

# **HEALTH ADVISORY AND GUIDELINES FOR EATING FISH FROM LAKE McSWAIN (MARIPOSA COUNTY)**

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## LIST OF ACRONYMS

ATL	Advisory Tissue Level
CDFG	California Department of Fish and Game
DDTs	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyl dichloroethane (DDD) and dichlorodiphenyl dichloroethylene (DDE)
FERC	Federal Energy Regulatory Commission
FMP	Fish Mercury Project
MDL	method detection limit
MID	Merced Irrigation District
OEHHA	Office of Environmental Health Hazard Assessment
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board

## 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 Game Sport Fishing Regulations.

This report presents guidelines for eating fish from Lake McSwain, a reservoir on the Merced River in Mariposa 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.

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# A Guide to Eating Fish from Lake McSwain

## Women 18-45 years and children 1-17 years



Rainbow trout ♥



Sucker



Spotted bass



Largemouth bass

♥ = High in Omega-3s and OK to eat

Safer to eat  
2 servings a week



1 serving a week

Do not eat

## Women over 45 years and men



Rainbow trout ♥



Sucker



Spotted bass ♥



Largemouth bass ♥

♥ = High in Omega-3s and OK to eat

Safer to eat  
7 servings a week



3 servings a week



1 serving a week  
from this group

### What is a serving?



For Adults

For Children

### ♥ 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.

### What is the risk?

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

The recommended serving is the size and thickness of your hand.

## INTRODUCTION

The Merced River originates in Yosemite National Park in the Sierra Nevada at an elevation of approximately 8,200 feet. From there, the river flows west through Yosemite Valley into the steep canyon of the Merced Gorge. It finally flows into the San Joaquin River near the Stanislaus/Merced County border. Two reservoirs were created on the Merced River in Mariposa County. New Exchequer Dam forms the first reservoir, Lake McClure, which releases directly into the second reservoir, Lake McSwain, shown in Figure 1 (MID, 2008).

FIGURE 1. MAP SHOWING LAKE MCSWAIN



The Merced Irrigation District (MID) owns and operates the Merced River Hydroelectric Project located on the Merced River in Mariposa County, California, about 23 miles northeast of the City of Merced. To pay for construction of the dams, each with a powerhouse, MID contracted with Pacific Gas and Electric Company to sell all the electric energy produced. The dams were built in the mid-1960s and put into service in 1967. The two dams generate tens of thousands of megawatt hours of electricity each month (MID, 2012a). Lake McClure has the larger storage capacity (1,024,600 acre-feet), which is drawn down slowly over the course of the year. McSwain Dam, six miles downstream, was built to create a regulating reservoir. Lake McSwain has a storage capacity of 9,730 acre-feet.

MID uses the reservoirs for irrigation, flood control, electricity, and recreation (MID, 2012b). Neither dam includes upstream or downstream fish passage or fish exclusion devices on intakes (MID, 2008).

The finding of chemicals in fish tissues prompted the Office of Environmental Health Hazard Assessment (OEHHA) to develop this advisory report. The basic OEHHA process to develop consumption advice involves these steps:

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

The ATLs are acceptable levels in fish tissue based on chemical toxicity with consideration of health benefits associated with including fish in the diet (Klasing and Brodberg, 2008; Appendix I ).

## FISH SPECIES IN LAKE MCSWAIN

Lake McSwain Recreation Area is located six miles east of Snelling, California. Lake McSwain is a small water body, and the main species targeted by fishers is rainbow trout. Compared to Lake McClure, Lake McSwain has colder temperatures and shorter water retention times (MID, 2012c). As a result, there are more coldwater fish in Lake McSwain. MID conducted a fish population study in the reservoir in 2010. The most frequently caught sport fish species in the study are shown in Table 1 (MID, 2012c).

TABLE 1. MID 2010 FISH POPULATION STUDY AT LAKE MCSWAIN

Fish Species	Number Caught	Percent of Catch
Sacramento sucker	1,235	71
Rainbow trout	230	13
Spotted bass	39	2
Channel catfish	24	1

Other sport fish species collected in fewer numbers included hitch, largemouth bass, brown trout, kokanee salmon, bluegill, green sunfish, black crappie, pikeminnow, and white catfish (MID, 2012c). These species together made up less than two percent of the total caught.

