



Health Advisory and Guidelines for Eating Fish from Whiskeytown Lake (Shasta County)

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LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife
DDT(s)	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE)
DHA	docosahexaenoic acid
EPA	eicosapentaenoic acid
FDA	Food and Drug Administration
FMP	Fish Mercury Project
Hg	mercury
MDL	method detection limit
MLML	Moss Landing Marine Laboratories
mm	millimeters
OEHHA	Office of Environmental Health Hazard Assessment
PBDEs	polybrominated diphenyl ethers
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
Se	selenium
SWAMP	Surface Water Ambient Monitoring Program
USDA	United States Department of Agriculture
USDHHS	United States Department of Health and Human Services
US EPA	United States Environmental Protection Agency

PREFACE

The Office of Environmental Health Hazard Assessment (OEHHA), a department in the California Environmental Protection Agency, is responsible for evaluating potential public health risks from chemical contamination of sport fish. This includes issuing fish consumption 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
 - 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 in the section on public health advisories.

This report presents guidelines for eating fish from Whiskeytown Lake in Shasta County. The report provides background information and a technical description of how the guidelines were developed. The resulting advice is summarized in the illustrations after the Table of Contents and List of Figures and Tables.

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Women
(18-49 Years)

Children
(1-17 Years)



Women
(50+ Years)

Men
(18+ Years)

A GUIDE TO EATING FISH

from

WHISKEYTOWN LAKE

(SHASTA COUNTY)

Eat the Good Fish
Eating fish that are low in chemicals may provide health benefits to children and adults.



Avoid the Bad Fish
Eating fish with higher levels of chemicals like mercury or PCBs may cause health problems in children and adults.



Choose the Right Fish
Chemicals may be more harmful to unborn babies and children.



Brook Trout
♥ high in omega-3s



Sunfish Species



Black Bass Species
♥ high in omega-3s



Sacramento Sucker



Sacramento Pikeminnow

Serving Size
A serving of fish is about the size and thickness of your hand. Give children smaller servings.




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Eat only the skinless fillet



Eat only the meat



Some chemicals are higher in the skin, fat, and guts.

INTRODUCTION

This report presents guidelines for eating fish from Whiskeytown Lake (Figure 1) in Shasta County, located about 9 miles west of Redding, CA.

LOCATION

Whiskeytown Lake was formed in 1963 by construction of the Whiskeytown Dam, designed to divert water to the Sacramento River from the Trinity River Basin. The lake is positioned at the confluence of seven large streams, which collectively comprise a major watershed that drains into the Sacramento River, and provides drinking water for many municipalities. Whiskeytown Lake is approximately 3200 surface acres in size, with more than 36 miles of shoreline. Whiskeytown Dam is owned and operated by the U.S. Bureau of Reclamation, and the US National Park Service manages the Whiskeytown National Recreation Area, including Whiskeytown Lake.¹

FIGURE 1. LOCATION OF WHISKEYTOWN LAKE



¹ Information regarding Whiskeytown Lake was obtained from Visit California, the United States Geological Survey, and the National Park Service. Online at: <https://www.visitcalifornia.com/attraction/whiskeytown-lake>, https://geonames.usgs.gov/apex/f?p=gnispq:3:0::NO::P3_FID:268967, and <https://www.nps.gov/whis/learn/management/index.htm>.

APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from two monitoring studies described in this report to develop the Whiskeytown Lake Advisory. OEHHA uses the following general process in developing consumption advice for sport fish:

- 1) Evaluation of all fish contaminant data available from a water body and selection of appropriate data that meet data quality criteria and sampling plan guidelines.
- 2) Determination of fish species for which adequate data are available to issue fish consumption advice.
- 3) Calculation of an appropriate measure of central tendency (often a weighted arithmetic mean²) and other descriptive statistics of the contaminant data, as appropriate, for a chemical of potential concern for the selected fish species.
- 4) Comparison of the chemical concentrations with the OEHHA Advisory Tissue Levels (ATLs) for each chemical of potential concern.
- 5) Development of final advice based on a thorough review of the data and best professional judgment relating to the benefits and risks of consuming a particular fish species.

