OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

GOOD CATCH CALIFORNIA
Your Fish Advisor

Health Advisory and Guidelines for Eating Fish from the Yuba River and Deer Creek (Nevada, Placer, Sierra, and Yuba Counties)

September 2018

Fish, Ecotoxicology, and Water Section
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ACKNOWLEDGMENTS

Developing fish consumption advisories depends on sampling and analysis of fish. The Office of Environmental Health Hazard Assessment acknowledges the contribution of information from the following entities: the State Water Resources Control Board, the California Department of Fish and Wildlife and its analytical resources, the Moss Landing Marine Laboratories and the Water Pollution Control Laboratory, the United States Geological Survey and its analytical resources, the Trace Element Research Laboratory and Brooks Rand Labs, and the University of California, Davis. Data are available at the California Environmental Data Exchange Network (http://ceden.waterboards.ca.gov/AdvancedQueryTool), the Fish Mercury Project's Final Technical Report (FMP 2007), and the USGS's National Water Information System (https://waterdata.usgs.gov/nwis). The map was created using ArcMap (10.5) from Environmental Systems Resource Institute (ESRI, Redlands, CA).

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LIST OF ACRONYMS AND ABBREVIATIONS

ATL	Advisory Tissue Level
CEDEN	California Environmental Data Exchange Network
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
FMP	Fish Mercury Project
Hg	mercury
MDL	method detection limit
MLML	Moss Landing Marine Laboratories
mm	millimeters
NWIS	National Water Information System
OEHHA	Office of Environmental Health Hazard Assessment
PBDEs	polybrominated diphenyl ethers
PCBs	polychlorinated biphenyls
ppb	parts per billion
RL	reporting limit
RWB5	Regional Water Board Region 5 (Central Valley)
Se	selenium
SWAMP	Surface Water Ambient Monitoring Program
TSMP	Toxic Substances Monitoring Program
UCD	University of California, Davis
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USDHHS	United States Department of Health and Human Services

