OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

Health Advisory and Guidelines for Eating Fish from the Alamo River and the New River (Imperial County)

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Fish, Ecotoxicology, and Water Section
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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)
FDA	Food and Drug Administration
Hg	mercury
MDL	method detection limit
MLML	Moss Landing Marine Laboratories
mm	millimeters
n	sample size
OEHHA	Office of Environmental Health Hazard Assessment
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
Se	selenium
SWAMP	Surface Water Ambient Monitoring Program
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 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 Sport Fishing Regulations in the section on public health advisories.

This report presents guidelines for eating fish from the Alamo River and the New River 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 - 45 years and Children 1 - 17 years

Carp

Tilapia

Channel Catfish

3 total servings a week **OR** **2 total servings a week**

Women 46 years and older and Men 18 years and older

Carp

Tilapia

Channel Catfish

3 total servings a week

What is a serving?

For Adults **For Children**

A serving is about the size and thickness of your hand for fish fillets. 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, DDTs, PCBs, or selenium. Mercury and DDTs can harm the brain, especially in unborn babies and children. PCBs can cause cancer. High levels of selenium can cause health problems.

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A Guide to Eating Fish from the New River

Women 18 - 45 years and Children 1 - 17 years

Tilapia

Carp

Channel Catfish

4 total servings a week	OR	1 total serving a week	Do not eat

Women 46 years and older and Men 18 years and older

Tilapia

Carp

Channel Catfish

4 total servings a week	OR	2 total servings a week	OR	1 total serving a week

What is a serving?

For Adults **For Children**

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

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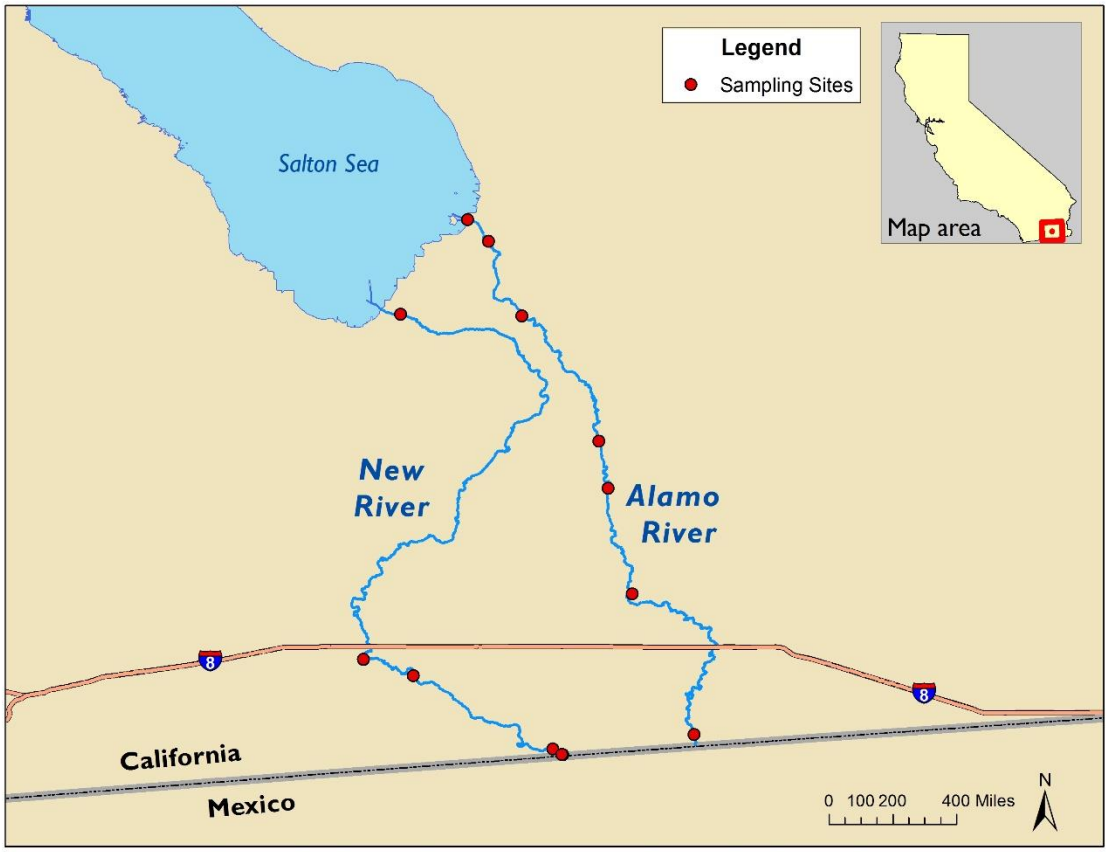
INTRODUCTION

