OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

Health Advisory and Guidelines for Eating Fish from Castaic Lake and Castaic Lagoon (Los Angeles County)

January 2017

Fish, Ecotoxicology, and Water Section
Pesticide and Environmental Toxicology Branch
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

LIST OF CONTRIBUTORS

Office of Environmental Health Hazard Assessment

Authors

Susan A. Klasing, Ph.D., Section Chief
Huyen Tran Pham, M.P.H.

Primary Reviewers

Shannon R. Murphy, Ph.D.
Wesley Smith, Ph.D.
Lori Chumney, M.S.

Final Reviewers

David Ting, Ph.D., Branch Chief
Allan Hirsch, Chief Deputy Director

Director

Lauren Zeise, Ph.D.

ACKNOWLEDGMENTS

Developing fish consumption advisories depends on sampling and analysis of fish. The Office of Environmental Health Hazard Assessment (OEHHA) acknowledges the contribution of information from the following entities: the State Water Resources Control Board (SWRCB), the California Department of Fish and Wildlife and its analytical resources, the Moss Landing Marine Laboratories and the Water Pollution Control Laboratory. Data were obtained from the California Environmental Data Exchange Network (http://www.ceden.us/AdvancedQueryTool). Huyen Tran Pham (OEHHA) created the map of Castaic Lake, Castaic Lagoon, and Elderberry Forebay on page 12 using ArcMap (10.3) from Environmental Systems Resource Institute (ESRI, Redlands, California).

For further information, contact:

Pesticide and Environmental Toxicology Branch
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

1515 Clay Street, 16th Floor
Oakland, California 94612
Telephone: (510) 622-3170
Email address: fish@oehha.ca.gov

1001 I Street, P.O. Box 4010
Sacramento, CA 95812-4010
Telephone: (916) 324-7572

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
n	sample size
OEHHA	Office of Environmental Health Hazard Assessment
PBDEs	polybrominated biphenyl 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 task 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 Castaic Lake and Castaic Lagoon 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 List of Figures and Tables.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

A Guide to Eating Fish from Castaic Lake

Women 18 - 45 years and Children 1 - 17 years

Sunfish species

Carp

Black Bass species

Channel Catfish

3 total servings a week	OR	2 total servings a week	Do not eat

Women 46 years and older and Men 18 years and older

Carp

Sunfish species

♥ Black Bass species

Channel Catfish

3 total servings a week	OR	2 total servings a week	OR	1 total serving a week

What is a serving?

For Adults **For Children**

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

Why eat fish?

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

♥ = Fish high in omega-3s

What is the concern?

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

California Office of Environmental Health Hazard Assessment • www.oehha.ca.gov/fish • (916) 324-7572 • fish@oehha.ca.gov

A Guide to Eating Fish from Castaic Lagoon

Women 18 - 45 years and Children 1 - 17 years

Sunfish species

Carp

♥ Black Bass species

7 total servings a week OR **2 total servings a week** OR **1 total serving a week**

Women 46 years and older and Men 18 years and older

Sunfish species

Carp

♥ Black Bass species

7 total servings a week OR **2 total servings a week**

What is a serving?

For Adults **For Children**

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

Why eat fish?

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

♥ = Fish high in omega-3s

What is the concern?

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

California Office of Environmental Health Hazard Assessment • www.oehha.ca.gov/fish • (916) 324-7572 • fish@oehha.ca.gov

INTRODUCTION

This report presents guidelines for eating fish from Castaic Lake and Castaic Lagoon (Figure 1), also known as Upper Lake and Lower Lake, respectively, in Los Angeles County, California. Castaic Lake and Dam is one of the 34 reservoirs and 25 dams that comprise the State Water Project, a system of storing and delivering water to approximately two-thirds of Californians (DWR, 2007 and 2016).

