OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

GOOD CATCH CALIFORNIA
Your Fish Advisor

Health Advisory and Guidelines for Eating Fish from Little Rock Reservoir (Los Angeles County)

October 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
RWB6	Regional Water Board 6 (Lahontan)
Se	selenium
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TSMP	Toxic Substances 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 updated guidelines for eating fish from Little Rock Reservoir in Los Angeles 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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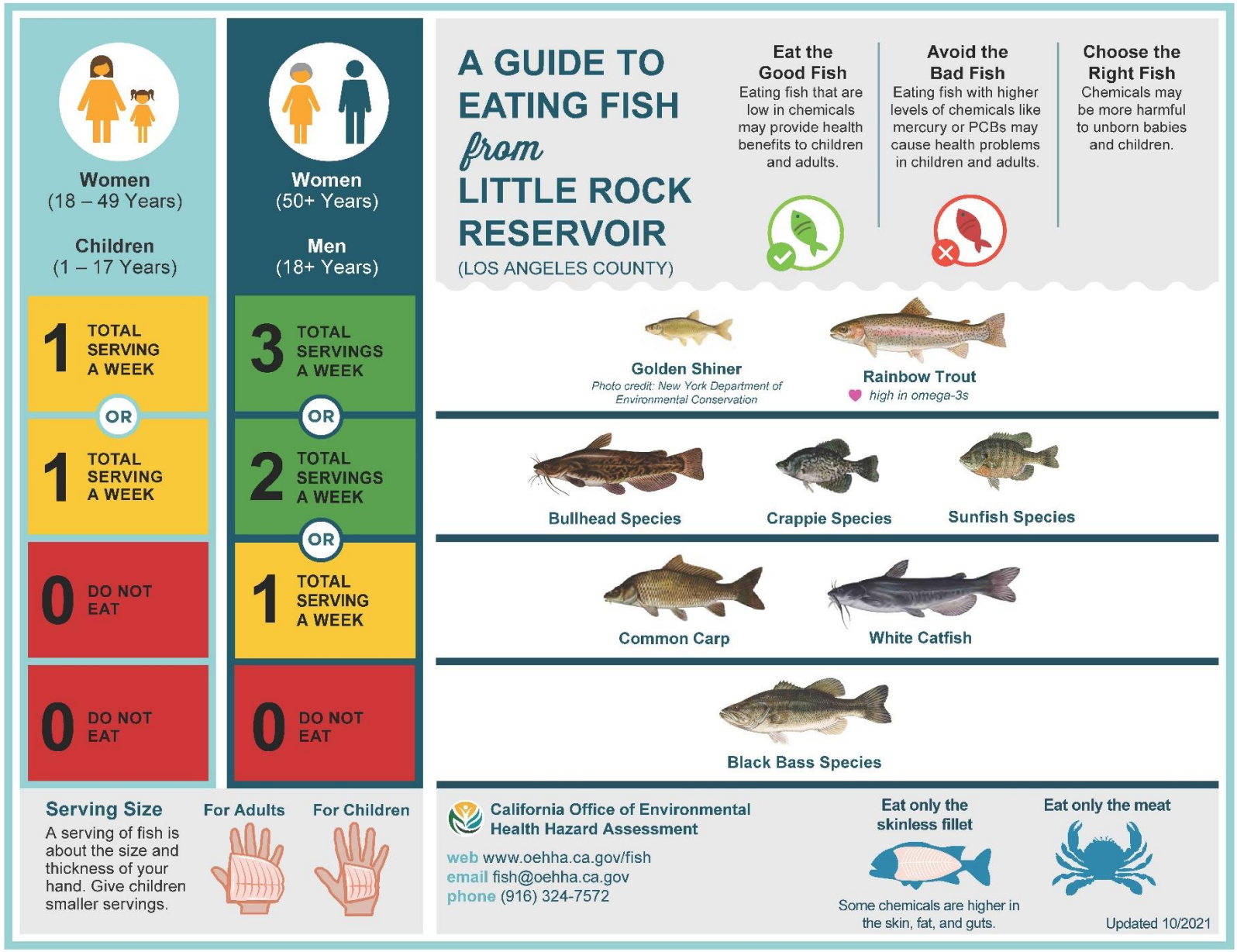
Women
(18 – 49 Years)
Children
(1 – 17 Years)
1 TOTAL SERVING A WEEK
OR
1 TOTAL SERVING A WEEK
0 DO NOT EAT
0 DO NOT EAT
Women
(50+ Years)
Men
(18+ Years)
3 TOTAL SERVINGS A WEEK
OR
2 TOTAL SERVINGS A WEEK
OR
1 TOTAL SERVING A WEEK
0 DO NOT EAT
A GUIDE TO EATING FISH from LITTLE ROCK RESERVOIR
(LOS ANGELES 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.
Golden Shiner
Photo credit: New York Department of Environmental Conservation
Rainbow Trout
high in omega-3s
Bullhead Species
Crappie Species
Sunfish Species
Common Carp
White Catfish
Black Bass Species
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
Some chemicals are higher in the skin, fat, and guts.
Eat only the meat
Updated 10/2021

