Appendix G. Fish Consumption Studies

G.1 Summary

This appendix is a summary of all California fish consumption studies identified to date. Table G-1 lists studies that provide numeric fish consumption rates in a format that is conducive for deriving water quality objectives (expressed as a rate in in units of grams per day (g/day)). Table G-2 and Table G-3 (Section G.3) summarizes results related to subsistence fishing. Section G.3 also includes descriptions of other studies not included in Table G-1, because they did not report the same type of statistics as in Table G-1. Finally, Table G-4 summarizes the studies in terms of the fish species that were consumed, if studies reported such information.

G.2 Consumption Rates

Table 1 shows all California locally-caught sport fish consumption studies with rates expressed in grams per day, which is useful in deriving water quality objectives (studies with rates that could be easily converted to g/day are also included). Better studies have large sample sizes (roughly 1000 or more participants) and are well- documented. The San Francisco Bay Seafood Consumption Study (San Francisco Estuary Institute 2000), shown in bold in Table G-1, is probably one of the highest-quality studies done to date. This particular study provided the fish consumption rate of 32 g/day (1 meal per week), which has been used to represent fish consumption statewide. This rate was the basis of the site-specific objectives for mercury/methylmercury, as well as the Office of Environment Health Hazard Assessment's (OEHHA) choice of consumption rate for their Fish Contaminant Goal. The Santa Monica Bay study is another higher-quality study because of the high number of participants (>1000) and because of its detailed analyses. Other good studies are Shilling et al.'s 2005 Delta study (Shilling et al. 2009, Shilling et al. 2010) and 2014 Tribes study (Shilling et al. 2014), and Allen and colleague's 2005 Ventura and LA County Study (Allen et al. 2008). An additional 15 studies are included in Table G-1. These studies have one or more of the following limitations: a small number of participants, they have not yet been published, or they have not been written into a report form (some studies are just spreadsheets with no supporting information).

Additional notes about the data presented in this summary

Sport/locally-caught consumption data only

All data shown in the tables below is for sport fish/locally-caught only, except as noted in footnote "e" of Table G-1, for the 2005 Women's Health Survey (Silver et al. 2008). Commercial fish consumption rates are reported in many of the studies and many people who consume sport fish also report eating commercial fish; however this data is not shown in the tables. Commercial fish consumption is not the primary activity that the Provisions are meant to protect, but this information is considered as part of other sources of mercury exposure when the objectives are calculated (the "relative source contribution", see Appendix H).

Various statistics reported

Authors report fish consumption rates using a variety of measurements, making side-by-side comparisons difficult. Four types of measures are shown in the following tables: geometric means (geomeans), means (arithmetic means or "averages"), medians (50th percentile), or upper percentile (i.e.: 90th or 95th percentile). The United States Environmental Protection Agency (U.S. EPA) has recommended the use of higher values upper percentile values (i.e.: 90th or 95th percentile; U.S. EPA 2000) for water qualify objectives, and the Water Boards and OEHHA have used these upper percentile values for water quality objectives and fish contaminant goals. However, some studies only report estimates of the central tendency of the data (mean, median, geomeans). Generally, for fish consumption rates, geomeans and medians are lower than mean rates. This is because there are generally many more respondents with low consumption rates than with high consumption rates. For instance, in the San Francisco Bay study, the geomean was 0, the median was 0, the arithmetic mean was 6, and the upper 95th percentile was 32 g/day.

Two major differences in the calculation of rates

Many studies only ask about consumption during a specific time period in the past, for example the previous 30 days ("*recall*" studies). Some people who eat fish in general, will have happened to not eat fish during that period, resulting in consumption rates of zero. This can provide a confusing result of a consumption rate of 0 g/day for a population that says they eat fish. Furthermore, combining these consumption rates of zero with other data can artificially lower the overall consumption rates. Study authors deal with these data in different ways. In the San Francisco Bay, Contra Costa, and Sacramento River studies, rates of zero consumption for respondents who said they ate fish but not in the recall period were used together with the other data to calculate the final statistics. Other studies only used data from people who had eaten fish during the recall period as noted in tables below. However, this later approach can artificially raise consumption rates.