The ATLs (discussed further in a subsequent section of this report) are chemical levels in fish tissue that are considered acceptable, based on chemical toxicity, for a range of consumption rates. Development of the ATLs also included consideration of health benefits associated with including fish in the diet (OEHHA, 2008). The ATLs should not be interpreted as static “bright lines,” but one component of a complex process of data evaluation and interpretation used by OEHHA in the assessment and communication of the benefits and risks of consuming sport fish.

CHEMICALS OF POTENTIAL CONCERN

Certain chemicals are considered to be of potential concern for people who eat fish because of their toxicity and their ability to accumulate in fish tissue. The majority of fish consumption advisories in California are issued because of mercury (Hg), followed by polychlorinated biphenyls (PCBs) and, in a few cases, selenium (Se) or some legacy pesticides (pesticides that are no longer used but remain in the environment).

Mercury is a natural element found in some rock and soil. Human activities, such as burning coal and the historic use of mercury to mine gold, also add mercury to the environment. If mercury enters waterways, it can be converted to a more toxic form

² Means are an arithmetic average of individual values and/or a weighted average of composites. A weighted average of composites is calculated by multiplying the chemical concentration in each composite by the number of fish in that composite for each species. Products are then summed and divided by the total number of fish in all composites for that species, combined.

known as methylmercury – which can pass into and build up in fish. High levels of methylmercury can harm the brain, especially in fetuses and children.

PCBs are industrial chemicals previously used in electrical transformers, plastics, and lubricating oils, often as flame retardants or electrical insulators. Their use was banned in the 1970s, but they persist in the environment because they do not break down easily and can accumulate in fish. Depending on the exposure level, PCBs may cause cancer or other health effects, including neurotoxicity, in humans.

Selenium is a naturally occurring metalloid and at low doses is an essential nutrient for many important human health processes, including thyroid regulation and vitamin C metabolism. Higher doses cause selenium toxicity, which can include symptoms ranging from hair loss and gastrointestinal distress to dizziness and tremors.

Chlordanes, dichlorodiphenyltrichloroethane (DDT), dieldrin, and toxaphene are pesticides that were banned from use in 1973 (DDT), the late 1980s (chlordanes and dieldrin) and 1990 (toxaphene), but are still found in some fish in certain water bodies in California. Depending on the exposure level, these chemicals may cause cancer or adverse effects on the nervous system.

Polybrominated diphenyl ethers (PBDEs) are a class of flame retardants historically used in a variety of consumer products including furniture, textiles, automotive parts, and electronics. The use of PBDEs in new products was largely phased out by 2013 but, due to their wide usage and persistence in the environment, they are still being detected in fish tissues. PBDEs may affect hormone levels or learning and behavior in children.

Detailed discussion of the toxicity of these chemicals and references are presented in “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene” (OEHHA, 2008) and “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Polybrominated Diphenyl Ethers (PBDEs)” (OEHHA, 2011).

All fish species collected from Whiskeytown Lake and used in advisory development were analyzed for mercury (as a measure of methylmercury). Largemouth Bass were further analyzed for PBDEs, PCBs, selenium, and the legacy pesticides chlordanes (cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane), dieldrin, DDTs (DDT and its metabolites dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethylene [DDE]). Fish species that do not normally accumulate PCBs or other organic chemicals may not be analyzed for those contaminants in a particular monitoring study.

DATA SOURCES

The guidelines for eating fish from Whiskeytown Lake are based on the chemicals detected in the fish collected for the two monitoring studies described below. Both studies met OEHHA's data quality criteria, including adequate documentation of sample collection, fish preparation method (e.g., skinning or filleting), chemical analyses, quality assurance, and sufficiently low detection limits. "Sample," as used in this report, refers to an individual fish or a composite of multiple fish for which contaminant data were reported. "Sampling" or "sampled" refers to the act of collecting fish for chemical analysis.

