HEALTH ADVISORY AND GUIDELINES FOR EATING FISH FROM MISSION BAY (SAN DIEGO COUNTY)

October 2013

Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

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LIST OF ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife, formerly the California Department of Fish and Game
CFCP	Coastal Fish Contamination Program
DDTs	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyl-dichloroethylene (DDE)
MDL	method detection limit
mm	millimeter
OEHHA	Office of Environmental Health Hazard Assessment
PCB(s)	polychlorinated biphenyls (as congeners)
ppb	parts per billion
NOAA	National Oceanic and Atmospheric Administration
RecFin	Recreational Fisheries Information Network
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
USEPA	U.S. Environmental Protection Agency

PREFACE

The Office of Environmental Health Hazard Assessment (OEHHA), a department within the California Environmental Protection Agency, is responsible for evaluating potential public health risks from chemical contamination of sport fish. This task includes issuing health advisories, when appropriate, for the State of California. OEHHA's authorities to conduct these activities are based on mandates in the:

- California Health and Safety Code
  - Section 59009, to protect public health; and
  - Section 59011, to advise local health authorities.

- California Water Code
  - Section 13177.5, to issue health advisories.

The health advisories are published in the California Department of Fish and Wildlife Sport Fishing Regulations booklets under the "Public Health Advisory on Fish Consumption" section.

This report presents guidelines for eating fish from Mission Bay in San Diego County, California. It provides background information and a description of how the guidelines were developed. The resulting advice is summarized in the two illustrations after the Table of Contents.

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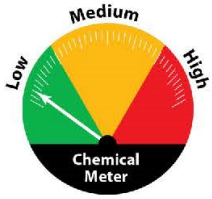
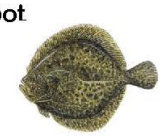
Women 18-45 years and children 1-17 years



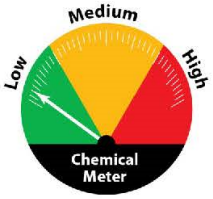
Diamond turbot



Spotted turbot

Opaleye

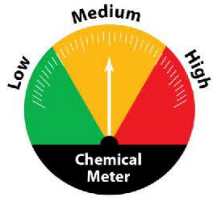
Topsmelt



Shiner perch

Black perch
White seaperch
Rainbow seaperch

Striped mullet



Spotted sand bass

Brown smoothhound shark

Yellowfin croaker

6-7 servings a week	OR	3 servings a week	OR	1 serving a week except 2 servings a week of yellowfin croaker

Eat only the skinless fillet.

PCBs are in the fat and skin of the fish.

- Remove and throw away the skin before cooking.
- Cook thoroughly and allow the juices to drain away.

What is a serving?

For Adults For Children

The recommended serving is the size and thickness of your hand. Give children smaller servings.

Why eat fish?

Eating fish is good for your health. Fish have Omega-3s that can reduce your risk for heart disease and improve how the brain develops in unborn babies and children.

What is the concern?

Some fish have high levels of mercury or PCBs. Mercury can harm the brain, especially in unborn babies and children. PCBs can cause cancer.

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A Healthy Guide to Eating Fish from Mission Bay

Women over 45 years and men can safely eat more fish

Diamond turbot

Spotted turbot

Opaleye

Black perch
White seaperch
Rainbow seaperch

Topsmelt

Yellowfin croaker

Shiner perch

Spotted sand bass

Striped mullet

Brown smoothhound shark

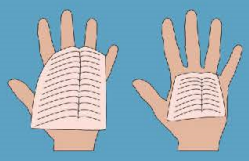
7 servings a week OR **5 servings a week** OR **3 servings a week**

Eat only the skinless fillet.

PCBs are in the fat and skin of the fish.

- Remove and throw away the skin before cooking.
- Cook thoroughly and allow the juices to drain away.

What is a serving?



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INTRODUCTION

This report presents guidelines for eating fish from Mission Bay, a saltwater bay, about 6 miles north of San Diego Bay in San Diego County (Figure 1). It provides background information and a description of how the consumption advice was developed. The recommended advice is the maximum number of servings per week for each fish species evaluated.

