OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

GOOD CATCH CALIFORNIA
Your Fish Advisor

Health Advisory and Guidelines for Eating Fish from Senator Wash Reservoir (Imperial County)

May 2021

Fish, Ecotoxicology, and Water Section
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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
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
RWB7	Regional Water Board 7 (Colorado River)
Se	selenium
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
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 Senator Wash Reservoir in Imperial 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 the List of Figures and Tables.

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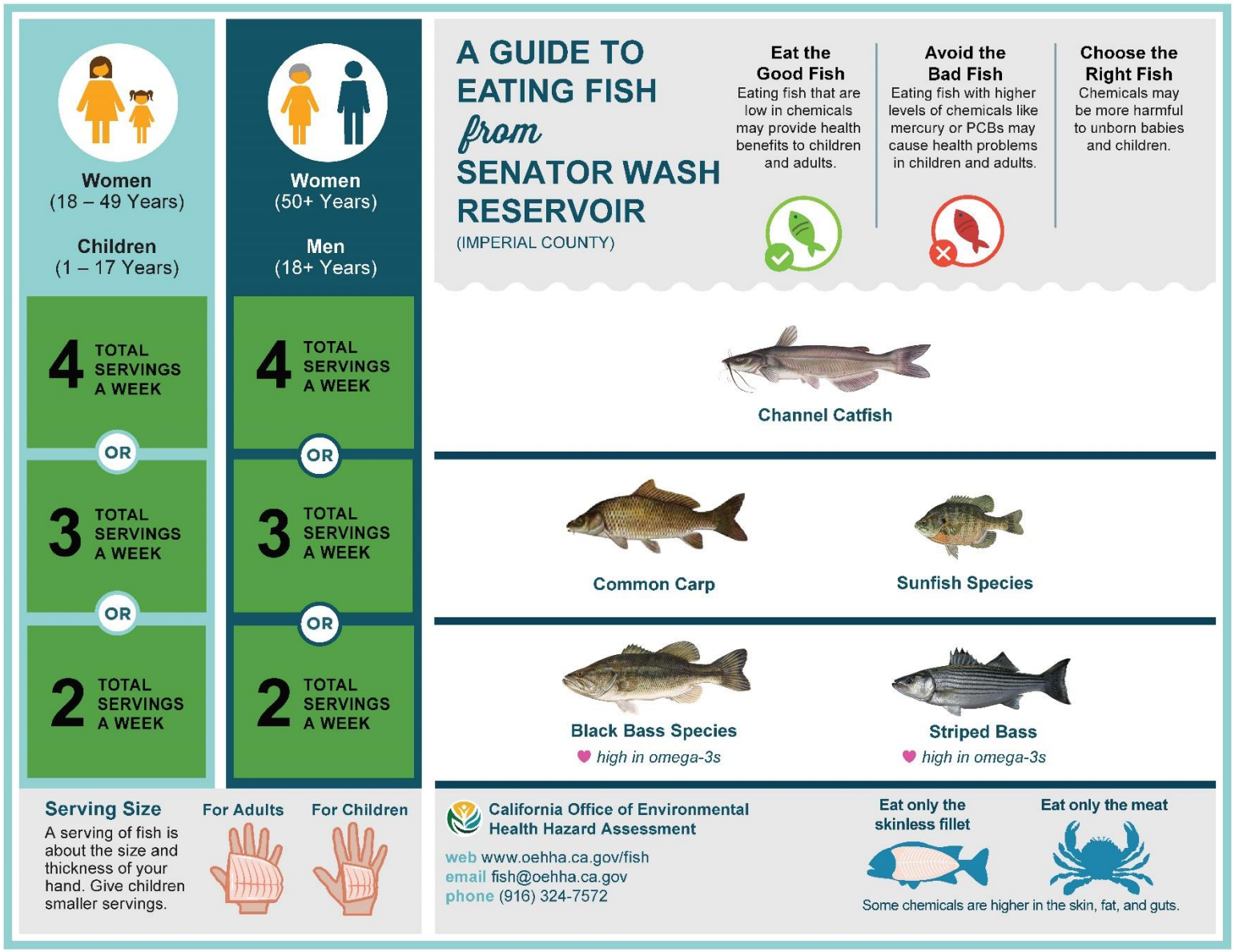
Women
(18 – 49 Years)
Children
(1 – 17 Years)
4 TOTAL SERVINGS A WEEK
OR
3 TOTAL SERVINGS A WEEK
OR
2 TOTAL SERVINGS A WEEK
Women
(50+ Years)
Men
(18+ Years)
4 TOTAL SERVINGS A WEEK
OR
3 TOTAL SERVINGS A WEEK
OR
2 TOTAL SERVINGS A WEEK
A GUIDE TO EATING FISH from SENATOR WASH RESERVOIR
(IMPERIAL COUNTY)
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.
Channel Catfish
Common Carp
Sunfish Species
Black Bass Species
high in omega-3s
Striped Bass
high in omega-3s
Serving Size
A serving of fish is about the size and thickness of your hand. Give children smaller servings.
For Adults
For Children
California Office of Environmental Health Hazard Assessment
web www.oehha.ca.gov/fish
email fish@oehha.ca.gov
phone (916) 324-7572
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 black bass species, Channel Catfish, Common Carp, Striped Bass, and sunfish species from Senator Wash Reservoir (Figure 1). Consumption advice is based on levels of mercury and selenium found in these species.