CALFED BAY-DELTA PROGRAM: FISH MERCURY PROJECT (FMP)

The FMP was a three-year (2005 to 2007) sampling program funded by CALFED³ (SFEI, 2009). Monitoring of sport fish from Central Valley water bodies was planned and conducted by staff at the California Department of Fish and Wildlife (CDFW), OEHHA, California Department of Public Health, University of California, Davis, and the San Francisco Estuary Institute. More than 4,000 fish and 31 sport fish species were collected under the project objective to characterize spatial and temporal trends in mercury in fishery resources. The project collected Bluegill, Brook Trout, Largemouth Bass, Sacramento Pikeminnow, Sacramento Sucker, Smallmouth Bass, and Spotted Bass from Whiskeytown Lake, and analyzed them for mercury.

SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP): CONTAMINANTS IN FISH FROM CALIFORNIA LAKES AND RESERVOIRS, 2007-2008

The SWAMP, operated by the State Water Resources Control Board (SWRCB) in cooperation with Regional Water Quality Control Board staff, monitors water quality in California's surface waters. As part of a SWAMP statewide sampling effort to survey contaminants in sport fish found in California lakes and reservoirs, the program collected Largemouth Bass from Whiskeytown Lake in 2008 to analyze chlordanes, DDTs, dieldrin, mercury, PBDEs, PCBs, and selenium. (SWRCB, 2010).

FISH SAMPLED FROM WHISKEYTOWN LAKE

The fish sampling data used in this advisory were retrieved from the California Environmental Data Exchange Network (CEDEN), the State's repository for environmental data. Samples were excluded when the fish were not legal size to take or did not meet OEHHA's criteria for minimum "edible" size based on species size at maturity, and professional judgment (as described in OEHHA, 2005). A summary of all

³ The CALFED Bay Delta Program was a state and federal partnership to improve water quality, increase water supply, as well as support ecosystem restoration and levee improvement in the San Francisco Bay-Delta region.

fish species evaluated for this advisory is shown in Table 1, including the name of the species, number of samples collected, total number of fish, project name, year sampled, and contaminants analyzed.

TABLE 1. FISH SAMPLES EVALUATED FOR THE WHISKEYTOWN LAKE ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Bluegill	<i>Lepomis macrochirus</i>	11	11	FMP	2006	Hg
Brook Trout	<i>Salvelinus fontinalis</i>	16	16	FMP	2006	Hg
Largemouth Bass	<i>Micropterus salmoides</i>	2	2	FMP	2006	Hg
		1	15	SWAMP	2008	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs, Se
		33	33	SWAMP	2008	Hg
Sacramento Pikeminnow	<i>Ptychocheilus grandis</i>	5	5	FMP	2006	Hg
Sacramento Sucker	<i>Catostomus occidentalis</i>	8	8	FMP	2006	Hg
Smallmouth Bass	<i>Micropterus dolomieu</i>	3	3	FMP	2006	Hg
Spotted Bass	<i>Micropterus punctulatus</i>	3	3	FMP	2006	Hg

CHEMICAL CONCENTRATIONS

As shown in Table 1, all samples were analyzed for total mercury, and Largemouth Bass were further analyzed for chlordanes, DDTs, dieldrin, PBDEs, PCBs (54 congeners⁴), and selenium. Among the chemicals analyzed for Largemouth Bass samples from Whiskeytown Lake, only mercury was sufficiently high to impact consumption advice. All fish samples were prepared as skinless fillets. Samples were analyzed as individual fish or composites.

⁴ Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54-55 are generally reported.

For this advisory, OEHHA used the weighted (by the number of individual fish) arithmetic mean (average) of the chemical concentrations (in wet weight) for each fish species to estimate average human exposure.