Mission Bay was originally called the "False Bay", an estuary outlet for the San Diego River[1]. It was created in 1852 when the U.S. Army built a dike along the south side of the river to prevent the river from shifting back to San Diego Bay. After the dike failed, the city of San Diego constructed a dam and levees to direct the river flow to the Pacific Ocean. Two creeks, Rose Creek and Tecolate Creek, drain into the bay. Mission Bay is now part of the Mission Bay Park, a man-made 4,000 acre tourist and recreational park created in the 1940s. Mission Bay is less industrialized than San Diego Bay. Houses, hotels, parks, and a major tourist attraction, Sea World San Diego, surround the Bay. Recreational amenities in Mission Bay Park include walking and jogging paths, playgrounds, camping sites, and marinas.

FIGURE 1. LOCATION OF MISSION BAY IN SAN DIEGO COUNTY, CALIFORNIA

[1] http://www.sandiego.gov/park-and-recreation/parks/missionbay/
http://sdfish.com/bays/mission-bay

Fishing is permitted in almost all areas of Mission Bay, including along the shore, except for certain marked swimming and sailing areas. Common sport fish caught in Mission Bay include jacksmelt, surfperch, spotted sand bass, bat ray, turbot, and yellowfin croaker. Other species that may be found in the bay include halibut, bonito, barracuda, calico bass, leopard shark, sculpin, and shortfin corvina (Stienstra, 2012; "sdfish" web site[2]). There is a legal size limit of 14 inches or longer for spotted sand bass. When smaller than 14 inches, spotted sand bass cannot be kept when caught (California Department of Fish and Wildlife; CDFW, 2013-2014).

Some areas of Mission Bay are listed under the Federal Clean Water Act Section 303(d) of impaired water bodies because of chemical (copper or lead) and biological (fecal coliforms) contamination (State Water Resources Control Board; SWRCB, 2012). Potential sources of contamination to Mission Bay are: sewage spills and discharge, urban runoff, and leaks from industrial activities. There is an old 120-acre landfill near Pacific Passage, on the south side of the bay, and it accepted municipal and industrial wastes from 1953 to 1959 (San Diego News, 2007). When it was closed, the site was covered with a cap made up of leftover material from the dredging of Mission Bay.

The results from two major monitoring studies on chemical contaminants in fish conducted through the Coastal Fish Contamination Program (CFCP) and the Surface Water Ambient Monitoring Program (SWAMP) coastal survey study provided sufficient sampling of representative fish species for the Office of Environmental Health Hazard Assessment (OEHHA) to develop this advisory for Mission Bay. The basic OEHHA process to develop consumption advice involves these steps:

1. Select the chemical data and fish species to be evaluated
2. Calculate average (mean) chemical concentrations and other descriptive statistics as appropriate for each fish species
3. Compare the chemical concentrations with the OEHHA Advisory Tissue Levels (ATLs) for each chemical of concern

OEHHA developed ATLs (Appendix I) that are acceptable exposure levels of specific contaminants in fish tissue based on the toxicity of each chemical for a range of consumption rates. Development of the ATLs also included consideration of health benefits linked to eating fish (Klasing and Brodberg, 2008).

[2] http://sdfish.com/bays/mission-bay

CHEMICALS OF POTENTIAL CONCERN

Fish samples from Mission Bay have been analyzed for mercury (as a measure of methylmercury), polychlorinated biphenyl congeners[3] (PCBs), and the persistent pesticides dieldrin, chlordane, and dichlorodiphenyltrichloroethane and its metabolites (DDTs).

Mercury, a metal, is widely found in nature in rock and soil. Its presence in the aquatic environment is primarily the result of mining activities and releases into the environment from industrial sources, including the burning of fossil fuels and solid wastes. Under the proper conditions, mercury in the sediment is transformed by bacteria to the more toxic organic form, methylmercury. Methylmercury is then absorbed by fish when they eat smaller aquatic organisms. High levels of methylmercury can cause subtle, adverse changes in the brain, especially in fetuses and children as they grow.