The San Francisco Bay study and the Santa Monica study were also *avidity-adjusted* so that the rates do not overestimate fish consumption. The avidity adjustment is an adjustment made to the consumption rate to account for bias because surveyors are more likely to encounter people who fish more often ("avid" fishers) rather than infrequent fishers. These avid fishers will have higher consumption rates (because they fish often), and since they are fishing often, the avid fishers are more likely to be surveyed. Therefore, these avid fishers will bias the final consumption rates to be higher. The consumption rates that are avidity-adjusted are lower than the non-adjusted rates. Besides the San Francisco Bay study and the Santa Monica study, no other studies appeared to be avidity-adjusted, although some authors make other adjustments (as noted in tables). On the other hand, there several factors why rates from surveys may be biased to underestimate true consumption, and therefore some authors choose not to adjust the rates further downward. For example, some fishers may not report all they really eat out of a concern for an actual or perceived infringement of fishing regulations. Also reluctance to report

actual consumption may come from a fisher's cautious attitude toward revealing personal information to the government or to people with a different cultural identity.

Table G-1. California Fish Consumption Surveys – Rates for Sport/Locally-Caught Fish

Survey (Source)	Target Population	Study Method[a], # Participants and/or # Consumers	Consumption Rates in g/day			
			Geomean	Median	Mean	Upper Level (percentile)
California Tribes (Shilling et al. 2014)	California Tribes: community members and tribe staff.	796 participants. Contemporary use: 30 day recall, 580 participants, (consumers and non-consumers) Traditional: Recall, number participants for traditional use 216.				Current: 142 (95th) 240 (99th) Traditional: 223 (95th)
2009-10 Gold Country Anglers (Sierra Fund 2011)	All anglers shore and boat ramps	Angler 30 day recall; 159 participants, 123 fish consumers			30	
2005-08 Delta (Shilling et al. 2010)	Shore anglers. Surveyed areas popular among anglers and had high mercury	Angler recall; 373 participants used for rates. Surveyed areas popular among anglers and areas with high mercury		17	27	127 (95th)
(Same as above)	Fishers in Asian community	137 community members		21	55	
2005 Ventura and LA Country (Allen et al. 2008)	All shore anglers	Angler creel/4 wk recall; 1243 fishers observed, 495 participants, 238 consumers, 140 used for rates		16	35	71 (90th)
2005 Women's Health Survey (Silver et al. 2008)	California women	30 day recall. Est. 700 sport consumers[e]. Results weighted to represent entire population of CA[e]	8			
2005 Delta angler pilot study (CDHS *unpublished*)	Shore anglers	Angler 30 d recall, 97 participants	22			
2005 Contra Costa Boaters (CCCPWD *unpublished*)	All boaters (not all boaters eat fish)	Angler recall, 1310 participants, 567 consumers. Rates from all participants				≥ 32 (95th) [I]
2004 Delta, low-income women (Silver et al. 2007)	low-income women	Low-income nutrition program participants, 30 d recall; 500 participants, 80 sport consumers	11			
2003 Sacramento River Anglers (CDHS *unpublished*)	All anglers: boat or shore	Recall 4 wk recall. 140 participants, 37 consumers. Rates estimated from data from all participants				≥ 32 (95th) [J]
1998-99 women in 12 states (Anderson et al. 2004) [b]	Women of childbearing age	Telephone survey, 12 mo. recall: 179 participants, 15 sport fish consumers (showing only CA results)		3[b]	8[b]	
1998-99 San Francisco Bay	**All anglers: boats and**	**Angler recall 4 wk; 1331 participants, 1152 consumers**	**0**	**0**	**6.3**	**32 (95th)**

Table G-1. California Fish Consumption Surveys – Rates for Sport/Locally-Caught Fish

