



Health Advisory and Guidelines for Eating Fish from Hensley Lake (Madera County)

March 2021



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

Project Leads

Lori Chumney, M.S.
Huyen Tran Pham, M.P.H.

Primary Reviewers

Susan A. Klasing, Ph.D., Section Chief
Wesley Smith, Ph.D.
Shannon R. Murphy, Ph.D.

Final Reviewers

David Ting, Ph.D., Branch Chief
David Siegel, Ph.D., Assistant to the Deputy Director
Vincent Cogliano, Ph.D., Deputy Director for Scientific Programs
Sam Delson, Deputy Director for External and Legislative Affairs

Director

Lauren Zeise, Ph.D.

ACKNOWLEDGMENTS

Developing fish consumption advisories depends on sampling and analysis of fish. The Office of Environmental Health Hazard Assessment acknowledges the contribution of information from the following entities: the State Water Resources Control Board, 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://ceden.waterboards.ca.gov/AdvancedQueryTool) (<http://ceden.waterboards.ca.gov/AdvancedQueryTool>). The map was created using ArcMap (10.5) 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

1001 I Street, P.O. Box 4010
Sacramento, CA 95812-4010
Telephone: (916) 324-7572
Email address: fish@oehha.ca.gov

1515 Clay Street, 16th Floor
Oakland, California 94612
Telephone: (510) 622-3170

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 |
| RWB5 | Regional Water Board 5 (Central Valley) |
| Se | selenium |
| SWAMP | Surface Water Ambient Monitoring Program |
| SWRCB | State Water Resources Control Board |
| USDA | United States Department of Agriculture |
| USDHHS | United States Department of Health and Human Services |
| US EPA | United States Environmental Protection Agency |

PREFACE

The Office of Environmental Health Hazard Assessment (OEHHA), a department in the California Environmental Protection Agency, is responsible for evaluating potential public health risks from chemical contamination of sport fish. This includes issuing fish consumption advisories, when appropriate, for the State of California. OEHHA's authorities to conduct these activities are based on mandates in the:

- California Health and Safety Code
 - Section 59009, to protect public health
 - Section 59011, to advise local health authorities
- California Water Code
 - Section 13177.5, to issue health advisories

The health advisories are published in the California Department of Fish and Wildlife Sport Fishing Regulations in the section on public health advisories.

This report presents guidelines for eating fish from Hensley Lake in Madera 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 HENSLEY LAKE | 5 |
| INTRODUCTION | 6 |
| <i>Location</i> | 6 |
| <i>Approach Used</i> | 7 |
| CHEMICALS OF POTENTIAL CONCERN..... | 7 |
| DATA SOURCES..... | 9 |
| <i>Fish Mercury Project (FMP)</i> | 9 |
| <i>Contaminants in Fish From California Lakes and Reservoirs, 2007–2008 (SWAMP)</i> | 9 |
| <i>Long-Term Monitoring of Bass Lakes and Reservoirs in California, 2015–ongoing (SWAMP)</i> .. | 10 |
| FISH SAMPLED FROM HENSLEY LAKE | 10 |
| CHEMICAL CONCENTRATIONS | 11 |
| <i>Mercury</i> | 11 |
| <i>PCBs, PBDEs, and Pesticides</i> | 11 |
| <i>Selenium</i> | 12 |
| DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM HENSLEY LAKE | 12 |
| CONSUMPTION ADVICE FOR FISH FROM HENSLEY LAKE..... | 15 |
| <i>Black Bass Species (Largemouth Bass)</i> | 15 |
| <i>Catfish Species (Channel, White Catfish)</i> | 16 |
| <i>Common Carp</i> | 16 |
| <i>Crappie Species (Black Crappie, Unidentified Crappie Species)</i> | 16 |
| <i>Sunfish Species (Bluegill, Pumpkinseed)</i> | 16 |
| RECOMMENDED MAXIMUM NUMBER OF SERVINGS..... | 17 |
| REFERENCES | 18 |

APPENDIX I. Advisory Tissue Levels.....21

LIST OF FIGURES AND TABLES

Figure 1. Location of Hensley Lake 6

Table 1. Fish Samples Evaluated for the Hensley Lake Advisory 10

Table 2. Mercury Concentrations in Fish from Hensley Lake 12

Table 3. Recommended Maximum Number of Servings per Week for Fish from
Hensley Lake 17