MERCURY

Samples were analyzed for total mercury, as either individual fish or composite samples, using a direct mercury analyzer (DMA) at the CDFW Moss Landing Marine Laboratories (MLML). The DMA method utilizes thermal decomposition and atomic absorption. OEHHA assumed all mercury detected was methylmercury, which is the most common form found in fish and is also the more toxic form (Bloom, 1992). Table 2 shows the averages and ranges for total length⁵, as well as mercury concentrations in each fish species. The DMA method detection limit (MDL)⁶ and the reporting limit (RL)⁷ for total mercury were each reported at 12 parts per billion (ppb).

PCBs, PBDEs, AND PESTICIDES

One Largemouth Bass composite sample was analyzed for PCBs, PBDEs, and the legacy pesticides (chlordanes, DDTs, and dieldrin). Pesticides, PBDEs and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. For chlordanes, DDTs, PCBs, and PBDEs, each of the concentrations presented was the sum of the detected parent compound, congeners, or metabolites, where applicable. Since the MDLs or RLs were relatively low (≤ 5 ppb), individual congeners or metabolites with concentrations reported as non-detects were assumed to be zero. This is a standard method of handling non-detect values for PCBs and other chemicals with multiple congeners or metabolites in a given sample when detection levels are adequate (US EPA, 2000a).

SELENIUM

The CDFW MLML analyzed Largemouth Bass collected from Whiskeytown Lake for selenium, as one composite sample, using inductively coupled plasma-mass spectrometry (ICP-MS). The ICP-MS method utilizes desolvation, atomization and ionization with ion separation based on a mass-to-charge ratio to detect the total selenium concentration in a sample. The ICP-MS method detection limit (MDL) and the reporting limit (RL) for total selenium were reported at 150 and 400 ppb, respectively.

Concentrations of chlordanes, DDTs, dieldrin, PBDEs, PCBs, and selenium were lower than the corresponding ATL threshold values for daily consumption (OEHHA, 2008 and

⁵ Total length is the maximum length of the fish, measured from the tip of the closed mouth to the tip of the pinched tail fin.

⁶ The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.

⁷ The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

2011). These chemicals were therefore not considered further for developing consumption advice and are not shown in this report.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM WHISKEYTOWN LAKE

Species from Whiskeytown Lake	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Black Bass Species	41	41	382	305 - 554	236	98 - 723
Largemouth Bass	35	35	381	305 - 451	233	110 - 445
Smallmouth Bass	3	3	413	305 - 554	364	98 - 723
Spotted Bass	3	3	364	359 - 369	140	132 - 154
Bluegill	11	11	139	103 - 175	98	31 - 213
Brook Trout	16	16	263	211 - 295	25	21 - 31
Sacramento Pikeminnow	5	5	645	399 - 756	635	231 - 826
Sacramento Sucker	8	8	521	459 - 584	435	210 - 619

*Means are an arithmetic average of individual values and/or a weighted average of composites.

**Range of individuals and/or range of the composites.

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM WHISKEYTOWN LAKE

The OEHHA fish advisory process considers the health benefits of fish consumption as well as the risk from exposure to the chemical contaminants found in fish. Benefits are included in the advisory process because there is considerable evidence and scientific consensus that fish should be part of a healthy, well-balanced diet. Fish contain many nutrients that are important for general health and, in particular, help promote optimal growth and development of babies and young children, and may reduce the incidence of heart disease in adults (FDA/US EPA, 2017; American Heart Association, 2016; OEHHA, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish are a significant source of the specific omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), thought to be associated with these beneficial health effects (USDA/USDHHS, 2015; Weaver et al., 2008).