PCBs are man-made chemicals previously used in electrical transformers, plastics, and lubricating oils. While PCBs were banned for use in the 1970s, they persist in the environment because they do not break down easily and can accumulate in fish. PCBs can cause cancer and other health effects in humans. Chlordanes, DDTs, and dieldrin are pesticides that were banned from use many years ago but have been found in some fish in certain water bodies in California. These chemicals may cause cancer or other adverse effects on the nervous system. Detailed discussion of the toxicity of these chemicals is presented in Klasing and Brodberg (2008).

DATA SOURCES

The guidelines for eating fish from Mission Bay were based on chemical analysis of fish samples by the two programs described below. These studies had adequate documentation of sample collection, fish preparation, chemical analyses, and quality assurance, and detection limits below levels of health concern. Fish were collected from various locations within Mission Bay as shown in Figure 2. Table 1 shows the scientific name and common names of fish species in the Mission Bay dataset. Data for some species may be combined later in the data evaluation as a single group based on their taxonomy (i.e., they are in the same family or genus). The table also shows the projects under which the samples were collected, as well as the years of sampling.

[3] Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54 are generally reported.

Figure 2. Sampling Locations in Mission Bay

Sampling locations were: (1) Crown Point, (2) Bahia Point, (3) Mission Bay-SWAMP, (4) Sunset Point, (5) Mission Bay-CFCP, (6) Jetty/ South Side, and (7) Pacific Passage. Figure constructed using Earth Point at http://www.earthpoint.us/ExcelToKml.aspx#GoogleEarthIcons

TABLE 1. FISH SPECIES SAMPLED FROM MISSION BAY

Scientific Name		Common Name	Project	Year Sampled
Family	**Genus species**			
Atherinidae	*Atherinops affinis*	Topsmelt	SWAMP	2009
Embiotocidae	*Amphistichus argenteus*	Barred Surfperch	CFCP	1999
	Cymatogaster aggregata	Shiner Perch	CFCP SWAMP	2001, 2002 2009
	Embiotoca jacksoni	Black Perch	CFCP	2002
	Hypsurus caryi	Rainbow Seaperch	CFCP	2001
	Phanerodon furcatus	White Seaperch	SWAMP	2009
Kyphosidae	*Girella nigricans*	Opaleye	CFCP	2002
Mugilidae	*Mugil cephalus*	Striped Mullet	CFCP	2002
Pleuronectidae	*Pleuronichthys guttulatus*	Diamond Turbot	CFCP	2002
	Pleuronichthys ritteri	Spotted Turbot	CFCP	2002
Sciaenidae	*Umbrina roncador*	Yellowfin Croaker	CFCP SWAMP	1999, 2002 2009
Serranidae	*Paralabrax maculatofasciatus*	Spotted Sand Bass	CFCP SWAMP	2002 2009
Triakidae	*Mustelus henlei*	Brown Smooth-hound Shark	CFCP	1999, 2002

COASTAL FISH CONTAMINATION PROGRAM (CFCP)

The Coastal Fish Contamination Program was a statewide monitoring program of chemical contamination in sport fish and shellfish in nearshore (marine and estuarine) waters in California (Gassel et al., 2002). The CFCP was conducted by SWRCB in consultation with OEHHA to provide data for assessing human health risks from fish consumption. The program began as a result of legislation (Assembly Bill 2872; California Water Code § 13177.5) enacted in 2000 and continued five years until it was halted due to budget constraints. Fish from Mission Bay were collected in years 1999 through 2002.

SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP)

SWRCB operates the Surface Water Ambient Monitoring Program, a program which monitors water quality of California's surface waters (Davis et al., 2012). In 2009 and 2010, the program performed a statewide coastal fish survey. Fish from Mission Bay were sampled in 2009.

CHEMICAL CONCENTRATIONS

CHEMICAL ANALYSIS

Most fish samples were prepared as skinless fillets for analysis of mercury, PCBs, and pesticides. Some samples of shiner perch and all turbot (diamond turbot and spotted turbot) samples were analyzed as whole fish (without head, tail and guts) with skin on. For shiner perch, OEHHA compared the results for samples analyzed as skin-off fillets and skin-on whole bodies, as discussed in the next section of the report.

The samples were analyzed as individual fish or as composite samples from a species. Composite samples are prepared from equal amounts of tissues from several individual fish, all of the same species. Composite sampling is usually done for samples to be analyzed for organics to reduce the cost of analyses. The analytical result from a composite sample represents an average concentration. All results were reported in wet weight.

