12.2
ACTINOPTYERYGII									
CYPRINIFORMES									
Cyprinidae									
Carassius auratus	goldfish	---	---	---	SCR	---	1	10.9	10.9
Cyprinus carpio	common carp	LAR	SGR	LAR,SGR	SCR	---	11	43.1	16.2
SILURIFORMES									
Ictaluridae									
Ameiurus melas	black bullhead	---	---	---	SCR	---	1	40.5	40.5
Ictalurus furcatus	blue catfish	---	---	LAR	---	---	1	48.6	48.6
Ictalurus punctatus	channel catfish	LAR	---	LAR,SGR	SCR	---	38	50.4	28.4
SALMONIFORMES									
Salmonidae									
Oncorhynchus mykiss	rainbow trout	---	---	SGR,LAR	VR,SCR,SGR	SCR,SGR	61	31.7	29.7
Salmo trutta	brown trout	---	---	---	---	SCR	1	40.5	40.5
PERCIFORMES									
Moronidae									
Morone saxatilis	striped bass	---	---	---	SCR	---	8	20.0	19.6
Serranidae									
Paralabrax clathratus	kelp bass	LAR,SGR	---	---	---	---	2	20.3	20.3
Paralabrax maculatofasciatus	spotted sand bass	SGR	---	---	---	---	1	32.4	32.4
Paralabrax nebulifer	barred sand bass	SGR	---	---	---	---	1	32.4	32.4
Centrarchidae									
Lepomis cyanellus	green sunfish	---	---	LAR	---	---	2	20.3	20.3
Lepomis macrochirus	bluegill	---	---	LAR,SGR	SCR	---	11	60.4	36.5
Lepomis microlophus	redear sunfish	---	---	---	VR	---	5	13.8	13.8
Micropterus salmoides	largemouth bass	---	---	LAR	VR,SCR,SGR	---	7	15.6	14.2
Pomoxis annularis	white crappie	---	---	SGR	---	---	1	16.2	16.2
Sciaenidae									
Genyonemus lineatus	white croaker	LAR	---	---	---	---	1	32.4	32.4
Menticirrhus undulatus	California corbina	LAR	---	---	---	---	1	32.4	32.4
Umbrina roncador	yellowfin croaker	LAR	---	---	---	---	3	58.3	58.3
Cichlidae									
Oreochromis mossambicus	Mozambique tilapia	---	---	LAR	---	---	2	12.2	12.2
Embiotocidae									
Embiotoca jacksoni	black perch	SGR	---	---	---	---	1	8.1	8.1
Rhachilus vacca	pile perch	LAR	---	---	---	---	2	24.3	24.3
Scombridae									
Scomber japonicus	Pacific chub mackerel	LAR	---	---	---	---	1	8.1	8.1
PLEURONECTIFORMES									
Paralichthyidae									
Paralichthys californicus	California halibut	LAR,SGR	---	---	---	---	9	38.9	51.8
Pleuronectidae									
Pleuronichthys (= *Hypsopsetta*) *guttulatus*)	diamond turbot	LAR,SGR	---	---	---	---	2	14.2	14.2
						Total =	177		

Watershed Abbreviations: VR = Ventura River; SCR = Santa Clara River; CC = Calleguas Creek; MC = Malibu Creek; LAR = Los Angeles River; SGR = San Gabriel River

Other abbreviations: Riv. = river; Coast. Terr. = Coastal Terrace; No. = number; Cons. = consumption rate

Common and scientific names of fish species are those of Nelson et al. (2004)

Of the 28 species, 14 are marine species caught only in the estuaries of this survey (Table 13). These included two classes of fishes: a) cartilaginous fishes (e.g., sharks and rays), and b) ray-finned (or bony) fishes. Cartilaginous fishes consumed by fishers in this study included gray smoothhound (*Mustelus californicus*), round stingray (*Urobatis halleri*), and bat ray (*Myliobatis californica*). Eleven species of ray-finned species were consumed. These included 1) three sea basses: kelp bass (*Paralabrax clathratus*), spotted sand bass (*Paralabrax maculatofasciatus*), and barred sand bass (*Paralabrax nebulifer*); 2) three species of croaker: white croaker (*Genyonemus lineatus*), California corbina (*Menticirrhus undulatus*), and yellowfin croaker (*Umbrina roncador*); 3) two species of surfperches: black perch (*Embiotoca jacksoni*) and pile perch (*Rhacochilus vacca*); 4) two species of flatfishes: California halibut (*Paralichthys californicus*) and diamond turbot (*Pleuronichthys* (= *Hypsopsetta*) *guttulatus*); and 5) Pacific chub mackerel (*Scomber japonicus*).

Of the 14 freshwater species (Table 13), 1) two were carps: goldfish (*Carassius auratus*) and common carp (*Cyprinus carpio*); 2) three were catfishes: black bullhead (*Ameiurus melas*), blue catfish (*Ictalurus furcatus*), and channel catfish (*Ictalurus punctatus*); 3) two were trouts: rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*). Other species included 4) striped bass (*Morone saxatilis*); 5) five species of sunfishes: green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), largemouth bass (*Micropterus salmoides*), and white crappie (*Pomoxis annularis*); and 6) Mozambique tilapia (*Oreochromis mossambicus*).

The freshwater species were caught and consumed at various fishing areas in the watersheds (Table 13). Common carp was caught in the most (four) fishing areas: river mouth/estuary, coastal terrace streams, urban lakes, and mountain reservoirs. Common carp was the only species caught and consumed from a coastal terrace stream in this survey. Channel catfish was caught at three fishing areas: river mouth/estuary, urban lakes, and mountain reservoirs. Rainbow trout were also caught at three fishing areas: urban lakes, mountain reservoirs, and mountain streams. Bluegill and largemouth bass were caught and consumed at urban lakes and mountain reservoirs. Eight species were only caught at one fishing area: 1) blue catfish, green sunfish, white crappie, and Mozambique tilapia at urban lakes; and 2) goldfish, black bullhead, striped bass, and redear sunfish at mountain reservoirs.

Although it was anticipated that Asian clam (*Corbicula fluminea*) and red swamp crayfish (*Procambarus clarkia*) might be caught by fishers in the survey, no fisher had collected or had recently consumed Asian clams. However, C. C. Swift (Entrix, pers. communication, 2004), has previously observed these being caught in parts of Los Angeles River. One fisher interviewed in the present survey on Conejo Creek said he typically trapped red swamp crayfish there but had lost his traps during a recent storm.

Consumption Rates

Overall and by Watersheds and Fishing Areas

Of 238 consumers interviewed, 140 provided sufficient information for calculation of consumption rates. Consumption-rate distributions were strongly right-skewed (Figure 15). The overall median consumption rate was 16.2 g/day with an upper decile rate of 70.6 g/day (Table 14). The mean consumption rate was 34.9 g/day with 95% confidence limits being 8.1 to 99.7 g/day.

