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

**July 2013 Update**

**Office of Environmental Health Hazard Assessment**
**California Environmental Protection Agency**

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# LIST OF ACRONYMS

| | |
|---|---|
| ATL | Advisory Tissue Level |
| CDFW | California Department of Fish and Wildlife (formerly the 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 |
| TSMP | Toxic Substances Monitoring Program |

# 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 needed, 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 is an update of the report issued in December 2012. It provides a health advisory and guidelines for eating fish from Lake McClure, a reservoir on the Merced River in Mariposa County. The health advisory and guidelines were developed as a result of studies of mercury in fish collected from this water body. The report provides background information and a description of how the guidelines were developed. The health advisory and guidelines were updated because, in 2013, the California Department of Fish and Wildlife changed the legal size requirement for black bass. As a result, the public may no longer keep some bass that were legal to keep and consume in 2012. The advisory, which is summarized in the illustration after the Table of Contents, and the report have been updated to reflect that only legal-sized fish have been used in the evaluation. Consumption guidelines are only given for legal-sized fish.

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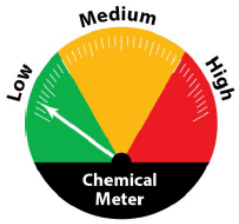
# A Healthy Guide to Eating Fish from Lake McClure

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

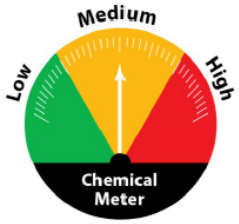


Rainbow trout ♥

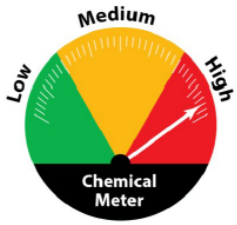
Kokanee ♥

Carp

♥ = High in Omega-3s



Bluegill



Spotted bass

Largemouth bass

Catfish

Chinook king salmon*

| 2 servings a week from this group | OR | 1 serving a week | Do not eat |
|---|---|---|---|

### Women over 45 years and men can safely eat more fish

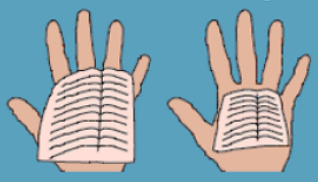
7 servings a week of rainbow trout *or*

4 servings a week of kokanee or carp *or*

3 servings a week of bluegill *or*

1 serving a week of bass, catfish, or king salmon

### What is a serving?



For Adults For Children

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

### What is the concern?

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

* River-run salmon are safer to eat

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# INTRODUCTION

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

FIGURE 1. MAP SHOWING LOCATION OF LAKE MCCLURE

The Merced Irrigation District (MID) owns and operates the Merced River Hydroelectric Project. The hydroelectric project is located on the Merced River, in Mariposa County, about 23 miles northeast of the city of Merced, California. A contract made by MID with Pacific Gas and Electric Company to sell all the electric energy produced paid for construction of the dams, each with a powerhouse. The dams were built in the mid-1960s and put into service in 1967. The two dams together generate tens of thousands of megawatt hours of electricity each month (MID, 2012a). Neither dam includes fish passage or fish exclusion devices on intakes (MID, 2008).

New Exchequer Dam tripled the storage capacity of the original dam built in 1926. Lake McClure now has a gross storage capacity of 1,024,600 acre-feet, which is drawn down slowly over the course of the year. MID uses the reservoirs for irrigation, flood control, electricity, and recreation (MID, 2012b).

The finding of mercury in fish tissues prompted the Office of Environmental Health Hazard Assessment (OEHHA) to develop this advisory report. The basic OEHHA process to develop fish 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; and (3) comparison of the chemical concentrations with the OEHHA Advisory Tissue Levels (ATLs) for each chemical of concern (Klasing and Brodberg, 2008 and 2011; Appendix I ). The ATLs are acceptable exposure levels based on chemical toxicity with consideration of health benefits associated with including fish in the diet.

## FISH SPECIES IN LAKE MCCLURE

Lake McClure is a popular fishing lake in California for rainbow trout, black bass[1], bluegill, crappie, catfish, kokanee salmon, and Chinook king salmon (Mother Lode Lakes, 2012). MID conducted a fish population study in 2010 and found the sport fish species shown in Table 1.