For total mercury, the samples were combusted and analyzed by direct mercury analyzer at the CDFW Moss Landing Marine Laboratories. Samples from all species were analyzed for PCBs, while a few species were analyzed for DDTs, dieldrin, and chlordane at the CDFW Water Pollution Control Laboratory. The specific chemicals were: total PCBs (congeners); total chlordanes including cis-chlordane, trans-chlordane,

cis-nonachlor, trans-nonachlor, and oxychlordane; total DDTs including o,p' and p,p' DDT, o,p' and p,p' dichlorodiphenyldichloroethane (DDD), and o,p' and p,p' dichlorodiphenyl-dichloroethylene (DDE); and dieldrin. Organic analytes were detected by gas chromatography. The method detection limits (MDLs)[4] are listed in Table 2.

TABLE 2. METHOD DETECTION LIMITS (PARTS PER BILLION, PPB)

Chemicals	CFCP	SWAMP
Mercury	12	12
PCBs	0.2	0.299
Chlordanes	2	0.472
DDTs	5	0.478
Dieldrin	2	0.43

CONCENTRATION CALCULATION

Results selected for calculations were those from samples that met CDFW's legal size requirement (spotted sand bass) or OEHHA's criteria for minimum "edible" size. OEHHA used species size at maturity, catch data from the Recreational Fisheries Information Network (RecFin[5]), and professional judgment to determine minimum size criteria (Gassel and Brodberg, 2005). For composite samples, the total fish length (in millimeters, mm)[6] of the smallest fish in the sample was at least 75% of the length of the largest fish in the composite. An exception was made for topsmelt (composite ratio of 0.64) because there was only one composite sample.

OEHHA used the arithmetic mean (average) concentrations of selected samples for each chemical as the representative mean chemical concentration to estimate human exposure. The means were computed (weighted) by taking into account the number of fish in each composite sample. For the calculation of mercury concentrations in fish tissue, OEHHA assumed all total mercury detected was methylmercury, the more toxic form that is present in fish, because nearly all mercury present in fish is methylmercury (Wiener et al., 2007). There was one sample of rainbow seaperch below the detection level of mercury. This sample was assumed to have no residue. Table 3 shows the weighted mean total fish lengths and mean mercury concentrations for each fish species collected from Mission Bay.

[4] The MDL is the lowest concentration of a chemical that can be distinguished (as greater than zero) in a sample.

[5] http://www.recfin.org

[6] Total length refers to the length from the tip of the snout to the tip of the longer lobe of the caudal fin. Fork length refers to the length from the tip of the snout to the end of the middle caudal fin rays.

TABLE 3. MERCURY CONCENTRATIONS IN FISH FROM MISSION BAY

Fish Species[a]	Number of Samples	Number of Fish[b]	Mean Total Length[c] (mm)	Mean Mercury[d] (ppb)	Range of Mercury (ppb)
Brown Smoothhound Shark	9	9	702	179	84-279
Opaleye	2	10	195	25	18-33
Spotted Sand Bass	5	10	375	217	113-270
Striped Mullet	3	15	435	7	2-14
Surfperch-Shiner Perch					
Shiner Perch	13	70	118	28	16-73
Shiner Perch[e]	4	82	116	48	38-53
Combined	17	152	117	39	16-73
Surfperch-Other Species					
Black Perch	1	5	162	65	NA
Rainbow Seaperch	1	10	184	41	NA
White Seaperch	10	10	236	37	<12-97
Topsmelt[e]	1	21	148	31	NA
Turbot					
Diamond Turbot[e]	1	5	223	19	NA
Spotted Turbot[e]	1	5	236	36	NA
Combined	2	10	230	27	19-36
Yellowfin Croaker	2	10	294	109	70-148

a/ Assume that the type of sample is fillet with the skin off unless otherwise specified.
b/ The number of fish can be greater than the number of samples because some samples are composites consisting of more than one fish for the chemical analysis.
c/ Mean total fish length is weighted according to the number of fish in each composite sample.
d/ Mean concentration is weighted according to number of fish in each composite sample. When the detected concentration is lower than the MDL, the highest MDL is shown in this table.
e/ Whole without head, tail, and guts; tissue preparation is with skin on.
NA=Not applicable because only one sample was analyzed.