The 2015-2020 U.S. Dietary Guidelines recommend that 1) the general population “consume eight or more ounces per week (less for young children)” of a variety of seafood⁸ “for the total package of nutrients that seafood provides, including its EPA and DHA content” and 2) “women who are pregnant or breastfeeding should consume at

⁸ “Marine animals that live in the sea and in freshwater lakes and rivers. Seafood includes fish, such as salmon, tuna, trout, and tilapia, and shellfish, such as shrimp, crab, and oysters” (USDHHS/USDA, 2015).

least eight and up to twelve ounces of a variety of seafood per week from choices that are lower in methylmercury” (USDA/USDHHS, 2015). The particular fish that people eat is an important factor in determining the net beneficial effects of fish consumption. For example, studies have shown that children of mothers who ate low-mercury fish during pregnancy scored better on cognitive tests compared to children of mothers who did not eat fish or ate high-mercury fish (Oken et al., 2005 and 2008). Accordingly, because of the high mercury content of certain fish species, the US Food and Drug Administration (FDA) and the US Environmental Protection Agency (US EPA) recommend that women who are pregnant (or might become pregnant) or breastfeeding, and young children avoid consuming shark, swordfish, tilefish (Gulf of Mexico), bigeye tuna, marlin, orange roughy, and king mackerel (FDA/US EPA, 2017).

In order to address the potential health concerns associated with exposure to contaminants in sport fish, OEHHA has established ATLS for chemicals that are known to accumulate in the edible tissues of fish. ATLS consider both the toxicity of the chemical and potential benefits of eating fish. OEHHA uses the ATLS to determine the maximum number of servings per week that consumers can eat, for each species and at each location, to limit their exposure to these contaminants. Consumers can use OEHHA’s guidance when choosing which fish and how much to eat as part of an overall healthy diet.

There are two sets of ATLS for methylmercury in fish because of the age-related toxicity of this chemical (OEHHA, 2008). The fetus and children are more sensitive to the toxic effects of methylmercury. Thus, the ATLS for the sensitive population, including women who might become pregnant (typically 18 to 49 years of age) and children 1-17 years, are lower than those for women 50 years and older, and men 18 years and older. The lower ATL values for the sensitive population provide additional protection to allow for normal growth and development of the brain and nervous system of unborn babies and children. Detailed discussion about the toxicity of common fish contaminants and health benefits of fish consumption, as well as derivation of the ATLS, are provided in “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene” (OEHHA, 2008) and “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Polybrominated Diphenyl Ethers (PBDEs)” (OEHHA, 2011). A list of the ATLS used in this report is presented in Appendix I.

For each fish species in this advisory, OEHHA compared the mean mercury concentration detected in the fillet to the corresponding ATL to establish the maximum number of servings per week that could be consumed (see Appendix I). A serving size is considered to be 8 ounces, prior to cooking, or about the size and thickness of a hand for fish fillets. Children should be given smaller servings. For smaller fish species, several individuals may be required to yield a serving.

The consumption advice for a fish species is initially based on the chemical with the lowest allowable number of servings per week. Because some chemicals, such as

mercury and PCBs, are known to have similar adverse effects, additivity of toxicity is assumed in such cases and may be assessed using multiple chemical exposure methodology (US EPA, 1989 and 2000b). If two or more chemicals with similar adverse effects are present in fish tissue at levels above the corresponding ATL values for daily consumption, multiple chemical exposure methodology is employed. This may result in advising the sensitive population to consume fewer meals per week than would be the case for the presence of one chemical alone, in a similar concentration. Mercury was the only contaminant analyzed in all species except Largemouth Bass, which had non-detectable PCB levels. Thus, the potential effect of multiple chemical exposures to mercury and PCBs was not a factor for Largemouth Bass and could not be assessed for other species. Advice for all species in this advisory was based solely on the concentration of mercury.

OEHHA recommends that individuals strive to meet the US Dietary Guidelines seafood consumption recommendations, while also adhering to federal and OEHHA recommendations to limit the consumption of fish with higher contaminant levels. The advice discussed in the following section represents the maximum recommended number of servings per week for different fish species. People should eat no more than the recommended number of servings for each fish species or species group. OEHHA's consumption advice for a particular fish species can be extended to other closely related fish species⁹ known to accumulate similar levels of contaminants.