US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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 Yuba River and Deer Creek in Nevada, Placer, Sierra, and Yuba counties. 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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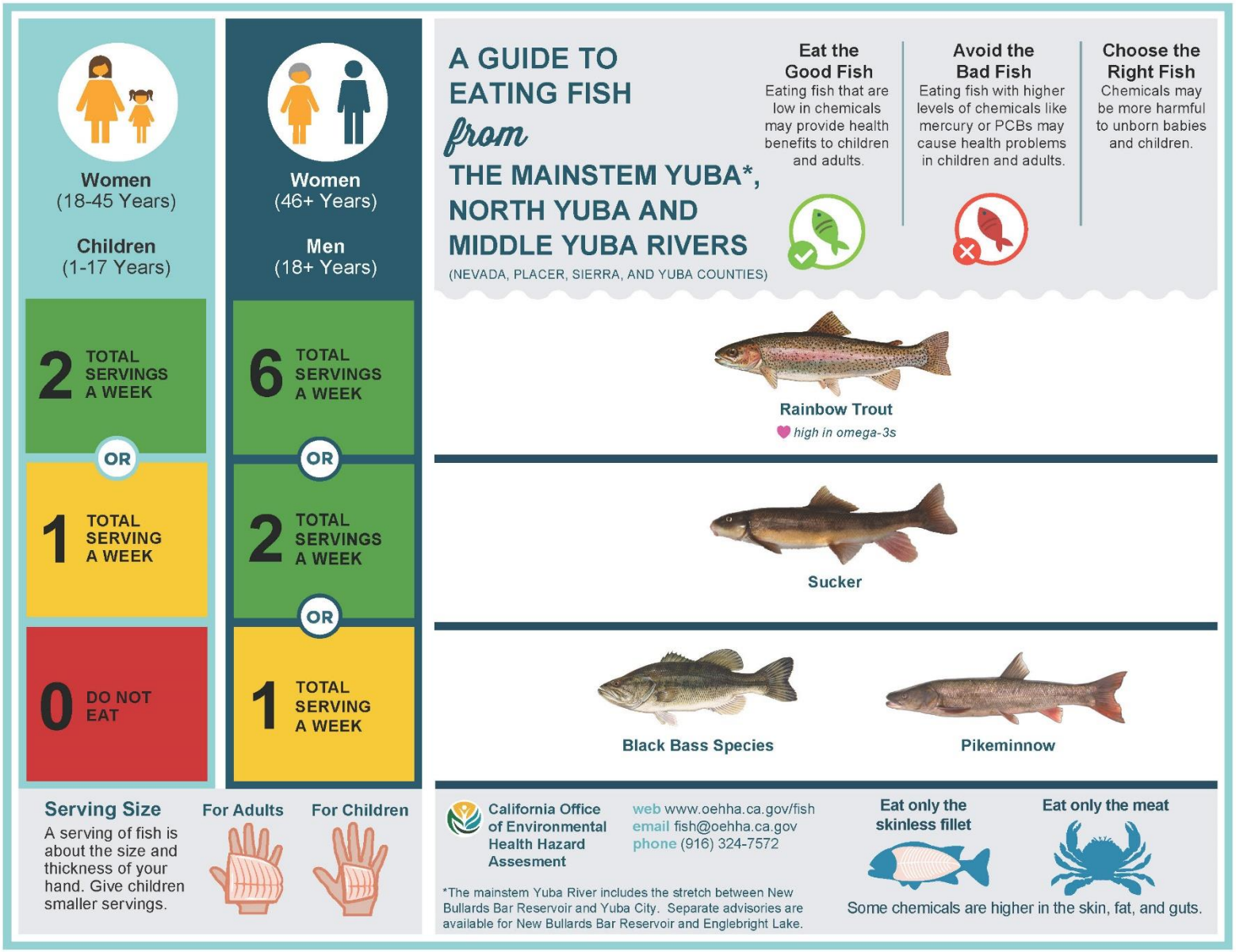
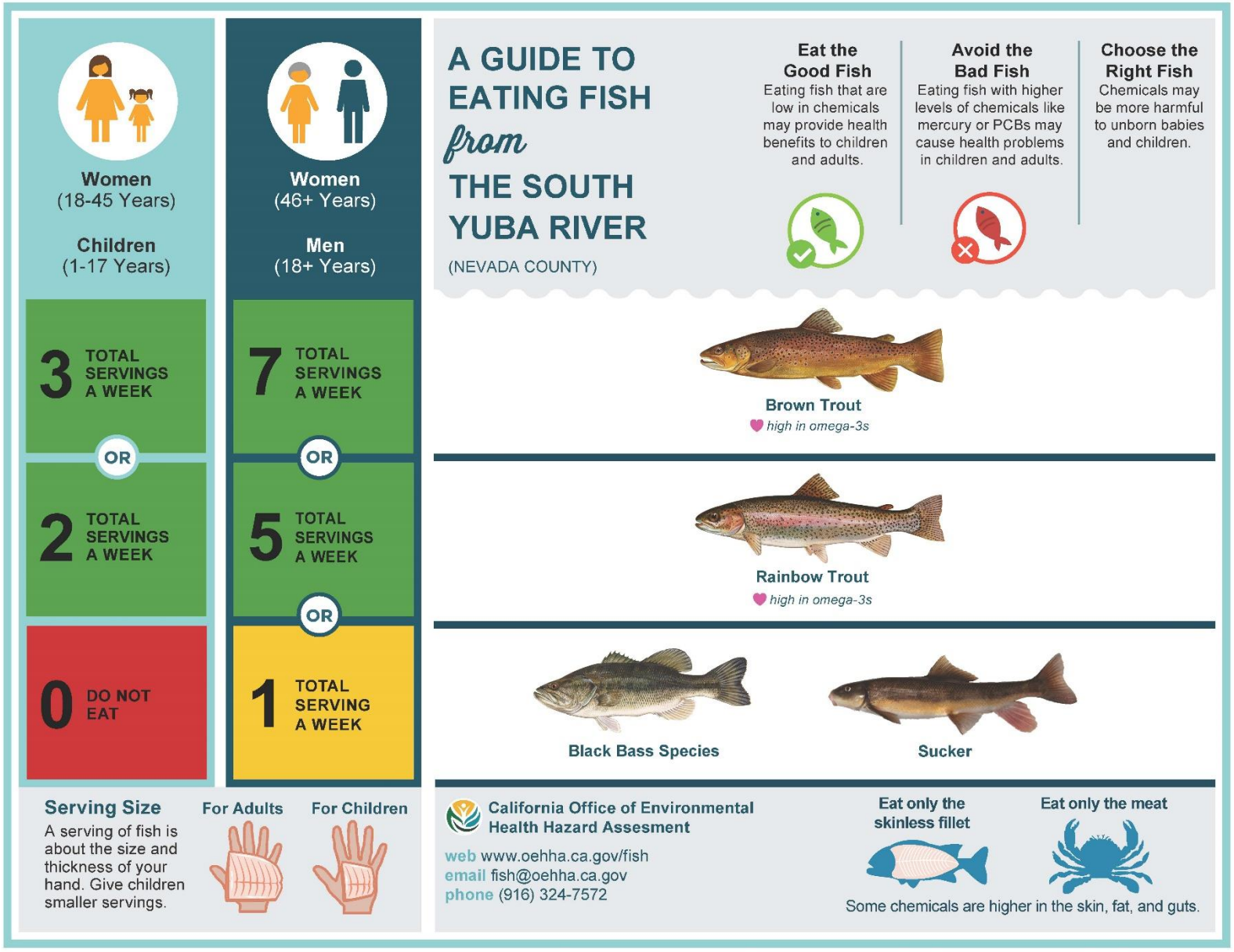

