HEALTH ADVISORY AND GUIDELINES FOR EATING FISH FROM OSO FLACO LAKE (SAN LUIS OBISPO COUNTY)

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LIST OF ABBREVIATIONS AND ACRONYMS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife, formerly California Department of Fish and Game
DDTs	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyl dichloroethane (DDD) and dichlorodiphenyl dichloroethylene (DDE)
OEHHA	Office of Environmental Health Hazard Assessment
PCBs	polychlorinated biphenyls
ppb	parts per billion
RWB-3	Central Coast Regional Water Quality Control Board
SPS	California State Parks Study
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
U.S. EPA	U.S. 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 (formerly the Department of Fish and Game) Sport Fishing Regulations in the section "Public Health Advisories."

This report presents guidelines for eating fish from Oso Flaco Lake, a small coastal lake in San Luis Obispo 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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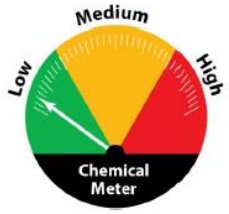
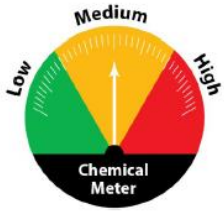


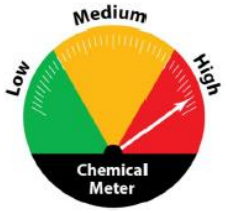
Bluegill

Hitch



Largemouth bass

♥ = High in Omega-3s



Goldfish

7 servings a week	OR	1 serving a week except women over 45 years and men can eat 2 servings a week	Do not eat

Eat only the skinless fillet.

Pesticides and PCBs are in the fat and skin of the fish.

- Remove and throw away the skin before cooking.
- Cook thoroughly and allow the juices to drain away.

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. Goldfish from Oso Flaco Lake have very high levels of long-banned pesticides. These pesticides might cause cancer and other health effects.

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INTRODUCTION

This report presents guidelines for eating fish from Oso Flaco Lake (Figure 1), a small coastal lake in San Luis Obispo County. The lake has an average depth of three feet. It is located about three miles north of Guadalupe, California and is part of the Oceano Dunes State Vehicular Recreation Area, a California State Park (Guadalupe-Nipomo Dunes Center, 2013). The report provides background information and a description of how the guidelines were developed.

FIGURE 1. MAP SHOWING LOCATION OF OSO FLACO LAKE IN CALIFORNIA

The finding of chemicals in fish tissues from Oso Flaco Lake 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 for the selected fish species
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 the toxicity of the chemical in the tissue. Development of the ATLs also included consideration of health benefits associated with including fish in the diet (Klasing and Brodberg, 2008; Appendix I).

CHEMICALS OF POTENTIAL CONCERN

Fish samples from Oso Flaco Lake were analyzed for mercury (as a measure of methylmercury), polychlorinated biphenyl congeners (PCBs), and the pesticides dieldrin, chlordanes, 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 can cause cancer and other health effects in humans. Chlordanes, DDTs, and dieldrin are pesticides that were banned from use many years ago but have persisted in our environment and accumulated in some fish from certain water bodies in California. These pesticides 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 Oso Flaco Lake 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, and detection limits below levels of health concern.

TOXIC SUBSTANCES MONITORING STUDY (TSMP)

The State Water Resources Control Board (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. Bluegill and hitch from Oso Flaco Lake were collected in 1993 and analyzed for mercury, PCBs, and pesticides. OEHHA used the results for mercury only in this evaluation because analytical methods for PCBs and pesticides have improved over time and detection limits have decreased. OEHHA therefore considers recent analyses of these chemicals more reliable. After 25 years, this program was incorporated into the SWRCB's currently operating program, described next.

SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP)

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). Goldfish, hitch, and largemouth bass were collected

from Oso Flaco Lake in 2008 and tested for mercury, and goldfish and hitch were analyzed for PCBs and pesticides.

STATE PARKS STUDY (SPS)

Central Coast Regional Water Quality Control Board (RWB-3) staff met with California State Parks staff following release of the SWAMP lakes study report. Oso Flaco Lake is managed by California State Parks, and RWB-3 staff informed them of high pesticide levels found in fish from the lake. Two follow-up efforts were planned:

1) California State Parks provided funding to have additional species collected by the SWAMP field crew in 2011 and have those samples analyzed for pesticides.
2) RWB-3 staff used SWAMP funds to analyze archived samples of the largemouth bass collected in the SWAMP study for pesticides.

Table 1 shows the type and number of fish sampled from Oso Flaco Lake, the year sampled, and the projects under which they were collected. The fish samples either met California Department of Fish and Wildlife's (CDFW) legal size requirements when specified (CDFW, 2013), or OEHHA's criteria for minimum "edible" size based on species size at maturity and professional judgment (Gassel and Brodberg, 2005).