For PCBs, chlordanes, and DDTs, each of the concentrations presented was the sum of the detected parent compound, congeners, and metabolites, where applicable. Since the MDLs were relatively low, ≤ 5 parts per billion (ppb) (Table 2), individual congeners or metabolites with concentrations reported as non-detects were assumed to have no residue. This is a standard method of handling non-detect samples for PCBs and other chemicals with multiple congeners or metabolites when detection levels are adequate (U.S. Environmental Protection Agency, USEPA, 2000a). Table 4 and Table 5 show the weighted mean total lengths and mean chemical concentrations for PCBs and pesticides, respectively.

TABLE 4. PCB CONCENTRATIONS IN FISH FROM MISSION BAY

Fish Species[a]	Number of Samples	Number of Fish[b]	Mean Total Length (mm)[c]	Mean PCBs[d] (ppb)	Range of PCBs (ppb)
Brown Smoothhound Shark	1	9	702	1	NA
Opaleye	2	10	195	1	<0.2-1
Spotted Sand Bass	1	6	364	7	NA
Striped Mullet	3	15	435	20	15-25
Surfperch-Shiner Perch					
Shiner Perch	3	60	119	23	15-35
Shiner Perch[e]	4	82	116	17	15-19
Combined	7	142	117	19	15-35
Surfperch-Other Species					
Black Perch	1	5	162	2	NA
Rainbow Seaperch	1	10	184	7	NA
White Seaperch	0	0	NA	NA	NA
Topsmelt[e]	1	21	148	9	NA
Turbot					
Diamond Turbot[e]	1	5	223	4	NA
Spotted Turbot[e]	1	5	236	2	NA
Combined	2	10	230	3	2-4
Yellowfin Croaker	2	10	294	7	3-11

a/ Assume that the type of sample is fillet with the skin off unless otherwise specified.
b/ The number of fish can be greater than the number of samples because some samples are composites consisting of more than one fish for the chemical analysis.
c/ Mean total fish length is weighted according to the number of fish in each composite sample.
d/ Mean concentration is weighted according to the number of fish in each composite sample. When the detected concentration is lower than the MDL, the highest MDL is shown in this table.
e/ Whole without head, tail, and guts; tissue preparation is with skin on.
NA=Not applicable because no or only one sample was analyzed.

TABLE 5. PESTICIDE CONCENTRATIONS IN FISH FROM MISSION BAY

Fish Species[a]	Number of Samples	Number of Fish[b]	Mean Chlordanes[c] (ppb)	Mean DDTs[c] (ppb)	Mean Dieldrin[c] (ppb)
Brown Smoothhound Shark	1	9	<2	7	<2
Opaleye	2	10	<2	<5	<2
Spotted Sand Bass	1	6	<2	<5	<2
Striped Mullet	3	15	4	11	<2
Surfperch-Shiner Perch					
Shiner Perch	3	60	<2	16	<2
Shiner Perch[d]	4	82	<2	8	<2
Combined	7	142	<2	11	<2
Surfperch-Other Species					
Black Perch	1	5	<1	<5	<2
Rainbow Seaperch	1	10	<2	<5	<2
White Seaperch	0	0	NA	NA	NA
Topsmelt[d]	1	21	<0.47	5	<0.43
Turbot					
Diamond Turbot[d]	1	5	<2	2	<2
Spotted Turbot[d]	1	5	<2	<5	<2
Yellowfin Croaker	2	10	<2	<5	<2

a/ Assume that the type of sample is fillet with the skin off unless otherwise specified.
b/ The number of fish can be greater than the number of samples because some samples are composites consisting of more than one fish for the chemical analysis.
c/ Mean concentration is weighted according to number of fish in each composite sample. When the detected concentration is lower than the MDL, the highest MDL is shown in this table.
d/ Whole without head, tail, and guts; tissue preparation is with skin on.
NA=Not applicable because no sample was analyzed.

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM MISSION BAY

GENERAL INFORMATION

Consumption advice was developed for fish species that meet OEHHA's criterion for sufficient samples (at least nine fish) to represent the population in the water body (Gassel and Brodberg, 2005). When appropriate, fish species were combined as a single group based on their taxonomy (i.e., they are in the same family and/or genus).

