



Health Advisory and Guidelines for Eating Fish from Lake Piru (Ventura County)

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LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife
DDTs	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyl dichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE)
FDA	Food and Drug Administration
OEHHA	Office of Environmental Health Hazard Assessment
MDL	method detection limit
mm	millimeters
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
RWB4	Regional Water Quality Control Board, Los Angeles Region
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 Lake Piru in Ventura County. The report provides background information and a description of how the guidelines were developed. The resulting advice is summarized in the illustration after the Table of Contents and List of Figures and Tables.

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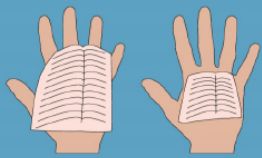
A Guide to Eating Fish from Lake Piru

Women 18-45 years and children 1-17 years

 Sunfish  Brown Bullhead	No fish in this group	 Black bass
2 servings a week	1 serving a week	Do not eat

Women 46 and older and men 18 and older

 Sunfish  Brown Bullhead	No fish in this group	 Black bass   = High in Omega-3s and OK to eat
7 servings a week	3 servings a week	1 serving a week <div style="display: inline-block; border: 1px solid black; padding: 2px; margin: 0 5px;">OR</div>

<h3 style="margin: 0;">What is a serving?</h3>  <p style="margin: 5px 0 0 20px;">For Adults For Children</p> <p style="margin: 5px 0 0 20px;">A serving is the size and thickness of your hand. Give children smaller servings.</p>	<h3 style="margin: 0;">Why eat fish?</h3> <p style="margin: 5px 0 0 20px;">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.</p>
<h3 style="margin: 0;">What is the risk?</h3> <p style="margin: 5px 0 0 20px;">Some fish have high levels of mercury. Mercury can harm the brain, especially in unborn babies and children.</p>	

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INTRODUCTION

This report presents guidelines for eating fish from Lake Piru (Figure 1) in Los Padres National Forest in Ventura County, California. The lake was created in 1955 by construction of the Santa Felicia Dam on Piru Creek, a tributary of the Santa Clara River. Lake Piru is part of the water resources managed by the United Water Conservation District. The lake has a surface area of about 1,240 acres and holds more than 100,000 acre-feet of winter run-off.¹ The lake is located near the town of Piru, California, and is downstream from Pyramid Lake, which is also on Piru Creek.

FIGURE 1. LOCATION OF LAKE PIRU IN CALIFORNIA



¹ https://en.wikipedia.org/wiki/Lake_Piru;
http://www.californiasgreatestlakes.com/piru/piru_fishing.html
Lake Piru Fish Advisory

OEHHA used the results from two monitoring projects described in this report to develop the fish advisory for Lake Piru. OEHHA uses the following process in developing consumption advice for sport fish:

- 1) Selection of the chemical data and fish species to be evaluated
- 2) Calculation of average chemical concentrations and other descriptive statistics, as appropriate, for the selected fish species
- 3) Comparison of the chemical concentrations with the OEHHA Advisory Tissue Levels (ATLs) for each chemical of potential concern

The ATLs (Appendix I) are acceptable exposure levels in fish tissue, 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).

FISH SPECIES IN LAKE PIRU

Lake Piru is popular for recreation, including fishing. Fishing occurs from shore or by boat. Fish species include Largemouth Bass, Rainbow Trout, catfish, Redear Sunfish, crappie, and Bluegill.² The monitoring studies collected Largemouth Bass, Brown Bullhead, Bluegill, and Goldfish.

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). Additionally, some legacy pesticides have the ability to accumulate in fish tissues.

High levels of methylmercury can harm the brain, especially in fetuses and children as they grow. PCBs are man-made 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 can cause cancer and other health effects, including neurotoxicity, in humans. Chlordane, DDT, and dieldrin are pesticides that were banned from use in 1973 (DDT) and in the late 1980s (chlordane and dieldrin) but have been found in some fish in certain water bodies in California. Depending on the exposure level, these chemicals may cause cancer or other adverse effects on the nervous system. Detailed discussion of the toxicity of these chemicals is presented in OEHHA (2008).

² http://www.californiasgreatestlakes.com/piru/piru_fishing.html
Lake Piru Fish Advisory

Fish samples from Lake Piru were analyzed for mercury (as a measure of methylmercury), PCBs, and the pesticides dieldrin, chlordane, and DDTs.

DATA SOURCES

The guidelines for eating fish from Lake Piru are based on chemical analysis of fish samples by the two studies described below. These studies meet OEHHA's data quality criteria, including adequate documentation of sample collection, fish preparation, chemical analyses, quality assurance, and low detection limits.

SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP)

The SWAMP, operated by the State Water Resources Control Board, monitors water quality in California's surface waters. In 2007 and 2008, the program performed a statewide survey of inland water bodies. The survey collected Brown Bullhead and Largemouth Bass from Lake Piru in 2007 and analyzed them for mercury, PCBs, chlordane, dieldrin, and DDTs.

REGIONAL WATER QUALITY CONTROL BOARD, LOS ANGELES REGION (RWB4) LAKES SPORTFISH CONTAMINATION STUDY

The RWB4 conducted studies of mercury in fish tissues in 2010 and 2013. The project analyzed samples of Bluegill, Goldfish, and Largemouth Bass.

Table 1 shows the type and number of fish sampled from Lake Piru, the project under which they were collected, and the year sampled. These fish (shown in Table 1) either met the California Department of Fish and Wildlife's (CDFW) legal size requirements (for Largemouth Bass; CDFW, 2015-2016), or OEHHA's criteria for minimum "edible" size based on species size at maturity and professional judgment (OEHHA, 2005).

TABLE 1. FISH COLLECTED FROM LAKE PIRU

Common Name	Scientific Name	Number of Fish Collected	Project	Year
Black bass (Largemouth Bass)	<i>Micropterus salmoides</i>	12	SWAMP	2007
		17	RWB4	2013
Brown Bullhead	<i>Ameiurus nebulosus</i>	10	SWAMP	2007
Sunfish (Bluegill)	<i>Lepomis macrochirus</i>	15	RWB4	2010
Goldfish	<i>Carassius auratus</i>	5	RWB4	2013

RWB4 = Los Angeles Regional Water Quality Control Board
SWAMP = Surface Water Ambient Monitoring Program

CHEMICAL CONCENTRATIONS

Fish samples were prepared as skinless fillets. They were analyzed for total mercury, legacy pesticides, and PCBs (54 congeners³) either as individual fish or composite samples prepared from equal amounts of tissues from several similarly sized fish of a species. For composite samples, the total length of the smallest fish in the sample was at least 75% of the length of the largest fish in the composite. OEHHA used the arithmetic mean (average) of the chemical concentrations for each fish species to represent average human exposure.

MERCURY

The CDFW Moss Landing Marine Laboratories analyzed all species collected from Lake Piru for total mercury, either as individual fish or composite samples, using a DMA (direct mercury analyzer). This method is an integration of thermal decomposition and atomic absorption. OEHHA assumed all total mercury detected was methylmercury, the more toxic form that is present in fish, because nearly all mercury present in fish is methylmercury (Bloom, 1992). Table 2 shows the averages and ranges for total length⁴ and mercury concentrations in each fish species. Results were reported in wet weight. The method detection limit (MDL)⁵ for total mercury was either four or 12 parts per billion (ppb). The reporting limit (RL)⁶ was either 12 ppb or 36 ppb.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM LAKE PIRU

Common Name	Number of Samples	Mean Total Length (mm)	Range of Lengths (mm)	Mercury	
				Mean (ppb)	Range (ppb)
Black bass (Largemouth Bass)	29 ^a	395	305-554	613	232-1060
Brown Bullhead	2	296	280-315	80	64-95
Goldfish	1	430	400-446	143	NA
Sunfish (Bluegill)	3	164	143-200	84	67-102

^a All samples were of individual fish

NA = not applicable because only one sample

³ Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54 are generally reported.

⁴ Total length is the maximum length of the fish, with the mouth closed and the tail fin pinched together.

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.

PESTICIDES AND PCBs

For analysis of legacy pesticides and PCBs, two composite samples, each comprised of five individual fish, were analyzed for each of two species, Brown Bullhead and Largemouth Bass. Pesticides and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory.

For 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, ≤ 0.5 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).

Dieldrin was not detected in the samples, and chlordanes, DDTs, and PCBs were only detected at very low levels, ≤ 1 ppb. The concentrations of the pesticides and PCBs were lower than the ATL threshold values for daily consumption (OEHHA, 2008). Therefore, pesticides and PCBs were not considered further for developing consumption advice. The guidelines for eating fish from Lake Piru were based solely on mercury concentrations.

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM LAKE PIRU

GENERAL INFORMATION

The OEHHA advisory process considers the health benefits of fish consumption as well as the risk from exposure to chemical contaminants that may be 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, 2010; Weaver et al., 2008).

