OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

GOOD CATCH CALIFORNIA
Your Fish Advisor

Health Advisory and Guidelines for Eating Fish from

Alamitos Creek
Almaden Lake
Almaden Reservoir
Calero Creek
Calero Reservoir
Guadalupe Creek
Guadalupe Reservoir and
Guadalupe River
(Santa Clara County)

Updated December 2020

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LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife
CVAA	cold vapor atomic absorption
DDT(s)	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE)
DHA	docosahexaenoic acid
DMA	direct mercury analyzer
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
RWB2	Regional Water Board 2 (San Francisco Bay)
Se	selenium
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TSMP	Toxic Substances 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 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 updated guidelines for eating fish from several water bodies in Santa Clara County, including Alamitos Creek, Almaden Reservoir, Calero Reservoir, Guadalupe Creek, Guadalupe Reservoir, Guadalupe River, and the associated percolation ponds, and includes new advice for Almaden Lake and Calero Creek. The resulting advice is summarized in the illustrations after the Table of Contents and List of Figures and Tables.

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Women
(18-49 Years)
Children
(1-17 Years)
DO NOT EAT
Women
(50+ Years)
Men
(18+ Years)
DO NOT EAT
A GUIDE TO EATING FISH
from
ALAMITOS CREEK
ALMADEN LAKE
ALMADEN RESERVOIR
CALERO CREEK
CALERO RESERVOIR
GUADALUPE CREEK
GUADALUPE RESERVOIR
GUADALUPE RIVER
AND ASSOCIATED
PERCOLATION PONDS
(SANTA CLARA COUNTY)
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.
ALL FISH
Updated 12/2020
California Office of Environmental Health Hazard Assessment web www.oehha.ca.gov/fish email fish@oehha.ca.gov phone (916) 324-7572

INTRODUCTION

This report presents an advisory for eating fish from several water bodies in the Guadalupe River Watershed in Santa Clara County:

- Almaden Reservoir,
- Calero Reservoir,
- Guadalupe Reservoir,
- Guadalupe River,
- Guadalupe Creek,
- Alamitos Creek,
- Almaden Lake,
- Calero Creek
- and their associated percolation ponds.

The advisory updates a 1987 advisory for the first six water bodies listed above, released by the Hazard Evaluation Section of the California Department of Health Services. (This section subsequently became the Office of Environmental Health Hazard Assessment (OEHHA) within the California Environmental Protection Agency). In addition, advisories for Almaden Lake and Calero Creek have not been the subject of advisories. The water bodies covered are shown in Figure 1. Only the water bodies listed above are covered by this advisory.

In developing this report, OEHHA evaluated existing and new fish contaminant data and found that, **because of high mercury levels, no fish from these water bodies should be consumed**.

LOCATION

The Guadalupe River watershed, located in and near the city of San Jose, covers 170 square miles in Santa Clara County and drains part of the eastern Santa Cruz Mountains into San Francisco Bay. The watershed contains several reservoirs, including Almaden Lake, Almaden Reservoir, Calero Reservoir, and Guadalupe Reservoir, which are owned by the Santa Clara Valley Water District and serve as flood protection, drinking water storage, recreation, and groundwater recharge. The watershed also consists of several creeks, such as Alamitos Creek, Calero Creek, and Guadalupe Creek, which feed the Guadalupe River, and generally run from south to north. Alamitos Creek (or Los Alamitos Creek) is a 7.7-mile creek that drains Almaden Reservoir and feeds Lake Almaden near its confluence with Guadalupe Creek. Calero Creek connects Calero Reservoir to Alamitos Creek, and Guadalupe Creek is a 10.5-mile stream with headwaters in the Santa Cruz Mountains, which drains Guadalupe Reservoir. The confluence of Alamitos and Guadalupe Creeks forms the Guadalupe River, which flows 14 miles northward through the city of San Jose and into San Francisco Bay.

