



# Health Advisory and Guidelines for Eating Fish from the All-American Canal (Imperial County)

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Fish, Ecotoxicology, and Water Section  
Pesticide and Environmental Toxicology Branch  
Office of Environmental Health Hazard Assessment  
California Environmental Protection Agency

# LIST OF CONTRIBUTORS

## ***Office of Environmental Health Hazard Assessment***

### ***Authors***

Lori A Chumney, M.S.  
Huyen Tran Pham, M.P.H.

### ***Primary Reviewers***

Susan A. Klasing, Ph.D., Section Chief  
Shannon R. Murphy, Ph.D.

### ***Final Reviewers***

David Ting, Ph.D., Branch Chief  
David Siegel, Ph.D., Assistant to the Deputy Director  
Allan Hirsch, Chief Deputy Director

### ***Director***

Lauren Zeise, Ph.D.

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### ***For further information, contact:***

Pesticide and Environmental Toxicology Branch  
Office of Environmental Health Hazard Assessment  
California Environmental Protection Agency

1515 Clay Street, 16<sup>th</sup> Floor  
Oakland, California 94612  
Telephone: (510) 622-3170  
Email address: fish@oehha.ca.gov

Sacramento, CA 95812-4010  
Telephone: (916) 324-7572

1001 I Street, P.O. Box 4010  
All-American Canal Fish Advisory

## LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CDFW	California Department of Fish and Wildlife
DDT(s)	dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE)
DHA	docosahexaenoic acid
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
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
RWB7	Regional Water Board 7 (Colorado River Basin)
Se	selenium
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 guidelines for eating fish from the All-American Canal in Imperial County. The report provides background information and a technical description of how the guidelines were developed. 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)



**Women**  
(50+ Years)

**Men**  
(18+ Years)

## A GUIDE TO EATING FISH


*from the*

# ALL-AMERICAN CANAL

(IMPERIAL 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.




**Sunfish Species**




**Flathead Catfish**

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**Black Bass Species**  
♥ high in omega-3s

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**Carp**




**Channel Catfish**


**Serving Size**


A serving of fish is about the size and thickness of your hand. Give children smaller servings.

For Adults




For Children




 **California Office of Environmental Health Hazard Assessment**

web [www.oehha.ca.gov/fish](http://www.oehha.ca.gov/fish)  
 email [fish@oehha.ca.gov](mailto:fish@oehha.ca.gov)  
 phone (916) 324-7572

**Eat only the skinless fillet**



**Eat only the meat**



Some chemicals are higher in the skin, fat, and guts.

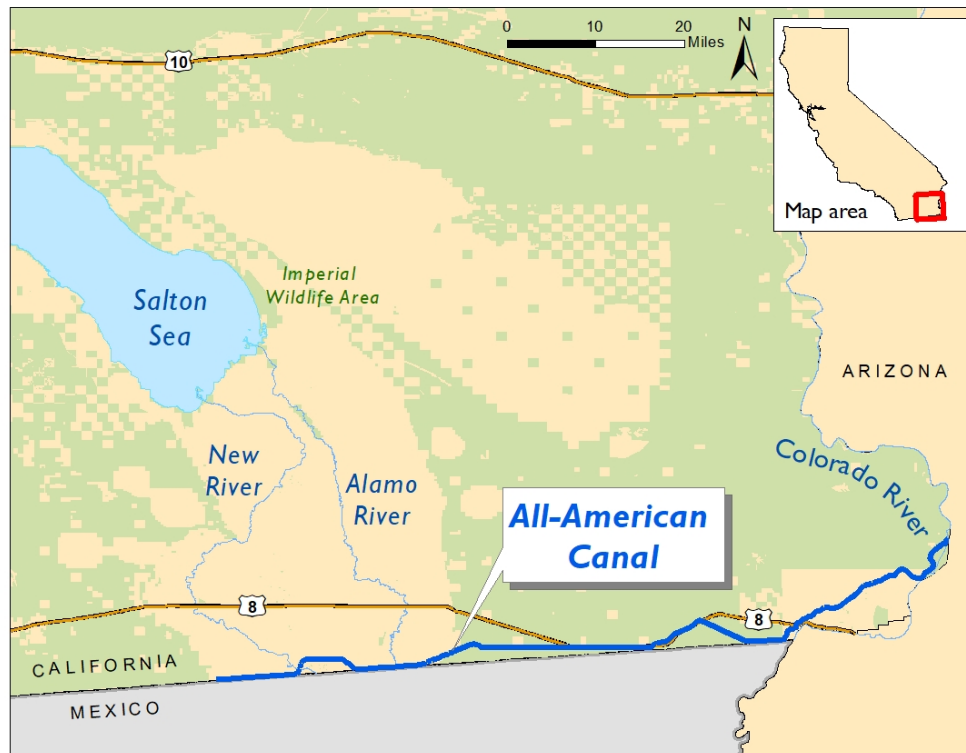
## INTRODUCTION

This report presents guidelines for eating fish from the All-American Canal (Figure 1) in Imperial County, located in southeastern California. The All-American Canal is located south and southeast of the Salton Sea, near the United States-Mexico border.