Castaic Lake is known for very large largemouth bass, including the state record-holder (and third largest in the world), weighing 21 pounds, 12 ounces, caught at Castaic Lake in 1991 (CDFW, 2016). As a result, there is significant interest in fishing for largemouth bass at the lake (Stienstra, 2004.) The minimum legal size for black bass at Castaic Lake is 15 inches (381 mm), which is larger than the typical minimum legal size of 12 inches (305 mm) for black bass for most other water bodies in the state (CDFW, 2016). The lake is also fished for Striped Bass, Rainbow Trout, catfish, Bluegill, and crappie (Stienstra, 2004). Sport fish caught in Castaic Lagoon include Rainbow Trout, Bluegill, crappie, and catfish (Stienstra, 2004).

Elderberry Forebay is a small reservoir at the northern end of Castaic Lake used for hydroelectric purposes (DWR, 2007). Fishing is not permitted at Elderberry Forebay; however, because it is thought that fish can move from Elderberry Forebay to Castaic Lake, some fish contaminant data collected from this water body were used in the development of fish consumption advice for Castaic Lake. This allowed advice to be developed for one additional species (catfish) and to provide supplemental data for largemouth bass. Contaminant levels in fish collected from Castaic Lagoon were generally lower than in fish collected from Castaic Lake; thus, separate advice was developed for Castaic Lake and Castaic Lagoon.

LOCATION

Castaic Lake and Castaic Lagoon are located just east of Interstate 5, approximately ten miles north of Santa Clarita. Castaic Lake has 29 miles of shoreline, a surface area of 2,240 acres, and a 425-foot-high dam (DWR, 2007). Just south of the lake is Castaic Lagoon (afterbay), which has three miles of shoreline and a surface area of 200 acres (DWR, 2007).

FIGURE 1. LOCATION OF CASTAIC LAKE AND CASTAIC LAGOON

APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from monitoring studies described in this report to develop the Castaic Lake and Castaic Lagoon advisories. 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[1]) 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 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, followed by polychlorinated biphenyls (PCBs) and, in a few cases, selenium 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 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

[1]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.

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" and "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport fish: Polybrominated Diphenyl Ethers (PBDEs)" (OEHHA, 2008 and 2011, respectively).

Fish sampling data used for the Castaic Lake and Castaic Lagoon advisories were analyzed for one or more of the following contaminants: mercury (as a measure of methylmercury), PCBs, selenium, PBDEs and the legacy pesticides (chlordanes, dieldrin, DDTs [DDT and its metabolites]). Fish species that do not normally accumulate PCBs or other organic chemicals may not be analyzed for those contaminants in a particular monitoring study. Only mercury and PCBs levels in fish tissue were sufficient to impact consumption advice for these water bodies; data for other contaminants are not shown in this report.

DATA SOURCES

The guidelines for eating fish from Castaic Lake and Castaic Lagoon are based on the chemicals detected in the fish collected for the three monitoring studies described below. These 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 composite of multiple fish for which contaminant data were reported. "Sampling" or "sampled" refers to the act of collecting fish for chemical analysis.

SWAMP Contaminants in Fish From California Lakes and Reservoirs, 2007-2008

The SWAMP (Surface Water Ambient Monitoring Program), operated by SWRCB in cooperation with Regional Water Quality Control Board staff, monitors water quality in

California's surface waters. In 2007, the survey collected Channel Catfish and Largemouth Bass from Elderberry Forebay, Common Carp and Largemouth Bass from Castaic Lake, and Largemouth Bass and Redear Sunfish from Castaic Lagoon, as part of a SWAMP statewide sampling effort to survey contaminants in sport fish found in California lakes and reservoirs (SWRCB, 2010). Fish were analyzed for chlordanes, DDTs, dieldrin, mercury, PCBs, PBDEs and, in some species, selenium.

SWAMP Survey of Lakes and Reservoirs with Low Concentrations of Contaminants in Sport Fish, 2014

In 2014, SWAMP collected Bluegill, Common Carp and Channel Catfish from Castaic Lake and Common Carp and Largemouth Bass from Castaic Lagoon, as part of a SWAMP statewide sampling effort to identify and better characterize low-contaminant California lakes and reservoirs (SWRCB, 2014). Bluegill, Channel Catfish, and Largemouth Bass were analyzed for mercury; Common Carp were analyzed for mercury and PCBs.