The Guadalupe watershed has a long history of intensive mercury mining, resulting in significant mercury contamination of local streams and reservoirs. The New Almaden Mining District, located in the Guadalupe watershed, was North America's largest producing mercury mine, and mining waste continues to deposit mercury into the watershed.[1] This advisory pertains only to Alamitos Creek, Almaden Lake, Almaden Reservoir, Calero Creek, Calero Reservoir, Guadalupe Creek, Guadalupe River, Guadalupe Reservoir, and their associated percolation ponds. This advisory does not include any other creeks or reservoirs within the Guadalupe watershed. Site-specific advice has previously been developed for other water bodies in this watershed, Lexington Reservoir and Vasona Lake and Camden Ponds.

FIGURE 1. LOCATION OF ALAMITOS CREEK, ALMADEN LAKE, ALMADEN RESERVOIR, CALERO CREEK, CALERO RESERVOIR, GUADALUPE CREEK, GUADALUPE RESERVOIR, AND GUADALUPE RIVER

[1] Information about the Guadalupe Watershed can be found online at: https://onewaterplan.wordpress.com/watersheds/guadalupe-watershed/, https://www.valleywater.org/your-water/local-dams-and-reservoirs, and https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/guadalupe_river_mercury/Final%20Report%20Guadalupe%20River%20Watershed%20CMP%20032417.pdf

APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from four monitoring studies described in this report to develop the advisory for these water bodies. 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 mean[2]) 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.

OEHHA typically evaluates data and issues advice on a water body-by-water body basis. However, for this advisory, data for all water bodies were combined to provide uniform advice for all species for reasons that are described later in this report.

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 (Hg), followed by polychlorinated biphenyls (PCBs) and, in a few cases, selenium (Se),

[2] Means are an arithmetic average of individual values and/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.

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 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 because they do not break down easily and can accumulate in fish. 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 used in the development of this advisory were analyzed for mercury (as a measure of methylmercury). Some species were additionally analyzed for PBDEs, PCBs, selenium, and/or the legacy pesticides chlordanes (cis-chlordane, trans-chlordane, cis-nonachlor, transnonachlor, and oxychlordane), dieldrin, DDTs (DDT and its metabolites dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethylene [DDE]), and toxaphene. 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 Alamitos Creek, Almaden Lake, Almaden Reservoir, Calero Creek, Calero Reservoir, Guadalupe Creek, Guadalupe Reservoir, and Guadalupe River, and their associated percolation ponds are based on the chemicals detected in the fish collected for the four 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, minimum legal/edible lengths, 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.

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 San Francisco Bay Regional Water Quality Control Board (RWB2), monitors water quality in California's surface waters. In 2007 and 2008, SWAMP conducted a two-year screening survey to initiate a statewide sampling effort to identify and quantify contaminants in sport fish found in California lakes and reservoirs (SWRCB, 2010) to examine exposure and risk to humans and wildlife. The program collected Common Carp and Largemouth Bass from Almaden Lake and Largemouth Bass from Calero Reservoir in 2008, which were analyzed for mercury, chlordanes, DDTs, dieldrin, PBDEs, PCBs, and/or selenium.

LONG-TERM MONITORING OF BASS LAKES AND RESERVOIRS, 2019 (SWAMP)

In 2015, SWAMP began a statewide sampling effort to monitor trends in mercury concentrations in lakes and reservoirs dominated by black bass species, a well-known accumulator of mercury, to assess the efficacy of management actions. In 2019, the program collected Largemouth Bass from Almaden Reservoir, and Bluegill, Largemouth Bass, and Rainbow Trout from Guadalupe Reservoir, which were analyzed for mercury.[3]

[3] Information on SWAMP's Long-Term Monitoring of Bass Lakes and Reservoirs study can be found online at: https://www.waterboards.ca.gov/water_issues/programs/swamp/lakes_study.html

National Study of Chemical Residues in Lakes Fish Tissue, 2000–2003 (NFTS)

The US Environmental Protection Agency's National Study of Chemical Residues in Lakes Fish Tissue was a screening-level survey of lakes and reservoirs in the United States to examine chemical residues in fish tissue. The goal of the study was to assess the percentage of lakes and reservoirs that pose a potential concern for fish consumers due to chemical concentrations in fish tissue. As part of this study, Largemouth Bass were collected from Guadalupe Reservoir in 2003 and analyzed for chlordanes, DDTs, dieldrin, mercury, PCBs, and toxaphene (US EPA, 2009).