TABLE 1. FISH SAMPLES FROM OSO FLACO LAKE

Common Name	Scientific Name	Number of Fish Collected	Year Sampled	Project (Data Source)
Bluegill	*Lepomis macrochirus*	21	1993	TSMP
		10	2011	SPS
Goldfish	*Carassius auratus*	10	2008	SWAMP
		5	2011	SPS
Hitch	*Lavinia exilicauda*	6	1993	TSMP
		10	2008	SWAMP
Largemouth bass	*Micropterus salmoides*	3	2008	SWAMP
		5	2011	SPS

CHEMICAL CONCENTRATIONS

Fish samples were analyzed for mercury as skinless fillets, either as individual fish or composite samples. Composite samples are prepared from equal amounts of tissues from several individual fish of the same species. Analysis of composite samples is done

for cost savings. The results represent average concentrations for the group of fish in the sample. 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.

Mercury Concentrations

Samples were combusted and analyzed for total mercury by DMA (direct mercury analyzer), a combination of thermal decomposition and atomic absorption, at the CDFW Moss Landing Marine Laboratories. Total mercury analyzed was assumed to be 100 percent methylmercury because almost all mercury present in fish is methylmercury (Bloom, 1992).

OEHHA used the arithmetic mean (average) of the mercury concentrations for each fish species to represent the concentration in fish consumed by people. The averages were weighted by the number of fish in the samples. Table 2 shows the mean mercury concentrations and ranges and the mean total lengths in fish species sampled from Oso Flaco Lake.

TABLE 2. CONCENTRATIONS OF MERCURY IN FISH FROM OSO FLACO LAKE

Species	Number of Samples	Total Number of Fish[a]	Mean Total Length[b] (mm)	Mean Mercury[b] (ppb wet weight)	Range of Mercury (ppb wet weight)
Bluegill	3	31	173	22	17-25
Goldfish	3	15	345	63	56-66
Hitch	3	16	259	31	29-35
Largemouth bass	8	8	383	196	178-228

[a] The number of fish can be greater than the number of samples because composite samples contain more than one fish.

[b] Weighted by the number of fish in the samples

Concentrations of Persistent Chlorinated Compounds

Chlordanes[1], DDTs[2], dieldrin, and PCBs (54 congeners)—legacy chemicals that have been prohibited for many years due to their toxicity and persistence in the environment—were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. The results are shown in Table 3. For chlordanes, DDTs, and PCBs, each of the concentrations presented is the sum of the detected parent

[1] cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane

[2] o,p' and p,p' DDT, o,p' and p,p' dichlorodiphenyl dichloroethane (DDD), and o,p' and p,p' dichlorodiphenyl dichloroethylene (DDE)

compound, congeners, and metabolites, where applicable. The method detection limits were relatively low, ≤ 3 parts per billion (ppb). Individual congeners or metabolites with concentrations reported as non-detects were assumed to have no residue. This is a standard method of handling non-detect samples for PCBs and other chemicals with multiple congeners or metabolites when detection limits are adequate (U.S. EPA, 2000a).

TABLE 3. CHEMICAL CONCENTRATIONS OF CHLORDANES, DDTS, DIELDRIN, AND PCBS IN FISH SAMPLES FROM OSO FLACO LAKE

Species	Number of Samples	Total Number of Fish[a]	Mean Total Length[b] (mm)	Sum of Chlordanes[b] (ppb wet weight)	Sum of DDTs[b] (ppb wet weight)	Dieldrin[b] (ppb wet weight)	Sum of PCBs[b] (ppb wet weight)
Bluegill	1	10	164	ND	18	5	ND
Goldfish	2	15	345	28	5731	226	48
Hitch	1	5	244	ND	156	6	0.4
Largemouth bass	2	8	383	1	188	12	1

[a] The number of fish can be greater than the number of samples because composite samples contain more than one fish.

[b] Weighted by the number of fish in the samples

DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM OSO FLACO LAKE

OEHHA used the average concentrations of each chemical analyzed in fish from Oso Flaco Lake to compare to the ATLs. There are two sets of ATLs for exposure to methylmercury in fish because of the age-related toxicity. The ATLs (summarized in Appendix I) for the sensitive population, women 18–45 years and children 1–17 years, are lower than for women over 45 years and men. This difference is to protect the brain and nervous system of the young during growth and development. Women ages 18–45 years are included in the sensitive population to protect the fetus because these women are of childbearing age.

There is much evidence and scientific consensus that eating fish promotes significant health benefits. 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”

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). OEHHA's advisory process and development of ATLs considered the health benefits from fish consumption. Further discussion on the benefits and risks of fish consumption can be found in Klasing and Brodberg (2008).

The maximum recommended numbers of servings per week for fish from Oso Flaco Lake are shown in Table 4. None of the chemical levels in bluegill and hitch were high enough to warrant restricted consumption. The advice for largemouth bass differs between the sensitive population (children and women of child-bearing age) and women over 45 years and men because it is based on mercury concentrations. The recommendation for no consumption of goldfish is due to high levels of DDTs and dieldrin.

TABLE 4. RECOMMENDED NUMBER OF SERVINGS PER WEEK

Fish Species	Women 18–45 years and Children 1–17 years	Women over 45 years and Men
Bluegill *or*	7	7
Hitch *or*	7	7
Largemouth bass	1	2
Goldfish	0	0

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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[3] for chemicals that are not known to cause cancer but cause other health effects, 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 (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 Oso Flaco Lake 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 Oso Flaco Lake 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 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.

[3] 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