Los Angeles Regional Water Quality Control Board Ongoing Monitoring of Contaminants in Lake Sport Fish Study

The Los Angeles Regional Water Quality Control Board, Region 4 (RWB4), coordinates ongoing sampling efforts to monitor contaminant levels, including mercury, in sport fish caught from lakes and reservoirs within the region (LARWQCB, 2012). RWB4 collected Bluegill and Largemouth Bass from Castaic Lake in 2010 and Largemouth Bass from Castaic Lake in 2013. Channel Catfish and Largemouth Bass were collected from Elderberry Forebay in 2012, and Common Carp were collected from Castaic Lagoon in 2010. Bluegill and Largemouth Bass at Castaic Lake were analyzed for mercury; Channel Catfish and Largemouth Bass at Elderberry Forebay were analyzed for chlordanes, DDTs, dieldrin, mercury, and PCBs. Common Carp at Castaic Lagoon were analyzed for chlordanes, DDTs, dieldrin, mercury, and PCBs.

FISH SAMPLED FROM CASTAIC LAKE, CASTAIC LAGOON, AND ELDERBERRY FOREBAY

The fish sampling data used in these advisories were retrieved from the California Environmental Data Exchange Network (CEDEN). 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 included in these advisories is shown in tables 1 and 2, 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 CASTAIC LAKE ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Bluegill	*Lepomis macrochirus*	1	5	SWAMP	2014	Hg
		3	15	RWB4	2010	Hg
Common Carp	*Cyprinus carpio*	2	10	SWAMP	2007	Chlordanes, DDTs, Dieldrin, Hg, PBDEs, PCBs
		1	10	SWAMP	2007	Se
		2	10	SWAMP	2014	Hg
		1	10	SWAMP	2014	PCBs
Channel Catfish	*Ictalurus punctatus*	1	1	SWAMP	2014	Hg
Channel Catfish (Elderberry Forebay)	*Ictalurus punctatus*	2	10	SWAMP	2007	Chlordanes, DDTs, Dieldrin, Hg, PBDEs, PCBs, Se
		1	5	RWB4	2012	Chlordanes, DDTs, Dieldrin, Hg, PCBs
Largemouth Bass	*Micropterus salmoides*	2	10	SWAMP	2007	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs
		10	10	SWAMP	2007	Hg
		3	3	RWB4	2010	Hg
		5	5	RWB4	2013	Hg

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Largemouth Bass (Elderberry Forebay)	*Micropterus salmoides*	2	10	SWAMP	2007	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs
		1	5	RWB4	2012	Chlordanes, DDTs, Dieldrin, PCBs
		4	4	SWAMP	2007	Hg
		3	3	RWB4	2012	Hg

Hg = Mercury, Se = Selenium, DDTs= dichlorodiphenyltrichloroethane, PBDEs = polybrominated diphenyl ethers, PCBs = polychlorinated biphenyls

TABLE 2. FISH SAMPLES EVALUATED FOR THE CASTAIC LAGOON ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Common Carp	*Cyprinus carpio*	1	5	RWB4	2010	Chlordanes, DDTs, Dieldrin, Hg, PCBs
		2	10	SWAMP	2014	Hg, PCBs
Largemouth Bass	*Micropterus salmoides*	2	10	SWAMP	2007	Chlordanes, DDTs, Dieldrin, PBDEs
		1	5	SWAMP	2007	PCBs, Se
		7	7	SWAMP	2007	Hg
		7	7	SWAMP	2014	Hg
Redear Sunfish	*Lepomis microlophus*	2	10	SWAMP	2007	Chlordanes, DDTs, Dieldrin, Hg, PBDEs, PCBs
		1	5	SWAMP	2007	Se

Hg = Mercury, Se = Selenium, DDTs= dichlorodiphenyltrichloroethane, PBDEs = polybrominated diphenyl ethers, PCBs = polychlorinated biphenyls

CHEMICAL CONCENTRATIONS

As shown in tables 1 and 2, samples were analyzed for total mercury, chlordanes, DDTs, dieldrin, PCBs (48-55 congeners[2]), PBDEs and selenium. All fish samples were prepared as skinless fillets. Samples were analyzed as individual fish or composites.

