OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

GOOD CATCH CALIFORNIA
Your Fish Advisor

Health Advisory and Guidelines for Eating Fish from Lake Gregory (San Bernardino County)

December 2016

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 (OEHHA)

Authors

Shannon R. Murphy, Ph.D.
Huyen Tran Pham, M.P.H.

Primary Reviewers

Susan A. Klasing, Ph.D., Section Chief
Wesley Smith, Ph.D.

Final Reviewers

David Ting, Ph.D., Branch Chief
David Siegel, Ph.D., Assistant to the Deputy Director
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 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)
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 diphenyl ethers
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
Se	selenium
SWAMP	Surface Water Ambient Monitoring Program
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 guidelines for eating fish from Lake Gregory in San Bernardino 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

A GUIDE TO EATING FISH FROM LAKE GREGORY 6

INTRODUCTION 7

Location 7

Approach Used 8

CHEMICALS OF POTENTIAL CONCERN 8

DATA SOURCES 9

Toxic Substances Monitoring Program (TSMP) 10

Contaminants in Fish From California Lakes and Reservoirs, 2007-2008 (SWAMP) 10

Survey of Lakes and Reservoirs with Low Concentrations of Contaminants in Sport Fish, 2014 (SWAMP) 10

FISH SAMPLED FROM LAKE GREGORY 10

CHEMICAL CONCENTRATIONS 12

Mercury 12

PBDEs, PCBs and Pesticides 13

Selenium 13

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM LAKE GREGORY 15

General Information 15

CONSUMPTION ADVICE FOR FISH FROM LAKE GREGORY 17

Black Bass Species (Largemouth) 17

Bullhead Species (Black, Brown) 18

Common Carp 18

Crappie (White) 18

Tule Perch 18

RECOMMENDED MAXIMUM NUMBER OF SERVINGS.....19

REFERENCES 20

APPENDIX I. Advisory Tissue Levels 23

LIST OF FIGURES AND TABLES

Figure 1. Location of Lake Gregory 7

Table 1. Fish Samples Evaluated for the Lake Gregory Advisory 11

Table 2. Mercury Concentrations in Fish from Lake Gregory 14

Table 3. Recommended Maximum Number of Servings per Week for Fish from Lake Gregory 19

Advisory Tissue Levels for Selected Analytes 23

A Guide to Eating Fish from Lake Gregory

Women 18 - 45 years and Children 1 - 17 years

Bullhead

Carp

Tule Perch

Black Bass species

Crappie

6 total servings a week of Bullhead OR 7 total servings a week of Carp OR **2 total servings a week** OR **1 total serving a week**

Women 46 years and older and Men 18 years and older

Bullhead

Carp

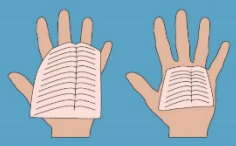
Tule Perch

Black Bass species

Crappie

7 total servings a week OR **5 total servings a week** OR **2 total servings a week of Black Bass species OR 3 total servings a week of Crappie**