Toxic Substances Monitoring Program (TSMP)

The TSMP operated from 1976 to 2003 as a state water quality-monitoring program managed by SWRCB (SWRCB, 2007 and 2013). Its objective was to provide statewide information on the occurrence of toxic substances by monitoring water bodies with known or suspected water quality impairment. Staff from the California Department of Fish and Wildlife (CDFW), then known as the California Department of Fish and Game, collected Black Crappie, Bluegill, Brown Bullhead, Goldfish, Largemouth Bass, Rainbow Trout, and Sacramento Sucker during the 1980s from several of the water bodies included in this advisory. All fish samples were analyzed for mercury, and Black Crappie, Bluegill, and Largemouth Bass were additionally analyzed for selenium.

FISH SAMPLED

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. Except where discussed below, 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.

Fish samples were not collected from Calero Creek; however, data from the connected Calero Reservoir were used to extend advice to this water body. Similarly, data collected from Guadalupe Reservoir were used to provide advice for Guadalupe Creek, and data collected from the flowing waters included in this advisory were used to extend advice to the adjacent percolation ponds. Additionally, mercury concentrations in undersized fish collected from Guadalupe Creek were used as supplemental data in developing this advisory. This is described in further detail in a later section of this report.

TABLE 1. FISH SAMPLES EVALUATED FOR THE ALAMITOS CREEK, ALMADEN LAKE, ALMADEN RESERVOIR, CALERO CREEK, CALERO RESERVOIR, GUADALUPE CREEK, GUADALUPE RESERVOIR, GUADALUPE RIVER, AND ASSOCIATED PERCOLATION PONDS ADVISORY FOR FISH MEETING MINIMUM SIZE REQUIREMENTS

Common Name	Scientific Name	Water body	Number of Samples	Total Number of Fish	Project[a]	Year Collected	Contaminants Analyzed[d]
Black Crappie	*Pomoxis nigromaculatus*	Calero Reservoir	11	20	TSMP[b]	1986	Hg
		Calero Reservoir	1	20	TSMP[b]	1986	Se
Bluegill	*Lepomis macrochirus*	Guadalupe Reservoir	5	5	SWAMP	2019	Hg
		Guadalupe Reservoir	21	31	TSMP[b]	1986	Hg
		Guadalupe Reservoir	1	11	TSMP[b]	1986	Se
Brown Bullhead	*Ameiurus nebulosus*	Almaden Reservoir	2	12	TSMP[b]	1988	Hg
		Guadalupe River	1	2	TSMP[b]	1982	Hg
Common Carp	*Cyprinus carpio*	Almaden Lake	2	10	SWAMP	2008	Chlordanes, DDTs, Dieldrin, Hg, PBDEs, PCBs
		Almaden Lake	1	5	SWAMP	2008	Se
Goldfish	*Carassius auratus*	Almaden Reservoir	1	3	TSMP[b]	1989	Hg
		Guadalupe River	1	3	TSMP[b]	1982	Hg
Largemouth Bass	*Micropterus salmoides*	Almaden Lake	7	7	SWAMP	2008	Hg
		Almaden Reservoir	8	8	SWAMP	2019	Hg
		Calero Reservoir	13	13	SWAMP	2008	Hg
		Calero Reservoir	1	5	SWAMP	2008	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs, Se
		Calero Reservoir	10	14	TSMP[b]	1986	Hg