Advisory Tissue Levels for Selected Analytes 21



Women
(18-49 Years)

Children
(1-17 Years)



Women
(50+ Years)

Men
(18+ Years)

A GUIDE TO EATING FISH

from

HENSLEY LAKE

(MADERA COUNTY)

1 TOTAL SERVING A WEEK

OR

1 TOTAL SERVING A WEEK

OR

0 DO NOT EAT

4 TOTAL SERVINGS A WEEK

OR

2 TOTAL SERVINGS A WEEK

OR

1 TOTAL SERVING A WEEK

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.



Common Carp



Crappie Species



Sunfish Species



Black Bass Species



Cattfish 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



Eat only the meat



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

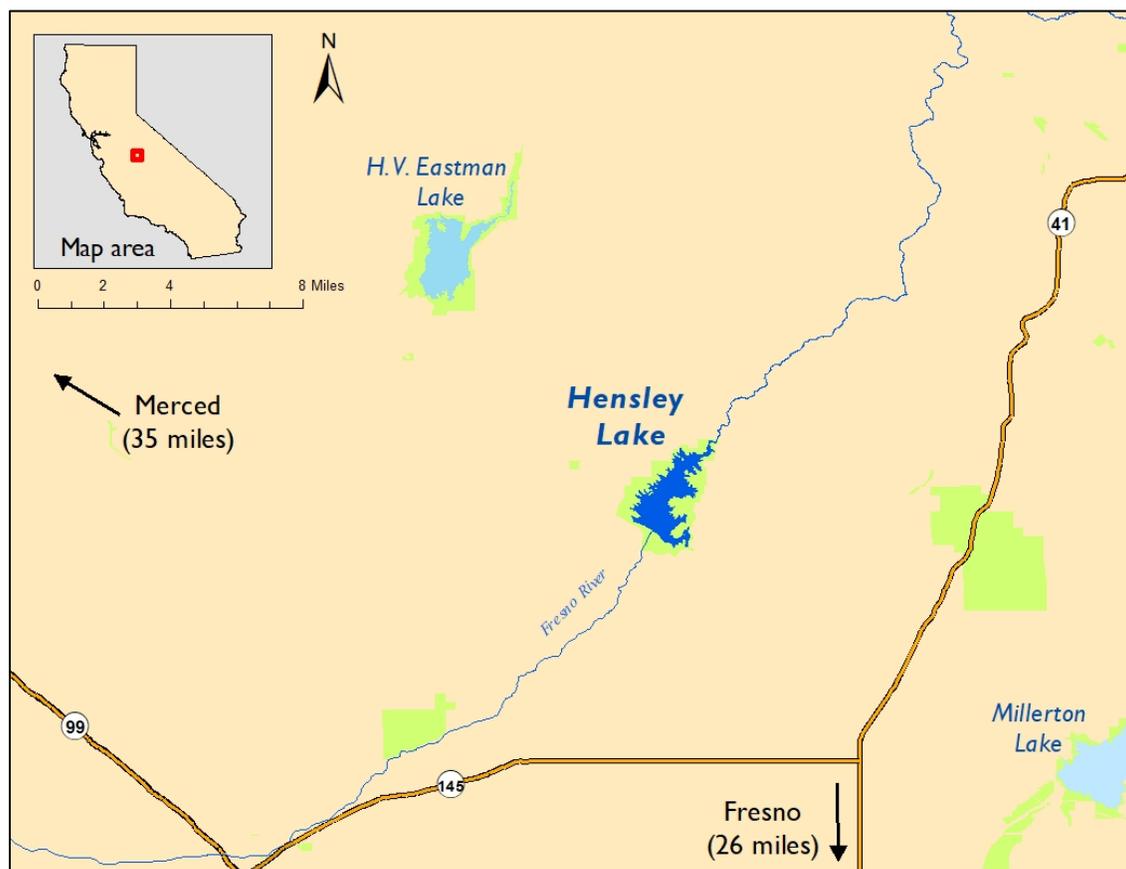
INTRODUCTION

This report presents guidelines for eating black bass species, catfish species, Common Carp, crappie species, and sunfish species from Hensley Lake (Figure 1). Consumption advice is based on levels of mercury found in these species.