Survey (Source)	Target Population	Study Method[a], # Participants and/or # Consumers	Consumption Rates in g/day			
			Geomean	Median	Mean	Upper Level (percentile)
(San Francisco Estuary Institute 2000)	**piers.**	**(1080 final rates)[f], 537 recent (4 wk) consumers. Avidity adjusted [g]**				
1992 Clear Lake[c] (Harnly et al. 1997)	Native American community	Community members, 6 mo. recall; 63 participants, 23 consumers			60	
1991-92 Santa Monica Bay[d] (Allen et al. 1996)	All anglers: boats and beaches	Angler recall; 1243 participants, 555 recent consumers (at least 1 meal/mo) used for rates. Data later avidity adjusted[g] (ATES/OEHHA 2000)		21 15[g]	50 31[g]	107 (90^{th}) 161 (95^{th}) [k] 85 (95^{th}) [g]
1988-89 San Diego Bay (San Diego County Department of Health Services 1990)	All anglers: boats, piers and shore	Angler recall; 369 participants, 59 year round consumers used for rates, adjusted[h]			31	73 (95^{th})
1980 Los Angeles (Puffer et al. 1982)	All anglers: boats, piers and shore	Angler creel; 1059 participants. Interviewed those with fish in hand. Used catch and frequency of fishing for rates, not recall.		37		225 (90^{th})

Notes:

[a] "Recall" generally involved asking participant about past consumption, e.g. in the past 4 weeks. Creel generally indicates the catch in possession at the time of the interview.

[b] Anderson et al. 2004 reports meals per yr. To convert to g/ day, the rate of 4 meals a month was assumed to equate to 32g/day (1 meal being about 8 oz). This study also presented rates for cooked fish, so rates will be lower (about 25% lower) than those for raw fish. Mercury objective will be for raw fish.

[c] Authors reported that advisories were in effects for Clear Lake and the 1991-92 Santa Monica Bay study, and likely in others areas too.

[d] Santa Monica is not an enclosed bay and some of the people used charter boats for ocean fishing. This data may not reflect freshwater/bay fishing, although state agency authorities argue freshwater fishing patterns are not that different (OEHHA 2001). Fish in hand were also counted in rates, which is atypical for these studies.

[e] The reference is a fact sheet more than a full report. In this fact sheet, it is not clear how many sport consumers there were. Authors report 3624 fish consumers (commercial and sport). The report also states that 84% of respondents ate commercial fish and 17% of respondents ate sport fish. To present this information in this summary it was assumed that commercial and sport fish consumption will overlap somewhat, and so approximately 20% of fish consumers ate sport fish, which equates to about 700 people. Also, the report states that the results were weighted to represent entire population of CA. It is not clear what effect this had or how this calculation was done.

[f] Rate calculations included people who ate fish in last 4 weeks and fish eaters who did not eat recently. This is a big difference in Santa Monica bay and other studies compared to the San Francisco Bay study. The San Francisco Bay study used data from people who ate fish in general, NOT just those who at fish in last 30 days (or 4 weeks).

[g] Avidity adjusted: adjusted to reduce bias from avid anglers (ATES/OEHHA 2000).

[h] Average consumption rates were based upon the subset of the population that caught and ate fish. These rates were adjusted to account for the percentage of interviewed anglers who had not caught fish at the time of the interview.

[i] Rates as g/day were not calculated. This report states that 8% ate ≥ 1 meal/wk, so 1 meal/wk or greater was roughly equated to the 95th percentile.

[j] Rates as g/day were not calculated. This report states that 5% of all anglers reported eating fish 4 or more times in the last 4 weeks. This was equated to a 95th percentile for this summary. Among the *fish consumers* (all anglers do not eat fish), 19% ate one meal per week or more. Any consumption in the last four weeks are defined as "high consumers" n= 37, (26%).

[k] Calculated by OEHHA 2001.