Common Name	Scientific Name	Water body	Number of Samples	Total Number of Fish	Project[a]	Year Collected	Contaminants Analyzed[d]
		Calero Reservoir	1	5	TSMP[b]	1986	Se
		Guadalupe Reservoir	10	10	SWAMP	2019	Hg
		Guadalupe Reservoir	1	5	NFTS[c]	2003	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Toxaphene
Rainbow Trout	*Oncorhynchus mykiss*	Alamitos Creek	1	3	TSMP[b]	1988	Hg
		Guadalupe Reservoir	4	4	SWAMP	2019	Hg
Sacramento Sucker	*Catostomus occidentalis*	Alamitos Creek	1	6	TSMP[b]	1987	Hg

[a]Samples were analyzed as skinless fillets, unless otherwise noted by footnotes b, c.
[b]Study report did not specify whether skin was removed prior to tissue analysis.
[c]Sample was analyzed with skin on.
[d]Organic data (chlordanes, DDTs, dieldrin, and toxaphene) generated prior to 2000 were excluded from the analysis because data that are more recent are considered more reliable due to improved analytical methods.

CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for one or more of the following: total mercury, selenium, chlordanes, DDTs, dieldrin, toxaphene, PBDEs (7 congeners), and PCBs (54–159 congeners)[4]. Among the chemicals analyzed in fish tissue samples from these water bodies, only mercury levels were sufficiently high to impact consumption advice.

Where reported, all fish samples were prepared as skinless fillets except for the NFTS study that analyzed Largemouth Bass fillets with skin on. The TSMP study did not report whether fillets had skin removed. 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.

[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.

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) or Cold Vapor Atomic Absorption (CVAA). The DMA method, used in the SWAMP studies, utilizes thermal decomposition and atomic absorption. The CVAA method, used in the NFTS study, determines the concentration of mercury by measuring the amount of radiation it absorbs. The mercury analysis method was not reported for the TSMP study. 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 length[5], as well as mercury concentrations in each fish species grouped across water bodies. For the SWAMP studies, the DMA method detection limit (MDL)[6] and the reporting limit (RL)[7] for total mercury were each reported at 3 or 12 parts per billion (ppb). For the NFTS study, the CVAA MDL and RL for total mercury were reported at 0.521 and 2 ppb, respectively. The MDL and RL for mercury were not reported for the TSMP study.

PCBS, PBDES, AND PESTICIDES

Some composite samples were analyzed for PCBs, PBDEs, and the legacy pesticides (chlordanes, DDTs, dieldrin, and toxaphene). Pesticides, PBDEs, and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory for the SWAMP study. NFTS samples were analyzed at AXYS Analytical Services, Ltd using gas chromatography combined with high resolution mass spectrometry. 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 generally low (≤ 5 ppb for most samples), 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). Table 3 shows the averages and ranges for total length[8], as well as PCB concentrations in each fish species grouped across water bodies. Appendix I shows the averages and ranges for both mercury and PCB concentrations in each fish species by individual water body.

SELENIUM

Common Carp and Largemouth Bass were analyzed by SWAMP for selenium, as composite samples, using inductively coupled plasma-mass spectrometry (ICP-MS).

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[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.
[8] 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.

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 RL for total selenium were reported at 150 and 400 ppb, respectively. The methodology, MDL, and RL were not reported for the TSMP study.

Concentrations of chlordanes, dieldrin, DDTs, PBDEs, selenium, and toxaphene 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 ALAMITOS CREEK, ALMADEN LAKE, ALMADEN RESERVOIR, CALERO RESERVOIR, GUADALUPE RESERVOIR, AND GUADALUPE RIVER FOR FISH MEETING MINIMUM SIZE REQUIREMENTS*