### LOCATION

The All-American Canal begins at the Imperial Dam on the Colorado River and runs west for 80 miles, in parallel with the U.S.-Mexico border for much of its course. As the world's largest irrigation canal, it serves to transport approximately 3.1 million acre-feet of water from the Colorado River to agricultural and urban areas in the Imperial Valley. The All-American Canal is owned and operated by the Imperial Irrigation District.<sup>1</sup>

FIGURE 1. LOCATION OF THE ALL-AMERICAN CANAL



<sup>1</sup> Information regarding the All-American Canal was obtained from the National Aeronautics and Space Administration, the Water Education Foundation, and the Imperial Irrigation District. Online at: [https://www.nasa.gov/multimedia/imagegallery/image\\_feature\\_1333.html](https://www.nasa.gov/multimedia/imagegallery/image_feature_1333.html), <https://www.watereducation.org/aquapedia-background/all-american-canal>, and <https://www.iid.com/water/water-transportation-system/colorado-river-facilities/all-american-canal>.



### *APPROACH USED*

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from the monitoring study described in this report to develop the All-American Canal Advisory. 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<sup>2</sup>) 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.

## 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) 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 historic 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

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<sup>2</sup> 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, combined.

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 water bodies in California. Depending on the exposure level, these chemicals may cause cancer or adverse effects on the nervous system.

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).

All fish species collected from the All-American Canal and used in advisory development were analyzed for mercury (as a measure of methylmercury) and selenium. Channel Catfish, Common Carp, Flathead Catfish, and Largemouth Bass were also analyzed for PCBs and the legacy pesticides chlordanes (cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane), DDTs (DDT and its metabolites dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethylene [DDE]), dieldrin, and toxaphene (except Largemouth Bass). Fish species that do not normally accumulate PCBs or other organic chemicals may not be analyzed for those contaminants in a particular monitoring study.

## DATA SOURCE

The guidelines for eating fish from the All-American Canal are based on the chemicals detected in the fish collected for the monitoring study described below. This study met OEHHA’s data quality criteria, including adequate documentation of sample collection, fish preparation method (e.g., skinning or filleting), chemical analyses, quality assurance, 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.

*COLORADO RIVER BASIN REGIONAL WATER QUALITY CONTROL BOARD, SPORT FISH MONITORING PROGRAM (RWB7)*

The Region 7 Water Board (RWB7), in cooperation with the State Water Resources Control Board, monitors water quality in California's surface waters. In 2014, the program performed regional monitoring surveys of the All-American Canal to evaluate contaminants in commonly consumed sport fish and to gain information about contamination in the greater aquatic food web<sup>3</sup>. The surveys collected Bluegill, Channel Catfish, Common Carp, Flathead Catfish, Largemouth Bass, and Redear Sunfish from the All-American Canal. Fish samples were analyzed for one or more of the following contaminants: mercury, chlordanes, DDTs, dieldrin, PCBs, selenium, and toxaphene.

## FISH SAMPLED FROM THE ALL-AMERICAN CANAL

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. 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 on the following page, including the name of the species, number of samples collected, total number of fish, project name, year sampled, and contaminants analyzed.

## CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for one or more of the following: total mercury, selenium, chlordanes, DDTs, dieldrin, PCBs (50-51 congeners<sup>4</sup>), and toxaphene. Among the chemicals analyzed in fish tissue samples from the All-American Canal, only mercury, PCBs, and selenium levels were sufficiently high to impact consumption advice.

All fish samples were prepared as skinless fillets. Samples were analyzed as individual fish or composites. Composites were prepared from equal amounts of tissue from several similarly sized individual fish of a species.

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.

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<sup>3</sup> For more information on this program, see RWQCB, 2012.

<sup>4</sup> Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54-55 are generally reported.