LOCATION

Hensley Lake is a 1,500-acre lake located in the Sierra Nevada foothills, approximately 26 miles north of Fresno and 35 miles southeast of Merced, in Madera County. Hensley Lake was formed by the impoundment of Fresno River by construction of Hidden Dam for flood control, recreation, irrigation, and other purposes.¹ The US Army Corps of Engineers owns and operates Hensley Lake.

FIGURE 1. LOCATION OF HENSLEY LAKE



¹ Information regarding Hensley Lake was obtained from the US Army Corps of Engineers. Online at: <https://www.spk.usace.army.mil/Missions/Recreation/Hensley-Lake/>.

APPROACH USED

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

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

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

CHEMICALS OF POTENTIAL CONCERN

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

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

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

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

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

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

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

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

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

All fish species collected from Hensley Lake and used in advisory development were analyzed for mercury (as a measure of methylmercury). Bluegill, Channel Catfish, Common Carp, crappie, and Pumpkinseed were also analyzed for selenium. Common Carp were additionally analyzed for PBDEs, PCBs, and the legacy pesticides chlordanes (cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane), dieldrin, and DDTs (DDT and its metabolites dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethylene [DDE]). 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 Hensley Lake 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 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.

FISH MERCURY PROJECT (FMP)

The FMP was a three-year (2005 to 2007) sampling program funded by CALFED³ (SFEI, 2009). Monitoring of sport fish from Central Valley water bodies was planned and conducted by staff at the California Department of Fish and Wildlife (CDFW), OEHHA, the California Department of Public Health, the University of California, Davis, and the San Francisco Estuary Institute. More than 4,000 fish, including 31 sport fish species, from 146 popular fishing locations in the Delta watershed were collected to help characterize spatial and temporal trends in mercury in fishery resources. Black Crappie, Bluegill, Common Carp, Largemouth Bass, and White Catfish were collected from Hensley Lake in 2007 for this program and analyzed for mercury.

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 Central Valley Regional Water Quality Control Board (RWB5), monitors water quality in California's surface waters. As part of a SWAMP statewide sampling effort to survey contaminants in sport fish found in California lakes and reservoirs, the program collected Common Carp and Largemouth Bass from Hensley Lake in 2007, which were analyzed for mercury (SWRCB, 2010).

The FMP and SWAMP studies described above collaborated in 2007 to analyze chlordanes, DDTs, dieldrin, PBDEs, PCBs, and selenium in Common Carp.

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

LONG-TERM MONITORING OF BASS LAKES AND RESERVOIRS IN CALIFORNIA, 2015–ONGOING (SWAMP)

This monitoring study is an ongoing multi-year effort to document status and trends related to contamination in sport fish from California lakes and reservoirs where bass species reside (Davis et al. 2019). In 2017, the program collected Bluegill, Channel Catfish, crappie, Largemouth Bass, and Pumpkinseed from Hensley Lake, which were analyzed for mercury and/or selenium.

FISH SAMPLED FROM HENSLEY LAKE

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

| Common Name | Scientific Name | Number of Samples | Total Number of Fish | Project | Year Collected | Contaminants Analyzed |
|-----------------|-------------------------------|-------------------|----------------------|------------|----------------|---|
| Black Crappie | <i>Pomoxis nigromaculatus</i> | 3 | 3 | FMP | 2007 | Hg |
| Bluegill | <i>Lepomis macrochirus</i> | 3 | 3 | FMP | 2007 | Hg |
| | | 1 | 5 | SWAMP | 2017 | Hg |
| | | 2 | 10 | SWAMP | 2017 | Se |
| Channel Catfish | <i>Ictalurus punctatus</i> | 1 | 6 | SWAMP | 2017 | Hg, Se |
| Common Carp | <i>Cyprinus carpio</i> | 6 | 10 | FMP | 2007 | Hg |
| | | 1 | 10 | FMP, SWAMP | 2007 | Chlordanes, DDTs, Dieldrin, PBDEs, PCBs, Se |
| | | 1 | 5 | SWAMP | 2007 | Hg |
| Crappie | <i>Pomoxis spp</i> | 1 | 6 | SWAMP | 2017 | Hg, Se |
| Largemouth Bass | <i>Micropterus salmoides</i> | 6 | 10 | FMP | 2007 | Hg |
| | | 2 | 2 | SWAMP | 2017 | Hg |
| | | 1 | 1 | SWAMP | 2007 | Hg |
| Pumpkinseed | <i>Lepomis gibbosus</i> | 2 | 8 | SWAMP | 2017 | Hg, Se |
| White Catfish | <i>Ameiurus catus</i> | 1 | 1 | FMP | 2007 | Hg |

All samples were analyzed as skinless fillets.

CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for one or more of the following: total mercury, selenium, chlordanes, DDTs, dieldrin, PBDEs (7 congeners), and PCBs (46 congeners)⁴. Among the chemicals analyzed in fish tissue samples from Hensley Lake, only mercury levels were sufficiently high to impact consumption advice.

All fish samples were prepared as skinless fillets. 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 length⁵, as well as mercury concentrations in each fish species. The DMA method detection limit (MDL)⁶ and the reporting limit (RL)⁷ for total mercury were reported at 3 or 12 and 9 or 12 parts per billion (ppb), respectively, depending on the study.

PCBs, PBDEs, AND PESTICIDES

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

⁴ Congeners are related compounds with similar chemical forms. Of the 209 possible PBDE and PCB congeners, 6-7 and 54-55 are generally reported, respectively.

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.

congeners or metabolites in a given sample when detection levels are adequate (US EPA, 2000a).

SELENIUM

The CDFW MLML analyzed species collected from Hensley Lake 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 MDL and the RL for total selenium were reported at 100 or 150 and 300 or 400 ppb, respectively, depending on the study.

Concentrations of chlordanes, dieldrin, DDTs, PBDEs, PCBs, and selenium were lower than the corresponding ATL threshold values for daily consumption (OEHHA, 2008 and 2011). These chemicals were therefore not considered further for developing consumption advice and are not shown in this report.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM HENSLEY LAKE

| Species from Hensley Lake | Number of Samples | Total Number of Fish | Mean* Total Length (mm) | Range of Total Lengths** (mm) | Mercury (ppb) | |
|---------------------------|-------------------|----------------------|-------------------------|-------------------------------|---------------|----------|
| | | | | | Mean* | Range** |
| Catfish Species | 2 | 7 | 592 | 473–710 | 474 | 455–588 |
| Channel Catfish | 1 | 6 | 611 | 550–710 | 455 | n/a |
| White Catfish | 1 | 1 | 473 | n/a | 588 | n/a |
| Common Carp | 7 | 15 | 473 | 452–511 | 157 | 132–231 |
| Crappie Species | 4 | 9 | 176 | 150–236 | 364 | 229–400 |
| Black Crappie | 3 | 3 | 204 | 151–236 | 291 | 229–345 |
| Unidentified Crappie | 1 | 6 | 163 | 150–170 | 400 | n/a |
| Largemouth Bass | 9 | 13 | 426 | 381–560 | 1027 | 825–1350 |
| Sunfish Species | 6 | 16 | 152 | 104–179 | 326 | 275–456 |
| Bluegill | 4 | 8 | 131 | 104–157 | 318 | 275–456 |
| Pumpkinseed | 2 | 8 | 172 | 165–179 | 333 | 307–348 |

^aSamples 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 HENSLEY LAKE

The OEHHA fish advisory process considers the health benefits of fish consumption as well as the risk from exposure to the chemical contaminants found in fish. Benefits are