Species	Number of Samples[a]	Total Number of Fish	Mean** Total Length (mm)	Range of Total Lengths*** (mm)	Mercury (ppb)	
					Mean**	Range***
Black Crappie	11	20	222	211 – 247	1305	1100 – 1900
Bluegill	26	36	184	119 – 236	1860	800 – 3800
Brown Bullhead	3	14	241	225 – 333	533	460 – 880
Common Carp	2	10	669	606 – 763	1035	1020 – 1050
Goldfish	2	6	285	285 – 285	1400	1200 – 1600
Largemouth Bass	49	57	393	312 – 578	2845	669 – 6605
Rainbow Trout	5	7	235	212 – 268	2844	1550 – 4850
Sacramento Sucker	1	6	292	n/a	2700	n/a

[a]Samples were analyzed as skinless fillets except as noted in the footnotes to Table 1.
*No samples collected from Guadalupe Creek met the required minimum total length. Samples were not collected from Calero Creek or from percolation ponds associated with these water bodies.
**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

TABLE 3. PCB CONCENTRATIONS IN FISH FROM ALMADEN LAKE, CALERO RESERVOIR, AND GUADALUPE RESERVOIR FOR FISH MEETING MINIMUM SIZE REQUIREMENTS*

Species	Number of Samples[a]	Total Number of Fish	Mean** Total Length (mm)	Range of Total Lengths*** (mm)	PCBs (ppb)	
					Mean**	Range***
Common Carp	2	10	669	606 – 763	49	37 – 61
Largemouth Bass	2	10	408	355 – 449	13	8 – 17

[a]Samples were analyzed as skinless fillets except as noted in the footnotes to Table 1.
*Samples from Alamitos Creek, Almaden Reservoir, or Guadalupe River were not analyzed for PCBs.
**Means are an arithmetic average of individual values and/or a weighted average of composites.
***Range of individuals and/or range of the composites.

DEVELOPMENT OF GUIDELINES FOR EATING FISH

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 specific omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), thought to be associated with these beneficial health effects (USDA/USDHHS, 2015; Weaver et al., 2008).

The 2015–2020 US Dietary Guidelines recommend that 1) the general population "consume eight or more ounces per week (less for young children)" of a variety of seafood[9] "for the total package of nutrients that seafood provides, including its EPA and DHA content" and 2) "women who are pregnant or breastfeeding should consume at least eight and up to twelve ounces of a variety of seafood per week from choices that are lower in methylmercury" (USDA/USDHHS, 2015). 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

[9] "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" (USDHHS/USDA, 2015).

children avoid consuming shark, swordfish, tilefish (Gulf of Mexico), bigeye tuna, marlin, orange roughy, and king mackerel (FDA/US EPA, 2017).

In order 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 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 49 years of age) and children 1–17 years, 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 II.

For each fish species in this advisory, OEHHA compared the mean mercury and PCB concentrations detected in the fillet to the corresponding ATLs to establish the maximum number of servings per week that could be consumed (see Appendix II). 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 individuals 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, 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 for this advisory because consumption of Common Carp and Largemouth Bass (the only

species which were analyzed for PCBs) by the sensitive population was not recommended based solely on mercury concentrations. The recommendation to not consume any fish from these water bodies is 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 species[10] 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 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

OEHHA's advisory protocol requires at least nine fish of a species to be collected from a water body before an advisory can be developed for the primary contaminant of concern. This is to ensure the sample dataset is representative of the fish species population in the water body. In some cases, an exception is made to develop advice for species that are commonly caught and consumed from a given water body but where available data may be limited. Generally, this practice applies when the advice supports no consumption of that species.

With the exception of Calero Reservoir, for which there was a sufficient sample size to provide advice for both collected species, the minimum sample size requirement was not met for some or all species collected from the other water bodies. However, when examining the data for eight species of adequate size collected across six water bodies, in most cases, mercury concentrations were largely consistent and would support "do not consume" advice for both the general and sensitive population groups, based on the ATLs. Brown Bullhead collected from Almaden Reservoir and Common Carp collected from Almaden Lake represent the only cases where data for a species with sufficient sample size could support any consumption, and only for the general population. Otherwise, mercury concentrations in samples of multiple species were exceedingly high, even in those that do not typically accumulate high mercury levels, such as

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

Rainbow Trout and Bluegill. Because of this and the significant impacts of historical mining activities on the watershed that these water bodies share, OEHHA elected to group all fish of each species collected into a single advisory. When data from all water bodies were combined, the minimum sample size requirement for each species was met except for Goldfish (n=6), Rainbow Trout (n=7), and Sacramento Sucker (n=6).