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

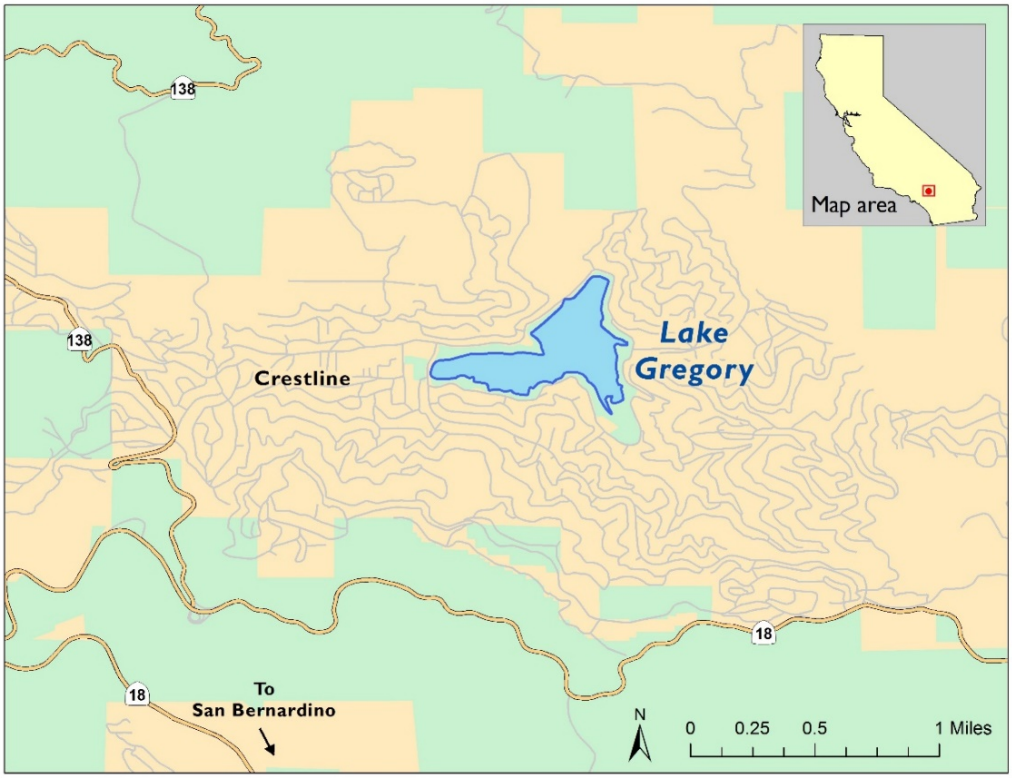
INTRODUCTION

This report presents guidelines for eating fish from Lake Gregory (Figure 1) in the San Bernardino County mountain community of Crestline.

LOCATION

Managed by the Lake Gregory Recreation Company, Lake Gregory is an artificial lake formed by a southwest dam on Houston Creek.[1] Initiated under the Works Progress Administration and completed in 1939, the Lake Gregory Dam construction project created the 84-acre lake. Lake Gregory is also connected to Albondigas Creek to the southeast and some minor mountain creeks within the greater Houston Creek Watershed. This advisory applies only to Lake Gregory and not adjacent water bodies.

FIGURE 1. LOCATION OF LAKE GREGORY



[1] Lahontan RWQCB, Lake Gregory Sediment Management Project, San Bernardino County Regional Parks Department, WDID Number 6B362211002. Available at: http://www.waterboards.ca.gov/lahontan/board_decisions/adopted_orders/2013/docs/r6v_2013_0019.pdf.

APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from three monitoring studies described in this report to develop the Lake Gregory 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 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 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

---

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

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

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

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

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

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

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

Fish sampling data used for the Lake Gregory advisory 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 levels in fish tissue samples from Lake Gregory were sufficient to impact consumption advice; data for other contaminants are not shown in this report.

DATA SOURCES

The guidelines for eating fish from Lake Gregory 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 a composite of multiple fish for which contaminant data was reported. “Sampling” or “sampled” refers to the act of collecting fish for chemical analysis.

Toxic Substances Monitoring Program (TSMP)

The TSMP (1976-2003) was a state water quality-monitoring program managed by the State Water Resources Control Board (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. The California Department of Fish and Wildlife (CDFW) staff, then known as the California Department of Fish and Game, collected Black Bullhead from Lake Gregory in 2001, as part of the program. Fish samples were analyzed for mercury and selenium.

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

The Surface Water Ambient Monitoring Program (SWAMP), operated by SWRCB in cooperation with Regional Water Quality Control Board staff, monitors water quality in California’s surface waters. The program collected Common Carp and Largemouth Bass from Lake Gregory in 2007 to analyze mercury in both species, and chlordanes, DDTs, dieldrin, mercury, PBDEs, and PCBs in Common Carp, 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)

SWAMP collected Brown Bullhead, Largemouth Bass, Tule Perch, and White Crappie from Lake Gregory in 2014 to analyze mercury in all species, and chlordanes, DDTs, dieldrin, and PCBs in Brown Bullhead and White Crappie, as part of a SWAMP statewide sampling effort to identify and better characterize low-contaminant California lakes and reservoirs (SWRCB, 2014).