Consumption advice should not be combined. That is, if a person chooses to eat a fish from the "one-serving-a-week" category, then they should not eat any other fish from any source (including commercial) until the next week. If a person chooses to eat a fish from the "two-servings-per-week" category, they can combine fish species from that category, or eat one fish from that category and one from a category that recommends more than two-servings-per-week (if available), for a total of two servings in that week. Then they should not eat any other fish from any source (including commercial) until the following week.

CONSUMPTION ADVICE FOR FISH FROM WHISKEYTOWN LAKE

OEHHA's advisory protocol requires that a minimum of nine edible-size fish of a species that may be legally caught are collected and analyzed from small- and medium-sized lakes and reservoirs before an advisory can be developed. Additional samples beyond this number will increase confidence that the sample dataset is representative of the fish species population in the water body (OEHHA, 2005). The majority of fish consumption advisories in California are based on mercury, which is typically analyzed in individual fish, rather than as composites. Mercury analysis is relatively inexpensive and mercury concentrations in fish are more likely to be positively correlated with fish size than other contaminants. Thus, individual analysis allows for advice to be based on fish size, when appropriate. Other contaminants, such as PCBs, pesticides, and selenium, may

⁹ Fish species within the same genus are most closely related, and family is the next level of relationship.

also impact advice. These contaminants are often analyzed as a composite of a smaller subset of fish (usually at least five individuals) as a cost-saving mechanism, a common practice that is considered acceptable. In some cases, an exception is made regarding the minimum sample size. This is particularly true if the advice is based on a chemical other than mercury where sample size is often limited, and/or if doing so leads to more health-protective advice than would otherwise be provided.

For Whiskeytown Lake, the sample size criterion was met for the following species: black bass species, Bluegill, and Brook Trout. Although the minimum sample size criterion was not met for Sacramento Pikeminnow (n=5) and Sacramento Sucker (n=8), they were included in the Whiskeytown Lake advisory for the following reasons.

To date, OEHHA has issued advice for Sacramento Pikeminnow at ten water bodies in the state. In each case, the sensitive population was advised not to consume this species and, in eight of the ten cases, the general population was advised to limit consumption to one meal per week. Because advice for Sacramento Pikeminnow at Whiskeytown Lake based on a relatively small sample size was almost universally consistent with advice given for this species at other California water bodies, it seemed reasonable to provide advice for this species based on the available data.

OEHHA has issued advice for Sacramento Sucker at 18 water bodies in the state. In the majority of cases (13/18 for the sensitive population and 10/18 for the general population), the advice for those water bodies was consistent with the advice developed for this species at Whiskeytown Lake. Additionally, the sample size of eight for this species nearly reached the target sample size of nine. Thus, OEHHA elected to include this species in this advisory.

There were not sufficient data to evaluate other species that may be found in this water body. For fish species found in Whiskeytown Lake that are not included in this advisory, OEHHA recommends following the [statewide advisory for eating fish from California's lakes and reservoirs without site-specific advice](#).

BLACK BASS SPECIES (LARGEMOUTH BASS, SMALLMOUTH BASS, SPOTTED BASS)

The mean mercury concentration in black bass species from Whiskeytown Lake was 236 ppb. Mercury concentrations for individual black bass species were as follows: Largemouth Bass (Hg: 233), Smallmouth Bass (Hg: 364 ppb), and Spotted Bass (Hg: 140 ppb). OEHHA recommends a maximum of one serving per week of black bass species from Whiskeytown Lake for the sensitive population (women 18 to 49 years and children 1 to 17 years), and a maximum of two servings a week for the general population (women 50 years and older, and men 18 years and older).

OEHHA has evaluated mercury concentrations in black bass species in many water bodies in California and has found a similar range of mercury concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA

extends the consumption advice for Largemouth Bass, Smallmouth Bass, and Spotted Bass to Redeye.