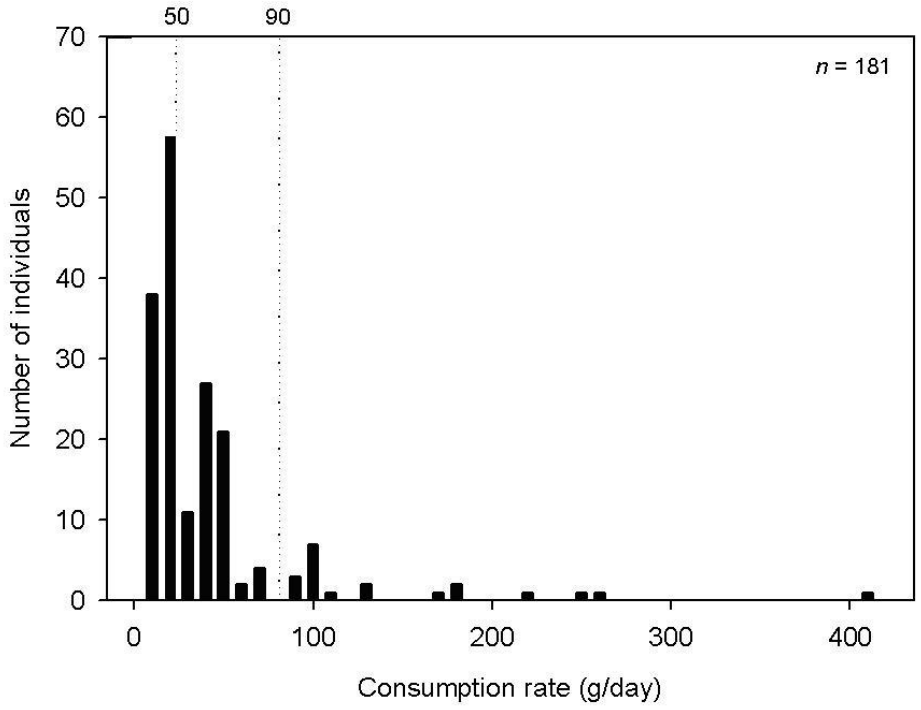


Figure 15. Frequency distribution of fish consumption rates (all fish species combined) for fishers interviewed in 2005 fish consumption survey of Ventura and Los Angeles County watersheds. The median (50%) and upper decile (90%) consumption rates are noted.

By watershed, the highest median consumption rate was 32.4 g/day for consumers in the Los Angeles River watershed, followed by those in the watersheds of the San Gabriel River and Santa Clara River (16.2 g/day for each), and Ventura River (12.2 g/day). As noted above, fishers providing fish consumption information were not encountered in Calleguas Creek or Malibu Creek. The upper decile consumption rates were highest (97.2 and 87.6 g/day) for Los Angeles and San Gabriel River watersheds, respectively. The upper decile rate was 48.6 g/day for the Santa Clara River and 16.2 g/day for the Ventura River. As expected given the skewed frequency distribution of consumption rates (Figure 15), means were higher than medians for watersheds and for fishing areas. By fishing area, the median consumption rate was highest (32.4 g/day) at river mouth/estuaries,

followed by urban lakes and mountain streams (24.3 g/day for each), and mountain reservoirs (16.2 g/day). Consumption rates for coastal terrace streams, based on the consumption rate of a single consumer, were 16.2 g/day (Table 14). The upper decile consumption rates were highest (97.2 and 70.2 g/day) for urban lakes and river mouth/estuaries, respectively. The upper decile rate was 48.6 g/day for mountain reservoirs and mountain streams.

Table 14. Overall fish consumption rates by watershed, fishing area, and entire survey of 2005 fish consumption survey of watersheds of Ventura and Los Angeles Counties.

Category Region	Number of Consumers	Consumption Rate (g/day)					
			Decile			Confidence Limits	
		Median	Lower	Upper	Mean	5%	95%
Watersheds							
Ventura River	13	12.2	8.1	16.2	11.8	8.1	16.2
Santa Clara River	35	16.2	8.1	48.6	27.5	3.6	69.7
Calleguas Creek	0	--	--	--	--	--	--
Malibu Creek	0	--	--	--	--	--	--
Los Angeles River	43	32.4	8.1	88.6	45.2	8.1	163.0
San Gabriel River	49	16.2	8.1	97.2	37.2	8.1	111.8
Fishing Areas							
River Mouth/Estuaries	19	32.4	8.1	70.2	33.3	8.1	75.3
Coastal Terrace Streams	1	16.2	16.2	16.2	16.2	16.2	16.2
Urban Lakes	55	24.3	8.1	97.2	44.6	8.1	188.1
Mountain Reservoirs	44	16.2	8.1	48.6	22.1	4.7	62.4
Mountain Streams	21	24.3	8.1	48.6	39.2	8.1	121.5
Overall	140	16.2	8.1	70.6	34.9	8.1	99.7

Note: Of 238 consumers interviewed, 140 provided sufficient information for consumption rate calculations.

Consumption Rates by Ethnic Group

Fish consumption rates varied to some degree by ethnic group (Table 15). The 140 fishers that provided sufficient information for calculating consumption rates represented 15 ethnic group categories. Of these fishers, 52 (37%) were White/non-Hispanic, 31 (22%) were Latino/Hispanic, and 27 (19%) were African-American/Black. These represented 79% of the fishers interviewed, with 10 (7%) western Asians (Armenians, Persians, Ukrainians); 8 (6%), representing eastern Asian groups (Thai, Japanese, Cambodians, Chinese, Koreans, Vietnamese, and Laotians); 5 (4%) Pacific Islanders; and 7 (5%) no ethnicity data. Those with no data were fishers that chose not to reveal their ethnicity.

The highest mean consumption rates were 92.0 g/day (no data group), 49.6 g/day (Armenians), and 42.4 g/day (African-American/Blacks) (Table 15). The lowest mean consumption rates were 4.1 g/day (Laotians), 8.1 g/day (Vietnamese), and 9.5 g/day

(Ukrainians). The highest median consumption rates were 32.4 g/day (no data group and African-American/Blacks) and 24.3 g/day (Armenians). The lowest median consumption rates were, 8.1 g/day (Pacific Islanders) and 12.2 g/day (Koreans). The highest upper decile rates were 249.5 g/day (no data group), 99.6 g/day (Armenians), and 97.2 g/day (African-American/Blacks) and the lowest upper decile rates were 21.1 g/day (Pacific Islanders) and 15.4 g/day (Koreans). The highest lower decile rates were 13.0 g/day (no data group and African-American/Blacks) and the lowest lower decile rates were 8.1 g/day (Latino/Hispanic, White/non-Hispanic, and Pacific Islanders).

Table 15. Fish consumption rates by ethnic groups in 2005 fish consumption survey of watersheds of Ventura and Los Angeles Counties.

		Consumption Rate (g/day)			
Ethnic Group	**N**	**Mean**	**Median**	**Upper Decile**	**Lower Decile**
No Data	7	92.0	32.4	249.5	13.0
Armenian	8	49.6	24.3	99.6	12.6
African American/Black	27	42.4	32.4	97.2	13.0
Thai	1	40.5	--	--	--
Persian	1	32.4	--	--	--
Japanese	1	32.4	--	--	--
Latino/Hispanic	31	30.8	16.2	51.0	8.1
White, Non-Hispanic	52	28.4	16.2	55.9	8.1
Cambodian	1	16.2	--	--	--
Chinese	1	16.2	--	--	--
Pacific Islander	5	13.0	8.1	21.1	8.1
Korean	2	12.2	12.2	15.4	8.9
Ukranian	1	9.5	--	--	--
Vietnamese	1	8.1	--	--	--
Laotian	1	4.1	--	--	--

N = Number of fishers interviewed
No Data - Fishers were asked to point to ethnic group in a list of potential ethnic groups that best describe their ethnicity. Some did not want to do this and could not be otherwise classified to ethnicity by the survey team.

Consumption Rates by Fish Species

The fish species consumed by the most fishers in the survey were rainbow trout (61 consumers), channel catfish (38), common carp and bluegill (11 each), California halibut (9), striped bass (8), and largemouth bass (7) (Table 13). Of the popular species, California halibut had the highest median consumption rate (51.8 g/day), followed by bluegill (36.5 g/day), rainbow trout (29.7 g/day), channel catfish (28.4 g/day), striped bass (19.6 g/day), common carp (16.2 g/day), and largemouth bass (14.2 g/day). Some of the fishers consuming channel catfish, common carp, rainbow trout, and bluegill consumed quantities much higher than the medians for these species (Figure 16).