G.3 Subsistence Results

Taken as a whole, these studies generally indicate that some ethnic groups have higher fish consumption rates compared to the general population, but not always. The relationship between consumption and demographics seems to be particular to a water body or regional scale. Drawing conclusions about subsistence fishers was challenging because it is hard to define what exactly makes a person a subsistence fisher. Several studies examine fish consumption rates by ethnic group or income. Others define subsistence fishers simply as people with high rates of fish consumption.

Tables 2 and 3 examine the subsistence aspects of the studies listed in Table G-1. Both Table G-2 and Table G-3 report rates of consumption by ethnicity and/or income, but the studies in Table G-2 are larger, while those in Table G-3 are smaller pilot-type studies with sample sizes of roughly 100 participants. The studies that did not present information that could easily be tabulated are described in a list located below Table G-3.

Table G-1. Larger Fish Consumption Studies - Results for Income or Ethnicity

<table>
<tr><th>Survey (Source)</th><th>Target population of study and subsistence aspect</th><th>No. of Participants</th><th>Main Conclusions for Subgroups

Rates are for sport fish /locally caught only.</th></tr>
<tr><td>California Tribes (Shilling et al. 2014)</td><td>California Tribes</td><td>580 for contemporary

216 for traditional</td><td>The entire survey was on California tribes. The results showed this population consumed more fish than the population in many other surveys. The rate of fish use (frequency and consumption rate) was suppressed for many tribes compared to traditional rates, which most tribes attributed to primarily water quantity and quality issues. Contemporary: 142 g/day (95th) vs. Traditional: 223 g/day (95th), with a statistically significant difference in the frequency distribution.

By tribe, the 95th percentile rates of consumption of caught-fish varied ranged between 30 g/day (Chumash) and 240 g/day (Pit River).

Rates broken down by Regional Water Board:

<table>
<tr><th>Region (n)</th><th>Salmon (95th)</th><th>Caught Fish (95th)</th></tr>
<tr><td>North Coast (107)</td><td>119</td><td>162</td></tr>
<tr><td>Central Valley (288)</td><td>43</td><td>83</td></tr>
<tr><td>Lahontan (135)</td><td>20</td><td>72</td></tr>
<tr><td>Central Coast (12)</td><td>8</td><td>30</td></tr>
</table>
</td></tr>
<tr><td>2005-08 Delta (Shilling et al. 2010)</td><td>All anglers, broken down by ethnicity

Asian community members (separate)</td><td>373 participants used for angler rates.

137 community members</td><td>Native American and whites had the lowest rates (means of 7 and 24 g/day respectively; and 95th percentile for whites of 139 g/day), while Lao had the highest average rate of 58 g/day and a 95th percentile rate of 310 g/day. However, differences were not statistically different. Mean for all 373 participants was 27 g/day and the 95th percentile was 127 g/day. The 95th percentile for all Southeast Asians (286 people including the community members separately) was 129 g/day.

The mean consumption rate for the Asian community member survey was 55 g/day.</td></tr>
<tr><td>2005 Ventura and LA Country (Allen et al. 2008)</td><td>All anglers, broken down by ethnicity</td><td>1243 fishers observed, 495 participants, 238 consumers, 140 used for rates</td><td>African American and “no data” had high rates compared to White and Hispanics were in the middle (tabulated below). For other groups too few individual were surveyed.

<table>
<tr><th>Ethnic Group (N)</th><th>Mean</th><th>Median</th><th>Upper Perc.(90th)</th></tr>
<tr><td>No Data (7)</td><td>92</td><td>32</td><td>250</td></tr>
<tr><td>African American/Black (27)</td><td>42</td><td>32</td><td>97</td></tr>
<tr><td>Latino/Hispanic (31)</td><td>31</td><td>16</td><td>51</td></tr>
<tr><td>White, Non-Hispanic (52)</td><td>28</td><td>16</td><td>56</td></tr>
<tr><td>All anglers</td><td>35</td><td>16</td><td>71</td></tr>
</table>
</td></tr>
</table>