INTRODUCTION

This report updates and supersedes the previous guidelines for eating fish from Little Rock Reservoir (Figure 1). This update provides new advice for bullhead species and Golden Shiner, and updates advice for Largemouth Bass. The previous advice remains the same for Common Carp, crappie species, Rainbow Trout, sunfish species, and White Catfish. Consumption advice for all species listed in the advisory is based on mercury levels in fish collected from Little Rock Reservoir.

LOCATION

Little Rock Reservoir is located about 12 miles south of Palmdale, CA, and was formed in 1922 by the construction of Littlerock Dam. The reservoir is approximately 150 surface acres in size with a storage capacity of 3,500 acre feet. It serves as a source of drinking water for the Palmdale Water District and is a popular recreation area for fishing and boating.[1]

FIGURE 1. LOCATION OF LITTLE ROCK RESERVOIR

[1] Information regarding Little Rock Reservoir was obtained from the Palmdale Water District and Lakelubbers.com. Online at: https://www.palmdalewater.org/about/water-supply/ and https://www.lakelubbers.com/littlerock-reservoir-1731/.

APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from four monitoring studies described in this report to develop the Little Rock 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 an 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 and/or composites weighted by number of fish. 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 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 an element 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 Little Rock Reservoir and used in advisory development were analyzed for mercury (as a measure of methylmercury). Common Carp were analyzed for 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]), and PBDEs. Black Crappie, Bluegill, Common Carp, Largemouth Bass, and White Catfish were also analyzed for PCBs. Additionally, Black Bullhead, Common Carp, and Golden Shiner were analyzed for selenium. 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 Little Rock Reservoir are based on the chemicals detected in the fish collected for the four 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 Lahontan Regional Water Quality Control Board (RWB6), monitors water quality in California's surface waters. This SWAMP survey of inland water bodies was the State's largest survey of chemical contaminants in sport fish. The survey sampled popular fishing sites at 272 lakes and reservoirs from 2007 to 2008 (SWRCB, 2010). The SWRCB used the data from this survey to characterize statewide water quality conditions. The program collected Common Carp from Little Rock Reservoir in 2007, which were analyzed for chlordanes, DDTs, dieldrin, PBDEs, PCBs, mercury, and selenium, as part of a SWAMP statewide sampling effort to survey contaminants in sport fish found in California lakes and reservoirs (SWRCB, 2010). Additionally, Largemouth Bass were collected in 2007 and analyzed for mercury.

LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD (RWB6)

The State Water Resources Control Board (SWRCB) develops water quality objectives and enforces implementation plans that protect the beneficial uses of waters in the State with consideration of the local differences between regions. One of these water quality objectives sets a numeric target for the concentration of methylmercury in fish tissue. The nine Regional Water Quality Control Boards (RWBs) work in collaboration with the SWRCB to assist in that objective. The RWBs coordinate ongoing sampling efforts to monitor contaminant levels, including mercury and PCBs, in sport fish caught from lakes and reservoirs within their regional boundaries.[3] In 2013, RWB6 collected Black Crappie, Bluegill, Common Carp, Green Sunfish, Largemouth Bass, Rainbow Trout, and White Catfish and analyzed them for mercury. All species except Green Sunfish and Rainbow Trout were also analyzed for PCBs.