Composites were prepared from equal amounts of tissue from several similarly sized individual fish of a species. For composite samples, the total length of the smallest fish in a composite sample must be at least 75% of the length of the largest fish in the sample (US EPA, 2000a). Composite samples for all species except for one composite of Common Carp from Castaic Lagoon (73.4%), one composite of Bluegill from Castaic Lake (73.9%), and one composite of Channel Catfish from Elderberry Forebay (70.2%) met this requirement. Evaluation of the data showed that including those composites did not affect advice. For this reason, OEHHA included these data to develop consumption advice for these species.

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, either as individual fish or composite samples, using a direct mercury analyzer (DMA) at the California Department of Fish and Wildlife (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). Tables 3 (Castaic Lake and Elderberry Forebay) and 4 (Castaic Lagoon) show the averages and ranges for total length[3] as well as mercury concentrations in each fish species. The DMA method detection limit (MDL)[4] was reported between 4 and 12 and the reporting limit (RL)[5] for total mercury was reported between 12 and 36 parts per billion (ppb).

PCBS, PBDES AND PESTICIDES

Samples were analyzed for legacy pesticides (chlordanes, DDTs, dieldrin), PCBs and PBDEs. Pesticides, PCBs and PBDEs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. For PCBs, PBDEs, chlordanes, and DDTs,

---

[2] Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 53-55 are generally reported.
[3] 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.
[4] The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.
[5] The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

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, ≤ 1.0 and ≤ 5 ppb, respectively, 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). Tables 5 (Castaic Lake and Elderberry Forebay) and 6 (Castaic Lagoon) show the averages and ranges for total length as well as PCB concentrations in each species. Concentrations of chlordanes, DDTs, dieldrin and PBDEs were not sufficiently high to alter consumption advice and are not shown.

SELENIUM

The CDFW MLML analyzed species collected from Elderberry Forebay and Castaic Lagoon for selenium, as composite samples, 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 100 and 300 ppb, respectively. Concentrations of selenium were not sufficiently high to alter consumption advice and are not shown.

TABLE 3. MERCURY CONCENTRATIONS IN FISH FROM CASTAIC LAKE AND ELDERBERRY FOREBAY

Species from Castaic Lake	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Bluegill	4	20	169	136-199	43	27-55
Carp, Common	4	20	605	549-714	141	63-251
Catfish, Channel	1	1	633	NA	1000	NA
Bass, Largemouth	18	18	413	375-490	427	213-750
Species from Elderberry Forebay	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Catfish, Channel	3	15	598	488-695	152	126-202
Bass, Largemouth	7	7	403	374-439	455	355-672

*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 4. MERCURY CONCENTRATIONS IN FISH FROM CASTAIC LAGOON

Species from Castaic Lagoon	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Carp, Common	3	15	651	550-790	32	15-46
Bass, Largemouth	14	14	427	374-504	263	124-542
Redear Sunfish	2	10	223	206-242	24	23-25

*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 5. PCB CONCENTRATIONS IN FISH FROM CASTAIC LAKE AND ELDERBERRY FOREBAY

Species from Castaic Lake	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCBs (ppb)	
					Mean*	Range**
Carp, Common	3	20	605	549-714	17	16-19
Bass, Largemouth	1	10	366	322-397***	17	NA
Species from Elderberry Forebay	**Number of Samples**	**Total Number of Fish**	**Mean* Total Length (mm)**	**Range of Total Lengths** (mm)**	**PCBs (ppb)**	
					Mean*	**Range****
Catfish, Channel	3	15	598	488-695	92	13-146
Bass, Largemouth	3	15	363	317-405***	6	4-7

*Means are an arithmetic average of individual values and/or a weighted average of composites.
**Range of individuals and/or range of the composites.
***Some fish in the largemouth bass composite analyzed for PCBs were below legal size for Castaic Lake, but above legal size for most other California water bodies. They were included in the evaluation because it was health protective to consider the contribution of PCBs to the toxicity of this species.