included in the advisory process because there is considerable evidence and scientific consensus that fish should be part of a healthy, well-balanced diet. Fish contain many nutrients that are important for general health and, in particular, help promote optimal growth and development of babies and young children, and may reduce the incidence of heart disease in adults (FDA/US EPA, 2017; American Heart Association, 2016; OEHHA, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish are a significant source of the 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 seafood⁸ per week. Young children need less, depending on their age and calorie needs” (MyPlate.gov). According to the 2020-2025 Dietary Guidelines, “women who are pregnant or lactating should consume at least 8 and up to 12 ounces of a variety of seafood per week from choices that are lower in methylmercury” (USDA/USDHHS, 2020). Additionally, “based on FDA and EPA’s advice, depending on body weight, some women should choose seafood lowest in methylmercury or eat less seafood than the amounts in the Healthy U.S.-Style Dietary Pattern” (USDA/USDHHS, 2020). For more detailed information, see USDA/USDHHS (2020) and other USDA MyPlate.gov materials. The particular fish that people eat is an important factor in determining the net beneficial effects of fish consumption. For example, studies have shown that children of mothers who ate low-mercury fish during pregnancy scored better on cognitive tests compared to children of mothers who did not eat fish or ate high-mercury fish (Oken et al., 2005 and 2008). Accordingly, because of the high mercury content of certain fish species, the US Food and Drug Administration (FDA) and the US Environmental Protection Agency recommend that women who are pregnant (or might become pregnant) or breastfeeding, and young children avoid consuming shark, swordfish, tilefish (Gulf of Mexico), bigeye tuna, marlin, orange roughy, and king mackerel (FDA/US EPA, 2017).

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

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,

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

are lower than those for women 50 years and older, and men 18 years and older. The lower ATL values for the sensitive population provide additional protection to allow for normal growth and development of the brain and nervous system of unborn babies and children. Detailed discussion about the toxicity of common fish contaminants and health benefits of fish consumption, as well as derivation of the ATLs, are provided in “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene” (OEHHA, 2008) and “Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Polybrominated Diphenyl Ethers (PBDEs)” (OEHHA, 2011). A list of the ATLs used in this report is presented in Appendix I.

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

The consumption advice for a fish species is initially based on the chemical with the lowest allowable number of servings per week. Because some chemicals, such as mercury and PCBs, are known to have similar adverse effects, additivity of toxicity is assumed in such cases and may be assessed using multiple chemical exposure methodology (US EPA, 1989 and 2000b). If two or more chemicals with similar adverse effects are present in fish tissue at levels above the corresponding ATL values for daily consumption, a 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. The potential effect of multiple chemical exposures (mercury and PCBs) was not assessed in Common Carp, the only species for which PCBs were analyzed, because the concentration of PCBs was 0 ppb. Advice for all species in this advisory was based solely on mercury concentrations.

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

Consumption advice should not be combined. That is, if a person chooses to eat a fish from the “one-serving-a-week” category, then they should not eat any other fish from

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

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 HENSLEY LAKE

OEHHA’s advisory protocol requires that a minimum of nine edible-size fish of a species that may be legally caught are collected and analyzed from small- and medium-sized lakes and reservoirs before an advisory can be developed. Additional fish beyond this number will increase confidence that the sample dataset is representative of the fish species population in the water body (OEHHA, 2005). The majority of fish consumption advisories in California are based on mercury, which is typically analyzed in individual fish, rather than as composites. Mercury analysis is relatively inexpensive and mercury concentrations in fish are more likely to be positively correlated with fish size than other contaminants. Thus, individual analysis allows for advice to be based on fish size, when appropriate. Other contaminants, such as PCBs, pesticides, and selenium, may also impact advice. These contaminants are often analyzed as a composite of a smaller subset of fish (usually at least five individuals) as a cost-saving mechanism, a common practice that is considered acceptable. In some cases, an exception is made regarding the minimum sample size. This is particularly true if the advice is based on a chemical other than mercury where sample size is often limited, and/or if doing so leads to more health-protective advice than would otherwise be provided.

For Hensley Lake, the sample size criterion was met for all species except catfish (n=7). Although this is fewer than the preferred number of samples, these data were included because the mercury concentration for catfish species prompts ‘do not consume’ advice for the sensitive population, and their inclusion is thus more health protective. There were not sufficient data to evaluate other species that may be found in this water body. For fish species found in Hensley Lake 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 SPECIES (LARGEMOUTH BASS)

Based on the mean mercury concentration of 1027 ppb in Largemouth Bass, OEHHA recommends no consumption of black bass species from Hensley Lake for the sensitive population, and a maximum of one serving a week for the general population.

OEHHA has evaluated mercury concentrations in black bass species in many water bodies in California and has found a similar range of mercury concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA extends the consumption advice for Largemouth Bass to other black bass species, including Redeye, Smallmouth, and Spotted Bass.