The California Department of Fish and Game (CDFG) and a private trout farm have been stocking rainbow trout in Lake McSwain yearly. All trout are planted at catchable size (10–14 inches in length, equivalent to 254–356 millimeters [mm], and three-quarters to one pound in weight). The last available record showed nearly 70,000 rainbow trout were planted in 2009 (MID, 2012c). All rainbow trout collected in the 2010 fish population study were hatchery trout. The absence of younger lifestages (less than 100 mm in length) indicated that rainbow trout are not reproducing in the reservoir (MID, 2012c). Until 2001 and 2004, smaller numbers of brown trout and brook trout, respectively, were also planted (MID, 2012c).



## CHEMICALS OF POTENTIAL CONCERN

Fish samples from Lake McSwain were analyzed for mercury (as a measure of methylmercury), polychlorinated biphenyl congeners (PCBs), and the pesticides dieldrin, chlordane, and dichlorodiphenyltrichloroethane and metabolites (DDTs).

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, lubricating oils, and plastics. PCBs may cause cancer and other health effects in humans. Chlordane, DDTs, and dieldrin are pesticides that were banned from use many years ago but have persisted in the environment. These chemicals may cause cancer or adverse effects on the nervous system. Detailed discussion of the toxicity of these chemicals is presented in Klasing and Brodberg (2008).

## DATA SOURCES

The guidelines for eating fish from Lake McSwain were based on the results of chemical analyses conducted on fish samples collected by the following programs or projects. These studies had adequate documentation of sample collection, fish preparation, chemical analyses, and quality assurance. Their detection limits were acceptable for use in this assessment. OEHHA staff used results the projects reported as acceptable in meeting quality assurance/quality control criteria to develop the guidelines for eating fish from this reservoir.

### MERCED RIVER HYDROELECTRIC PROJECT, MERCED IRRIGATION DISTRICT (MID)

MID holds the Federal Energy Regulatory Commission (FERC) license for the project, which expires February 28, 2014.<sup>1</sup> As part of its application for relicensing, MID was required by the California State Water Resources Control Board (SWRCB) to conduct fish tissue sampling and analysis of mercury for human health risk assessment. MID collected fish samples from Lake McSwain in 2009.

### FISH MERCURY PROJECT (FMP)

The Fish Mercury Project (FMP) was a three-year sampling program funded by the CALFED Bay-Delta Program ([www.calwater.ca.gov](http://www.calwater.ca.gov)), a state-federal partnership. Monitoring of mercury in fish from Central Valley water bodies was planned and implemented cooperatively by CDFG, OEHHA, the California Department of Public Health, the University of California at Davis, and the San Francisco Estuary Institute in 2005–2007. In 2007, the third year of the project, fish were sampled from various

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<sup>1</sup> The public website for relicensing of MID's Merced River Hydroelectric Project, FERC Project No. 2179 is <http://www.eurekasw.com/MID/default.aspx>.

reservoirs in the Central Valley including Lake McSwain. The project website is [www.sfei.org/cmr/fishmercury/](http://www.sfei.org/cmr/fishmercury/).

## SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP)

The SWRCB operates the Surface Water Ambient Monitoring Program (SWAMP) to monitor water quality in all California’s surface waters. In 2007 and 2008, the program performed a statewide survey of fish from 272 of California’s more than 9,000 lakes and reservoirs (Davis et al., 2010). Fish from Lake McSwain were tested for mercury, and in addition, sucker were tested for PCBs and pesticides.

Table 2 shows the type and number of fish sampled from Lake McSwain, the year sampled, and the projects under which they were collected. The fish samples shown in Table 2 either met CDFG’s legal size requirements, when specified, or OEHHA’s criteria for minimum “edible” size based on species size at maturity and professional judgment (Gassel and Brodberg, 2005). Appendix II provides images for each species and their scientific names.