TABLE 1. FISH SAMPLES EVALUATED FOR THE ALL-AMERICAN CANAL ADVISORY

Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed
Bluegill	<i>Lepomis macrochirus</i>	3	15	RWB7	2014	Hg, Se
Channel Catfish	<i>Ictalurus punctatus</i>	2	20	RWB7	2014	Chlordanes, DDTs, Dieldrin, PCBs, Toxaphene
		4	20	RWB7	2014	Hg
		20	20	RWB7	2014	Se
Common Carp	<i>Cyprinus carpio</i>	3	15	RWB7	2014	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Toxaphene
		15	15	RWB7	2014	Se
Flathead Catfish	<i>Pylodictis olivaris</i>	3	13	RWB7	2014	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Toxaphene
		13	13	RWB7	2014	Se
Largemouth Bass	<i>Micropterus salmoides</i>	5	17	RWB7	2014	Chlordanes, DDTs, Dieldrin
		24	24	RWB7	2014	Hg, Se
		2	6	RWB7	2014	PCBs
Redear Sunfish	<i>Lepomis microlophus</i>	2	10	RWB7	2014	Hg, Se

### 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). The DMA method utilizes thermal decomposition and atomic absorption. OEHA 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<sup>5</sup>, as well as mercury concentrations in each fish species. The DMA method detection limit (MDL)<sup>6</sup> and the reporting limit (RL)<sup>7</sup> for total mercury were reported at 4 and 12 parts per billion (ppb), respectively.

<sup>5</sup> 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.

<sup>6</sup> The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.

<sup>7</sup> The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

*PCBS AND PESTICIDES*

Some composite samples were analyzed for PCBs and the legacy pesticides (chlordanes, DDTs, dieldrin, and toxaphene). Pesticides and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. For chlordanes, DDTs, and PCBs, each of the concentrations presented was the sum of the detected parent compound, congeners, or metabolites, where applicable. Since the MDLs or RLs were relatively low ( $\leq 5$  ppb, except for two composite samples of Common Carp analyzed for DDTs, which were reported at 10), 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<sup>8</sup>, as well as PCB concentrations in each fish species.

*SELENIUM*

The CDFW MLML analyzed species collected from the All-American Canal for selenium, as composite samples, using inductively coupled plasma-mass spectrometry (ICP-MS). 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 method detection limit (MDL) and the reporting limit (RL) for total selenium were reported at 150 and 400 ppb, respectively. Table 4 shows the averages and ranges for total length, as well as selenium concentrations in each fish species.

Concentrations of chlordanes, dieldrin, DDTs, and toxaphene were lower than the corresponding ATL threshold values for daily consumption (OEHHA, 2008). These chemicals were therefore not considered further for developing consumption advice and are not shown in this report.

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<sup>8</sup> 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.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM THE ALL-AMERICAN CANAL

Species from All-American Canal	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Channel Catfish	4	20	581	470 - 650	52	41 - 64
Common Carp	3	15	630	480 - 724	66	46 - 103
Flathead Catfish	3	13	554	424 - 760	119	64 - 147
Largemouth Bass	24	24	396	331 - 647	100	20 - 302
Sunfish Species	5	25	223	161 - 307	37	27 - 45
Bluegill	3	15	188	161 - 207	31	27 - 34
Redear Sunfish	2	10	276	245 - 307	45	44 - 45

\*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 3. PCB CONCENTRATIONS IN FISH FROM THE ALL-AMERICAN CANAL

Species from All-American Canal	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCBs (ppb)	
					Mean*	Range**
Channel Catfish	2	20	581	470 - 650	25	14 - 29
Common Carp	3	15	630	480 - 724	38	27 - 56
Flathead Catfish	3	13	554	424 - 760	1	0 - 2
Largemouth Bass	2	6	423	344 - 647	0	0 - 0

\*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 4. SELENIUM CONCENTRATIONS IN FISH FROM THE ALL-AMERICAN CANAL

Species from All-American Canal	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Se (ppb)	
					Mean*	Range**
Channel Catfish	20	20	581	470 - 650	577	430 - 780
Common Carp	15	15	630	480 - 724	1586	1090 - 3010
Flathead Catfish	13	13	554	424 - 760	904	430 - 1430
Largemouth Bass	24	24	396	331 - 647	1484	820 - 2220
Sunfish Species	5	25	223	161 - 307	1536	1440 - 1640
Bluegill	3	15	188	161 - 207	1563	1500 - 1640
Redear Sunfish	2	10	276	245 - 307	1495	1440 - 1550

\*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

## DEVELOPMENT OF GUIDELINES FOR EATING FISH FROM THE ALL-AMERICAN CANAL

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 U.S. Dietary Guidelines recommend that 1) the general population “consume eight or more ounces per week (less for young children)” of a variety of seafood<sup>9</sup> “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 (US EPA) recommend that women who are pregnant (or might become pregnant) or breastfeeding, and young 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.

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<sup>9</sup> “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).

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). A list of the ATLS used in this report is presented in Appendix I.

For each fish species in this advisory, OEHHA compared the mean mercury, PCB, and selenium concentrations detected in the fillet to the corresponding ATLS to establish the maximum number of servings per week that could be consumed (see Appendix I). 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 assessed in Channel Catfish and Common Carp and did not affect advice for either species. Advice for all species in this advisory was based solely on mercury, PCB, or selenium concentrations. The multiple chemical exposure analysis did not include selenium because it has different endpoints affecting human health, and therefore does not have an additive quality relative to toxicity.