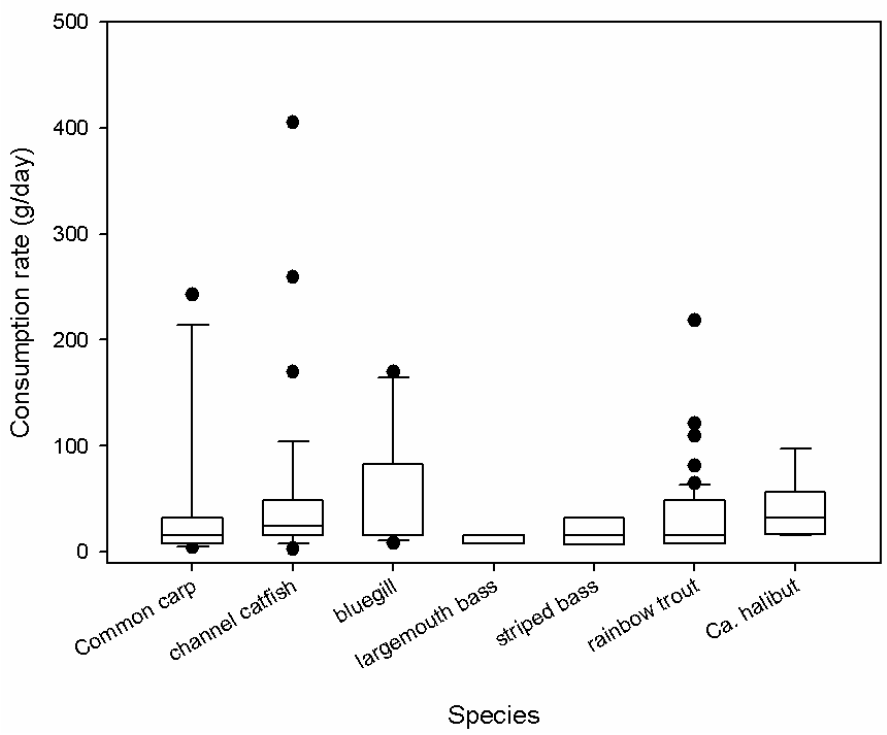


Figure 16. Fish consumption rates by fish species consumed by the most fishers interviewed in the 2005 fish consumption survey of Ventura and Los Angeles County watersheds. Box and whisker plots represent the following: box encloses 25% to 75% of values; line in box is median; whiskers represent 10% (lower) and 90% (upper) deciles; and black dots represent outliers.

Consumption Rates by Fish Species at Sampling Sites

Ventura River. The fish species consumed by fishers varied by sampling sites within watersheds. In the Ventura River watershed, Lake Casitas was the only site where fishers interviewed consumed fish caught at the site (Table 16). Three fish species (rainbow trout, red-ear sunfish, and largemouth bass) were caught there and consumed, with the most fishers (7) consuming rainbow trout but the highest mean consumption rate (14.2 g/day) for largemouth bass (2 consumers).

Santa Clara River. In the Santa Clara River watershed, fishers interviewed consumed fish caught in four mountain reservoirs (Castaic Lagoon, Lake Piru, Pyramid Lake, Quail Lake) and two mountain stream sites (Bouquet Canyon Creek, Frenchman's Flat on Piru Creek; Table 16). Fish species caught and consumed at the mountain reservoir sites varied greatly by site. At Castaic Lagoon three species (rainbow trout, bluegill, striped bass) were caught and consumed, with rainbow trout having the highest number of consumers (8) and the highest consumption rate (45.6 g/day). At Lake Piru, two species (rainbow trout, channel catfish) were consumed, with rainbow trout with the most consumers (10) and the highest consumption rate (29.7 g/day). At Pyramid Lake, five species were consumed with the most consumers (4) eating striped bass and rainbow trout (3) but with black bullhead (1 consumer) having the highest consumption rate (40.5

g/day). At Quail Lake, three species (striped bass, goldfish, common carp) were caught and consumed, with striped bass having the most consumers (4) and goldfish the highest consumption rate (10.9 g/day). At the mountain streams, rainbow trout was the only species caught and consumed by fishers at Bouquet Canyon Creek in this survey (2 consumers, 48.6 g/day). At Frenchman's Flat on Piru Creek, rainbow trout and brown trout were consumed, with the former having the most consumers (3) and the latter the highest consumption rate (40.5 g/day).

Table 16. Mean consumption rates of fish species caught and consumed at Ventura and Santa Clara River sites in the 2005 Fish Consumption Survey of Ventura and Los Angeles County Watersheds (January-December 2005).

Watershed/Fishing Area Sampling Site	Common Name	Scientific Name	No. of Consumers	Cons.Rate (g/day)
VENTURA RIVER				
Mountain Reservoirs				
Lake Casitas	rainbow trout	*Oncorhynchus mykiss*	7	10.4
Lake Casitas	red-ear sunfish	*Lepomis microlophus*	5	13.8
Lake Casitas	largemouth bass	*Micropterus salmoides*	2	14.2
SANTA CLARA RIVER				
Mountain Reservoirs				
Castaic Lagoon	rainbow trout	*Oncorhynchus mykiss*	8	45.6
Castaic Lagoon	bluegill	*Lepomis macrochirus*	2	16.2
Castaic Lagoon	striped bass	*Morone saxatilis*	1	32.4
Lake Piru	rainbow trout	*Oncorhynchus mykiss*	10	29.7
Lake Piru	channel catfish	*Ictalurus punctatus*	1	2.7
Pyramid Lake	striped bass	*Morone saxatilis*	3	29.7
Pyramid Lake	rainbow trout	*Oncorhynchus mykiss*	3	18.9
Pyramid Lake	black bullhead	*Ameiurus melas*	1	40.5
Pyramid Lake	channel catfish	*Ictalurus punctatus*	1	24.3
Pyramid Lake	largemouth bass	*Micropterus salmoides*	1	8.1
Quail Lake	striped bass	*Morone saxatilis*	4	9.6
Quail Lake	goldfish	*Carassius auratus*	1	10.9
Quail Lake	common carp	*Cyprinus carpio*	1	8.1
Mountain Streams				
Bouquet Canyon Creek	rainbow trout	*Oncorhynchus mykiss*	2	48.6
Frenchman's Flat (Piru Creek)	rainbow trout	*Oncorhynchus mykiss*	3	21.6
Frenchman's Flat (Piru Creek)	brown trout	*Salmo trutta*	1	40.5

Los Angeles River. In the Los Angeles River watershed, the fishers interviewed consumed fishes caught in at the Los Angeles River estuary, and at 10 urban lakes (Table 17). At the river mouth/estuary, 10 species were caught and consumed by fishers interviewed in this study with California halibut consumed by the most fishers (4) and yellowfin croaker having the highest mean consumption rate (58.3 g/day). Fish species caught at urban lakes varied by lake. Five species were caught and consumed at Alondra Park Lake, with channel catfish consumed by the most fishers (5) and having the highest consumption rate (79.4 g/day). At Balboa Lake, the Mozambique tilapia had the most consumers (2) and common carp (one consumer) had the highest consumption rate (16.2 g/day). Rainbow trout was the only species caught and consumed at Belvedere Park Lake (by one fisher) interviewed in this survey. Green sunfish was the only species caught and

consumed (one fisher) at Hansen Dam Aquatic Center. At Machado Lake, bluegill and channel catfish were each consumed by one fisher in this survey but the consumption rate of bluegill was much higher (170.1 g/day vs. 28.4 g/day). Common carp, channel catfish, green sunfish, and rainbow trout were all equally caught and consumed (one consumer, consumption rates of 8.1 g/day) at Hollenbeck Park Lake. Common carp was the only species consumed (16.2 g/day) by a single fisher at John Ford Park Lake and channel catfish was the only species caught and consumed (10 consumers, 57.9 g/day) at Ken Hahn State Recreation Area. Of three species (channel catfish, common carp, bluegill) caught and consumed at Lincoln Park Lake. Channel catfish and common carp were each consumed there by 2 fishers and bluegill by one fisher, but the consumption rate (230.9 g/day) for channel catfish was highest. At Peck Road Water Conservation Park, three species (rainbow trout, bluegill, largemouth bass) were consumed, with rainbow trout having the highest number of consumers (3) and consumption rate (24.3 g/day).

Table 17. Mean consumption rates of fish species caught and consumed from Los Angeles River sites in the 2005 Fish Consumption Survey of Ventura and Los Angeles County Watersheds (January-December 2005).