LOCATION

Senator Wash Reservoir is located on the California side of the Colorado River, approximately two miles upstream from Imperial Dam, and 18 miles northeast of Yuma, Arizona. The reservoir was formed by the creation of Senator Wash Dam in 1966, for the purpose of improving regulation and management of water from the Colorado River to Imperial Dam.[1] The Bureau of Reclamation manages Senator Wash Dam, and the Bureau of Land Management manages recreational areas around the reservoir.

FIGURE 1. LOCATION OF SENATOR WASH RESERVOIR

[1] Information regarding Senator Wash Reservoir was obtained from the US Bureau of Reclamation. Online at: https://www.usbr.gov/projects/index.php?id=328

APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from two monitoring studies described in this report to develop the Senator Wash Reservoir 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 mean[2]) 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 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), polybrominated diphenyl ethers (PBDEs), 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 historical 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 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.

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 and can accumulate in fish because they do not break down easily. 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 California water bodies. Depending on the exposure level, these chemicals may cause cancer or adverse effects on the nervous system.

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 Senator Wash Reservoir and used in advisory development were analyzed for mercury (as a measure of methylmercury) and selenium. Bluegill, Channel Catfish, Common Carp, and Striped Bass were also analyzed for the legacy pesticides chlordanes (cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane), dieldrin, and DDTs (DDT and its metabolites dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethylene [DDE]), and Bluegill, Common Carp, and Striped Bass were further analyzed for PCBs. Additionally, Common Carp were analyzed for PBDEs. Fish species that do not normally accumulate PCBs or other organic chemicals may not be analyzed for those contaminants in a particular monitoring study. Additionally, some studies do not analyze these chemicals and instead focus only on mercury.

DATA SOURCES

The guidelines for eating fish from Senator Wash Reservoir are based on the chemicals detected in the fish collected for the two monitoring studies described below. These studies met OEHHA's data quality criteria, including adequate documentation of sample collection, fish preparation methods (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.

CONTAMINANTS IN FISH FROM CALIFORNIA LAKES AND RESERVOIRS, 2007 – 2008 (SWAMP)

The Surface Water Ambient Monitoring Program (SWAMP), operated by the State Water Resources Control Board (SWRCB) in cooperation with the Colorado River Regional Water Quality Control Board (RWB7), monitors water quality in California's surface waters. The program collected Common Carp and Largemouth Bass from Senator Wash Reservoir in 2007, which were analyzed for mercury. Additionally, Common Carp were analyzed for chlordanes, DDTs, dieldrin, PBDEs, PCBs, and selenium, as part of a SWAMP statewide sampling effort to survey contaminants in sport fish found in California lakes and reservoirs (SWRCB, 2010).

SURVEY OF LAKES AND RESERVOIRS WITH LOW CONCENTRATIONS OF CONTAMINANTS IN SPORT FISH, 2014 (SWAMP)

The purpose of this study was to identify and characterize lakes with low concentrations of mercury and other contaminants in fish tissue to improve understanding of the conditions and factors that contribute to these lower concentrations.[3] In 2014, the study collected Bluegill, Channel Catfish, Common Carp, Largemouth Bass, and Striped Bass, which were analyzed for mercury and selenium. Bluegill, Channel Catfish, and Striped Bass were also analyzed for chlordanes, DDTs, and dieldrin; Bluegill and Striped Bass were additionally analyzed for PCBs.