TABLE 2. FISH SAMPLES FROM LAKE MCSWAIN

Fish Species	Number of Fish Collected	Year Sampled	Project (Data Source)
Rainbow trout	8	2007	FMP
	5	2009	MID
Brown trout	1	2009	MID
Sacramento sucker	5	2007	FMP
	5	2007	SWAMP
	6	2009	MID
Largemouth Bass <sup>2</sup>	9	2007	FMP

## CHEMICAL CONCENTRATIONS

Fish samples were analyzed for mercury as skinless fillets, either as individual fish or composite samples of several fish from a species. The total length of the smallest fish in each composite sample was at least 75% of the length of the largest fish in the composite. Samples were combusted and analyzed for total mercury by DMA (direct mercury analyzer), a combination of thermal decomposition and atomic absorption, at the CDFG Moss Landing Marine Laboratories. The method detection limit (MDL) and

<sup>2</sup> Black bass, including largemouth, smallmouth, and spotted bass, have a minimum legal catch size of 12 inches (305 mm) total length (CDFG, 2012). The nine largemouth bass met this requirement.

reporting limit (RL)<sup>3</sup> for mercury were 0.010 ppb and 0.030 parts per billion (ppb), respectively. Results were reported in wet weight. Total mercury analyzed was assumed to be 100% methylmercury because almost all mercury present in fish is methylmercury (Bloom, 1992).

Table 3 shows the averages (mean) and ranges for total length and mercury concentrations in fish species from Lake McSwain. Means were weighted by the number of fish in the samples.

TABLE 3. CONCENTRATIONS OF MERCURY IN FISH FROM LAKE MCSWAIN

Species	Number of Samples	Total Number of Fish	Mean Total Length (mm)	Range of Total Lengths (mm)	Mean Mercury (ppb wet weight)	Range of Mercury (ppb wet weight)
Rainbow trout	13	13	379	246-470	76	19-326
Brown trout	1	1	365	NA	61	NA
Sacramento sucker	13	16	417	341-485	173	61-388
Largemouth Bass	9	9	435	312-557	675	264-878

NA Not applicable because only one sample was taken

PCBs (54 congeners), dieldrin, DDTs, and chlordane were analyzed in one composite sample of five sucker by the CDFG Water Pollution Control Laboratory. These chemicals will not be discussed further because their levels were lower than the ATLs for daily consumption and would not result in recommendations for restricted consumption. The concentrations, however, are shown in Table 4 with fish sizes. Means were weighted by the number of fish in the samples. The low concentrations suggest these contaminants are not a cause for concern at Lake McSwain; however, the sample size was too small to draw definitive conclusions.

TABLE 4. CHEMICAL CONCENTRATIONS OF PCBs, DDTs, DIELDRIN, AND CHLORDANE IN SUCKER FROM LAKE MCSWAIN

Species	Number of Samples	Total Number of Fish	Mean Total Length (mm)	Range of Lengths (mm)	Mean PCBs (ppb)	Mean DDTs (ppb)	Mean Chlordane (ppb)	Mean Dieldrin (ppb)
Sacramento sucker	1	5	411	359-476	3	3	2	< MDL

< MDL Less than the method detection limit (0.421 ppb)

<sup>3</sup> The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample. The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

## DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM LAKE McSWAIN

OEHHA's evaluation of the chemical concentrations showed that mercury levels should be used as the basis for guidelines for eating fish from Lake McSwain. OEHHA staff used the weighted average (mean) concentrations of mercury in rainbow trout, sucker, and largemouth bass shown in Table 3 to determine the recommended number of servings per week. The mean mercury concentrations in fish from Lake McSwain were compared to ATLS to develop the guidelines.

There are two sets of ATLS for exposure to methylmercury in fish because of age-related toxicity. The ATLS (summarized in Appendix I) for the sensitive population (women 18 to 45 years, and children 1 to 17 years) are lower than for the general population (women over 45 years and men) to protect the brain and nervous system of the young while it grows. Women ages 18–45 years are treated as sensitive to protect the fetus because these women are of childbearing age. A complete description of the process of developing ATLS can be found in Klasing and Brodberg (2008).

OEHHA's advisory process and ATLS also consider and incorporate the health benefits from fish consumption. There is considerable evidence and scientific consensus that eating fish promotes significant health benefits, including decreased mortality. Reported health benefits include reduced rates of heart disease and stroke, decreased inflammation, and improvements in mental and visual functions (IOM, 2007). The potential beneficial effects are thought to stem largely from specific omega-3 fatty acids found in significant quantities only in fish:

- docosahexaenoic acid or "DHA"
- eicosapentaenoic acid or "EPA"

A discussion on the risks and benefits of fish consumption can be found in Klasing and Brodberg (2008).