Women
(18-45 Years)
Children
(1-17 Years)
2 TOTAL SERVINGS A WEEK
OR
1 TOTAL SERVING A WEEK
0 DO NOT EAT
Women
(46+ Years)
Men
(18+ Years)
6 TOTAL SERVINGS A WEEK
OR
2 TOTAL SERVINGS A WEEK
OR
1 TOTAL SERVING A WEEK
A GUIDE TO EATING FISH from THE MAINSTEM YUBA*, NORTH YUBA AND MIDDLE YUBA RIVERS
(NEVADA, PLACER, SIERRA, AND YUBA COUNTIES)
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.
Rainbow Trout
high in omega-3s
Sucker
Black Bass Species
Pikeminnow
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 Assesment
web www.oehha.ca.gov/fish
email fish@oehha.ca.gov
phone (916) 324-7572
*The mainstem Yuba River includes the stretch between New Bullards Bar Reservoir and Yuba City. Separate advisories are available for New Bullards Bar Reservoir and Englebright Lake.
Eat only the skinless fillet
Eat only the meat
Some chemicals are higher in the skin, fat, and guts.


Women
(18-45 Years)
Children
(1-17 Years)
3 TOTAL SERVINGS A WEEK
OR
2 TOTAL SERVINGS A WEEK
0 DO NOT EAT
Women
(46+ Years)
Men
(18+ Years)
7 TOTAL SERVINGS A WEEK
OR
5 TOTAL SERVINGS A WEEK
OR
1 TOTAL SERVING A WEEK
A GUIDE TO EATING FISH from THE SOUTH YUBA RIVER
(NEVADA 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.
Brown Trout
high in omega-3s
Rainbow Trout
high in omega-3s
Black Bass Species
Sucker
Serving Size
A serving of fish is about the size and thickness of your hand. Give children smaller servings.
For Adults
For Children
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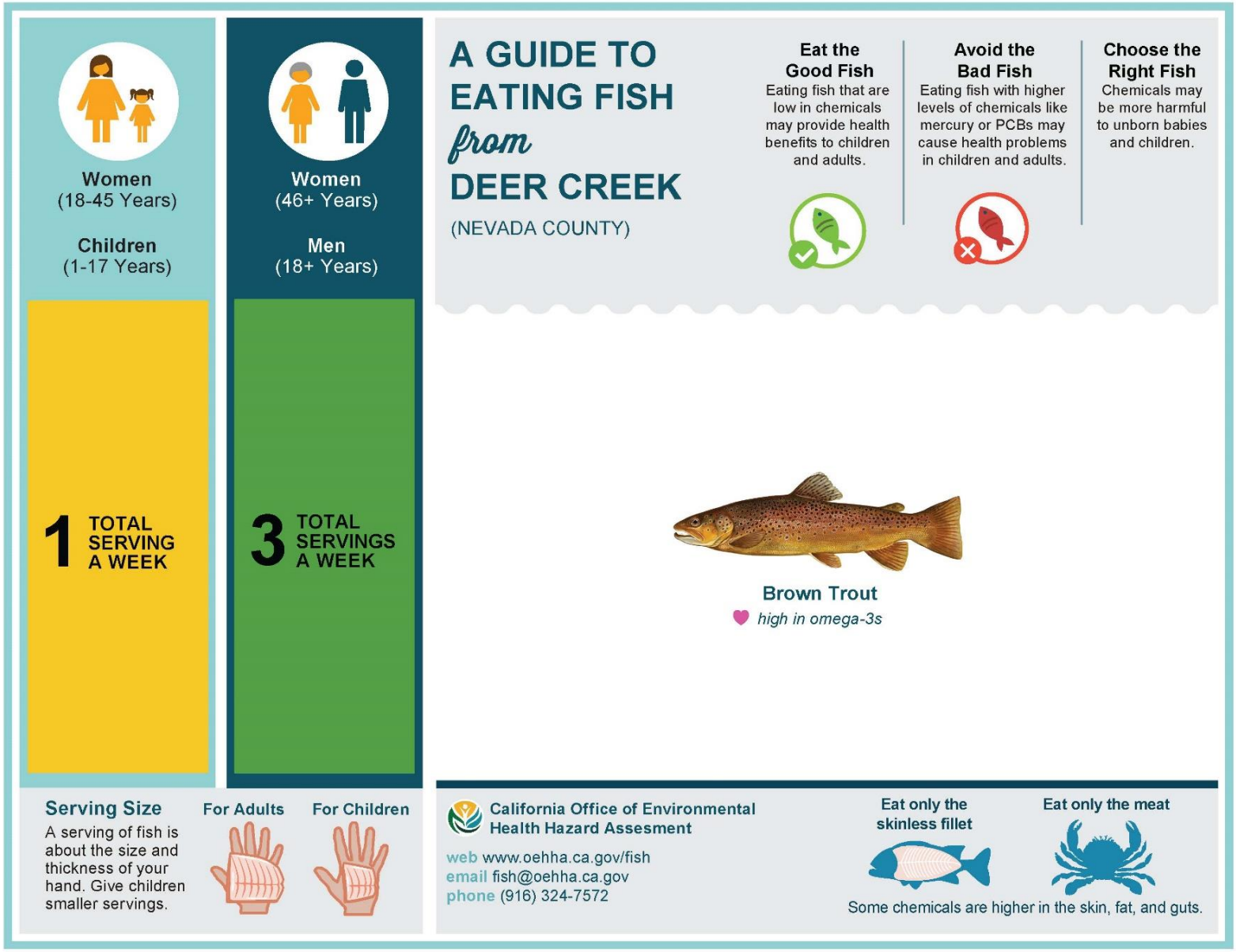
Eat only the skinless fillet
Eat only the meat
Some chemicals are higher in the skin, fat, and guts.


Women
(18-45 Years)
Children
(1-17 Years)
1 TOTAL SERVING A WEEK
Women
(46+ Years)
Men
(18+ Years)
3 TOTAL SERVINGS A WEEK
A GUIDE TO EATING FISH from DEER CREEK
(NEVADA 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.
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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 all stretches of the Yuba River, as defined below, and Deer Creek (Figure 1). The Yuba River watershed encompasses an area of the western slope of the Sierra Nevada from Donner Pass to the river's confluence with the Feather River, near Yuba City. The Yuba River flows through Nevada, Placer, Sierra, and Yuba counties.

LOCATION

The Yuba River is composed of a mainstem section along with three forks. Based on an analysis of all available data, advice was grouped as follows: 1) the mainstem Yuba River, North and Middle Yuba Rivers, 2) the South Yuba River, and 3) Deer Creek.

1. The North Yuba River originates from the eastern edge of the Tahoe National Forest, encompasses New Bullards Bar Reservoir, and ends where it meets the Middle Yuba River and forms the mainstem Yuba River. The headwaters of the Middle Yuba River lie in Moscove Meadow and the river runs on the border between Nevada and Yuba counties for several miles before joining with the North Yuba River. The mainstem of the Yuba River is formed by the confluence of the North and Middle Yuba Rivers just below New Bullards Bar Reservoir and flows south-southwest, further defining the Yuba-Nevada county lines. The mainstem Yuba River flows into Englebright Lake where it is joined on its eastern banks by the South Yuba River. The section of river below Englebright Dam is also commonly referred to as the Lower Yuba River. The river continues to flow southwest, passing just south of the city of Marysville until it reaches its confluence with the Feather River.