TABLE 6. PCB CONCENTRATIONS IN FISH FROM CASTAIC LAGOON

Species from Castaic Lagoon	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCBs (ppb)	
					Mean*	Range**
Carp, Common	3	15	651	550-790	23	13-42
Bass, Largemouth	1	5	367	329-401***	9	NA
Redear Sunfish	2	10	223	206-242	1	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.
***Some fish in the Largemouth Bass composite analyzed for PCBs were below legal size for Castaic Lake, but above legal size for most other California water bodies. They were included in the evaluation because it was health protective to consider the contribution of PCBs to the toxicity of this species.

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM CASTAIC LAKE AND CASTAIC LAGOON

GENERAL INFORMATION

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, 2014; American Heart Association, 2014; OEHHA, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish is 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 seafood[6] "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 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 FDA and US EPA recommend that women who are pregnant (or might become pregnant) or breastfeeding, and young children do not consume shark, swordfish, tilefish, or king mackerel, and limit consumption of white (albacore) tuna to six ounces per week (FDA/US EPA, 2004 and 2014).

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

[6] "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).

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 45 years of age) and children 1-17 years, are lower than those for women 46 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" and "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport fish: Polybrominated Diphenyl Ethers (PBDEs)" (OEHHA 2008 and 2011, respectively). 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 species in Castaic Lake and Castaic Lagoon where chlordanes, DDTs, dieldrin, PBDEs, and selenium were analyzed, mean concentrations of these chemicals were lower than the corresponding ATL threshold values for daily consumption (OEHHA, 2008 and 2011).

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. For the Castaic Lake advisory, the potential effect of multiple chemical exposures was assessed and determined to affect the consumption advice for Channel Catfish and Largemouth Bass, based on mercury and PCB concentrations. For other species, advice was based on mercury or PCB concentrations alone.

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 for each water body. People

should eat no more than the recommended number of servings for each fish species or species group. OEHHA's advice on consuming a particular fish species can be extended to other closely related fish species[7] 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 a serving of 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 CASTAIC LAKE AND CASTAIC LAGOON

OEHHA's advisory protocol requires at least nine fish of a species to be collected from a water body before an advisory can be developed for the primary contaminant of concern. This is to ensure the sample dataset is representative of the fish species population in the water body. For Castaic Lake, the sample size criterion was met for the following species: black bass species (Largemouth), carp, catfish, and sunfish species (Bluegill). For Castaic Lagoon, the sample size criterion was met for the following species: black bass species (Largemouth), carp, and sunfish species (Redear). There were not sufficient data to evaluate other species that may be found in these water bodies.

CASTAIC LAKE

BLACK BASS SPECIES (LARGEMOUTH BASS)

The mean mercury and PCB concentrations for Largemouth Bass from Castaic Lake were mercury (427 ppb) and PCBs (17 ppb), respectively. Seven Largemouth Bass were collected from Elderberry Forebay and analyzed for mercury (455 ppb) and PCBs (6 ppb). When combined using a weighted average, the mean mercury and PCB concentrations for both water bodies were 435 and 11 ppb, respectively. Based on this weighted average, OEHHA recommends that the sensitive population (women 18 to 45 years and children 1 to 17 years) not consume Largemouth Bass from Castaic Lake, based on exposure to mercury and PCBs. OEHHA recommends that the general population (women 46 years and older, and men 18 years and older) may eat up to two servings a week of this species, based on exposure to mercury.

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

OEHHA evaluated mercury concentrations in black bass species in many water bodies in California and 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.

Channel Catfish

Only one Channel Catfish was collected from Castaic Lake and that fish was only analyzed for mercury (1000 ppb). Fifteen Channel Catfish were analyzed for mercury and PCBs from Elderberry Forebay, with mean mercury and PCB concentrations of 152 and 92 ppb, respectively. OEHHA combined fish from both lakes using a weighted average to provide consumption advice (Hg: 205 ppb; PCBs: 92 ppb). Based on these concentrations, OEHHA recommends that the sensitive population (women 18 to 45 years and children 1 to 17 years) not consume Channel Catfish from Castaic Lake, based on exposure to mercury and PCBs. OEHHA recommends that the general population (women 46 years and older, and men 18 years and older) may eat up to one serving a week this species, based on exposure to PCBs.