CATFISH SPECIES (CHANNEL, WHITE CATFISH)

The mean mercury concentration in catfish species from Hensley Lake was 474 ppb. Mercury concentrations for individual catfish species were as follows: Channel Catfish (Hg = 455 ppb), and White Catfish (Hg = 588 ppb). Based on the concentration of mercury in these catfish species, OEHHA recommends no consumption for the sensitive population, and a maximum of one serving a week for the general population.

COMMON CARP

The mean mercury concentrations in Common Carp from Hensley Lake was 157 ppb. OEHHA recommends a maximum of one serving a week of Common Carp for the sensitive population, and a maximum of four servings a week for the general population, based on mercury. -

CRAPPIE SPECIES (BLACK CRAPPIE, UNIDENTIFIED CRAPPIE SPECIES)

The mean mercury concentration in crappie species from Hensley Lake was 364 ppb. Mercury concentrations for crappie species were as follows: Black Crappie (Hg = 291 ppb), and unidentified crappie species (Hg = 400 ppb). OEHHA recommends a maximum of one serving a week of crappie species for the sensitive population, and a maximum of two servings a week for the general population.

SUNFISH SPECIES (BLUEGILL, PUMPKINSEED)

The mean mercury concentration in sunfish species from Hensley Lake was 326 ppb. Mercury concentrations for individual sunfish species were as follows: Bluegill (Hg = 318 ppb), and Pumpkinseed (Hg = 333 ppb). Based on the concentration of mercury in these sunfish species, 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.

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, Pumpkinseed) to other sunfish species, including Green Sunfish and Redear.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

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

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

| Fish Species from Hensley Lake | Women 18–49 years and Children 1–17 years | Women 50 years and older and Men 18 years and older |
|--------------------------------|---|---|
| Black Bass Species | 0 | 1 |
| Catfish Species | 0 | 1 |
| Common Carp | 1 | 4 |
| Crappie Species | 1 | 2 |
| Sunfish Species | 1 | 2 |

REFERENCES

- American Heart Association. 2016. Fish and Omega-3 Fatty Acids. Online at: http://www.heart.org/HEARTORG/HealthyLiving/HealthyEating/HealthyDietGoals/Fish-and-Omega-3-Fatty-Acids_UCM_303248_Article.jsp#.Wl57BnlG2Uk.
- 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.
- Davis, J.A., J.R.M. Ross, S.N. Bezalel, A. Bonnema, G. Ichikawa, B. Jakl, and W.A. Heim. 2019. Long-Term Monitoring of Bass Lakes and Reservoirs in California: 2017 Data Report. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
- FDA/US EPA. 2017. Eating Fish: What pregnant women and parents should know. Advice by FDA and US EPA/January, 2017. Online at: <https://www.fda.gov/food/consumers/advice-about-eating-fish>
- 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: Polybrominated diphenyl ethers (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.

SFEI. 2009. Fish Mercury Project. A collaborative effort of the San Francisco Estuary Institute, the University of California, Davis, the California Department of Fish and Game, the Moss Landing Marine Laboratory, the California Department of Health Services, and the California Protection Agency's Office of Environmental Health Hazard Assessment. Online at: <http://www.sfei.org/cmr/fishmercury/index.php#sthash.puWVjPvC.dpbs>.

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.

USDA/USDHHS. 2020. 2020–2025 Dietary Guidelines for Americans. 9th Edition. U.S. Department of Health and Human Services and U.S. Department of Agriculture. Online at: https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf.

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 Edition. 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 dose¹⁰ for chemicals not known to cause cancer, such as methylmercury, or
- For cancer-causing chemicals, a risk level greater than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime. This cancer endpoint is the maximum acceptable risk level recommended by the US EPA (2000b) for fish advisories.

For each chemical, ATLs were determined for both cancer and non-cancer risk, if appropriate, for one to seven eight-ounce servings per week. The most health protective ATLs for each chemical, selected from either cancer or non-cancer based risk, are shown in the table below for zero to seven servings per week. When the guidelines for eating fish from Hensley Lake are followed, exposure to chemicals in fish from Hensley Lake would be at or below the average daily reference dose or the cancer risk probability of one in 10,000.

ADVISORY TISSUE LEVELS FOR SELECTED ANALYTES

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

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

¹⁰ The reference dose is an estimate of the maximum daily exposure to a chemical likely to be without significant risk of harmful health effects over a lifetime.