The 2010 U.S. Dietary Guidelines recommend that 1) consumers eat at least eight ounces of cooked seafood⁷ per week (children need less depending on age and calorie needs) and 2) women who are pregnant or breastfeeding consume eight to twelve ounces of seafood per week from a variety of seafood types (USDA/USDHHS, 2010). 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, 2008). Accordingly, because of the high mercury content of certain fish species, the Dietary Guidelines recommend that women who are pregnant or breastfeeding do not consume shark, swordfish, tilefish, or king mackerel, and limit consumption of albacore tuna to six ounces per week (USDA/USDHHS, 2010).

In order to address the potential health concerns associated with consuming 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 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, are lower than for women 46 years and older, and men. The lower ATL values for the sensitive population provide 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 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 average mercury concentration detected in fish fillet to the ATL to establish the maximum number of servings per week that could be consumed. When OEHHA evaluates the chemical

⁷ "Seafood is a large category of 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" (USDA/USDHHS, 2010).

levels measured in fish, advice can be extended to closely related species⁸ known to accumulate similar levels of contaminants.

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 from this water body. People should eat no more than the recommended number of servings for each fish species or species group. 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 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 for a total of two servings in that week. Then they should not eat any other fish from any source until the next week.

SAMPLE EVALUATION

Sample sizes were sufficient for Bluegill, Brown Bullhead, and Largemouth Bass. Only five Goldfish were collected. This species did not meet OEHHA’s criterion for at least nine fish of a species to represent the population in the water body. Therefore, OEHHA did not include Goldfish in the advisory.

BLACK BASS

Based on the mean mercury concentration in Largemouth Bass, 613 ppb, OEHHA recommends no consumption of black bass for the sensitive population and a maximum of one serving a week for women 46 years and older, and men. Black bass includes Largemouth, Smallmouth, and Redear Bass, all members of the same genus. OEHHA evaluated mercury concentrations in these three black bass species in California and found a similar range of concentrations when two or more of these species were present in the same water body. Therefore, the advice for Largemouth Bass can be extended to other black bass species.

BULLHEAD

The mean mercury concentration in Brown Bullhead was 80 ppb. OEHHA recommends a maximum of two servings a week of bullhead for the sensitive population and seven servings a week for women 46 years and older, and men.

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

SUNFISH

The mean mercury level in Bluegill was 84 ppb. OEHHA evaluated the mercury levels in sunfish species in California including Bluegill, Redear Sunfish, and Green Sunfish, and found the concentrations within a water body were similar between species. Therefore, the advice for Bluegill can be extended to the other sunfish species. OEHHA recommends a maximum of two servings a week of sunfish for the sensitive population and seven servings a week for women 46 years and older, and men.

MAXIMUM RECOMMENDED NUMBER OF SERVINGS

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

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

Fish Species	Women 18–45 years and Children 1–17 years	Women 46 years and older and Men
Black bass	0	1
Brown Bullhead	2	7
Sunfish	2	7

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APPENDIX I. ADVISORY TISSUE LEVELS

Advisory Tissue Levels (ATLs) guide the development of advice for people eating sport fish. ATLs show maximum numbers of recommended fish servings that correspond to the chemical levels found in fish. OEHHA uses ATLs to provide advice to prevent consumers from being exposed to:

- more than the average daily reference dose⁹ 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 three servings per week. Exposure to chemicals in fish from Lake Piru would be at or below the average daily reference dose or the cancer risk probability of one in ten thousand if the guidelines for eating fish from Lake Piru are followed.

Advisory Tissue Levels (ATLs) Based on Cancer or Non-Cancer Risk Using an 8-Ounce Serving Size				
Chemical	Consumption Frequency Categories^a and ATLs^b (in ppb)			
	Three Servings per Week	Two Servings per Week	One Serving per Week	No consumption
Chlordanes	>140-190	>190-280	>280-560	>560
DDTs	>390-520	>520-1,000	>1,000-2,100	>2,100
Dieldrin	>11-15	>15-23	>23-46	>46
Methylmercury (Women 18 to 45 years and children 1 to 17 years of age)	>55-70	>70-150	>150-440	>440
Methylmercury (Women 46 years and older and men)	>160-220	>220-440	>440-1,310	>1,310
PCBs	>15-21	>21-42	>42-120	>120

^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.

^b When residue data are compared to this table, they should also first be rounded to the second significant digit.

⁹ The reference dose is an estimate of the daily oral exposure to a chemical likely to be without significant risk of harmful health effects during a lifetime.