FISH SAMPLED FROM SENATOR WASH RESERVOIR

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

[3] The sampling plan for this study can be found on the SWAMP website, online at: https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/lakes_study/lakes_sampling_plan_may14.pdf.

maturity, and professional judgment (as described in OEHHA, 2005). A summary of all 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 SENATOR WASH RESERVOIR ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Bluegill	*Lepomis macrochirus*	1	14	SWAMP	2014	Chlordanes, DDTs, Dieldrin, PCBs
		2	14	SWAMP	2014	Hg, Se
Channel Catfish	*Ictalurus punctatus*	2	10	SWAMP	2014	Chlordanes, DDTs, Dieldrin, Hg, Se
Common Carp	*Cyprinus carpio*	1	5	SWAMP	2007	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs
		2	10	SWAMP	2007	Hg, Se
		1	5	SWAMP	2014	Hg, Se
Largemouth Bass	*Micropterus salmoides*	4	4	SWAMP	2007	Hg
		7	7	SWAMP	2014	Hg
		2	7	SWAMP	2014	Se
Striped Bass	*Morone saxatilis*	1	15	SWAMP	2014	Chlordanes, DDTs, Dieldrin, PCBs
		10	10	SWAMP	2014	Hg
		3	15	SWAMP	2014	Se

All samples were analyzed as skinless fillets.

CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for one or more of the following: total mercury, chlordanes, DDTs, dieldrin, PBDEs (7 congeners), and PCBs (54 congeners)[4], and selenium. Among the chemicals analyzed in fish tissue samples from Senator

[4] Congeners are related compounds with similar chemical forms. Of the 209 possible PBDE and PCB congeners, 6-7 and 48-54 are generally reported, respectively.

Wash Reservoir, only mercury and selenium levels were sufficiently high to impact consumption advice.

All fish samples were prepared as skinless fillets, and samples were analyzed as individual fish or composites.

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 length[5], 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 reported at 4 or 12 and 12 parts per billion (ppb), respectively, depending on the study.

PCBS, PBDES, AND PESTICIDES

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. Because 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 species collected from Senator Wash Reservoir for selenium as composite samples, using inductively coupled plasma-mass spectrometry (ICP-MS). The ICP-MS method uses 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 MDL and RL for total selenium were reported at 100 or 150 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.

300 or 400 ppb, respectively, depending on the study. Table 3 shows the averages and ranges for total length, as well as selenium concentrations in each fish species.

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

Species from Senator Wash Reservoir	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Bluegill	2	14	151	132 – 180	30	29 – 30
Channel Catfish	2	10	326	250 – 445	43	27 – 59
Common Carp	3	15	593	547 – 660	70	22 – 104
Largemouth Bass	11	11	370	330 – 465	93	27 – 185
Striped Bass	10	10	351	315 – 420	72	57 – 93

All samples were prepared as skinless fillets.
*Means are an arithmetic average of individual values and/or a weighted average of composites.
**Range of individuals and/or range of the composites.

TABLE 3. SELENIUM CONCENTRATIONS IN FISH FROM SENATOR WASH RESERVOIR

Species from Senator Wash Reservoir	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Selenium (ppb)	
					Mean*	Range**
Bluegill	2	14	151	132 – 180	1905	1850 – 1960
Channel Catfish	2	10	326	250 – 445	1585	1520 – 1650
Common Carp	3	15	593	547 – 660	2247	1910 – 2490
Largemouth Bass	2	7	383	330 – 465	3016	2730 – 3230
Striped Bass	3	15	351	315 – 420	4453	4320 – 4570

All samples were prepared as skinless fillets.
*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 SENATOR WASH RESERVOIR

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 beneficial omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) (USDA/USDHHS, 2020; Weaver et al., 2008).

The US Department of Agriculture (USDA) recommends "including at least 8 ounces of cooked seafood[8] per week. Young children need less, depending on their age and calorie needs" (MyPlate.gov). According to the 2020-2025 Dietary Guidelines, "women who are pregnant or lactating should consume at least 8 and up to 12 ounces of a variety of seafood per week from choices that are lower in methylmercury" (USDA/USDHHS, 2020). Additionally, "based on FDA and EPA's advice, depending on body weight, some women should choose seafood lowest in methylmercury or eat less seafood than the amounts in the Healthy U.S.-Style Dietary Pattern" (USDA/USDHHS, 2020). For more-detailed information, see USDA/USDHHS (2020) and other USDA MyPlate.gov materials. 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 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).