This report presents guidelines for eating fish from the Alamo River and the New River (Figure 1) in Imperial County, California, between the US-Mexico International Border and the Salton Sea.

LOCATION

The Alamo River and the New River are part of the Colorado River Basin watershed. They flow north from just south of the US-Mexico Border (Alamo River) or Mexicali, Mexico (New River) and empty into the Salton Sea (RWQWB, 2000). The Alamo River to the east and the New River to the west run slightly parallel to each other, bracketing acres of agricultural land known as the lower Imperial Valley. Multiple urban and agricultural runoff sources contribute to pesticide and selenium levels observed in the Alamo River and the New River (RWQCB, 2000; 2002a; 2002b). This advisory applies to the Alamo River and the New River and not the greater watershed region, the Salton Sea, or the All-American Canal on the US-Mexico Border. All species included in this advisory are self-sustaining populations.

FIGURE 1. LOCATION OF THE ALAMO RIVER AND THE NEW RIVER



APPROACH USED

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from three monitoring studies described in this report to develop the Alamo River and the New River Advisories. 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[1]) 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 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. OEHHA has developed ATLs for seven common contaminants that can be found in California sport fish (chlordane, DDTs, dieldrin, methylmercury, PCBs, selenium, and toxaphene (OEHHA, 2008). Subsequently, OEHHA developed an ATL for polybrominated diphenyl ethers (PBDEs) – a potential emerging group of chemicals of concern that can bioaccumulate in fish tissue (OEHHA, 2011). When developing an advisory for a water body, OEHHA evaluates all available and appropriate fish tissue data for those chemicals that have ATLs. If concentrations of a chemical exceed the ATL threshold for daily consumption, they are evaluated more thoroughly in order to determine

[1] 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.

consumption advice. The majority of fish consumption advisories in California are issued because of mercury, followed by polychlorinated biphenyls (PCBs), and in a few cases, selenium 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 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 man-made 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, 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).

Fish used for the Alamo River and the New River advisories were analyzed for two or more of the following contaminants: mercury (as a measure of methylmercury), PCBs, selenium, and the legacy pesticides (chlordanes, dieldrin, DDTs (DDT and its metabolites), 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. As both the Alamo and the New River flow through the lower Imperial Valley, an area with a legacy of extensive pesticide use, OEHHA evaluation of available fish tissue data for several additional chemicals. Of all of the chemicals evaluated, only mercury, DDT, PCB and selenium levels in fish tissue were sufficient to impact consumption advice.

DATA SOURCES

The guidelines for eating fish from the Alamo River and the New River are based on the chemicals detected in the fish collected for the three monitoring studies described below. These studies 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 composite of multiple fish for which contaminant data was reported or the act of collecting fish for chemical analysis ("sampling" or "sampled").

TOXIC SUBSTANCES MONITORING PROGRAM (TSMP)

The TSMP (1976-2003) was a state water quality-monitoring program managed by the SWRCB (SWRCB, 2007). Its objective was to provide statewide information on the occurrence of toxic substances by monitoring water bodies with known or suspected water quality impairment. CDFW staff, then known as the California Department of Fish and Game, collected Channel Catfish and Common Carp from the Alamo River, and Channel Catfish, Common Carp, and Tilapia from the New River, as part of the program. Fish samples were analyzed for mercury, chlordanes, DDTs, dieldrin, PCBs, selenium, and toxaphene.