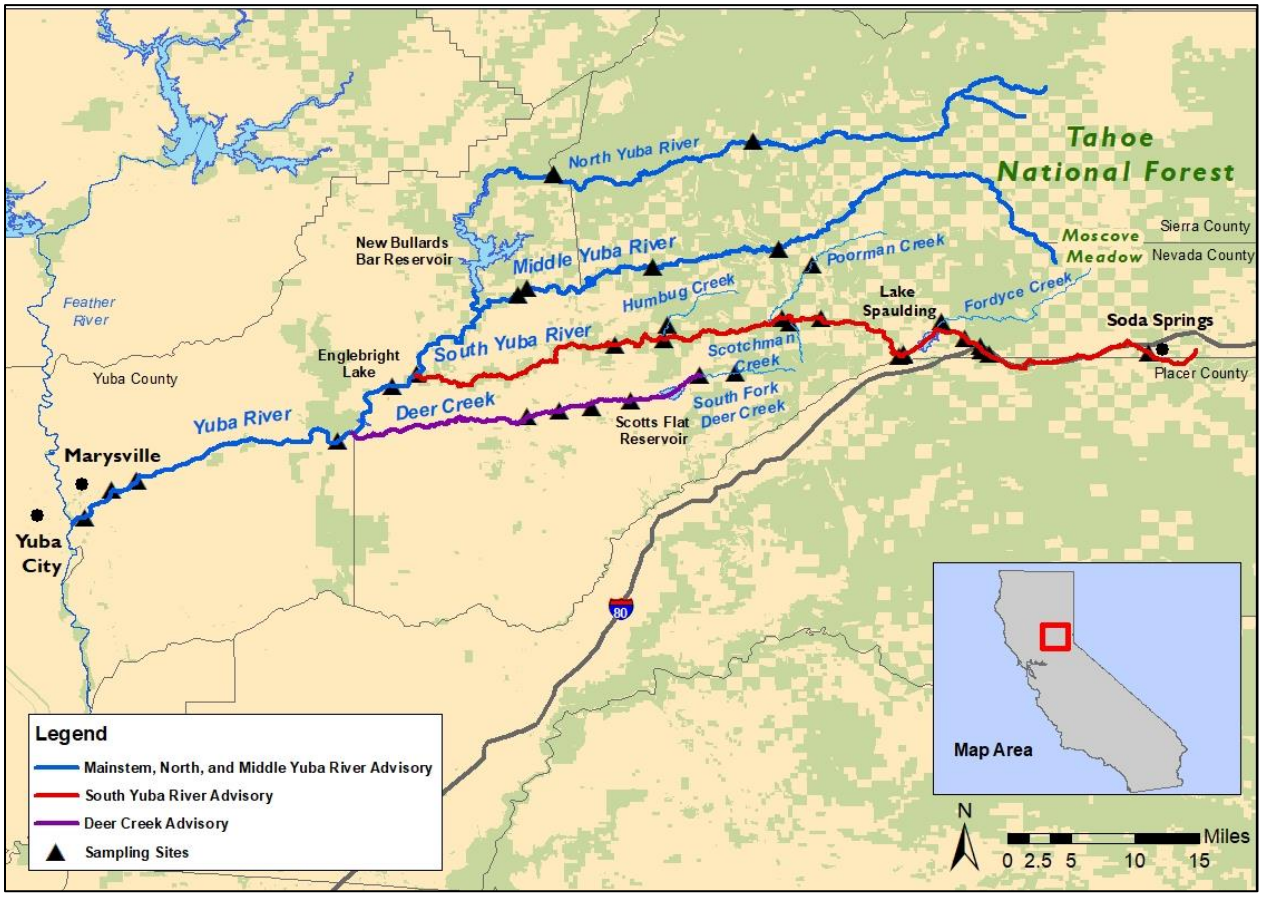
2. The South Yuba River originates near Soda Springs at Donner Pass, and encompasses Lake Spaulding as it travels west through the foothills to end at Englebright Lake.

3. Deer Creek begins above Scotts Flat Lake in the Tahoe National Forest and ends where it is received by the Yuba River below Englebright Lake.[1]

This advisory applies only to the mainstem Yuba River, the North, Middle, and South Yuba Rivers, and Deer Creek. This advisory does not include other flowing waters within the Yuba River watershed, nor the reservoirs that impound the rivers. Specific advice has previously been developed for two of these reservoirs, New Bullards Bar Reservoir and Englebright Lake.

[1] Information regarding the Yuba River was obtained from the Sacramento River Watershed Program. Online at: http://www.sacriver.org/aboutwatershed/roadmap/watersheds/american/yuba-river-watershed

FIGURE 1. LOCATION OF THE YUBA RIVER WATERSHED



Approach Used

The Office of Environmental Health Hazard Assessment (OEHHA) used the results from eleven monitoring studies described in this report to develop the Yuba River and Deer Creek 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[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.