Table G-1. Larger Fish Consumption Studies - Results for Income or Ethnicity

Survey (Source)	Target population of study and subsistence aspect	No. of Participants	Main Conclusions for Subgroups Rates are for sport fish /locally caught only.
1998-99 San Francisco Bay (San Francisco Estuary Institute 2000)	All anglers, broken down by ethnicity, income, education, fishing mode	1331 participants, 1152 consumers (1080 used for final rates), 537 recent (4 wk) consumers. Avidity adjusted[8]	Income, education and fishing mode (boat or shore) were not good predictors of rates. There are some differences by ethnicity- 49% of Asians and 24% of Caucasians were above advisory, while 26% of Asians and 46% of Caucasians were below advisory. "Above advisory" equated to more than two meals per month, with meal size adjusted for body weight. (Rates for ethnicity were calculated for *recent* consumers (who ate fish in the previous 4 weeks), but the final results were calculated for *all* consumers, so the values for "Overall" do not match those shown in Table G-1.) **Group (n)** — **Geomean** — **Upper Percentile (95h)** African American (41) 18 23 Latino (52) 13 17 Caucasian (158) 12 14 Asian: all subgroups (190) 15 18 Chinese (26) 15 23 Filipino (70) 17 23 Vietnamese (51) 15 19 Pacific Islander (12) 22 45 Other Asian (31) 13 18 Other (7) 28 55 **Overall** (448) 14 15
1991-92 Santa Monica Bay (Allen et al. 1996, SCCWRP and MBC 1994)	All anglers, broken down by ethnicity, income	1243 participants, 555 recent consumers (at least 1 meal/month) used for rates	Consumption rates similar across income (40-59 g/day) with the highest income earners having the highest consumption rate. According to ethnic group break down, consumption was highest for 'other' followed by white (tabulated below). **Ethnicity (n)** — **Mean rates** — **Upper Percentile (90th)** White (217) 58 113 Hispanic (137) 28 64 Black(57) 49 87 Asian(122) 51 116 Other (14) 137 174 All anglers (555) 50 161
1980 Los Angeles (Puffer et al. 1982)	Anglers. Results broken down by ethnicity	1059 consumers	Median consumption rates: Asian/Samoan: 71 g/day Whites: 46 g/day Mexican-Americans: 33 g/day Blacks: 24 g/day

Table G-2. Smaller Fish Consumption Studies - Results for Income or Ethnicity

Survey (Source)	Target Population / Subsistence Aspect	No. of Participants	Main Conclusions for Subgroups Rates are for sport fish /locally caught only, unless noted.
2009-10 Gold Country Anglers (Sierra Fund 2011)	Survey fishing spots were chosen based on likely use by low income anglers, proximity to low-income communities, and absences of entrance fees.	159 participants , 123 fish consumers	No subgroups, but likely to include many low income participants. Mean rate: 30 g/day
2005 Delta angler pilot study (CDHS *unpublished*)	Shore anglers. One goal of study was to look at demographic differences and consumption rates	97 participants,	Blacks had the highest sport consumption: All groups: Geomean 22 g/day White: Geomean 17 g/day Black: Geomean 38 g/day
2004 Delta, low-income women (Silver et al. 2007)	low-income women	500 participants, 80 sport consumers	Minorities are more likely to eat sport fish, eat more sport fish, and are 2 – 3 times more likely to exceed consumption advisories.
2003 Sacramento River Angler Survey (CDHS *unpublished*)	All anglers: boat or shore, conducted by boat Results broken down by ethnicity	140 participants 37 "high consumers"	Any consumption in the last four weeks was defined as "high consumers" The ethnicity of "high consumers" is similar to all anglers. Yet, Hmong made up half the respondents who ate fish once per week or more often, although the n was very small (n=7).
1992 Clear Lake, CA[2] (Harnly et al. 1997)	Californian Tribal community members near Clear Lake	63 participants, 23 consumers	60 g/day mean rate for Clear Lake Tribes

Studies from Table G-1 that seem to address subsistence, but were not included in Table 2 or Table 3

The reason why these studies were not included in Tables 2 or 3 is described below. More details on the studies may be found in Table G-1.