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

The SWAMP (Surface Water Ambient Monitoring Program), operated by SWRCB in cooperation with RWB7 staff, monitors water quality in California's surface waters. In 2004 and 2014, the program performed regional monitoring surveys of the Alamo River and the New River to evaluate contaminants in commonly consumed sport fish and to gain information about contamination in the greater aquatic food web (RWQCB, 2013; SWRCB, 2014). The surveys collected Channel Catfish, Common Carp and Tilapia from the Alamo River, and Common Carp and Tilapia from the New River. Fish samples were analyzed for several common fish contaminants (mercury, chlordanes, DDTs, dieldrin, PCBs, selenium, and toxaphene).

REGION 7 WATER BOARD TOTAL MAXIMUM DAILY LOAD IMPERIAL VALLEY PROJECT

The US Environmental Protection Agency (US EPA) Total Maximum Daily Load (TMDL) Program develops plans and actions to help impaired water bodies comply with water quality standards, pursuant to Section 303(d) of the Clean Water Act (1972)[2]. The

[2] US EPA Clean Water Act §303(d). http://www.epa.gov/tmdl

Alamo River and the New River TMDL projects are a multi-agency effort (RWQCB 2002a; 2002b). The US EPA, in cooperation with Region 7 Water Board staff, collected Channel Catfish, and Common Carp from the Alamo River, and Channel Catfish, Common Carp and Tilapia from New River during 2011-2012. These species were analyzed for mercury, chlordanes, dieldrin, DDTs, PCBs, selenium and toxaphene (RWQCB, 2013).

FISH SAMPLED FROM THE ALAMO RIVER AND THE NEW RIVER

The fish sampling data used in these advisories were retrieved from the California Environmental Data Exchange Network (CEDEN). Samples were excluded that are not legal 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 included in these advisories 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.

Table 1. Fish Samples Evaluated for the Alamo and the New River Advisories

River	Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed*
ALAMO RIVER	Channel Catfish	*Ictalurus punctatus*	8	28	TSMP	1978-1982, 1993-1994, 2002	Chlordanes, DDTs, Dieldrin, Hg, Se, Toxaphene
			7	20	RWB7	2004	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
			1	2	RWB7 TMDL	2011	Chlordanes, Dieldrin, DDTs, PCBs, Toxaphene
	Common Carp	*Cyprinus carpio*	6	14	TSMP	1981-1982, 1993-1994, 2000, 2002	Chlordanes, DDTs, Dieldrin, Hg, Se Toxaphene
			4	18	RWB7 TMDL	2011-2012	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
			4	10	RWB7	2014	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se Toxaphene
	Tilapia	*Tilapia species*	10	10	RWB7	2014	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se

River	Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed*
NEW RIVER	Channel Catfish	*Ictalurus punctatus*	13	41	TSMP	1978-1982, 1987, 1990-1993, 1995, 1997-1998, 2001-2002	Chlordanes, DDTs, Dieldrin, Hg, Se, Toxaphene
			4	15	RWB7 TMDL	2011	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Toxaphene
NEW RIVER	Common Carp	*Cyprinus carpio*	9	23	TSMP	1982, 1986, 1989-1991, 1993-1994, 1997, 1999	Hg, Se
			7	26	RWB7 TMDL	2011-2012	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
			3 (10 for Se)	10	RWB7	2014	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
	Tilapia	*Tilapia species*	1	3	TSMP	1996	Hg, Se
			3	15	RWB7 TMDL	2012	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se, Toxaphene
			19	19	RWB7	2014	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se

Hg = Mercury, Se = Selenium

*Organic data (chlordanes, DDTs, dieldrin, PCBs or toxaphene) generated prior to 2000 was excluded from the analysis because more recent data are considered more reliable because of improved analytical methods.