TABLE 1. SPORT FISH SPECIES IN LAKE MCCLURE FISH POPULATION STUDY

| Bass | Catfish | Sunfish | Salmonids[2] | Other |
|---|---|---|---|---|
| Spotted bass<br>Largemouth bass | Brown bullhead<br>Channel catfish<br>White catfish | Bluegill<br>Redear sunfish<br>Green sunfish<br>White crappie<br>Black crappie | Chinook king salmon<br>Kokanee salmon<br>Rainbow trout | Carp<br>Goldfish<br>Pikeminnow |

The California Department of Fish and Wildlife (CDFW) introduced spotted bass from Millerton Reservoir into Lake McClure in 1982. CDFW has also stocked salmon and rainbow trout annually (MID, 2012c). CDFW manages Lake McClure as a put-and-take fishery for rainbow trout by planting catchable size rainbow trout (10–14 inches, equivalent to 254-356 millimeters (mm), and between three-quarters and one pound). Chinook king salmon and kokanee are managed by CDFW as a put-and-grow fishery. These two species are planted as fry (juvenile fish) that will grow to catchable size (MID, 2012c). MID contracted with a private hatchery to plant rainbow trout in 1998 and 1999 but otherwise has not stocked the lake (MID, 2012c).

CDFW no longer has a slot limit at Lake McClure for black bass. All bass smaller than 12 inches total length[3] must be released back into the lake (CDFW, 2013).

[1] "Black bass" includes largemouth, smallmouth, spotted bass, and the less common species redeye bass.
[2] Salmonid fish include salmon and trout
[3] The equivalent metric size is 305 mm.

# CHEMICALS OF POTENTIAL CONCERN

Fish samples from Lake McClure were analyzed for mercury, as a measure of methylmercury, a chemical of potential concern. High levels of methylmercury can harm the brain, especially in fetuses and children as they grow.

One composite sample of 15 carp was also analyzed for polychlorinated biphenyls (PCBs) and the pesticides dieldrin, chlordane, and dichlorodiphenyltrichloroethane and metabolites (DDTs). 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 harm the nervous system. Detailed discussion of the toxicity of these chemicals is presented in Klasing and Brodberg (2008).

All pesticides and PCBs were below detection limits and will not be discussed further. Mercury levels in fish from Lake McClure guided the development of guidelines for eating fish from Lake McClure.

# DATA SOURCES

Fish from Lake McClure were sampled in one of the following programs or projects. These studies had adequate documentation of sample collection, fish preparation, chemical analyses, and quality assurance. Their detection limits were adequate for use in this assessment. OEHHA staff used results that the projects reported as acceptable in meeting quality assurance/quality control criteria to develop the guidelines for eating fish from Lake McClure.

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

MID holds the initial Federal Energy Regulatory Commission (FERC) license for the Hydroelectric Project, which expires February 28, 2014[4]. 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 to provide data for human health risk assessment. MID collected fish samples from Lake McClure in 2009 and 2010.

## 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), a state-federal partnership.

[4] The public website for relicensing of MID's Merced River Hydroelectric Project, FERC Project No. 2179 is http://www.eurekasw.com/MID/default.aspx.

Monitoring of mercury in fish from Central Valley water bodies was planned and implemented cooperatively by CDFW, OEHHA, the California Department of Public Health, the University of California at Davis, and the San Francisco Estuary Institute in 2005–2007. In the third year of the project (2007), fish were sampled from various reservoirs in the Central Valley including Lake McClure. The website for this project is 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 of 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, including sampling and analysis of fish from Lake McClure for mercury and, in one sample, for pesticides and PCBs (Davis et al., 2010).

## Toxic Substance Monitoring Program (TSMP)

The SWRCB initiated the Toxic Substances Monitoring Program (TSMP) in 1976. The TSMP was organized to provide a statewide approach to detection and evaluation of toxic substances in fresh, estuarine, and marine waters through the analysis of fish and other aquatic life. This program was incorporated into the currently operating SWAMP. Black bass from Lake McClure were collected in 1984 and analyzed for mercury.

Table 2 shows the type and number of fish collected from Lake McClure, the years sampled, and the projects under which they were collected. For black bass, only samples meeting the minimum legal size of 12 inches (305 mm) are shown. The fish samples shown in Table 2 that do not have legal size requirements (species other than black bass) met 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 SAMPLED FROM LAKE MCCLURE

| Fish Species | Years Sampled | Project | Number of Fish Collected |
|---|---|---|---|
| Bluegill | 2007 | FMP | 10 |
| Carp | 2007 | FMP/SWAMP | 15 |
| Channel catfish | 2007 | FMP | 5 |
| Chinook king salmon | 2009-2010 | MID | 8 |
| Kokanee salmon | 2009-2010 | MID | 9 |
| Rainbow trout | 2009 | MID | 9 |
| Largemouth bass | 1984 | TSMP | 4 |
| | 2007 | FMP/SWAMP | 22 |
| Spotted bass | 2007 | FMP | 8 |

MID Merced Irrigation District, Merced River Hydroelectric Project
FMP Fish Mercury Project
SWAMP Surface Water Ambient Monitoring Program
TSMP Toxic Substances Monitoring Program