FISH SAMPLED FROM LAKE GREGORY

The fish sampling data used in these advisories were retrieved from the California Environmental Data Exchange Network (CEDEN). Samples were excluded that are not legal 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 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 Lake Gregory Advisory

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Black Bullhead	*Ameiurus melas*	1	6	TSMP	2001	Hg, Se
Brown Bullhead	*Ameiurus nebulosus*	2	10	SWAMP 2014	2014	Chlordanes, DDTs, Dieldrin, Hg, PCBs
Common Carp	*Cyprinus carpio*	2	10	SWAMP 2010	2007	Hg
		1	5	SWAMP 2010	2007	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs, Se
Largemouth Bass	*Micropterus salmoides*	7	7	SWAMP 2010	2007	Hg
		11	11	SWAMP 2014	2014	Hg
Tule Perch	*Hysterocarpus traskii*	2	10	SWAMP 2014	2014	Hg
White Crappie	*Pomoxis annularis*	8	8	SWAMP 2014	2014	Hg
		1	10*	SWAMP 2014	2014	Chlordanes, DDTs, Dieldrin, PCBs

Hg = Mercury, Se = Selenium

*Sample contains some fish that do not meet the OEHHA minimum edible length for this species.

CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for total mercury, selenium, chlordanes, DDTs, dieldrin, PBDEs, and PCBs (54-55 congeners[3]). All fish samples were prepared as skinless fillets, except for the TSMP study where the fillet preparation method for Black Bullhead was not recorded. 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 from Lake Gregory except Brown Bullhead met this requirement. There were two Brown Bullhead composite samples of five fish where the smallest fish in the sample was 72% or 74%, respectively, of the length of the largest fish. Brown Bullhead comprise a major fraction of the overall sport fish catch in Lake Gregory, making this lake a preferred sport fishing location for this species. For this reason, OEHHA included these data to develop consumption advice for the bullhead group, based on a combination of both Black and Brown Bullhead samples.

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 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[4] as well as mercury concentrations in each fish species. The DMA method detection limit (MDL)[5] and the reporting limit (RL)[6] for total mercury were reported at 4 or 12 and 12 parts per billion (ppb), respectively.

---

[3] Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54-55 are generally reported.
[4] 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.
[5] The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.
[6] The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

PBDEs, PCBs and Pesticides

Some composite samples were analyzed for legacy pesticides (chlordanes, DDTs, and dieldrin), PBDEs, and PCBs. Pesticides, PBDEs and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. For PBDEs, PCBs, chlordanes, and DDTs, 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, ≤ 0.9 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). Concentrations of chlordanes, dieldrin, DDTs, PBDEs, and PCBs were not sufficiently high to alter consumption advice and are not shown.

Selenium

The CDFW MLML analyzed species collected from Lake Gregory 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 150 and 400 ppb, respectively. The selenium concentrations were not sufficiently high to alter consumption advice and are not shown.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM LAKE GREGORY

Species from Lake Gregory	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Bass, Largemouth	18	18	389	305-470	289	113-555
Bullhead Group***	3	16	269	202-316	36	30-49
Bullhead, Black	1	6	316	n/a	30	n/a
Bullhead, Brown	2	10	240	202-281	40	30-49
Carp, Common	2	10	414	380-441	21	19-23
Crappie, White	8	8	152	143-158	167	89-235
Tule Perch	2	10	119	106-136	110	101-119

*Means are an arithmetic average of individual values and/or a weighted average of composites.
**Range of individuals and/or range of the composites.
***Black and Brown Bullhead were combined ("Bullhead Group") for the purpose of developing consumption advice.
n/a = not applicable due to a single sample.

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM LAKE GREGORY

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 are a significant source of the specific omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) thought to be associated with these beneficial health effects (USDA/USDHHS, 2015; Weaver et al., 2008).

The 2015-2020 U.S. Dietary Guidelines recommend that 1) the general population "consume eight or more ounces per week (less for young children)" of a variety of seafood[7] "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

[7] "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" (OEHHA, 2008). 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 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 Lake Gregory where chlordanes, DDTs, dieldrin, PBDEs, PCBs, and selenium were analyzed, mean concentrations of these chemicals 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.