Fishing Area/Sampling Site	Common Name	Scientific Name	No. of Consumers	Cons.Rate (g/day)
River Mouth/Estuary				
Los Angeles River Estuary	California halibut	*Paralichthys californicus*	4	22.8
Los Angeles River Estuary	yellowfin croaker	*Umbrina roncador*	3	58.3
Los Angeles River Estuary	pile perch	*Rhacochilus vacca*	2	24.3
Los Angeles River Estuary	common carp	*Cyprinus carpio*	1	32.4
Los Angeles River Estuary	white croaker	*Genyonemus lineatus*	1	32.4
Los Angeles River Estuary	channel catfish	*Ictalurus punctatus*	1	32.4
Los Angeles River Estuary	California corbina	*Menticirrhus undulatus*	1	32.4
Los Angeles River Estuary	diamond turbot	*Pleuronichthys guttulatus*	1	12.2
Los Angeles River Estuary	kelp bass	*Paralabrax clathratus*	1	8.1
Los Angeles River Estuary	Pacific chub mackerel	*Scomber japonicus*	1	8.1
Urban Lakes				
Alondra Park Lake[1]	channel catfish	*Ictalurus punctatus*	5	79.4
Alondra Park Lake[1]	rainbow trout	*Oncorhynchus mykiss*	2	24.3
Alondra Park Lake[1]	blue catfish	*Ictalurus furcatus*	1	48.6
Alondra Park Lake[1]	bluegill	*Lepomis macrochirus*	1	40.5
Alondra Park Lake[1]	largemouth bass	*Micropterus salmoides*	1	32.4
Balboa Lake	Mozambique tilapia	*Oreochromis mossambicus*	2	12.2
Balboa Lake	common carp	*Cyprinus carpio*	1	16.2
Belvedere Park Lake	rainbow trout	*Oncorhynchus mykiss*	1	56.7
Hansen Dam Aquatic Center	green sunfish	*Lepomis cyanellus*	1	32.4
Machado Lake[1]	bluegill	*Lepomis macrochirus*	1	170.1
Machado Lake[1]	channel catfish	*Ictalurus punctatus*	1	28.4
Hollenbeck Park Lake	common carp	*Cyprinus carpio*	1	8.1
Hollenbeck Park Lake	channel catfish	*Ictalurus punctatus*	1	8.1
Hollenbeck Park Lake	green sunfish	*Lepomis cyanellus*	1	8.1
Hollenbeck Park Lake	rainbow trout	*Oncorhynchus mykiss*	1	8.1
John Ford Park Lake	common carp	*Cyprinus carpio*	1	16.2
Ken Hahn State Recreation Area[2]	channel catfish	*Ictalurus punctatus*	10	57.9
Lincoln Park Lake	channel catfish	*Ictalurus punctatus*	2	230.9
Lincoln Park Lake	common carp	*Cyprinus carpio*	2	50.6
Lincoln Park Lake	bluegill	*Lepomis macrochirus*	1	162.0
Peck Road Water Conservation Park	rainbow trout	*Oncorhynchus mykiss*	3	24.3
Peck Road Water Conservation Park	bluegill	*Lepomis macrochirus*	1	16.2
Peck Road Water Conservation Park	largemouth bass	*Micropterus salmoides*	1	16.2

[1] Although bordering Los Angeles River watershed, these lakes are in Dominguez Channel/Los Angeles Harbor watershed

[2] Although bordering Los Angeles Rive watershed, Ken Hahn Recreation Area is in Ballona Creek watershed

San Gabriel River. In the San Gabriel River watershed (Table 18), the fishers interviewed consumed fishes caught in at the San Gabriel River estuary, at one coastal terrace stream (San Jose Creek Reach 1), four urban lakes, one mountain reservoir, and two mountain streams (Table 18). At the river mouth/estuary, nine species were caught and consumed by fishers, with California halibut having the highest number of consumers (5) and consumption rate (51.8 g/day). Common carp was the only species caught (one fisher) and consumed (16.2 g/day) at San Jose Creek Reach 1. At La Mirada Lake, four species were consumed, with channel catfish having the most consumers (14) and bluegill having the highest consumption rate (97.2 g/day). Common carp was the only species caught and consumed (one consumer, 243.0 g/day) at Legg Lakes by fishers interviewed in this study. Channel catfish was the only species caught and consumed at Milton Arthur Lakes (El Dorado Lakes) in this survey (one consumer, 24.3 g/day). At Puddingstone Lake, five species were consumed by fishers interviewed in this study with bluegill and rainbow trout having the most consumers (4 each) and bluegill having the highest consumption rate (36.5 g/day). At San Gabriel Reservoir, rainbow trout and largemouth bass were equally consumed (one consumer, 16.2 g/day). In the mountain streams, rainbow trout was caught and consumed at the East and West Forks of the San Gabriel River, including Bear Creek (one consumer at each fork, with consumption rates of 32.4 and 42.1 g/day, respectively).

Table 18. Mean consumption rates of fish species caught and consumed from San Gabriel River sites in the 2005 Fish Consumption Survey of Ventura and Los Angeles County Watersheds (January-December 2005).

Sampling Site	Common Name	Scientific Name	No. of Consumers	Cons.Rate (g/day)
River Mouth/Estuary				
San Gabriel River Estuary	Callifornia halibut	*Paralichthys californicus*	5	51.8
San Gabriel River Estuary	kelp bass	*Paralabrax clathratus*	1	32.4
San Gabriel River Estuary	spotted sand bass	*Paralabrax maculatofasciatus*	1	32.4
San Gabriel River Estuary	barred sand bass	*Paralabrax nebulifer*	1	32.4
San Gabriel River Estuary	diamond turbot	*Pleuronichthys guttulatus*	1	16.2
San Gabriel River Estuary	bat ray	*Myliobatis californica*	1	12.2
San Gabriel River Estuary	black perch	*Embiotoca jacksoni*	1	8.1
San Gabriel River Estuary	gray smoothhound	*Mustelus californicus*	1	8.1
San Gabriel River Estuary	round stingray	*Urobatis halleri*	1	4.1
Coastal Terrace Streams				
San Jose Creek Reach 1	common carp	*Cyprinus carpio*	1	16.2
Urban Lakes				
La Mirada Lake	channel catfish	*Ictalurus punctatus*	14	23.1
La Mirada Lake	bluegill	*Lepomis macrochirus*	1	97.2
La Mirada Lake	common carp	*Cyprinus carpio*	1	16.2
La Mirada Lake	largemouth bass	*Micropterus salmoides*	1	8.1
Legg Lakes	common carp	*Cyprinus carpio*	1	243.0
Milton Arthur Lakes (El Dorado Lakes)	channel catfish	*Ictalurus punctatus*	1	24.3
Puddingstone Lake	bluegill	*Lepomis macrochirus*	4	36.5
Puddingstone Lake	rainbow trout	*Oncorhynchus mykiss*	4	28.4
Puddingstone Lake	channel catfish	*Ictalurus punctatus*	1	32.4
Puddingstone Lake	common carp	*Cyprinus carpio*	1	16.2
Puddingstone Lake	white crappie	*Pomoxis annularis*	1	16.2
Mountain Reservoirs				
San Gabriel Reservoir	largemouth bass	*Micropterus salmoides*	1	16.2
San Gabriel Reservoir	rainbow trout	*Oncorhynchus mykiss*	1	16.2
Mountain Streams				
East Fork San Gabriel River	rainbow trout	*Oncorhynchus mykiss*	1	32.4
West Fork San Gabriel River/Bear Creek	rainbow trout	*Oncorhynchus mykiss*	1	42.1

Most Frequently Consumed Fish Species by Watershed and Fishing Area

Fish species most consumed by fishers at different fishing areas in the six watersheds varied by watershed and fishing habitat (Table 19). The fish species consumed were often distinctive to fishing areas within a watershed and similar within a fishing area across watersheds. Fifteen river mouth/estuarine species were caught and consumed by fishers interviewed in this study at the river mouth/estuaries of the Los Angeles and San Gabriel Rivers. In this study, 10 species were consumed from the Los Angeles River estuary and nine from the San Gabriel River estuary. At both estuaries, California halibut was the species consumed by the most fishers (5 and 4 respectively, in the San Gabriel and Los Angeles River estuaries). Yellowfin croaker was second (3 consumers) at the Los Angeles River estuary). Of the 15 species consumed by fishers at these estuaries, seven were only consumed at Los Angeles River estuary and six only at San Gabriel River estuary.