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 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

[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, combined.

metabolism. Higher doses cause selenium toxicity, which can include symptoms ranging from hair loss and gastrointestinal distress to dizziness and tremors.

Chlordanes, dichlorodiphenyltrichloroethane (DDT), and dieldrin are pesticides that were banned from use in 1973 (DDT) and the late 1980s (chlordanes and dieldrin), 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.

Polybrominated diphenyl ethers (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 collected from the mainstem Yuba River and the North and Middle Yuba Rivers, and used in advisory development, were analyzed for mercury (as a measure of methylmercury). Rainbow Trout and Sacramento Sucker were also analyzed for selenium. All fish species collected from the South Yuba River were analyzed for mercury (as a measure of methylmercury). Rainbow Trout and Sacramento Sucker were additionally analyzed for PCBs, selenium, and the legacy pesticides: chlordanes, dieldrin, DDTs (DDT and its metabolites dichlorodiphenyldichloroethane [DDD] and dichlorodiphenyldichloroethylene [DDE]). Sacramento Sucker were further analyzed for PBDEs. Brown Trout collected from Deer Creek were analyzed for mercury (as a measure of methylmercury).

DATA SOURCES

The guidelines for eating fish from the Yuba River and Deer Creek are based on the chemicals detected in the fish collected for the eleven 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 a composite of multiple fish for which contaminant data was reported. "Sampling" or "sampled" refers to the act of collecting fish for chemical analysis.

CALFED BAY-DELTA PROGRAM

The CALFED Bay-Delta Program was a state and federal interagency group, established in 1994, to develop strategies and provide funding for projects that improve water quality, increase water supply, and support ecosystem restoration and levee improvement in the San Francisco Bay-Delta. This program was composed of more than 20 state and federal agencies, including the California Environmental Protection Agency, the California Department of Fish and Wildlife, US Environmental Protection Agency, and the US Fish and Wildlife Service. CALFED funded sampling efforts for historical bioaccumulation studies in fish. Sacramento Pikeminnow and Sacramento Sucker were collected from mainstem Yuba River in 1999 and were analyzed for mercury.

CONTAMINANTS IN FISH FROM CALIFORNIA LAKES AND RESERVOIRS, 2007-2008 (SWAMP1)

The SWAMP (Surface Water Ambient Monitoring Program), operated by the State Water Resources Control Board (SWRCB) in cooperation with Region 5 Regional Water Quality Control Board (RWB5) staff, monitors water quality in California's surface waters. Samples were collected as part of a SWAMP statewide sampling effort to survey contaminants in sport fish found in California lakes and reservoirs (SWRCB, 2010). The program collected Rainbow Trout and Sacramento Sucker from Lake Englebright in 2008 to analyze total mercury. Sacramento Sucker were also analyzed for chlordanes, DDTs, dieldrin, PBDEs, PCBs, and selenium. These samples were collected approximately two miles downstream from where the South Yuba River drains into Englebright Lake. Due to the ability of these fish to move unimpeded into the South Yuba River and the high mercury level in Sacramento Sucker collected at this site, OEHHA elected to include samples collected at this site in Englebright Lake in the South Yuba River advisory.

CONTAMINANTS IN FISH FROM CALIFORNIA RIVERS AND STREAMS, 2011 (SWAMP2)

In 2011, SWAMP performed a statewide survey of California rivers and streams to evaluate contaminants in commonly consumed sport fish and to gain information about contamination in the greater aquatic food web (SWRCB, 2011). The survey collected Brown Trout and Rainbow Trout from the South Yuba River in 2011, which were analyzed for mercury. Rainbow Trout were further analyzed for chlordanes, DDTs, dieldrin, PCBs, and selenium.

FISH MERCURY PROJECT (FMP)

The FMP was a three-year (2005 to 2007) sampling program funded by CALFED (SFEI, 2009, Grenier et al. 2007). Monitoring of sport fish from Central Valley water bodies was planned and conducted by staff at the California Department of Fish and Wildlife (CDFW), OEHHA, California Department of Public Health, the University of California, Davis (UCD), and the San Francisco Estuary Institute. More than 4,000 fish and 31

sport fish species were collected under the project objective to characterize spatial and temporal trends in mercury in fishery resources. Rainbow Trout, Sacramento Pikeminnow, and Sacramento Sucker were collected from the mainstem Yuba River in 2005, and analyzed for total mercury.