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 should 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.

[8] Seafood as used here refers to fish and shellfish from freshwater and marine environments.

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 and selenium concentrations detected in the fillet to the corresponding ATLs 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 individual fish 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, the multiple chemical exposure methodology is employed. This may result in advising fewer meals per week than would be the case for the presence of one chemical alone, in a similar concentration. For the Senator Wash Reservoir advisory, PCB concentrations for all species were below the corresponding ATL value for daily consumption. Thus, the potential effect of multiple chemical exposures was not evaluated. Advice for all species in this advisory was based solely on mercury and selenium concentrations, which are not known to have additive effects.

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 species[9] 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 SENATOR WASH RESERVOIR

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 fish 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 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 Senator Wash Reservoir, the sample size criterion was met for mercury for all species. However, only seven Largemouth Bass were analyzed for selenium. Although this is fewer than the preferred number of samples, the data were included because they reduced the number of recommended servings per week for this species for the general population from seven to two compared to the advice based on mercury and were thus more health protective. There were not sufficient data to evaluate other species that may be found in this water body. For fish species found in Senator Wash Reservoir that are not included in this advisory, OEHHA recommends following the statewide advisory for lakes and reservoirs without site-specific advice.

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

The following advice is based solely on mercury and selenium concentrations. The sensitive population is defined as women 18 to 49 years and children 1 to 17 years, and the general population is defined as women 50 years and older, and men 18 years and older.

Black Bass Species (Largemouth Bass)

The mean mercury and selenium concentrations in Largemouth Bass were 93 and 3016 ppb, respectively. OEHHA recommends a maximum of two servings a week of black bass species from Senator Wash Reservoir for the sensitive population, based on mercury or selenium, and a maximum of two servings a week for the general population, based on selenium.

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. Selenium levels are presumed to show a similar pattern with comparable concentrations expected to be observed in individual black bass species within the same water body. Therefore, OEHHA extends the consumption advice for Largemouth Bass to other black bass species, including Redeye, Smallmouth, and Spotted Bass.

Channel Catfish

The mean mercury and selenium concentrations in Channel Catfish from Senator Wash Reservoir were 43 and 1585 ppb, respectively. OEHHA recommends a maximum of four servings a week of Channel Catfish for both the sensitive and general populations, based on selenium.

Common Carp

The mean mercury and selenium concentrations in Common Carp from Senator Wash Reservoir were 70 and 2247 ppb, respectively. OEHHA recommends a maximum of three servings a week of Common Carp for the sensitive population, based on mercury or selenium, and a maximum of three servings a week for the general population, based on selenium.

Striped Bass

The mean mercury and selenium concentrations in Striped Bass from Senator Wash Reservoir were 72 and 4453 ppb, respectively. OEHHA recommends a maximum of two servings a week of Striped Bass the sensitive population, based on mercury or selenium, and a maximum of two servings a week for the general population, based on selenium.

SUNFISH SPECIES (BLUEGILL)

The mean mercury and selenium concentrations in Bluegill from Senator Wash Reservoir were 30 and 1905 ppb, respectively. Based on the concentration of selenium, OEHHA recommends a maximum of three servings a week of sunfish species for both the sensitive and general populations.

Selenium concentrations in sunfish species in this region of California are generally similar within the same water body. Therefore, OEHHA extends the consumption advice for sunfish species (Bluegill) to other sunfish species, including Green Sunfish, Pumpkinseed, and Redear Sunfish.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

The recommended maximum numbers of servings per week for fish from Senator Wash Reservoir are shown in Table 4.

TABLE 4. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM SENATOR WASH RESERVOIR

Fish Species from Senator Wash Reservoir	Women 18–49 years and Children 1-17 years	Women 50 years and older and Men 18 years and older
Black Bass Species	2	2
Channel Catfish	4	4
Common Carp	3	3
Striped Bass	2	2
Sunfish Species	3	3

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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 reference dose[10] on an average daily basis 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 are followed, exposure to chemicals in fish 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 over a lifetime.