2005 Women's Health Survey (Silver et al. 2008)
Data was broken down by ethnicity, but included commercial fish. There were 3,624 fish consumers, 17% of which ate sport fish. For all consumers, ethnicity was also a strong predictor of sport fish consumption (P = .01) among White (7 g/day), Black/African Americans (11 g/day), Hispanics (9 g/day), and Asians/Others (9.5 g/day).

2005 Contra Costa Boater Survey (CCCPWD unpublished)
This was a boater Survey with 1310 participants. The study included no ethnicity or income information and no rates in the typical manner (units of g/day). A small portion of participants (8%) reported consuming more than 1 meal per week.

1998-99 Women in 12 States (Anderson et al. 2004)
This study included 75% Caucasian participants and a variety of income, but results were not reported or broken down into ethnic/income sub categories. There were not that many participants: 179 participants, 82 fish eaters, 15 people ate 'sport fish'

*1988-89 San Diego Bay (*San Diego County Department of Health Services *1990, OEHHA 2001)*
In this study, the sample sizes were inadequate to break down by sub groups. There were 369 participants, but data from only 59 participants were year round consumers and only those data were used to calculate consumption rates.

G.4 Other Fish Consumption Studies

These additional studies did not include a fish consumption rate (and not enough information was provided to calculate one from the report). Therefore, these studies were not included in Tables G-1 through 3.

Survey of Fishers on Piers in San Diego Bay (Environmental Health Coalition 2005)
The survey population of 109 fishers from South Bay piers was primarily people of Latino or Filipino descent, with smaller numbers of Native American, African American, and European Americans. Of all of the fishers surveyed: 25% fish daily or almost daily (4 to 7 times a week), while 31% fish weekly. Most fishers (61%) eat the fish they catch, and 73% of fishers eat other types of seafood in addition to what they catch.

Fish Consumption and Methylmercury Contamination in Contra Costa (Ma'at Youth Academy)
This study does not report consumption rates per se, but it discusses the fishing habits and the frequency that the catch is eaten among the local population in Contra Costa County, including some highly contaminated fishing spots. The authors report that 73% of all respondents (n = 105) eat some or all of the fish they catch from local fishing spots. Many anglers (57%)fish at the surveyed fishing spot (Richmond Harbor or San Pablo Reservoir) between 1-3 times per month (n = 96). Forty-three percent (43%) of those surveyed, however, fish at this location four or more times per month. Many anglers indicated that they also frequently fish in other local

spots, with 50% of them fishing there between 1-3 times per month, and 50% four or more times per month (n = 98). Species information is also provided.

State of the River 2: The Fish Study (Friends of the Los Angeles River 2008)
The aim of the study was threefold: 1) survey fish present in LA River (with seines); 2) gauge fish health; and 3) interview anglers about their fishing practices. The following species were caught by seine (number caught indicated in parentheses): mosquitofish (668), tilapia (271), green sunfish (92), fathead minnow (83), carp (58), black bullhead (24), Amazon sailfin catfish (7), largemouth bass (1). This study does not indicate that people eat these fish, but is a representation of the fish present in the River. No known native species were collected.

Several anglers (16) were interviewed and the results were presented in a narrative form. The authors divided anglers into two categories: 1) fly fishermen, mostly "Anglo," who mostly practice catch and release, and 2) "subsistence fishermen," who were mostly Latino. Subsistence fishers were defined in the report as fishermen who eat the fish. There was not a discussion of economic need, although the authors report that one fisherman sells his catch to a lady in the Frogtown neighborhood, and another said he sells the fish in Chinatown for fifty cents a pound. The report goes on to describe the habits of fly fishers and subsistence fishers. There has been a somewhat surprising recent surge of interest in fly fishing for carp in the LA River. Subsistence fishers are generally less willing to talk to interviewers. Many anglers report being asked by police to leave or being cited for violating an L.A. City code that forbids loitering along the river. To date, however, every such case that has come before a judge has been immediately thrown out.