[3] Further information on the SRWCB and the RWBs can be found online at: https://www.waterboards.ca.gov/water_issues/programs/mercury/ and https://www.waterboards.ca.gov/about_us/contact_us/rwqcbs_directory.html,

Long-Term Monitoring of Bass Lakes and Reservoirs in California, 2015–ongoing (SWAMP)

This monitoring study is a multi-year effort initiated in 2015 to document status and trends related to contamination in sport fish from California lakes and reservoirs where bass species reside (Davis et al., *in preparation*). In 2019, the program collected Largemouth Bass from Little Rock Reservoir, which were analyzed for mercury.

Toxic Substances Monitoring Program (TSMP)

The TSMP operated from 1976 to 2003 as a state water quality-monitoring program managed by the SWRCB (SWRCB, 2007 and 2013). Its objective was to provide statewide information on the occurrence of toxic substances by monitoring water bodies with known or suspected water quality impairment. As part of the program, the California Department of Fish and Wildlife (CDFW), then known as the California Department of Fish and Game, collected Black Bullhead and Golden Shiner in 1991 and 1992, respectively. All fish samples were analyzed for mercury and selenium.

FISH SAMPLED FROM LITTLE ROCK 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 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 LITTLE ROCK RESERVOIR ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Black Bullhead	*Ameiurus melas*	2	12	TSMP[a]	1991	Hg, Se
Black Crappie	*Pomoxis nigromaculatus*	10	10	RWB6	2013	Hg
		1	10	RWB6	2013	PCBs
Bluegill	*Lepomis macrochirus*	10	10	RWB6	2013	Hg
		1	8	RWB6	2013	PCBs

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Common Carp	*Cyprinus carpio*	1	5	SWAMP	2007	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs, Se
		2	10	SWAMP	2007	Hg
		10	10	RWB6	2013	Hg
		1	10	RWB6	2013	PCBs
Golden Shiner	*Notemigonus crysoleucas*	1	16	TSMP[b]	1992	Hg, Se
Green Sunfish	*Lepomis cyanellus*	10	10	RWB6	2013	Hg
Largemouth Bass	*Micropterus salmoides*	9	9	SWAMP	2007	Hg
		10	10	RWB6	2013	Hg
		1	10	RWB6	2013	PCBs
		10	10	SWAMP	2019	Hg
Rainbow Trout	*Oncorhynchus mykiss*	7	7	RWB6	2013	Hg
White Catfish	*Ameiurus catus*	12	12	RWB6	2013	Hg
		2	10	RWB6	2013	PCBs

Samples were analyzed as skinless fillets, with the following exceptions:
[a]Study report did not specify whether skin was removed from fillets prior to tissue analysis.
[b]Samples were analyzed as whole organisms, including head, skin, internal organs, muscle, and bones.

CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for one or more of the following: total mercury, selenium, chlordanes, DDTs, dieldrin, PBDEs (7 congeners), and PCBs (50 – 54 congeners)[4]. Among the chemicals analyzed in fish tissue samples from Little Rock Reservoir, only mercury levels were sufficiently high to impact consumption advice.

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

All fish samples were prepared as skinless fillets, except for the TSMP study where the fillet preparation method for Black Bullhead was not recorded and Golden Shiner were prepared as whole bodies. 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] for total mercury was reported at 3, 4 or 12 parts per billion (ppb) and the reporting limit (RL)[7] was reported at 9 or 12 ppb, depending on the study. Although mercury was detected at commonly found concentrations in the TSMP study, the MDL and RL for mercury were not reported.

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). Table 3 shows the averages and ranges for total length, as well as PCB concentrations in each fish species.

Selenium

The CDFW MLML analyzed species collected from Little Rock 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

[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.

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 150 and 400 ppb, respectively, in the SWAMP study. Although selenium was detected at commonly found concentrations in the TSMP study, the MDL and RL for selenium were not reported.