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<sup>10</sup> 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 FROM THE ALL-AMERICAN CANAL

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 for species that are commonly caught and consumed from a given water body but where available data may be limited. For the All-American Canal, the sample size criterion was met for the following species: Bluegill, Channel Catfish, Common Carp, Flathead Catfish, Largemouth Bass, and Redear Sunfish. There were not sufficient data to evaluate other species that may be found in this water body.

### *BLACK BASS SPECIES (LARGEMOUTH BASS)*

The mean mercury, PCB, and selenium concentrations in black bass species from the All-American Canal were 100, 0, and 1484 ppb, respectively. OEHHA recommends a maximum of two servings a week for the sensitive population (women 18 to 49 years and children 1 to 17 years) based on mercury, and a maximum of four servings a week for the general population (women 50 years and older, and men 18 years and older), based on selenium.

OEHHA has evaluated mercury concentrations in black bass species in many water bodies in California and has found a similar range of mercury concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA extends the consumption advice for the sensitive population for Largemouth Bass to other black bass species, including Redeye, Smallmouth, and Spotted Bass.

There are only a few water bodies in the state where selenium has been analyzed in more than one black bass species. In those cases, OEHHA found a similar range of

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<sup>10</sup> Fish species within the same genus are most closely related, and family is the next level of relationship.

selenium concentrations among black bass species. Concentrations of selenium were also very similar in different sunfish species collected and analyzed from a larger number of California water bodies (see below). OEHHA anticipates that this would also be true for black bass species if more data were available. Therefore, OEHHA extends the consumption advice for the general population for Largemouth Bass to other black bass species, including Redeye, Smallmouth, and Spotted Bass.

#### *CHANNEL CATFISH*

The mean mercury, PCB, and selenium concentrations in Channel Catfish from the All-American Canal were 52, 25, and 577 ppb, respectively. OEHHA recommends a maximum of two servings a week of Channel Catfish for both the sensitive population (women 18 to 49 years and children 1 to 17 years) and the general population (women 50 years and older, and men 18 years and older), based on PCBs.

#### *COMMON CARP*

The mean mercury, PCB, and selenium concentrations in Common Carp from the All-American Canal were 66, 38, and 1586 ppb, respectively. Based on PCBs, OEHHA recommends a maximum of two servings per week of Common Carp for both the sensitive population (women 18 to 49 years and children 1 to 17 years), and the general population (women 50 years and older, and men 18 years and older).

#### *FLATHEAD CATFISH*

The mean mercury, PCB, and selenium concentrations in Flathead Catfish from the All-American Canal were 119, 1, and 904 ppb, respectively. Based on the concentration of mercury, OEHHA recommends a maximum of two servings a week of Flathead Catfish for the sensitive population (women 18 to 49 years and children 1 to 17 years), and a maximum of five servings a week for the general population (women 50 years and older, and men 18 years and older).

#### *SUNFISH SPECIES (BLUEGILL, REDEAR SUNFISH)*

The mean mercury and selenium concentrations in sunfish species from the All-American Canal were 37 ppb and 1536 ppb, respectively. Mercury and selenium concentrations for individual sunfish species were as follows, Bluegill (Hg: 31 ppb, Se: 1563 ppb), and Redear Sunfish (Hg: 45, Se: 1495 ppb). Based on the concentration of selenium in these sunfish species, OEHHA recommends a maximum of four servings a week of sunfish species for both the sensitive population (women 18 to 49 years and children 1 to 17 years) and the general population (women 50 years and older, and men 18 years and older). PCBs were not analyzed in sunfish species.

OEHHA has evaluated selenium concentrations in sunfish species in many water bodies in California and has found a similar range of selenium concentrations when two or more of these species were caught from the same water body. Therefore, OEHHA

extends the consumption advice for sunfish species (Bluegill, Redear Sunfish) to other sunfish species, including Green Sunfish and Pumpkinseed.

### RECOMMENDED MAXIMUM NUMBER OF SERVINGS

The recommended maximum numbers of servings per week for fish from the All-American Canal are shown in Table 5.

TABLE 5. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM THE ALL-AMERICAN CANAL

Fish Species from the All-American Canal	Women 18–49 years and Children 1-17 years	Women 50 years and older and Men 18 years and older
Black Bass species	2	4
Channel Catfish	2	2
Common Carp	2	2
Flathead Catfish	2	5
Sunfish species	4	4

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## APPENDIX I. 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<sup>11</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 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 the All-American Canal are followed, exposure to chemicals in fish from the All-American Canal 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) <sup>a</sup> 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

<sup>a</sup> 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.

<sup>11</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.