BROOK TROUT

The mean mercury concentration in Brook Trout from Whiskeytown Lake was 25 ppb. OEHHA recommends a maximum of seven servings a week of Brook Trout for both the sensitive population (women 18 to 49 years and children 1 to 17 years), and the general population (women 50 years and older, and men 18 years and older).

SACRAMENTO PIKEMINNOW

The mean mercury concentration in Sacramento Pikeminnow from Whiskeytown Lake was 635 ppb. OEHHA recommends no consumption of Sacramento Pikeminnow for the sensitive population (women 18 to 49 years and children 1 to 17 years), and a maximum of one serving a week for the general population (women 50 years and older, and men 18 years and older).

SACRAMENTO SUCKER

The mean mercury concentration in Sacramento Sucker from Whiskeytown Lake was 435 ppb. OEHHA recommends a maximum of one serving a week of Sacramento Sucker for the sensitive population (women 18 to 49 years and children 1 to 17 years), and a maximum of two servings a week for the general population (women 50 years and older, and men 18 years and older).

SUNFISH SPECIES (BLUEGILL)

The mean mercury concentration in Bluegill from Whiskeytown Lake was 98 ppb. OEHHA recommends a maximum of two servings a week of sunfish species for the sensitive population (women 18 to 49 years and children 1 to 17 years), and a maximum of six servings a week for the general population (women 50 years and older, and men 18 years and older).

OEHHA has evaluated mercury concentrations in sunfish species in many water bodies in California and has found a similar range of mercury concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA extends the consumption advice for Bluegill to other sunfish species, including Green Sunfish, Redear Sunfish, and Pumpkinseed.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

The recommended maximum numbers of servings per week for fish from Whiskeytown Lake are shown in Table 3.

TABLE 3. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM WHISKEYTOWN LAKE

Fish Species from Whiskeytown Lake	Women 18–49 years and Children 1-17 years	Women 50 years and older and Men 18 years and older
Black Bass Species	1	2
Brook Trout	7	7
Sacramento Pikeminnow	0	1
Sacramento Sucker	1	2
Sunfish Species	2	6

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APPENDIX I. ADVISORY TISSUE LEVELS

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

- More than the average daily reference dose¹⁰ 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 US EPA (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 Whiskeytown Lake are followed, exposure to chemicals in fish from Whiskeytown Lake would be at or below the average daily reference dose or the cancer risk probability of one in 10,000.

ADVISORY TISSUE LEVELS FOR SELECTED ANALYTES

Contaminant	Consumption Frequency Categories (8-ounce servings/week) ^a and ATLs (in ppb)							
	7	6	5	4	3	2	1	0
Chlordanes	≤ 80	>80-90	>90-110	>110-140	>140-190	>190-280	>280-560	>560
DDTs	≤ 220	>220-260	>260-310	>310-390	>390-520	>520-1,000	>1,000-2,100	>2,100
Dieldrin	≤ 7	>7-8	>8-9	>9-11	>11-15	>15-23	>23-46	>46
MeHg (Women 18-49 and children 1-17)	≤ 31	>31-36	>36-44	>44-55	>55-70	>70-150	>150-440	>440
MeHg (Women > 49 and men)	≤ 94	>94-109	>109-130	>130-160	>160-220	>220-440	>440-1,310	>1,310
PBDEs	≤ 45	>45-52	>52-63	>63-78	>78-100	>100-210	>210-630	>630
PCBs	≤ 9	>9-10	>10-13	>13-16	>16-21	>21-42	>42-120	>120
Selenium	≤ 1000	>1,000-1200	>1,200-1,400	>1,400-1,800	>1,800-2,500	>2,500-4,900	>4,900-15,000	>15,000
Toxaphene	≤ 87	>87-100	>100-120	>120-150	>150-200	>200-300	>300-610	>610

^a Serving sizes (prior to cooking, wet weight) are based on an average 160-pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts.

¹⁰ 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.