Table 19. Summary of fish species consumed by fishing area and watershed in 2005 Fish Consumption Survey of Ventura and Los Angeles County Watersheds.

Fishng Area		Watershed with Number of Consumers by Fish Species						
Common Name	Scientific Name	Ventura River	Santa Clara River	Calleguas Creek	Malibu Creek	Los Angeles River	San Gabriel River	Total Consumers
River Mouth/Estuary								
gray smoothhound	*Mustelus californicus*						1	1
round stingray	*Urbobatis halleri*						1	1
bat ray	*Myliobatis californica*						1	1
common carp	*Cyprinus carpio*					1		1
channel catfish	*Ictalulurus punctatus*					1		1
kelp bass	*Paralabrax clathratus*					1	1	2
spotted sand bass	*Paralabrax maculatofasciatus*						1	1
barred sand bass	*Paralabrax nebulifer*						1	1
white croaker	*Genyonemus lineatus*					1		1
California corbina	*Menticirrhus undulatus*					1		1
yellowfin croaker	*Umbrina roncador*					3		3
black perch	*Embiotoca jacksoni*						1	1
pile pech	*Rhacochilus vacca*					2		2
Pacific chub mackerel	*Scomber japonicus*					1		1
California halibut	*Paralichthys californicus*					4	5	9
diamond turbot	*Pleuronichthys guttulatus*					1	1	2
Coastal Terrace Streams								
common carp	*Cyprinus carpio*						1	1
Urban Lakes								
common carp	*Cyprinus carpio*					5	3	8
channel catfish	*Ictalurus punctatus*					19	16	35
rainbow trout	*Oncorhynchus mykiss*					7	4	11
blue catfish	*Ictalurus furcatus*					1		1
bluegill	*Lepomis macrochirus*					4	5	9
green sunfish	*Lepomis cyanellus*					2		2
largemouth bass	*Micropterus salmoides*					2	1	3
white crappie	*Pomoxis annularis*						1	1
Mozambique tilapia	*Oreochromis mossambicus*					2		2
Mountain Reservoirs								
goldfish	*Carassius auratus*		1					1
common carp	*Cyprinus carpio*		1					1
black bullhead	*Ameiurus melas*		1					1
channel catfish	*Ictalurus punctatus*		2					2
rainbow trout	*Oncorhynchus mykiss*	7	21				1	29
striped bass	*Morone saxatilis*		8					8
bluegill	*Lepomis macrochirus*		2					2
red-ear sunfish	*Lepomis microlophus*	5						5
largemouth bass	*Micropterus salmoides*	2	1				1	4
Mountain Streams								
rainbow trout	*Oncorhynchus mykiss*		5				2	7
brown trout	*Salmo trutta*		1					1

Common carp was the only species caught and consumed from a coastal terrace stream (San Jose Creek in the San Gabriel River watershed), and this by a single fisher (Table 18).

Nine fish species were caught and consumed by fishers at urban lakes in this study, and these were all caught at urban lakes in the watershed areas of Los Angeles and San Gabriel Rivers (Table 18). Channel catfish was the species consumed by the most fishers in lakes of both watersheds (19 and 16, respectively, in the Los Angeles River and San Gabriel River watersheds), but rainbow trout was second (7 consumers) in the Los Angeles River lakes, and bluegill was second (5 consumers) the San Gabriel River lakes.

A total of nine fish species were caught and consumed in the mountain reservoirs surveyed in this study, with eight consumed by fishers in the Santa Clara River reservoirs, three from the Ventura River watershed, and two from the San Gabriel River watershed (Table 19). Rainbow trout was caught and consumed at mountain reservoirs of all three watersheds, and was consumed by the most fishers in the Santa Clara River (21 consumers) and Ventura River watersheds (7 consumers). Striped bass was next (8 consumers) in the Santa Clara River reservoirs and red-ear sunfish was second (5 consumers) in the Ventura River reservoir (Lake Casitas). Rainbow trout and largemouth bass were each consumed by single fishers interviewed at the San Gabriel River reservoirs.

Rainbow trout was the fish species consumed by the most fishers of the mountain streams of the Santa Clara and San Gabriel River watersheds (5 and 2 consumers, respectively) (Table 19). Brown trout was consumed from a single fisher at Piru Creek in the Santa Clara River watershed.

Overall, channel catfish and rainbow trout were consumed by the most fishers interviewed in this study, with the former primarily caught at urban lakes and the latter primarily at mountain reservoirs (Table 19).

DISCUSSION

Overview and Objectives

Although fishing is an important recreational activity in southern California, there has not been a recent description of its distribution in the coastal watersheds of southern California. With increased focus on pollution control, there has been a need for understanding the extent of fishing and fish consumption as a beneficial use in these watersheds. The objectives of this study were 1) to develop a survey instrument and survey protocol that may provide a standard methodology for assessing fish consumption rates throughout California; 2) to determine the extent of fishing and fish consumption as beneficial use in these watersheds; and 3) to assess fish consumption rates by fishers at different sites for potential use in human health-risk assessments related to consumption of contaminated fish. For the latter purpose, the objectives are to determine from what fishing habitats and sites are fish most frequently consumed by fishers and what species at each site are most frequently consumed by fishers. This study differed from other studies with an immediate public health need to obtain fish consumption information to protect consumers from contaminants of concern, such as DDT (Allen *et al*. 1996) or methyl-mercury (Silver *et al*. 2007). Those studies also focused on the effectiveness of fish consumption advisories, and on obtaining information from other areas a fisher might have caught contaminated fish. As there was little information on the distribution of fishing and fish consumption in general in the Ventura and Los Angeles County watersheds, this study provides a broad brush description of these activities in these watersheds.

Survey Instrument

As noted in the Methods section of this report, the survey design and survey instrument used in this study was based on and modified from those used in the Santa Monica Bay Seafood Consumption Survey of 1991-1992 (MBC 1991, MBC 1993, SCCWRP and MBC 1994, Allen *et al*. 1996). Because the Santa Monica Bay study was a survey of marine anglers, marine fishing modes (piers and jetties, party boats, private boats, and beaches), and marine fishes, the survey design and survey instrument of the present study were modified to make them appropriate for surveying fishing and fish consumption in six coastal watersheds of Ventura and Los Angeles Counties in southern California. Instead of focusing on the marine fishing modes used in the Santa Monica Bay study, the present study focused on five types of fishing areas (river mouth/estuaries, coastal terrace streams, urban lakes, mountain reservoirs, and mountain streams) found in the watersheds. It also focused on freshwater and anadromous fishes, but also included marine and estuarine fishes found at the mouth of the watersheds.

The survey instrument consisted of census forms and questionnaires in English and Spanish (Appendix A: Sections A1, A2, A3, A4). The census forms provided general characteristics of the site on the day sampled, as well as a census of fishers observed at the site. Of the fishers observed, as many as possible were interviewed on a survey day, using the English and/or Spanish questionnaires as appropriate. Survey teams used these questionnaires to obtain information on characteristics of the fisher (age, ethnicity,

gender, income, number of years fishing, etc.), how frequent he or she had caught and consumed selected fish species from the fishing/interview site, and how much they consumed of the species relative to a model of a fish fillet representing the size of a standard USEPA fish meal of 227 g (8 oz; USEPA 2000). Note that this fillet model was larger than the standard USEPA fish meal of 142 g (5 oz; USEPA 1989) used in the Santa Monica Bay study (Allen *et al*. 1996). In combination, these two types of information (frequency of consumption and amount consumed) provided the basis for determining a consumption rate for a fisher consuming a particular fish species at a particular site. In addition to obtaining information on fish species that a fisher had caught at a site on the interview day, the Santa Monica Bay study also included photos of eight marine species that the fisher might catch at the site to further expand knowledge of consumption rates of other species not in-hand on the interview day (Allen *et al*. 1996). Similarly, pictures of about 84 fish and 2 invertebrate species were available to show to fishers in the present study for the same purpose (Appendix C: Section C2). However, in this survey, the fishes shown were those potentially found at the fishing area being surveyed (a much smaller set of species). These pictures aided the survey team in identifying fish species caught by a fisher at the site. The pictures were also shown to the fisher, who was asked if he or she had caught and consumed any of these species from the site in the last 4 weeks (28 days), and if so, how much of the fish did they consume when they ate the species. Fish common names included English and Spanish names from Nelson *et al*. (2004). Additional information made available to the survey teams in the present study were site lists and maps, instructions on how to get to a site, equipment to take on a survey, protocol for conducting a survey, and information for assessing weather and road conditions prior to conducting a survey.