# MERCURY CONCENTRATIONS

Fish samples were analyzed as skinless fillets, either as individual fish or composite samples of several fish from a species. For composite samples, the total length of the smallest fish in the composite sample was at least 75 percent of the length of the largest fish in the composite. At the CDFW Moss Landing Marine Laboratories, samples were combusted and analyzed for total mercury by DMA (direct mercury analyzer), a combination of thermal decomposition and atomic absorption. Results were reported in wet weight. The method detection limit (MDL) and reporting limit (RL)[5] for mercury were 0.010 ppb and 0.030 ppb, respectively. OEHHA assumed that all mercury detected was methylmercury, the more toxic form that is present in fish, because nearly all mercury in fish is methylmercury (Bloom, 2002).

Table 3 shows the averages (mean) and ranges for total length and mercury concentrations in each fish species from Lake McClure. The results were weighted by the number of fish in samples. The total lengths of bluegill, carp, catfish, salmon, and trout collected from Lake McClure were all large enough to meet OEHHA's criteria for minimum "edible" sizes (Gassel and Brodberg, 2005). Samplers were not successful in collecting a sufficient number of fish for some species to meet OEHHA's requirements for representative sample sizes, as discussed below.

[5] 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.

TABLE 3. MERCURY CONCENTRATIONS AND SIZE IN FISH FROM LAKE MCCLURE

| Fish Species | Mean[a] Total Length (mm) | Range of Total Length (mm) | Mean[a] Mercury (ppb wet weight) | Range of Mercury (ppb wet weight) | Number of Samples | Total Number of Fish[b] |
|---|---|---|---|---|---|---|
| Bluegill | 164 | 139-187 | 181 | 128-228 | 10 | 10 |
| Carp | 428 | 384-511 | 139 | 65-236 | 3 | 15 |
| Channel Catfish | 566 | 505-629 | 521 | 390-711 | 5 | 5 |
| Chinook salmon | 418 | 347-519 | 460 | 138-775 | 8 | 8 |
| Kokanee salmon | 388 | 324-414 | 140 | 89-170 | 9 | 9 |
| Rainbow Trout | 387 | 346-433 | 78 | 18-202 | 9 | 9 |
| Largemouth bass | 362 | 306-533 | 821 | 237-1200 | 23 | 26 |
| Spotted bass | 352 | 311-412 | 703 | 452-865 | 8 | 8 |

[a] Mean length and mean mercury are weighted averages based on the number of fish per sample

[b] The number of fish can be greater than the number of samples because composite samples are made of more than one fish

# DEVELOPMENT OF ADVICE FOR EATING FISH FROM LAKE MCCLURE

To determine the recommended number of servings per week, OEHHA staff compared the mean mercury concentrations in each fish species with a sufficient sample size to Advisory Tissue Levels (ATLs). ATLs are acceptable exposure levels based on chemical toxicity. OEHHA's advisory process and ATLs also consider and incorporate the health benefits from fish consumption.

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 women over 45 years and men to protect the developing brain and nervous system of the young. 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). The recommended maximum numbers of servings for Lake McClure fish species are shown in Table 4.

TABLE 4. RECOMMENDED NUMBER OF SERVINGS PER WEEK

| Fish Species | Women 18–45 and Children 1–17 years | Women over 45 years and Men |
|---|---|---|
| Bluegill | 1 | 3 |
| Carp | 2 | 4 |
| Catfish | 0 | 1 |
| Chinook king salmon | 0 | 1 |
| Kokanee | 2 | 4 |
| Largemouth and spotted bass | 0 | 1 |
| Rainbow trout | 2 | 7 |

### Bluegill, Carp, Kokanee, and Rainbow Trout

Sample sizes were adequate for bluegill, carp, kokanee, and rainbow trout. OEHHA used the mean mercury concentration for each species to determine the recommended number of servings per week for each population group.

### Black Bass

The black bass species, largemouth and spotted, were considered together. They are related species (same genus) and the mercury levels for each species result in the same advice.

OEHHA staff did not include smallmouth bass in the advisory because this species was not identified as a current fish species in Lake McClure. The only samples of smallmouth bass from Lake McClure were collected in 1984, which supports the idea that it is presently unlikely to be caught.

### Catfish

OEHHA generally requires at least nine fish per species to be minimally representative of the fish population in the water body. Only five channel catfish were collected. The mean mercury level was high (521 parts per billion [ppb]). OEHHA staff has observed that this species is one that accumulates mercury in more contaminated water bodies. The high mercury concentrations in black bass from Lake McClure suggest this water body is relatively highly contaminated. For these reasons, OEHHA provided advice for catfish from Lake McClure based on the mercury concentration in the five catfish sampled.