CHEMICAL CONCENTRATIONS

As shown in Table 1, samples were analyzed for total mercury, selenium, chlordanes, DDTs, dieldrin, PCBs (54-55 congeners[3]), and toxaphene. 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 composite samples, the total length of the smallest fish in a composite sample must be at least 75% of the length of the largest fish in the sample (US EPA, 2000a). Composite samples for all species except Channel Catfish and Tilapia from the Alamo River and carp from the New River met this requirement. There was one Channel Catfish composite sample of two fish, and one Tilapia composite sample of five fish where the smallest fish in the sample was 72% or 69%, respectively, of the length of the largest fish. There was also one carp composite sample of 3 fish from the New River where the smallest fish in the sample was 73% of the length of the largest fish. Carp, Channel Catfish and Tilapia comprise a major fraction of the overall sport fish catch in the Alamo-New River watershed, making these rivers preferred sport fishing locations for these species (RWQCB, 2002a). For this reason, OEHHA included these data to develop consumption advice for carp, Channel Catfish and Tilapia.

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.

MERCURY

Samples were analyzed for total mercury, either as individual fish or composite samples, using a direct mercury analyzer (DMA) or flow injection mercury system (FIMS) at the CDFW Moss Landing Marine Laboratories (MLML). The DMA method is an integration of thermal decomposition and atomic absorption and the FIMS approach combines cold vapor flow injection and amalgamation concentration with atomic absorbance. OEHHA assumed all mercury detected was methylmercury; methylmercury 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[4] as well as mercury concentrations in each fish species. The DMA method detection limit (MDL)[5] and the reporting limit (RL)[6] for total mercury were reported at 12 and 36 parts per

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[3] Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54-55 are generally reported.
[4] 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.
[5] The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.
[6] The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

billion (ppb), respectively. The FIMS method detection limit (MDL) and the reporting limit (RL) for total mercury were reported at 4 and 12 ppb, respectively.

PCBs and Pesticides

Samples were analyzed for legacy pesticides (chlordanes, DDTs, dieldrin, and toxaphene) and PCBs. Pesticides and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. For PCBs, chlordanes, and DDTs, 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, ≤ 0.1 and ≤ 5 ppb, respectively, 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). Total toxaphene concentrations were reported with a MDL/RL value of 20 ppb. Tables 3 and 4 show the averages and ranges for total length as well as DDT or PCB concentrations in each species. Concentrations of chlordanes, dieldrin and toxaphene were not sufficiently high to alter consumption advice and are not shown.

Selenium

The CDFW MLML analyzed species collected from the Alamo River and the New River for selenium, either as individual fish or composite samples, using inductively coupled plasma-mass spectrometry (ICP-MS). The ICP-MS method is an integration of 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 15 and 40 ppb, respectively. The selenium concentrations were sufficiently high to alter consumption advice and are shown in Table 5.

TABLE 2. MERCURY CONCENTRATIONS IN FISH FROM THE ALAMO RIVER AND THE NEW RIVER

Species from Alamo River	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Carp, Common	14	42	504	223 - 675	63	10 - 100
Catfish, Channel	15	48	318	201 - 445	49	0 - 104
Tilapia	2	10	252	220 - 321	2	0 - 4
Species from New River	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
					Mean*	Range**
Carp, Common	19	59	463	255 - 610	165	0 - 600
Catfish, Channel	17	56	390	227 - 575	74	0 - 290
Tilapia	8	37	276	200 - 390	6	0 - 19

*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. DDT CONCENTRATIONS IN FISH FROM THE ALAMO RIVER AND THE NEW RIVER