The recommended number of servings per week for fish from Lake McSwain are shown in Table 5. Rainbow trout are high in omega-3 fatty acids. Choosing to eat this species at the recommended frequency will maximize the benefits of fish consumption while lowering the risk from exposure to mercury.

TABLE 5. RECOMMENDED NUMBER OF SERVINGS PER WEEK

Fish Species	Women 18–45 and Children 1–17 years	Women over 45 years and Men
Largemouth and spotted bass	0	1
Rainbow trout	2	7
Sucker	1	3

## DATA LIMITS

At Lake McSwain, spotted bass, which can be targeted by fishers in deeper water, are reputed to be more common than largemouth bass ([motherlodelakes.com](http://motherlodelakes.com), 2012). However, only largemouth bass, was sampled at this reservoir. OEHHA staff observed similarly high mercury concentrations in largemouth bass and spotted bass from other water bodies in northern California (for example, Sierra Lakes; Klasing and Brodberg, 2003). Therefore, the advice given for largemouth bass at Lake McSwain also applies to spotted bass.

A sample size of one fish is insufficient for developing safe eating guidelines. Only a single brown trout was collected from Lake McSwain. The mean mercury concentration in the brown trout sample was lower than the mean concentration for rainbow trout. However, it is not possible to determine whether that single result is representative of the brown trout population in Lake McSwain. Although brown trout were previously stocked in Lake McSwain, the last planting was in 2004. MID (2012c) did not observe brown trout in the fish population study, and, therefore, it is unlikely they are self-reproducing or that many have survived. OEHHA staff considers the likelihood of catching brown trout lower than catching rainbow trout. For these reasons, brown trout were not included in the advice for Lake McSwain. In addition, no channel catfish, hitch, kokanee salmon, bluegill, green sunfish, black crappie, or pikeminnow were collected from Lake McSwain. Therefore, these species could not be included in the guidelines for eating fish from Lake McSwain. They are reportedly less common in Lake McSwain; channel catfish represented one percent of catch, and the other species combined accounted for one percent of catch in the MID fish population survey (MID, 2012c).

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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 dose<sup>4</sup> 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 U.S. EPA (2000) 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 McSwain 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 McSwain are followed.

<b>Advisory Tissue Levels (ATLs) Based on Cancer or Non-Cancer Risk Using an 8-Ounce Serving Size</b>				
<b>Chemical</b>	<b>Consumption Frequency Categories<sup>a</sup> and ATLs<sup>b</sup> (in ppb)</b>			
	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 over age 45 years 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.

<sup>4</sup> 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



## APPENDIX II. FISH SPECIES IMAGES

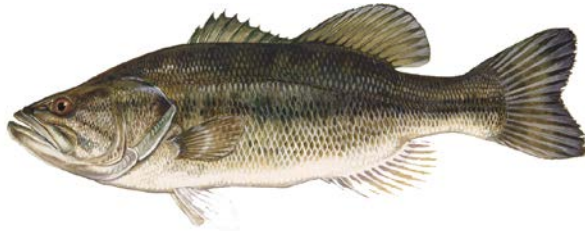
(not to scale)

Rainbow trout (*Oncorhynchus mykiss*)



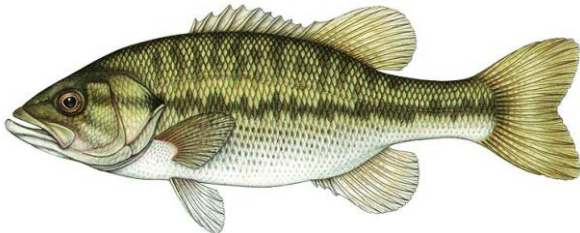
Duane Raver, USFWS

Largemouth bass (*Micropterus salmoides*)



Duane Raver, USFWS

Spotted Bass (*Micropterus punctulatus*)



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Sacramento sucker (*Catostomus occidentalis*)



René Reyes, USBR