A supplemental analysis was conducted using all available data, including undersized individuals, which significantly increased the sample size for most species. There is a well established positive correlation between mercury concentration and fish length (Sackett et al. 2013), and including these smaller fish predictably reduced the mean mercury concentration in each species. However, despite the reduced mean mercury concentrations from including undersized individuals, levels remained above the concentration at which they should not be consumed by the sensitive population. Table 4 shows the averages and ranges for total length and mercury concentrations in all fish, including undersized individuals.

A summary of all fish species evaluated for this advisory, including the undersized individuals, is shown in Appendix III, including the name of the species, number of samples collected, total number of fish, project name, year sampled, and contaminants analyzed.

As can be seen in Table 1, the majority (~70%) of samples used in this advisory were collected in the 1980s. Fish mercury concentrations tend to be fairly stable at a water body; however, mercury mitigation efforts are ongoing in the Guadalupe River Watershed[11], which may result in lower fish mercury concentrations over time. Of the fish samples suitable for use in developing fish advisories for which a comparison can be made, the only species that was collected in both the 1980s and in recent years was Largemouth Bass at Calero Reservoir. Table 5 shows the averages and ranges for total length and mercury concentrations in Largemouth Bass collected at four Guadalupe River Watershed water bodies. Although the mean mercury concentration in Largemouth Bass at Calero Reservoir collected in 2008 (1263 ppb) was lower than those collected in 1986 (2207 ppb), this may be partially due to the somewhat smaller fish collected in 2008. Nonetheless, given the range of mercury concentrations in Largemouth Bass collected in 2008 at this reservoir (up to 1820 ppb), OEHHA would continue to recommend no consumption for this species. In the most recent samples available, Largemouth Bass collected from Almaden and Guadalupe reservoirs in 2019 had mercury concentrations as high as 5230 and 5040 ppb, respectively, with mean concentrations of 3076 and 3872 ppb, respectively. All samples substantially exceeded

[11] Information on the SWRCB's mercury mitigation efforts in the Guadalupe River Watershed can be found online at: https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/guadaluperivermercurytmdl.html

the do not consume cutoff of 1310 ppb for the general population. Mercury concentrations in these fish remain high and are not out of character with the older data.

TABLE 4. MERCURY CONCENTRATIONS IN FISH FROM ALAMITOS CREEK, ALMADEN LAKE, ALMADEN RESERVOIR, CALERO RESERVOIR, GUADALUPE CREEK, GUADALUPE RESERVOIR, AND GUADALUPE RIVER, INCLUDING UNDERSIZED INDIVIDUALS*

Species	Number of Samples[a]	Total Number of Fish	Mean** Total Length (mm)	Range of Total Lengths*** (mm)	Mercury (ppb)	
					Mean**	Range***
Black Crappie	11	20	222	211 – 247	1305	1100 – 1900
Bluegill	26	36	184	119 – 236	1860	800 – 3800
Brown Bullhead	5	32	214	193 – 333	503	430 – 880
Common Carp	2	10	669	606 – 763	1035	1020 – 1050
Goldfish	5	25	188	138 – 285	474	170 – 1600
Largemouth Bass	86	95	317	135 – 578	2252	491 – 6605
Rainbow Trout	48	92	128	73 – 268	1511	370 – 4850
Sacramento Sucker	2	15	225	180 – 292	1878	1330 – 2700

[a]Samples were analyzed as skinless fillets; however, the TSMP study did not report the fillet preparation method, as noted in the footnotes to Appendix III.
*Samples were not collected from Calero Creek or from percolation ponds associated with these water bodies.
**Means are an arithmetic average of individual values and/or a weighted average of composites.
***Range of individuals and/or range of the composites.