Concentrations of chlordanes, dieldrin, DDTs, PBDEs, and selenium, were lower than the corresponding ATL threshold values for daily consumption (OEHHA, 2008 and 2011). With the exception of assessing for multiple chemical exposures, these chemicals were not considered further for developing consumption advice and are not shown in this report.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM LITTLE ROCK RESERVOIR

Species from Little Rock Reservoir[a]	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Black Bullhead	2	12	218	214 – 221	295	280 – 310
Black Crappie	10	10	187	169 – 211	268	227 – 368
Common Carp	12	20	519	448 – 591	441	366 – 571
Golden Shiner	1	16	85	n/a	200	n/a
Largemouth Bass	29	29	388	315 – 506	1174	454 – 2540
Rainbow Trout	7	7	388	235 – 470	217	107 – 361
Sunfish Species	20	20	179	128 – 232	280	145 – 394
Bluegill	10	10	191	159 – 232	303	257 – 385
Green Sunfish	10	10	166	128 – 209	256	145 – 394
White Catfish	12	12	372	273 – 630	453	244 – 734

[a]Samples were prepared as skinless fillets, except as noted in the footnotes to Table 1.
*Means are an arithmetic average of individual values and/or a weighted average of composites.
**Range of individuals and/or range of the composites.
n/a = not applicable due to a single sample.

TABLE 3. PCB CONCENTRATIONS IN FISH FROM LITTLE ROCK RESERVOIR

Species from Little Rock Reservoir[a]	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCBs (ppb)	
					Mean*	Range**
Black Crappie	1	10	187	169 – 211	0	n/a
Bluegill	1	8	199	180 – 232	2	n/a
Common Carp	2	15	526	448 – 591	23	8 – 31
Largemouth Bass	1	10	352	315 – 422	2	n/a
White Catfish	2	10	390	293 – 630	23	7 – 27

[a]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.
n/a = not applicable due to a single sample

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM LITTLE ROCK 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

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

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.

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 PCB 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). For fish fillets, a serving size is considered to be 8 ounces, prior to cooking, or about the size and thickness of a hand. 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, multiple-chemical-exposure methodology is employed. This may result in advising fewer servings per week than would be the case for the presence of one chemical alone, in a similar concentration. Although both mercury and PCBs concentrations were measured in Common Carp and White Catfish, the potential effect of multiple chemical exposures was not assessed because both species exceeded the threshold for no consumption based on mercury alone. Advice for all species in this advisory was based solely on mercury concentrations without the need to apply the multiple-chemical method.

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 serving of 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 serving of fish from the "two-servings-per-week" category, they can combine fish species from that category, or eat one serving of 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 LITTLE ROCK 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. 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 doing so leads to more health-protective advice than would otherwise be provided.

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

For Little Rock Reservoir Lake, the sample size criterion was met for all species except Rainbow Trout analyzed for mercury (n=7) and Bluegill analyzed for PCBs (n=8). Although this is fewer than the preferred number of samples, Rainbow Trout data were included because the mercury concentration for this species prompts significantly more restrictive advice than the statewide advisory for lakes and reservoirs without site-specific advice, and their inclusion is thus more health protective. Bluegill PCB data did not exceed the threshold for daily consumption (<9 ppb) and did not impact advice. There were not sufficient data to evaluate other species that may be found in this water body. For fish species found in Little Rock Reservoir that are not included in this advisory, OEHHA recommends following the statewide advisory for lakes and reservoirs without site-specific advice.

The following advice is based solely on mercury 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 (LARGEMOUTH BASS)

Black bass species are one of the most targeted species of freshwater game fish in California. OEHHA groups black bass species because they have similar predatory diets, which suggests a comparable chemical uptake (Long and Fisher, 2000). They are also known to hybridize (Pierce and Van Den Avyle, 2011), largely due to species introductions for angling purposes and weak genetic barriers between members of the genus (Thongda et al., 2020). OEHHA has also 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 to other black bass species, including Redeye, Smallmouth, and Spotted Bass.

The mean mercury and PCB concentrations in Largemouth Bass from Little Rock Reservoir were 1,174 and 2 ppb, respectively. Based on the mean mercury concentration, OEHHA recommends no consumption of black bass species from Little Rock Reservoir for the sensitive population. Although the mean concentration in all 29 samples nears, but does not exceed, the “do not consume” threshold for the general population, the most recent 10 samples collected in 2019 had a mean mercury concentration of 1,956 ppb – well above this threshold. The 2019 mean mercury concentration was approximately 2 ½-fold higher than previously collected Largemouth Bass from this reservoir. Fish lengths in the 2019 samples were smaller than Largemouth Bass collected in previous years, so size does not account for the difference in mercury concentrations. Because of the high mercury concentrations in recently collected samples, OEHHA also recommends no consumption of this species for the general population.