Species from Alamo River	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	DDT (ppb)	
					Mean*	Range**
Carp, Common	9	30	553	223 - 675	273	59 - 2636
Catfish, Channel	9	23	270	207 - 415	418	102 - 1307
Tilapia	2	10	252	220 - 321	10	5 - 15
Species from New River	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	DDT (ppb)	
					Mean*	Range**
Carp, Common	10	36	488	298 - 610	163	19 - 822
Catfish, Channel	6	18	424	227 - 575	523	53 - 1945
Tilapia	7	34	283	200 - 390	8	3 - 13

*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 4. PCB CONCENTRATIONS IN FISH FROM THE ALAMO RIVER AND THE NEW RIVER

Species from Alamo River	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCB (ppb)	
					Mean*	Range**
Carp, Common	7	28	563	411 - 675	3	0 - 10
Catfish, Channel	8	22	264	207 - 415	11	2 - 26
Tilapia	2	10	252	220 - 321	0	0
Species from New River	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	PCB (ppb)	
					Mean*	Range**
Carp, Common	10	36	488	298 - 610	34	0 - 95
Catfish, Channel	4	15	400	227 - 570	114	33 - 183
Tilapia	7	34	283	200 - 390	0	0 - 2

*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. SELENIUM CONCENTRATIONS IN FISH FROM THE ALAMO RIVER AND THE NEW RIVER

Species from Alamo River	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Selenium (ppb)	
					Mean*	Range**
Carp, Common	21	45	539	223 - 675	1805	1210 - 2620
Catfish, Channel	14	37	313	207 - 559	777	550 - 1060
Tilapia	10	10	252	220 - 321	1870	1740 - 2130
Species from New River	**Number of Samples**	**Total Number of Fish**	**Mean* Total Length (mm)**	**Range of Total Lengths** (mm)**	**Selenium (ppb)**	
					Mean*	**Range****
Carp, Common	24	52	466	255 - 610	1331	460 - 2140
Catfish, Channel	10	28	399	242 - 575	632	360 - 1000
Tilapia	23	37	276	200 - 390	1505	830 - 4330

*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 FROM THE ALAMO RIVER AND THE NEW RIVER

GENERAL INFORMATION

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, 2014; American Heart Association, 2014; OEHHA, 2008; Institute of Medicine, 2007; Kris-Etherton et al., 2002). Fish is 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[7] "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 FDA and US EPA recommend that women who are pregnant (or might become pregnant) or breastfeeding, and young children do not consume shark, swordfish, tilefish, or king mackerel, and limit consumption of white (albacore) tuna to six ounces per week (FDA/US EPA, 2004 and 2014).

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

[7] "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).

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 45 years of age) and children 1-17 years, are lower than those for women 46 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, DDT, 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). For fish species in each river where chlordanes, dieldrin and toxaphene were analyzed, mean concentrations of these chemicals were lower than the corresponding ATL threshold values for daily consumption (OEHHA, 2008). These chemicals were therefore not considered further for developing consumption advice. Consumption advice was based on mercury, DDT, PCB, and selenium concentrations.

The consumption advice for a fish species is initially based on the chemical with the lowest allowable number of servings per week. Because mercury, DDTs, and PCBs are known to affect the nervous system, particularly during brain development, additivity of toxicity is assumed and assessed by using multiple chemical exposure methodology (US EPA, 1989 and 2000b). The presence of these three chemicals in fish tissue 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. For the Alamo River and the New River advisories, the potential effect of multiple chemical exposures was assessed and determined to affect the consumption advice for catfish, based on DDT, mercury, and PCB concentrations. Details can be found 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).

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 from each water body. People should eat no more than the recommended number of servings for each fish species or species

group. OEHHA's advice on consuming a particular fish species can be extended to other closely related fish species[8] 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 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 ALAMO RIVER AND THE NEW RIVER

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 population in the water body. For the Alamo River and the New River, the sample size criterion was met for the following species: Common Carp, Catfish, and Tilapia. There were not sufficient data to evaluate other species that may be found in these water bodies.