TABLE 5. MERCURY CONCENTRATIONS IN LARGEMOUTH BASS FROM ALMADEN LAKE, ALMADEN RESERVOIR, CALERO RESERVOIR, AND GUADALUPE RESERVOIR

Water Body	Year Collected	Number of Samples[a]	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
						Mean*	Range**
Almaden Lake	2008	7	7	420	348 – 578	2639	1800 – 3870
Almaden Reservoir	2019	8	8	387	337 – 449	3076	1760 – 5230
Calero Reservoir	1986	10	14	395	345 – 458	2207	1700 – 3100
	2008	13	13	374	315 – 470	1263	669 – 1820
Guadalupe Reservoir	2003	1	5	449	n/a	6605	n/a
	2019	10	10	373	312 – 433	3872	2900 – 5040

[a]Samples were analyzed as skinless fillets; however, some samples collected by TSMP from Calero Reservoir did not report the fillet preparation method.
*Means are an arithmetic average of individual values and/or a weighted average of composites.
**Range of individuals and/or range of the composites.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

Due to very high mercury levels measured in multiple species, OEHHA does not recommend consumption of any fish from Alamitos Creek, Almaden Lake, Almaden Reservoir, Calero Creek, Calero Reservoir, Guadalupe Creek, Guadalupe Reservoir, Guadalupe River, and associated percolation ponds. This is shown in Table 6.

TABLE 6. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM ALAMITOS CREEK, ALMADEN LAKE, ALMADEN RESERVOIR, CALERO CREEK, CALERO RESERVOIR, GUADALUPE CREEK, GUADALUPE RESERVOIR, GUADALUPE RIVER, AND ASSOCIATED PERCOLATION PONDS

Fish Species	Women 18–49 years and Children 1–17 years	Women 50 years and older and Men 18 years and older
All Fish	0	0

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APPENDIX I. MERCURY AND PCB CONCENTRATIONS BY WATER BODY FOR FISH MEETING MINIMUM SIZE REQUIREMENTS

Species	Water Body	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
						Mean*	Range**
Black Crappie	Calero Reservoir	11	20	222	211 – 247	1305	1100 – 1900
Bluegill	Guadalupe Reservoir	26	36	184	119 – 236	1860	800 – 3800
Brown Bullhead	Almaden Reservoir	2	12	225	225 – 226	475	460 – 490
	Guadalupe River	1	2	333	n/a	880	n/a
Common Carp	Almaden Lake	2	10	669	606 – 763	1035	1020 – 1050
Goldfish	Almaden Reservoir	1	3	285	n/a	1600	n/a
	Guadalupe River	1	3	285	n/a	1200	n/a
Largemouth Bass	Almaden Reservoir	8	8	387	337 – 449	3076	1760 – 5230
	Almaden Lake	7	7	420	348 – 578	2639	1800 – 3870
	Calero Reservoir	23	27	385	315 – 470	1753	669 – 3100
	Guadalupe Reservoir	11	15	399	312 – 449	4783	2900 – 6605
Rainbow Trout	Alamitos Creek	1	3	212	n/a	1550	n/a
	Guadalupe Reservoir	4	4	253	244 – 268	3815	3270 – 4850
Sacramento Sucker	Alamitos Creek	1	6	292	n/a	2700	n/a

[a]Samples were analyzed as skinless fillets except as noted in the footnotes to Table 1.
*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

Species	Water Body	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCBs (ppb)	
						Mean*	Range**
Common Carp	Almaden Lake	2	10	669	606 – 763	49	37 – 61
Largemouth Bass	Calero Reservoir	1	5	367	n/a	8	n/a
Largemouth Bass	Guadalupe Reservoir	1	5	449	n/a	17	n/a

[a]Samples were analyzed as skinless fillets except as noted in the footnotes to Table 1.
*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

APPENDIX II. 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 dose[12] 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 Alamitos Creek, Almaden Lake, Almaden Reservoir, Calero Creek, Calero Reservoir, Guadalupe Creek, Guadalupe Reservoir, or Guadalupe River are followed, exposure to chemicals in fish from these water bodies 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.