Fish Contamination: Environmental and Health Risk (Brown-Williams 2008)
This is not a fish consumption survey, but outlines impacts on communities who fish in contaminated waters. This report also presents data from Silver et al. 2007.

G.5 Fish Species Information from Fish Consumption Surveys

Table G-4. Fish Species Consumed and Trophic Level (TL)

Survey (Source)	Species (percent of respondents who ate this species)	TL*
California Tribes (Shilling et al. 2014)	Tribes used 26 freshwater/anadromous fin-fish species, 23 marine fin-fish species, and 18 other invertebrate, and plant species and groups of species. The single most commonly caught and/or eaten fish species group among all tribes was "salmon", which could include chinook or coho salmon. Catfish and trout were also important as well as smaller amounts of bass, perch, bluegill, carp, and sucker and many other species in smaller amounts (see report).	3,4,3, 4,3,3,3,4 (and many others see report)
Gold Country Anglers 2009-10 (Sierra Fund 2011)	Rainbow/brown trout (77%), any species of bass(65%, largemouth bass 47%, striped bass 45%, small mouth bass 39%) catfish/bullhead (39%), Kokannee (39%), Crappie (28%), Crawdads (26%), sunfish/bluegill (24%), chinook (12%), other (11%), sturgeon (11%), clams(11%).	3/4,4, 4/3,3,4, 3,3,3, (NA),4,2
Delta (Shilling et al. 2010)	"Creel survey data collected by the California Department of Fish and Game (CDFG) indicate that the primary target fish species for all anglers, regardless of ethnicity, in the Northern region of the Central Valley Delta were striped bass, salmon, shad, and catfish (Murphy et al. 1999, 2000; Schroyer et al. 2001)." Summarizing tabulated information on preferences: Striped bass and catfish most popular, while sturgeon, sunfish, Chinook, largemouth bass, and carp were also in the top angler choices.	CDFG Creel: 4,3,3,4 This study: 4,4, 4,3,3,4,3,
Ventura and LA Country (Allen et al. 2008)	"Stocked rainbow trout, channel catfish, bluegill, and common carp were the most frequently consumed species."	3,4,3,3
Delta, low-income women (Silver et al. 2007)	"The most common sport fish species that women reported ever consuming were catfish (43% of 158 sport fish consumers), striped bass (38%), salmon (25%), bluegill/perch (21%), crawdad/crayfish (18%), crab (17%), and trout (17%).	4,4,3,3,3, 3,3
Delta angler pilot study 2005 (CDHS *unpublished*)	catfish (72%), striped bass (72%), bluegill (49%), and largemouth bass (45%), although there were some differences in species consumption by ethnic group.	4,4,3,4
Contra Costa Boater Survey 2005 (CCCPWD *unpublished*)	Striped Bass (39%), Catfish (26%), Sturgeon (20%), Salmon (15%), Black Bass (12%), and 1% or less of Crappie, Bluegill/Sunfish, Crawdad, Sucker, Shark, Trout.	Top 5: 4,4,4,3,4