A stratified randomized survey design was used in both the present survey and the Santa Monica Bay survey. The fishing modes in the Santa Monica Bay study and the fishing areas in the present study provided the primary strata for the survey design. In the present study, a number of survey sites for each fishing area within a watershed were identified for sampling, much in the way that a number of pier sites, party boats, private boat launch sites, and beaches were selected for the Santa Monica Bay study. Sites within the fishing modes or fishing areas were listed in random order at the beginning of the survey and this random list provided the basis for selecting sites on each survey day until the list had been completely sampled, at which point the order of sites on the list was randomized again. In both studies, seasons were defined as summer and nonsummer and days were partitioned into weekday days and weekend days. As more people are likely to fish on weekends than on weekday days, five weekend days and four weekday days were sampled each month, with survey sites selected at random for morning and afternoon sampling.

The survey instrument and protocol used in the present survey of fishing and fishing consumption of watersheds were successfully used to collect extent of fishing and fish consumption data for this survey and will hopefully, with modification, provide a basis for collecting fish consumption information elsewhere in California for assessing fish consumption by fishes in both marine and freshwater environments.

Extent of Fishing and Fish Consumption in the Watersheds

Numbers of fishers were distributed differently by fishing area among the six watersheds (Table 5). Fishers were observed in all five fishing areas in the San Gabriel River watershed but were only observed in the river mouth estuary and urban lakes in the Los Angeles River watershed, only at mountain reservoirs and mountain streams in the Santa Clara River watershed, and only in mountain reservoirs in the Ventura River watershed. In Malibu Creek, a few fishers were observed in the coastal terrace streams and urban lakes, and in Calleguas Creek watershed, in Arroyo Simi (a coastal terrace stream). Total numbers of fishers observed during the survey were highest in mountain reservoirs in the Ventura and Santa Clara River watersheds, and in urban lakes in the San Gabriel River and Los Angeles River watersheds.

Consumers were less frequently encountered than fishers at the sites surveyed (Table 9). No consumers were encountered in the Calleguas Creek and Malibu Creek watersheds. In the other watersheds, consumers averaged about 19% of the fishers observed in a fishing area in a watershed.

Although many miles of rivers and streams and many lakes and reservoirs exist in the Ventura and Los Angeles County watersheds, fishing was observed primarily in the larger watersheds (San Gabriel River, Los Angeles River, Santa Clara River, and Ventura River) and was very low in Calleguas Creek and Malibu Creek (Figure 10). By fishing area, fishing occurred primarily at urban lakes, mountain reservoirs, mountain streams, mountain reservoirs, and much less overall in river mouth/estuaries and coastal terrace streams (Figure 10). In part, this reflects the fact that many urban lakes and mountain reservoirs exist for the purpose (at least in part) of fishing. Many of these lakes and reservoirs are stocked with rainbow trout, channel catfish, and other species for the purpose of enhancing fishing there. Similarly, the most popular mountain streams (primarily in the San Gabriel River watershed) for fishing are those stocked with rainbow trout. River mouth/estuary sites vary in their use by fishers. The most popular of these are the San Gabriel and Los Angeles Rivers (Tables 10, 11).

Whereas fishers interviewed in Santa Monica Bay in 1991-1992 generally consumed fish that they caught (Allen *et al*. 1996), many fishers in the watersheds released their catch. Some fishing areas, for instance some private lakes (e.g., Malibou Lake, Lake Sherwood, Westlake, and Lake Calabasas) required catch-and-release fishing only.

Factors Affecting Survey Success

Coastal terrace stream fishing was particularly low in this study. This is likely due to a variety of reasons. Many of the coastal terrace streams had been altered (e.g., are cement-lined), had little access, had areas considered unsafe, were frequently dry or with low water flow, or in major storms, had intense stream flow. However, part may also be due to limitations of the survey design for this study. Many fishers were found at urban lakes and mountain reservoirs in part due to stocking of desirable fishes there, and specific access sites which concentrate fishers. Coastal terrace stream reaches are generally not stocked, and these reaches often extended for several miles, resulting in fishers having

access at widely separated points that might be missed by the survey team on a given time on a given day. The survey team was required to spend at least two hours at a sampling site, but this often required searching the length of the stream reach before finding a fisher or perhaps not finding one at all. The odds of finding a fisher along a stretch of stream that was not particularly desirable for fishing was low compared with going to an urban lake with desirable fishing and nearby parking areas which congregate fishers at certain parts of the lake. In addition, there were many coastal terrace streams in the survey area, and these had the most potential sampling sites (34) of any of the fishing areas (Table 3). Given a random draw of sites among the different fishing areas and working through a list of random sites at a fishing area before resurveying any site, there were fewer opportunities for a given coastal terrace stream site to be resurveyed. Hence, many coastal terrace sites were surveyed only once during the survey period. Although two visits were made to the Middle Reach of the Los Angeles River (both in the Glendale Narrows area) were made in this survey, fishers were not observed. In contrast, many fishers have been observed in this region by other investigators. (e.g., Dr. C. C. Swift [Entrix], and Dr. Sabrina Drill, [University of California, Davis], pers. communication, August 2008). Visits to many of the other sites suggested that frequent surveying might not improve the success. Some of these areas were simply not suitable for surveying. In addition, much of the coastal stream area (particularly in the Ventura, Santa Clara, Los Angeles, and San Gabriel River watersheds) were closed to fishing in 2005 to protect any migrating steelhead rainbow trout that might be in the stream (Figure 2) (Mary Larson, CDFG, Los Alamitos, personal communication, 2004). It is not certain to what degree this closure was actually known to fishers and, if known, to what degree it affected the amount of fishing in the streams. Portions of the San Gabriel River are also closed for safety and liability reasons (Philip Markle, County Sanitation Districts of Los Angeles County [CSDLAC], personal communication, 2008).

Another factor that affected survey success in this survey was the heavy rainfall during the first part of the survey period. In the rainfall season of July 2004-June 2005, southern California received the most annual rainfall since 1883. A total of 94.6 cm (37 in.) of rain was recorded in Los Angeles during this period with the most, 28 cm (11 in.) occurring in Feb 2005, followed by Jan 2005, and December 2004 (Malnic 2005). The field survey for this study began in January 10, 2005 in the middle of this storm period. As it was not known if die-hard fishers would fish under these conditions, survey teams were sent to sites during this period. During and following these storms, many sites could not be reached due to road closures and where fishers were encountered, high water levels often affected fishing at the site. At a site visit to Lake Casitas in late January, a fisher noted that the water level there had increased 8.5 m (28 ft) during the previous two weeks, with poor fishing during this period. In early January, the water level in the Santa Clara River was nearly at road level at the Pacific Coast Highway bridge, posing potential flood danger or bridge washout. In other parts of the study area, roads were washed out or had landslides. Hence, it was important for survey team to get information on weather and road conditions prior to conducting a survey. In addition, due to contract constraints, field surveys had to be conducted between the hours of 8:00 AM and 5:00 PM. Many fishers are likely to fish earlier and/or later than this timeframe. Also, some sites were not

sampled if potentially unsafe conditions occurred at a site (in some cases due to persons at the site).