[12] 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.

APPENDIX III. FISH SAMPLES EVALUATED FOR THE ALAMITOS CREEK, ALMADEN LAKE, ALMADEN RESERVOIR, CALERO CREEK, CALERO RESERVOIR, GUADALUPE CREEK, GUADALUPE RESERVOIR, GUADALUPE RIVER, AND ASSOCIATED PERCOLATION PONDS ADVISORY, INCLUDING UNDERSIZED INDIVIDUALS

Common Name	Scientific Name	Water body	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed[b]
Black Crappie	*Pomoxis nigromaculatus*	Calero Reservoir	11	20	TSMP[a]	1986	Hg
		Calero Reservoir	1	10	TSMP[a]	1986	Se
Bluegill	*Lepomis macrochirus*	Guadalupe Reservoir	5	5	SWAMP	2019	Hg
		Guadalupe Reservoir	21	31	TSMP[a]	1986	Hg
		Guadalupe Reservoir	1	11	TSMP[a]	1986	Se
Brown Bullhead	*Ameiurus nebulosus*	Almaden Reservoir	4	30	TSMP[a]	1988, 1990	Hg
		Guadalupe River	1	2	TSMP[a]	1982	Hg
Common Carp	*Cyprinus carpio*	Almaden Lake	2	10	SWAMP	2008	Chlordanes, DDTs, Dieldrin, Hg, PBDEs, PCBs
		Almaden Lake	1	5	SWAMP	2008	Se
Goldfish	*Carassius auratus*	Almaden Reservoir	1	3	TSMP[a]	1989	Hg
		Guadalupe River	4	22	TSMP[a]	1981 – 1984	Hg
Largemouth Bass	*Micropterus salmoides*	Almaden Lake	11	11	SWAMP	2008	Hg
		Almaden Reservoir	12	12	SWAMP	2019	Hg
		Calero Reservoir	16	16	SWAMP	2008	Hg
		Calero Reservoir	1	5	SWAMP	2008	Chlordanes, DDTs, Dieldrin, PBDEs, PCBs, Se
		Calero Reservoir	11	15	TSMP[a]	1986	Hg
		Calero Reservoir	1	5	TSMP[a]	1986	Se

Common Name	Scientific Name	Water body	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed[b]
		Guadalupe Reservoir	1	5	NFTS	2003	Chlordanes, DDTs, Dieldrin, Hg, PCBS, Toxaphene
		Guadalupe Reservoir	14	14	SWAMP	2019	Hg
		Guadalupe River	21	22	TSMP[a]	1986	Hg
		Guadalupe River	1	2	TSMP[a]	1986	Se
Rainbow Trout	*Oncorhynchus mykiss*	Alamitos Creek	23	48	TSMP[a]	1986 – 1988	Hg
		Alamitos Creek	1	20	TSMP[a]	1986	Se
		Guadalupe Creek	21	40	TSMP[a]	1986	Hg
		Guadalupe Creek	1	20	TSMP[a]	1986	Se
		Guadalupe Reservoir	4	4	SWAMP	2019	Hg
Sacramento Sucker	*Catostomus occidentalis*	Alamitos Creek	2	15	TSMP[a]	1987 – 1988	Hg

[a]Study report did not specify whether skin was removed prior to tissue analysis.
[b]Organic data (chlordanes, DDTs, dieldrin, PBDEs, and toxaphene) generated prior to 2000 were excluded from the analysis because data that are more recent are considered more reliable due to improved analytical methods.