Common Carp

The mean mercury and PCB concentrations in Common Carp from Castaic Lake were 141 and 17 ppb, respectively. OEHHA recommends a maximum of two servings a week of Common Carp for the sensitive population (women 18 to 45 years and children 1 to 17 years), based on exposure to mercury, and a maximum of three servings a week for the general population (women 46 years and older, and men 18 years and older), based on an exposure to PCBs.

Sunfish Species (Bluegill)

The mean mercury concentration in Bluegill at Castaic Lake was 43 ppb. PCBs were not analyzed in Bluegill. Although small sunfish species, such as bluegill, are generally low in PCBs, PCB concentrations in these species can be elevated in some environments. Because the level of PCBs affected consumption advice for other species in Castaic Lake, OEHHA considered it prudent to use the concentration of PCBs in another, larger sunfish species (Largemouth Bass, 17 ppb) to provide advice for Bluegill and other small sunfish species. OEHHA thus recommends a maximum of three servings a week of Bluegill for both the sensitive population (women 18 to 45 years and children 1 to 17 years) and general population (women 46 years and older, and men 18 years and older), based on potential exposure to PCBs.

OEHHA evaluated mercury concentrations in sunfish species in many water bodies in California and 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.

CASTAIC LAGOON

BLACK BASS SPECIES (LARGEMOUTH BASS)

The mean mercury and PCB concentrations in Largemouth Bass from Castaic Lagoon were 263 and 9 ppb, respectively. OEHHA recommends a maximum of one serving a week of Largemouth Bass for the sensitive population (women 18 to 45 years and children 1 to 17 years) and two servings per week for the general population (women 46 years and older, and men 18 years and older), based on an exposure to mercury.

COMMON CARP

The mean mercury and PCB concentrations in Common Carp from Castaic Lagoon were 32 and 23 ppb, respectively. OEHHA recommends a maximum of two servings a week of Common Carp for the sensitive (women 18 to 45 years and children 1 to 17 years) and general (women 46 years and older, and men 18 years and older) populations, based on an exposure to PCBs.

SUNFISH SPECIES (REDEAR SUNFISH)

The mean mercury and PCB concentrations in Redear Sunfish from Castaic Lagoon were 24 and 1 ppb, respectively. OEHHA recommends a maximum of seven servings a week of Redear Sunfish for the sensitive (women 18 to 45 years and children 1 to 17 years) and general (women 46 years and older, and men 18 years and older) populations, based on mercury.

OEHHA evaluated mercury concentrations in sunfish species in other water bodies in California and 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 Redear Sunfish to other sunfish species.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

The recommended maximum numbers of servings per week for fish from Castaic Lake and Castaic Lagoon are shown in Table 7 and Table 8, respectively.

TABLE 7. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM CASTAIC LAKE

Fish Species	Women 18–45 years and Children 1–17 years	Women 46 years and older and Men 18 years and older
Sunfish species	3	3
Carp	2	3
Channel Catfish	0	1
Black Bass species	0	2

TABLE 8. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM CASTAIC LAGOON

Fish Species	Women 18–45 years and Children 1–17 years	Women 46 years and older and Men 18 years and older
Carp	2	2
Black Bass species	1	2
Sunfish species	7	7

REFERENCES

American Heart Association. 2014. Fish and Omega-3 Fatty Acids. Online at: http://www.americanheart.org/presenter.jhtml?identifier=4632.

Bloom, N.S. 1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. Can. J. Fish. Aquat. Sci. 49(5):1010-1017.

CDFW. 2016. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=117095&inline

DWR. 2007. Castaic Lake. Online at: http://www.water.ca.gov/pubs/swp/castaic_lake__west_branch_/castaic_lake.pdf

DWR. 2016. California State Water Project Overview. Online at: http://www.water.ca.gov/swp/

FDA/USEPA. 2004. What you need to know about mercury in fish and shellfish (brochure). Advice by FDA and USEPA/March 2004. Online at: http://www.fda.gov/food/resourcesforyou/consumers/ucm110591.htm.

FDA/USEPA. 2014. Fish: What pregnant women and parents should know. Draft Updated Advice by FDA and USEPA/June 2014. Online at: http://www.fda.gov/downloads/Food/FoodborneIllnessContaminants/Metals/UCM400358.pdf.