Survey (Source)	Species (percent of respondents who ate this species)	TL*
Sacramento River Angler Survey Report 2003 (CDHS *unpublished*)	Anglers most often reported striped bass (39% of anglers) and king salmon (25% of anglers). High consumers most often reported consuming either catfish (30%), striped bass (26%), or carp (17%) in the previous 4 weeks. There were differences in target species by fishing method and ethnicity. Boat anglers most often targeted king salmon (49%), but only 8% of shore anglers targeted this species (Table 7). Shore anglers most often targeted striped bass (43%) followed by "any" species (24%). Boat anglers also targeted striped bass (33%). Only 5% of boat anglers targeted "any" species. Over 80% of Caucasian anglers targeted king salmon (45%) or striped bass (36%) (Table 8). Asian/Pacific Islander (API) anglers mostly targeted striped bass (40%) or "any" species (26%)	All: 4,3 High consumer: 4,4,3
San Francisco Bay (San Francisco Estuary Institute 2000)	Top 5 species consumed (% recent consumers reporting consumption): Striped bass (54%), halibut (24%), jacksmelt (17%), sturgeon (17%), white croaker (16%). Also black perch, leopard shark, salmon, brown rockfish, walleye surfperch, shiner surfperch, Pacific Sandabs, Smoothhound Shark, Pacific Sardines. Consumption practices for white croaker, leopard shark, and striped bass were of particular interest due to the higher levels of contaminants found in these species (organochlorine compounds in white croaker, and mercury in leopard shark and striped bass).	Top 5: 4,4,3,4,4
1992 Sulphur Bank Mercury Mine/ Clear Lake, CA (Harnly et al. 1997)	Species consumed (% recent consumers reporting consumption): Catfish (83%), hitch (17%), perch (17%), bass (9%), carp (4%)	4 3,3,4,3
1991-92 Santa Monica Bay Seafood Consumption (Allen et al. 1996, SCCWRP and MBC 1994)	Species with consumption rates: Chub mackerel, barred sand bass, kelp bass, rock fishes, Pacific bonito, white croaker, Pacific barracuda, California halibut, surfperches, jacksmelt (Allen et al. 1996).	3,4,4,4,4, 4,4,4,3,3
Fish Consumption and Methylmercury Contamination In Contra Costa County (Ma'at Youth Academy)	Anglers reported (n=105) that they most frequently catch bass (70%), trout (58%), and catfish (47%). Other species caught with moderate frequency are salmon (31%), halibut (26%), perch (19%), and kingfish (15%).	Frequent: 4,3,4 Moderate: 3,4,3,(NA)

*TL notes the Trophic Level from Table G-5. NA: not applicable or could not be determined from given information.

Table G-5. Trophic Level Categories for Fish Species

Trophic Level 3 (TL3)	Trophic Level 4 (TL4)
Freshwater Fish	
Bullhead (Brown, Black)	Crappie (Black, White, > 150 mm)
Bluegill	Catfish (White, Channel, > *200mm*)
Carp	Largemouth Bass
Crayfish/Crawdad	Sacramento Pikeminnow
Hitch	Smallmouth Bass
Kokannee	Spotted Bass
Perch	Striped Bass
Pumpkinseed	
Rainbow Trout	
Redear Sunfish	
Sacramento Sucker	
Salmon (Chinook or Coho)	
Tule Perch	
Estuarine Fish	
American Shad	Barred Sand Bass
Black Perch	California halibut
Chub Mackerel	Kelp Bass
Crabs	Leopard Shark
Crayfish	Pacific Bonito
Jacksmelt	Pacific Barracuda
Opaleye	Rockfish (Brown)
Pile Perch	Spotted Sand Bass
Surfperch (Rainbow, Shiner)	Striped Bass
Striped Mullet	Sturgeon
	White Croaker
	Yellowfin Croaker

Sources: Most freshwater TL classifications from the Delta methylmercury TMDL staff report (Table B1, Central Valley Water Board 2010). Catfish and crappie are TL3 if > 200 mm. Since the human health objective will apply to a specific size of fish (150mm at minimum) and most fish caught by SWAMP are well above this size, these species were categorized as TL4. Estuary species classifications partly from Davis et al. 2012. Also, for estuarine species, the San Francisco Bay TMDL Staff Report (San Francisco Bay Water Board 2006) was used for species in the San Francisco Bay Study: jacksmelt was trophic level 3, and striped bass, halibut, sturgeon, and white croaker were trophic level 4. American shad eat mostly invert and fish larvae according to Moyle (2002), so shad were characterized as TL3. Salmon (data often do not refer to a specific type of salmon) were also categorized as TL3. Crayfish and crabs were classified as TL3. In the USFWS wildlife analysis (USFWS 2003, p 29), some species were classified as TL3, but some TL2. U.S. EPA classified crabs as TL 3.3 (U.S. EPA 1995). Clams were classified as TL2.

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