### Chinook King Salmon

Only eight Chinook king salmon were collected. The mean mercury concentration in these salmon (460 ppb) exceeded the threshold for consumption for the sensitive population (women 18–45 years and children 1–17 years). OEHHA has observed that when Chinook king salmon are landlocked in lakes and reservoirs, mercury concentrations are much higher than in the same species caught from free-flowing rivers and streams, the bay, or the ocean. OEHHA has data for king salmon in other California reservoirs (Lake Berryessa, for example) showing very high mercury levels (Gassel et al., 2006). For these reasons, OEHHA considered the Chinook king salmon samples sufficient for providing advice.

### Kokanee Salmon

Sample size was adequate for kokanee. Whereas adult Chinook king salmon feed on fish, kokanee salmon mainly feed on plankton and sometimes insects. The mean mercury concentration for kokanee was relatively low, as expected based on dietary

differences between the species. Therefore, compared to king salmon, kokanee can be eaten more often and are a good source of omega-3s, as discussed below.

## Health Benefits of 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 in fish:

- docosahexaenoic acid or “DHA”
- eicosapentaenoic acid or “EPA”

The advice OEHHA develops considers both the health risks and benefits from fish consumption. A complete description of the process of developing ATLs, including information on the toxicity of methylmercury (the more toxic form of mercury, which is found in fish) and a discussion on the risks and benefits of fish consumption can be found in Klasing and Brodberg (2008). The Guide to Eating Fish from Lake McClure provides OEHHA’s recommendations for the maximum number of servings to eat each week and identifies species that are high in omega-3s. Follow these guidelines to lower risk and get the most benefit from fish consumption.

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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[6] 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. When the guidelines for eating fish from Lake McClure are followed, exposure to chemicals in fish from this lake would be at or below the average daily reference dose or the cancer risk probability of one in ten thousand.

| **Advisory Tissue Levels (ATLs) for Mercury Based on Non-Cancer Risk Using an 8-Ounce Serving Size** | | | | |
|---|---|---|---|---|
| **Chemical** | **Consumption Frequency Categories[a] and ATLs[b] (in ppb)** | | | |
| | Three 8-ounce Servings per Week | Two 8-ounce Servings per Week | One 8-ounce Serving per Week | No consumption |
| Methylmercury (for Women 18 to 45 years and children 1 to 17 years of age) | >55-70 | >70-150 | >150-440 | >440 |
| Methylmercury (for Women over 45 years and men) | >160-220 | >220-440 | >440-1,310 | >1,310 |

[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.

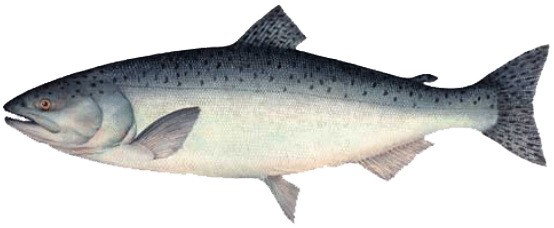
[b] When tissue concentrations are compared to this table, they should also first be rounded to the second significant digit.

[6] 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 AND SCIENTIFIC NAMES

(*not to scale*)

Chinook (king) salmon *(Oncorhynchus tshawytscha)*



USBR Battlecreek

Kokanee salmon *(Onchorhynchus nerka)*

J. Tomerelli

Rainbow trout *(Oncorhynchus mykiss)*

Duane Raver, USFWS

Bluegill *(Lepomis macrochirus)*

Duane Raver, USFWS

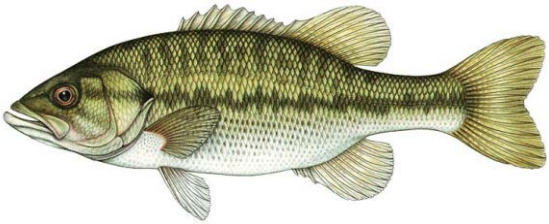
Channel catfish (*Ictalurus punctalus)*

Duane Raver, USFWS

Carp *(Cyprinus carpio)*

Duane Raver, USFWS

Spotted Bass (*Micropterus punctulatus*)



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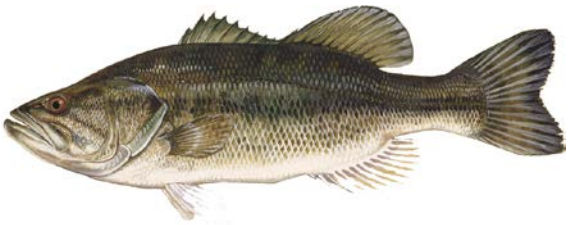
Largemouth bass *(Micropterus salmoides)*



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