In 2004 and 2005, the County Sanitation Districts of Los Angeles County conducted weekly water quality surveys at NPDES permit determined sites in the Santa Clara and San Gabriel River (Philip J. Markle, CSDLAC, pers. comm., and data, Aug 6, 2006). These surveys were conducted during daylight hours, typically from 0900-1400, with 15-20 min being spent at a site. The presence of a fisher or fishers observed at a site at the time it was visited for water quality sampling was noted (but not the number of fishers) and reported in the NPDES monitoring reports. These observations provide additional information of presence or absence of a fisher or fishers for many sites sampled in this survey. In the CSDLAC surveys of 2005, fishers were not observed in 378 site visits to Santa Clara River reach 8 (at Saugus and Valencia sites). In the present (2005) study, fishers were not observed in 11 site visits to Santa Clara River Reach 8). In the San Gabriel River watershed, CSDLAC surveys in 2005, fishers were not observed in 159 site visits to San Gabriel River Reach 1, in 104 site visits to Coyote Creek, in 260 site visits to San Jose Creek, nor in 67 site visits to San Gabriel River reach 2. However, that survey observed fishers at 1 of 120 site visits to San Gabriel River Reach 3), in 1 of 265 visits to Rio Hondo Basin (at Whittier Narrows), and in 9 of 325 visits to San Gabriel River estuary. Similar rates of observation were seen at these sites in the 2004 data.

Results were similar in the present study of 2005, but with many fewer site visits. Fishers were not observed in 11 visits to Santa Clara River Reach 8 (Table 8). In the San Gabriel River watershed (Table 11), no fishers were observed in San Gabriel River Reach 1 (Lower) in 3 site visits, in Coyote Creek in 1 site visit, and in San Gabriel River Reach 3 (Upper) in 1 site visit. As in the CSDLAC survey, fishers were more frequently (54 in 8 visits) seen in the San Gabriel River Estuary (Table 11) than in the other stream reaches.

These data appear to support the finding in the present study that fishers are uncommon in coastal terrace streams (at least in the Santa Clara and San Gabriel River watersheds). However, it must be remembered that the focus of CSDLAC survey was to collect water quality samples as part of an NPDES monitoring program, not primarily to assess the extent of fishing in the area. In addition, the time spent at a site was much shorter (15-20 min) than in the present survey where a field team was instructed to spend about 4 hours at a site, although at least 1 hr of this was allowed for driving to the next site (Appendix D). Within the coastal terrace stream reach sites, which usually extended for several miles, the survey team would sample several locations within a stream reach site. Hence, they spent about 30 minutes per site before moving to another location within the assigned stream reach, and driving between two sites, which also took about 30 min. Prior to this survey, Dr. Camm C. Swift (Entrix) noted that he had observed fishers in the coastal terrace part of the Los Angeles River collecting Asian clam and red swamp crayfish for consumption. Fishers in our survey were not observed collecting Asian clams for consumption. One fisher at Conejo Creek said that he had caught red swamp crayfish for consumption in the past. None of the fishers observed or interviewed had caught frogs or turtles for consumption.

Characteristics of Fishers

In the present study in 2005, most (93%) of the fishers interviewed that consumed their catch were male, white (37%), 41-50 years old (26%), and refused to state their household incomes (39%), with the highest percentage (24%) of those providing information on incomes having household incomes greater than $50,000 per year (Figure 14). In the Santa Monica Bay study of 1991-1992, fishers were mostly male (93%), white (43%), 21-40 years old (54%), with 42% refusing to give annual household incomes and of those that gave this information, 39% had incomes of $25,000-$50,000 (Allen *et al*. 1996). Hence, the watershed fishers in 2005 appeared to be older and somewhat wealthier than Santa Monica Bay fishers of 1991-1992.

By ethnic groups, the highest percentage of fishers at river mouth/estuaries and at coastal terrace streams were Hispanic/Latino, whereas white fishers were the highest percentage of fishers at urban lakes, mountain streams, and mountain reservoirs (Figure 13). The highest percentage of African-American/Blacks fishers was at river mouth/estuaries and urban lakes, and the highest percentage of Asian fishers was at urban lakes and river mouth/estuaries.

In the present study, low income fishers (<$5,000 per year; possibly subsistence fishers) predominantly fished the Los Angeles River watershed and at the river mouth estuary (Table 12). The highest income (>$50,000) fishers predominantly fished the mountain streams and mountain reservoirs. Given that waterborne contaminants move downstream, the highest income fishers likely encountered lower levels of contamination in fish than did low income fishers fishing near the river mouth. However, low-income fishers may not be able to afford the cost of traveling to the mountains to fish and may find that fish species at the river mouth estuaries are more consistently caught (and hence provide dependable source of food) than fish at reservoirs and streams in the mountains.

Hence, although the Santa Monica Bay study was based on fishing in the marine environment, and the present study in watersheds, the results of the two studies can be compared. Both surveys were conducted for one year (January 1 to December 31, 2005 for the present study and September 1 1991 to August 30, 1992 for the Santa Monica Bay study). Whereas the present study assessed fishing and fish consumption in six watersheds and at five fishing areas (river mouth/estuaries, coastal terrace streams, urban lakes, mountain reservoirs, and mountain streams), the Santa Monica Bay study focused on Santa Monica Bay and on four fishing modes: piers and jetties, commercial passenger fishing vessels (party boats), private boats (survey conducted at boat launches), and beaches. In the Santa Monica Bay study, 2,376 fishers were censused (observed), 1,244 fishers were interviewed, and 555 of these provided sufficient information for consumption-rate calculations. In the present study, 1,243 fishers were censused (observed), 495 were interviewed, and 140 provided sufficient information for calculating consumption rates. These differences in survey success may in part represent the greater number and concentration of fishers fishing in Santa Monica Bay than in the watersheds. It may also reflect the more limited geographic range of the Santa Monica Bay survey area. Fishers at all fishing mode sites in the Santa Monica Bay area could be accessed linearly between Malibu and Los Angeles Harbor, whereas the present study extended

along the coast from the San Gabriel River estuary to the Ventura River estuary and inland to the mountain streams at the source of the Ventura, Santa Clara, Los Angeles, and San Gabriel Rivers. The watershed survey comprised a much larger area that was much more difficult to traverse for fishers and the survey teams of this study.

Fish Consumption Rates

As the methodology used in conducting both the Santa Monica Bay and the present fish consumption surveys were similar, the results should be comparable. This provides a basis for assessing differences in fishing and fish consumption in the ocean and in watersheds of north- central coast of southern California. As in the Santa Monica Bay fish consumption survey (Allen *et al*. 1996), the overall fish consumption rate distribution in the present study was strongly skewed to the right (Figure 15). The overall mean, median, and upper decile consumption rates in the present study were 34.9, 16.2, and 70.6 g/day, respectively (Table 14). In contrast, the mean, median, and upper decile consumption rates in the Santa Monica Bay study were 50, 21, and 107 g/day, respectively (Allen *et al*. 1996). Thus fish consumption rates among fishers fishing in watersheds of Ventura and Los Angeles Counties in 2005 were somewhat lower than among fishers fishing in Santa Monica Bay in 1991-1992. OEHHA (2001) recommended the mean, median, and upper decile consumption rates (in addition to 161 g/day for 95th percentile rate) from the Santa Monica Bay fish consumption study as default values for consumption of fish from both marine and freshwater in California. EPA's Clean Water Act Section 304(a) used 17.5 g/day, which is lower than the 34.9 g/day of the present study.

Within watersheds, the median consumption rate was highest (32.4 g/day) for the Los Angeles River and the highest upper decile rate (97.2 g/day) was for the San Gabriel River Watershed (Table 14). These were the two largest watersheds in urban Los Angeles County. By fishing area, the median consumption rate was highest (32.4 g/day) for river mouth/estuaries, with the upper decile rate highest (97.2 g/day) for urban lakes. For fish species in the present study, the highest median consumption rates were for yellowfin croaker (58.3 g/day), California halibut (51.8 g/day), and blue catfish (48.6 g/day) (Table 13). In the Santa Monica Bay fish consumption study, the median consumption rates of the most consumed species were lower -- 16 g/day for barred sand bass, kelp bass, rockfishes (*Sebastes* spp.), Pacific barracuda (*Sphyraena argentea*), and California halibut (Allen *et al*. 1996).