ALAMO RIVER

COMMON CARP

The mean mercury, DDT, PCB, and selenium levels in Common Carp from the Alamo River were 63, 273, 3, and 1805 ppb, respectively. OEHHA recommends a maximum of three servings a week of Common Carp for the sensitive population (women 18 to 45 years and children 1 to 17 years) based on an exposure to mercury or selenium, and a maximum of three servings a week for the general population (women 46 years and older, and men 18 years and older), based on selenium. DDT and PCB concentrations did not impact advice for Common Carp from the Alamo River.

CHANNEL CATFISH

The mean mercury, DDT, PCB, and selenium levels in Channel Catfish from the Alamo River were 49, 418, 11, and 777 ppb, respectively. OEHHA recommends a maximum of two servings a week of Channel Catfish for the sensitive population (women 18 to 45 years and children 1 to 17 years), based on a combined exposure to mercury, DDT, and PCBs and a maximum of three servings a week for the general population (women 46 years and older, and men 18 years and older), based on DDTs. Selenium concentrations did not impact advice for Channel Catfish from the Alamo River.

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

TILAPIA

The mean mercury, DDT, PCB, and selenium levels in Tilapia from the Alamo River were 2, 10, 0, and 1870 ppb, respectively. OEHHA recommends a maximum of three servings a week of Tilapia for both the sensitive (women 18 to 45 years and children 1 to 17 years) and general (women 46 years and older, and men 18 years and older) populations, based on selenium. Mercury, DDT and PCB concentrations did not impact advice for Tilapia from the Alamo River.

NEW RIVER

COMMON CARP

The mean mercury, DDT, PCB, and selenium levels in Common Carp from the New River were 165,163, 34, and 1331 ppb, respectively. OEHHA recommends a maximum of one serving a week of Common Carp for the sensitive population (women 18 to 45 years and children 1 to 17 years), based on the mean mercury concentration, and a maximum of two servings a week for the general population (women 46 years and older, and men 18 years and older), based on PCBs. DDT and selenium concentrations did not impact advice for Common Carp from the New River.

CHANNEL CATFISH

The mean mercury, DDT, PCB and selenium levels in Channel Catfish from the New River were 74, 523, 114, and 632 ppb, respectively. OEHHA recommends no consumption of catfish for the sensitive population (women 18 to 45 years and children 1 to 17 years), based on a combined exposure to mercury, DDTs and PCBs, and a maximum of one serving a week for the general population (women 46 years and older, and men 18 years and older), based on PCBs. The mean selenium concentration did not impact advice for Channel Catfish from the New River.

TILAPIA

The mean mercury, DDT, PCB, and selenium levels in Tilapia from the New River were 6, 8, 0, and 1505 ppb, respectively. OEHHA recommends a maximum of four servings a week of Tilapia for both the sensitive (women 18 to 45 years and children 1 to 17 years) and general (women 46 years and older, and men 18 years and older) populations, based on selenium. Mercury, DDT, and PCB concentrations did not impact advice for Tilapia from the New River.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

The recommended maximum numbers of servings per week for fish from the Alamo River and the New River are shown in Table 6.

TABLE 6. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM THE ALAMO RIVER AND THE NEW RIVER

Fish Species	Women 18–45 years and Children 1–17 years		Women 46 years and older and Men 18 years and older	
	Alamo River	*New River*	*Alamo River*	*New River*
Carp, Common	3	1	3	2
Catfish, Channel	2	0	3	1
Tilapia	3	4	3	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[9] 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 Alamo River and the New River are followed, exposure to chemicals in fish from the Alamo River and the New River 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 18-45 and children 1-17)	≤ 31	>31-36	>36-44	>44-55	>55-70	>70-150	>150-440	>440
MeHg (Women > 45 and men)	≤ 94	>94-109	>109-130	>130-160	>160-220	>220-440	>440-1,310	>1,310
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.

[9] 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.