Bullhead Species (Black Bullhead)

Black and Brown Bullhead are benthic, opportunistic omnivores, with adults feeding primarily on plants, invertebrates, and small fish. They can tolerate a wide range of conditions, including waters with low oxygenation and high pollution levels[10]. Bullhead species are bottom-dwellers which can expose them to chemical contaminants in bottom sediments. The species are also known to hybridize in some water bodies where they are co-located (Cingolani, et al. 2007). Although there are not sufficient data to state conclusively, due to their similar diet and habitat preferences, it is expected that Black and Brown Bullhead would have similar levels of contaminant uptake. OEHHA has evaluated mercury concentrations in Black Bullhead and Brown Bullhead in water bodies in California and has found a similar range of mercury concentrations when both of these species were caught from the same water body. These two species also have a similar statewide mean mercury concentrations. For these reasons, OEHHA extends the consumption advice for Black Bullhead to Brown Bullhead.

The mean mercury concentration in Black Bullhead from Little Rock Reservoir was 295 ppb. OEHHA recommends a maximum of one serving per week of Black Bullhead for the sensitive population and a maximum of two servings per week for the general population.

Common Carp

The mean mercury and PCB concentrations in Common Carp from Little Rock Reservoir were 441 and 23 ppb, respectively. Based on mercury, OEHHA recommends no consumption of Common Carp for the sensitive population, and a maximum of one serving a week for the general population.

Crappie Species (Black Crappie)

Black and White Crappie were grouped because they have similar diets and may hybridize when they are co-located, making them difficult to distinguish (Dunham et al., 1994; Kelly and Baumhoer, 2014). Further, statewide analysis of Black and White Crappie data shows similar mean mercury concentrations. Therefore, OEHHA extends the consumption advice for Black Crappie to White Crappie.

The mean mercury and PCB concentrations in Black Crappie from Little Rock Reservoir were 268 and 0 ppb, respectively. Based on mercury, OEHHA recommends a

[10] Species profiles for Black and Brown Bullhead can be found on the University of Michigan website, online at: https://animaldiversity.org/accounts/Ameiurus_nebulosus/, and https://animaldiversity.org/accounts/Ameiurus_melas/

maximum of one serving per week of Black Crappie for the sensitive population, and a maximum of 2 servings a week for the general population.

Golden Shiner

The mean mercury concentration in Golden Shiner from Little Rock Reservoir was 200 ppb. OEHHA recommends a maximum of one serving per week for the sensitive population and a maximum of three servings per week for the general population.

Rainbow Trout

The mean mercury concentration in Rainbow Trout from Little Rock Reservoir was 217 ppb. OEHHA recommends a maximum of one serving per week for the sensitive population and a maximum of three servings per week for the general population.

Sunfish Species (Bluegill, Green Sunfish)

OEHHA groups sunfish species due to extensive diet overlap (Kirby, 1982), which suggests similar contaminant uptake, and a known ability to hybridize (Avise and Smith, 1974). 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 sunfish species (Bluegill, Green Sunfish) to other sunfish species, including Pumpkinseed and Redear.

The mean mercury concentration in sunfish species from Little Rock Reservoir was 280 ppb. Mercury concentrations for individual sunfish species were 303 ppb in Bluegill and 256 ppb in Green Sunfish. PCBs were also analyzed in Bluegill and were 2 ppb but did not impact advice. Based on mercury, OEHHA recommends a maximum of one serving a week of sunfish species for the sensitive population, and a maximum of two servings a week for the general population.

White Catfish

The mean mercury and PCB concentrations in White Catfish from Little Rock Reservoir were 453 and 23 ppb, respectively. Based on mercury, OEHHA recommends no consumption of White Catfish for the sensitive population and a maximum of one serving per week for the general population.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

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

TABLE 4. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM LITTLE ROCK RESERVOIR

Fish Species from Little Rock Reservoir	Women 18–49 years and Children 1-17 years	Women 50 years and older and Men 18 years and older
Black Bass Species	0	0
Bullhead Species	1	2
Common Carp	0	1
Crappie Species	1	2
Golden Shiner	1	3
Rainbow Trout	1	3
Sunfish Species	1	2
White Catfish	0	1

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APPENDIX. ADVISORY TISSUE LEVELS

Advisory Tissue Levels (ATLs; OEHHA 2008 and 2011) 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[11] 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 ≥ 50 and men ≥ 18)	≤ 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.

[11] 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.