Institute of Medicine. 2007. Seafood choices, balancing benefits and risks. Committee on Nutrient Relationships in Seafood: Selections to Balance Benefits and Risks. Institute of Medicine, Food and Nutrition Board. The National Academies Press, Washington, D.C.

Kris-Etherton, P.M., W.S. Harris, and L.J. Appel. 2002. Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. Circ. 106:2747-2757.

LARWQCB. 2012. Fact Sheet Region 4: Los Angeles Regional Water Board. State Water Resources Control Board. Online at: http://www.swrcb.ca.gov/water_issues/programs/swamp/docs/factsheets/rb4_cw101.pdf

OEHHA. 2005. General Protocol for Sport Fish Sampling and Analysis. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California. Online at: http://oehha.ca.gov/media/downloads/fish/document/fishsamplingprotocol2005.pdf.

OEHHA. 2008. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene. Office of Environmental Health

Hazard Assessment, California Environmental Protection Agency, Sacramento, California. Online at: http://oehha.ca.gov/media/downloads/fish/report/atlmhgandothers2008c.pdf.

OEHHA. 2011. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Polybrominated Diphenyl Ethers (PBDEs). Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California. Online at: http://oehha.ca.gov/fish/gtlsv/pdf/PBDEs052311.pdf.

Oken, E., R.O. Wright, K.P. Kleinman, D. Bellinger, C.J. Amarasiriwardena, H. Hu, J.W. Rich-Edwards, and M.W. Gillman. 2005. Maternal fish consumption, hair mercury, and infant cognition in a U.S. cohort. Environ. Health Perspect. 113(10):1376-1380.

Oken, E., J.S. Radesky, R.O. Wright, D. Bellinger, C.J. Amarasiriwardena, K.P. Kleinman, H. Hu, J.W. Rich-Edwards, and M.W. Gillman. 2008. Maternal fish intake during pregnancy, blood mercury levels, and infant cognition at age 3 years in a U.S. cohort. Am. J. Epidemiol. 167(10):1171-1181.

Stienstra, T. 2004. California Fishing: The Complete Guide to Fishing on Lakes, Streams, Rivers and Coasts. 7th Edition. Avalon Travel Publishing. Emeryville, CA.

SWRCB. 2010. Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey. State Water Resources Control Board, California Environmental Protection Agency, Sacramento, California. Online at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/lakes_study/lake_survey_yr2_no_app.pdf

SWRCB. 2014. SWAMP Survey of Lakes and Reservoirs with Low Concentrations of Contaminants in Sport Fish. Surface Water Ambient Monitoring Program, State Water Resources Control Board, California Environmental Protection Agency, Sacramento, California. Online at: http://www.waterboards.ca.gov/water_issues/programs/swamp/achievements/2014/s_bog_lakereservoir.pdf

USDA/USDHHS. 2015. 2015-2020 Dietary Guidelines for Americans. 8th Edition. U.S. Government Printing Office, Washington, D.C. December. Online at: http://health.gov/dietaryguidelines/2015/guidelines/.

US EPA. 1989. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A) Interim Final. EPA/5401-89/002, December 1989. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Online at: https://rais.ornl.gov/documents/HHEMA.pdf.

US EPA. 2000a. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 1. Fish Sampling and Analysis. 3rd Ed. EPA 823-B00-007. Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

US EPA. 2000b. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 2. Risk Assessment and Fish Consumption Limits, 3rd Edition. EPA 823-B-00-007. Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

Weaver, K.L., P. Ivester, J.A. Chilton, M.D. Wilson, P. Pandey, and F.H. Chilton. 2008. The content of favorable and unfavorable polyunsaturated fatty acids found in commonly eaten fish. J. American Dietetic Assoc. 108:1178-1185.

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 dose[8] 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 the Alamo River and the New River are followed, exposure to chemicals in fish from Castaic Lake and Castaic Lagoon 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 18-45 and children 1-17)	≤ 31	>31-36	>36-44	>44-55	>55-70	>70-150	>150-440	>440
MeHg (Women > 45 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.

[8] 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.