Although fishers were not observed at Mugu Lagoon by survey teams for this study, fishers were occasionally observed fishing in the surf zone at the mouth of Mugu Lagoon during the survey period by U.S. Navy biologists (Martin K. Ruane, U.S. Navy, Naval Air Weapons Station, Mugu Lagoon, CA, personal communication, 01/27/05). Species observed being caught there by fishers included leopard shark (*Triakis semifasciata*), gray smoothhound, shovelnose guitarfish (*Rhinobatos productus*), bat ray, surfperches (Embiotocidae), California halibut, California corbina, and barred sand bass. Fishing is not allowed in Mugu Lagoon due to its 303d listing and the access to the lagoon is not open to the public without special permission from the U. S. Navy.

Fishers represented at least 14 different ethnic groups with some fishers not providing information in their ethnicity. The no data group had the highest mean consumption rate (92.0 g/day) and the highest upper decile consumption rate (249.5 g/day). This group and African-American/Blacks had the highest median consumption rate (32.4 g/day) and highest lower decile rate (13.0 g/day).

Concluding Thoughts

As there have been no broad surveys of fishing and fish consumption in watersheds of Ventura and Los Angeles Counties, this study provides a first attempt to characterize the extent and distribution of fishing in this area. Due to the large area occupied by these watersheds and a one-year survey period, it was difficult to adequately characterize the extent of fishing and fish consumption in these watersheds. Hence, the results should be viewed as a broad-brush view of fishing in the coastal watersheds in these counties. Larger studies (in budget, staff, and years of sampling), will no doubt improve the understanding of extent of fishing in this area. The focus of analysis on results from fishing areas (estuaries, coastal terrace streams, urban lakes, mountain reservoirs, and mountain streams) in the six watersheds surveyed provides a perspective of potentially common habitats among watersheds, which would be more difficult to discern if the focus had been on watersheds alone. The low occurrence of fishers in the coastal terrace streams appears to be likely in many areas, in spite of the relatively low number of site visits to any one site in this fishing area.

The identification of fishing sites with high numbers of fish consumers as well as what species are being consumed can be used to assess health risks of human consumers of fish if the fish caught there are high in contaminants of concern. This would provide a reasoned approach to selecting species of concern for tissue contaminant analysis.

CONCLUSIONS

1. Fishing and fish consumption varies by watershed and fishing area in the Ventura and Los Angeles County watersheds.

    - Most fishing occurred in urban lakes and mountain reservoirs and least in coastal terrace streams.

    - Fishing in the Ventura River and Santa Clara River watersheds occurred primarily in mountain reservoirs

    - Fishing in the Los Angeles River occurred primarily in urban lakes and in the river mouth/estuary area.

    - Fishing was most widespread in the San Gabriel River, occurring commonly in urban lakes, mountain reservoirs, mountain streams, and the river mouth/estuary area.

    - Fishing was rarely or not observed in the Calleguas Creek and Malibu Creek watersheds.

2. Fish consumption rates were based on information from 140 fishers from 27 sites

    - Most fish consumers occurred at urban lakes of Los Angeles River and San Gabriel River watersheds and mountain reservoirs of the Ventura River and Santa Clara River watersheds.

    - At least 28 fish species were consumed by fishers in the study, with a median consumption rate of 16.2 g/day for all fishers over all species.

    - Overall, rainbow trout and channel catfish were most frequently consumed but bluegill and channel catfish had the highest consumption rates.

    - The fish consumption rates determined in this study can be used with information on contaminant concentrations in fishes to assess potential health risk to fishers.

ACKNOWLEDGEMENTS

This study is funded by the State Water Resources Control Board (SWRCB) (Grant Nos. SWRCB 02-202-250-0 and 06-430-140 [in part]); Los Angeles Regional Water Quality Control Board (LARWQCB); County Sanitation Districts of Los Angeles County (CSDLAC); and Santa Monica Bay Restoration Commission (SMBRC). We thank SWRCB contract managers William Reeves, Stephanie Rose, and Tom Kimball; Renee Purdy and Michael Lyons of LARWQCB; Heather Lamberson, Beth Bax, and Phil Markle of CSDLAC; Dr. Shelly Luce and Dr. Guangyu Wang of SMBRC, and Dr. Stephen B. Weisberg and Kenneth Schiff of the Southern California Coastal Water Research Project (SCCWRP) for their assistance in obtaining funds for this study. I also thank Stephanie Rose, Renee Purdy, Heather Lamberson, and Dwayne Maxwell (California Department of Fish and Game, CDFG) for their advice on the scope and details of the survey. We thank Brian Roney (Casitas Municipal Water District, Oak View, CA), Martin Ruane (U.S. Navy, Naval Air Weapons Station, Mugu Lagoon, CA), and Mark Subbotin (Newhall Land and Farming Company, Valencia, CA) for their assistance in obtaining permission us to conduct surveys at Lake Casitas, Mugu Lagoon, and Santa Clara River Reaches 7 and 8, respectively. We thank Dr. Camm Swift (Entrix), Phil Markle (CSDLAC), Mary Larson (CDFG), and Dwayne Maxwell (CDFG) for providing anecdotal information on fish and fishing in these watersheds. We also thank Margy Gassel of the Office of Environmental Health Hazard Assessment (OEHHA), Alyce Ujihara of California Department of Public Health (CDPH), Tom Kimball (SWRCB), Renee Purdy (LARWQCB), Phil Markle (CSDLAC), and Camm Swift (Entrix) for reviewing and providing valuable comments and suggestions on the draft report of this document.

Dr. M. James Allen (SCCWRP) was Project Manager and Principal Investigator of the study and was responsible for the overall organization and writing the draft and final reports. Dr. Allen and Erica Jarvis (at SCCWRP during most of the study, currently at CDFG, Los Alamitos). developed the survey design, survey protocol, census forms, and questionnaire for the survey. Jesus Reyes (SCCWRP/CSULB) translated the census forms and questionnaire from English to Spanish. Valerie Raco-Rands (SCCWRP) provided maps and pictures of fishes and other organisms for the survey documents, and the balsa wood fillet models for use in the fish consumption interviews. We thank our field survey team for their valuable effort in censusing and interviewing fishers at the more than 260 site visits during the survey. The field survey team included the following SCCWRP staff members: Greg Lyon, Dawn Petschauer, Jesus Reyes, Junice Uy, Darin Topping, Tom Mason, Erica Jarvis, Ryan Prevost, Heather Gliniak, Lisa Marie Surquia, Anthony Liaw, Michelle Budish, and Ben Lockhart. Greg Lyon, Dawn Petschauer, and Jesus Reyes conducted the most field surveys in the study. Survey team management and scheduling was conducted by Erica Jarvis. Data quality control and data entry were conducted by Erica Jarvis, Greg Lyon, Heather Gliniak, and Dawn Petschauer, and most data analyses were conducted by Erica Jarvis and Greg Lyon. We thank SCCWRP staff members Dario Diehl for safety instruction to survey team, Dr. Kerry Ritter for assistance in survey design and statistical analysis, and Jeffrey S. Brown for assistance in statistical analysis. We also thank Larry Cooper, Bruce Bealer, and Shelly Moore for their

assistance in database development and development of a user-friendly data entry tool; and Karlene Miller for document review and production.

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APPENDIX A: CENSUS FORMS AND QUESTIONNAIRES

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/574_Appendix_A.pdf

APPENDIX B: SAMPLING SITE INFORMATION AND MAPS

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/574_Appendix_B.pdf

APPENDIX C: FISH SPECIES IN STUDY AREA

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/574_Appendix_C.pdf

APPENDIX D: INFORMATION AND PROTOCOL FOR SURVEY TEAMS

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/574_Appendix_D.pdf

APPENDIX E: DATABASE DATA ENTRY GUIDELINES

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/574_Appendix_E.pdf

APPENDIX F: SURVEY SUCCESS

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/574_Appendix_F.pdf