The recommended fish consumption frequency (number of servings of fish per week) was determined for each fish species or group by comparing the chemical's mean concentration to the ATLs. For exposure to methylmercury in fish, there are two sets of ATLs because of age-related toxicity (Klasing and Brodberg, 2008). The ATLs for the sensitive population (women of child bearing age at 18 to 45 years, and children 1 to 17 years of age) are lower than for women over 45 years and men (summarized in

Appendix I). This lower value provides protection for the brain and nervous system of unborn babies and children during growth and development. Women ages 18-45 years are included in the sensitive population because these women are of childbearing age. A complete description of the process of developing ATLs can be found in Klasing and Brodberg (2008). A list of all the ATLs is in Appendix I.

The consumption advice for each fish species is initially based on the chemical with the lowest allowable number of fish servings per week. When both mercury and PCBs are detected in the fish tissues, a co-exposure assessment of potential additive toxicity is conducted for the sensitive population using multiple chemical exposure methodology (USEPA, 1989 and 2000b), based on the concern for developmental neurotoxicity.

OEHHA's advisory process and ATLs also consider the health benefits from fish consumption. There is considerable evidence and scientific consensus that fish consumption is an important part of a healthy well-balanced diet and provides many health benefits (American Heart Association, 2011; Klasing and Brodberg, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish is a significant source of the specific omega-3 fatty acids, docosahexaenoic acid and eicosapentaenoic acid, associated with these beneficial effects (U.S. Department of Agriculture, 2011; Weaver et al., 2008).

Consumption Advice for Fish from Mission Bay

After evaluating the chemical concentrations in these fish species, OEHHA used mercury and PCB concentrations as the basis for advice for eating fish from Mission Bay. While there were limited data, the concentrations of the tested pesticides were lower than the ATL threshold value for daily consumption (Klasing and Brodberg, 2008) and were not considered further for developing consumption advice. Co-exposure assessment results are mentioned only when it caused a reduction in the consumption frequency from that based on consideration of individual chemical concentrations. The recommended maximum number of servings per week for each fish species with sufficient data is presented in Table 6, following the discussion.

Brown Smoothhound Shark

In brown smoothhound shark, the mean mercury concentration was 179 ppb, while mean PCB concentration was low (1 ppb). For the sensitive population, the advice is one serving per week, the lower consumption frequency as determined by the mercury concentration. Women over 45 years and men can eat three servings per week, also determined by mercury concentration.

Opaleye

There were two samples of opaleye, the mean concentrations were 25 ppb mercury and 1 ppb PCBs. These mean concentrations were low enough that daily consumption can be recommended for both populations.

Spotted Sand Bass

In spotted sand bass, the mean mercury concentration was 217 ppb, while the mean PCB concentration was 7 ppb. For the sensitive population, the advice is one serving per week, the lower consumption frequency determined by mercury concentration. Women over 45 years and men can eat three servings per week, also determined by mercury concentration.

Striped Mullet

In striped mullet, the mean concentrations were 7 ppb mercury and 20 ppb PCBs. The recommended advice for both population groups is three servings per week, determined by the PCB concentration.

Surfperch-Shiner Perch

For shiner perch, there was no clear relationship between the two tissue preparation methods (fillet and whole fish) and the chemical concentrations. Thus, the consumption advice was based on combined results. The combined mean concentrations were 39 ppb mercury and 19 ppb PCBs. The recommended advice for both population groups is three servings per week, the lower consumption frequency determined by PCB concentration.

Surfperch-Other Species

Barred surfperch, black perch, rainbow seaperch, and white seaperch were also sampled from Mission Bay. OEHHA grouped these members of the surfperch family to determine consumption advice because they have a common feeding behavior; and they feed in or near the bottom sediments (National Oceanic and Atmospheric Administration, NOAA, 2007). In contrast, shiner surfperch (discussed above) feeds in the water column. OEHHA did not include the only sample of barred surfperch in the data evaluation because the fish length (133 mm) was under the minimum size (160 mm).