The consumption advice for a fish species is initially based on the chemical with the lowest allowable number of servings per week. Because mercury, DDTs, and PCBs are known to affect the nervous system, particularly during brain development, additivity of toxicity is assumed and assessed by using multiple chemical exposure methodology (US EPA, 1989 and 2000b). The presence of these three chemicals in fish tissue 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 Lake Gregory advisory, the potential effect of multiple chemical exposures was assessed and determined not to affect the consumption advice. Advice for all species in this advisory was based solely on mercury concentrations because the levels of the other chemicals evaluated were not sufficient to impact advice.

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 advice on consuming a particular fish species can be extended to other closely related fish species[8] 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 LAKE GREGORY

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. In some cases, an exception is made for species that are commonly caught and consumed from a given water body but where available data may be limited. Although only eight White Crappie collected from Lake Gregory were of sufficient minimum edible size (within 5% of the 150 mm minimum total length), OEHHA considers it appropriate to offer consumption advice for this species at this lake because of its popularity as a sport fish and relatively moderate mercury concentration. Additionally, OEHHA does not currently provide statewide advice for crappie species. For Lake Gregory, the sample size criterion was met for the following species: black bass, bullhead, carp, crappie and Tule Perch. There were not sufficient data to evaluate other species that may be found in this water body.

BLACK BASS SPECIES (LARGEMOUTH)

Based on the mean mercury concentration in Largemouth Bass, 289 ppb, OEHHA recommends a maximum of one serving a week of black bass species for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of two servings a week for the general population (women 46 years and older, and men 18 years and older). Black bass species include Largemouth, Smallmouth, Redeye, and Spotted Bass, all members of the same genus.

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.

---

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

Bullhead Species (Black, Brown)

The mean mercury level in bullhead species from Lake Gregory was 36 ppb. The mean mercury levels in individual bullhead species were 30 (Black) and 40 (Brown) ppb, respectively. OEHHA recommends a maximum of six servings a week of bullhead species for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of seven servings a week for the general population (women 46 years and older, and men 18 years and older), based on mercury.

Common Carp

The mean mercury level in Common Carp from Lake Gregory was 21 ppb. OEHHA recommends a maximum of seven servings a week of carp for both 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.

Crappie (White)

The mean mercury level in White Crappie from Lake Gregory was 167 ppb. OEHHA recommends a maximum of one serving a week of White Crappie for the sensitive population (women 18 to 45 years and children 1 to 17 years), 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 mercury.

Contaminant concentrations in crappie species are generally similar within the same water body. Therefore, the advice for White Crappie can be extended to Black Crappie.

Tule Perch

The mean mercury level in Tule Perch from Lake Gregory was 110 ppb. OEHHA recommends a maximum of two servings a week of Tule Perch for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of five servings a week for the general population (women 46 years and older, and men 18 years and older), based on mercury.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

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

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

Fish Species	Women 18–45 years and Children 1–17 years	Women 46 years and older and Men 18 years and older
Black Bass	1	2
Bullhead	6	7
Carp	7	7
Crappie	1	3
Tule Perch	2	5

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.

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.

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: Polybrominate Diphenyls (PBDEs). Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California. Online at: http://oehha.ca.gov/media/downloads/fish/report/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.

SWRCB. 2007. Bioaccumulation of Pollutants in California Waters: A Review of Historic Data and Assessment of Impacts on Fishing and Aquatic Life. State Water Resources Control Board, California Environmental Protection Agency, Sacramento, California. Online at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/bop/cw117_swrcb_report.pdf.

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. 2013. State Mussel Watch (SMW) Program/Toxic Substances Monitoring (TSM) Program. State Water Resources Control Board, California Environmental Protection Agency, Sacramento, California. Online at: http://www.waterboards.ca.gov/water_issues/programs/swamp/mussel_watch.shtml.

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[9] 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 Lake Gregory are followed, exposure to chemicals in fish from Lake Gregory 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

[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.

[9] 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.