The consumption frequency was determined using the results for black perch because, according to the RecFin database, this species is more commonly caught in Southern California and it also has a higher mercury level (65 ppb) than the other species. For the sensitive population, the advice is three servings per week. For women >45 years and men, the recommend consumption frequency is seven servings per week, determined by either mercury or PCB concentrations.

Topsmelt

For the sensitive population, the consumption frequency was seven servings per week of topsmelt based on either mean mercury (31 ppb) or PCB (9 ppb) concentrations. However, OEHHA decided to reduce the recommended number of servings to six servings per week of topsmelt for the sensitive population because of concerns regarding co-exposure to mercury and PCBs. For women over 45 years and men, the advice is seven servings per week, determined by either mercury or PCB concentrations.

Turbot, Diamond and Spotted

Both diamond turbot and spotted turbot samples were prepared as whole body for chemical analysis. They were considered together because they belonged to the same family and genus. The combined mean concentrations were 27ppb mercury and 3 ppb PCBs. For the sensitive population, the advice is seven servings per week. For women over 45 years and men, the advice is seven servings per week, determined by either mercury or PCB concentrations.

Yellowfin Croaker

In yellowfin croaker, the mean concentrations were 109 ppb mercury and 7 ppb PCBs. For the sensitive population the advice is two servings per week, the lower consumption frequency determined by mercury concentration. For women over 45 years and men, the advice is five servings per week, also determined by mercury concentration.

Table 6. Recommended Maximum Number of Servings per Week

Fish Species	**Women 18–45 Years and Children 1 to 17 Years**	**Women over 45 Years and Men**
Brown Smoothhound Shark	1	3
Spotted Sand Bass	1	3
Yellowfin Croaker	2	5
Striped Mullet	3	3
Surfperch: Shiner Perch	3	3
Surfperch, other species: Black Perch Rainbow Seaperch White Seaperch	3	7
Topsmelt	6	7
Opaleye	7	7
Turbot: Diamond Turbot Spotted Turbot	7	7

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APPENDIX I. ADVISORY TISSUE LEVELS

Advisory Tissue Levels (ATLs) guide the development of advice for people eating sport fish. ATLs show maximum numbers of recommended fish servings that correspond to the chemical levels found in fish. OEHHA uses ATLs to provide advice to prevent consumers from being exposed to:

- More than the average daily reference dose[7] for chemicals not known to cause cancer, such as methylmercury, or
- For cancer-causing chemicals, a risk level greater than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime. This cancer endpoint is the maximum acceptable risk level recommended by the USEPA (2000b) for fish advisories.

For each chemical, ATLs were determined for both cancer and non-cancer risk, if appropriate, for one to seven eight-ounce servings per week. The most health-protective ATLs for each chemical, selected from either cancer or non-cancer based risk, are shown in the table below for zero to seven servings per week. When the guidelines for eating fish from Mission Bay are followed, exposure to chemicals in fish from this bay would be at or below the average daily reference dose or the cancer risk probability of one in 10,000.

Number of servings per week[a]	**Advisory Tissue Levels (ATLs, in ppb)**					
				Methylmercury		
	Chlordanes	DDTs	Dieldrin	Women 18 to 45 years and children 1 to 17 years	Women over 45 years and men	PCBs
0	>560	>2,100	>46	>440	>1,310	>120
1	>280-560	>1,000-2,100	>23-46	>150-440	>440-1,310	>42-120
2	>190-280	>520-1,000	>15-23	>70-150	>220-440	>21-42
3	>140-190	>390-520	>11-15	>55-70	>160-220	>16-21
4	>110-140	>310-390	>9-11	>44-55	>130-160	>13-16
5	>90-110	>260-310	>8-9	>36-44	>109-130	>10-13
6	>80-90	>220-260	>7-8	>31-36	>94-109	>9-10
7	≤ 80	≤ 220	≤ 7	≤ 31	≤ 94	≤ 9

a/ Serving sizes (prior to cooking, wet weight of 8-ounce serving size) are based on an average 160 pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts.
b/ When residue data are compared to this table they should also first be rounded to the second significant digit.

[7] The reference dose is an estimate of the maximum daily exposure to a chemical likely to be without significant risk of harmful health effects during a lifetime.