TOXIC SUBSTANCES MONITORING PROGRAM (TSMP)

The TSMP (1976-2003) was a state water quality-monitoring program managed by the 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 CDFW, then known as the California Department of Fish and Game, collected Sacramento Pikeminnow from the Middle Yuba River in 1980, which were analyzed for mercury. The TSMP also collected Rainbow Trout, Sacramento Pikeminnow, Sacramento Sucker, and Smallmouth Bass from the mainstem Yuba River between 1978 and 1991, which were analyzed for mercury; Rainbow Trout and Sacramento Sucker were additionally analyzed for selenium.

UNITED STATES GEOLOGICAL SURVEY 1999 (USGS1)

The USGS conducted a reconnaissance survey of mercury concentrations in edible tissue from fish throughout the northwestern Sierra Nevada. The USGS collected 161 fish samples for analysis from August to October 1999, at 22 designated sites in the region (May et al. 2000), including the South Yuba River and Deer Creek. Brown Trout, Rainbow Trout, and Smallmouth Bass were collected from the South Yuba River, and Brown Trout were collected from Deer Creek. All samples were analyzed for mercury.

UNITED STATES GEOLOGICAL SURVEY 2010-2012 (USGS2)

The USGS, in cooperation with the Bureau of Land Management (BLM), sampled fish near Stocking Flat and Deer Creek from 2010 to 2012. The purpose of the study was to determine whether remediation of Deer Creek was necessary due to the erosion of a bank containing mining waste. As part of this study, Brown Trout were collected from Deer Creek in 2010 and 2011, and analyzed for mercury.[3]

UNITED STATES GEOLOGICAL SURVEY 2011-2012 (USGS3)

The USGS collected fish tissue samples from 20 to 24 Sierra Nevada streams in 2011 and 2012, during low-flow conditions. This study was part of a larger effort to assess factors that influence mercury levels in fish tissue and to develop a predictive model for mercury concentrations in selected fish species in Sierra Nevada streams (Stumpner et

[3] At the time of this advisory, data from this USGS study were pending publication; however the raw data may be accessed from https://waterdata.usgs.gov/nwis.

al. 2017). As part of this study, Brown Trout were collected from Deer Creek and the South Yuba River in 2012. Rainbow Trout were also collected from the South Yuba River in 2012. All samples were analyzed for mercury.

UNITED STATES GEOLOGICAL SURVEY 2011-2012 (USGS4)

The USGS, in cooperation with the BLM, sampled fish from Humbug Creek and the South Yuba River near the confluence with Humbug Creek during 2011 and 2012. The purpose of the study was to determine how much mercury and methylmercury Humbug Creek was contributing to the South Yuba River, and to better understand the bioaccumulation of mercury in the system following many years of a moratorium on recreational suction dredging. As part of this study, Rainbow Trout and Sacramento Sucker were collected from the South Yuba River in 2012, and analyzed for mercury.[4]

UNITED STATES GEOLOGICAL SURVEY 1999-2004 (USGS5)

The USGS, in cooperation with the BLM and the US Forest Service, sampled fish at over 200 locations in the Sierra Nevada and Trinity Mountains from 1999 to 2004. The purpose of the study was to identify areas that may require remediation due to high levels of mercury contamination associated with historical mining. Rainbow Trout were collected from the South Yuba River in 2002, and analyzed for mercury.[5]

UNIVERSITY OF CALIFORNIA, DAVIS (UCD)

UCD conducted a study to examine the extent of mercury contamination of aquatic invertebrates and trout in the rivers of historic gold mining regions from 1993 to 1995 (Slotton et al. 1997). Brown Trout and Rainbow Trout were collected from the South Yuba River, Rainbow Trout and Sacramento Pikeminnow were collected from the Middle Yuba River, and Rainbow Trout were collected from the mainstem Yuba River. All samples collected for this study were analyzed for mercury.

FISH SAMPLED FROM THE YUBA RIVER AND DEER CREEK

The fish sampling data used in this advisory are available at the California Environmental Data Exchange Network (CEDEN), the State's repository for environmental data, the Fish Mercury Project's Final Technical Report (FMP 2007), and the USGS's National Water Information System (NWIS). With the exception of

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[4,6] At the time of this advisory, data from these USGS studies were pending publication; however the raw data may be accessed from https://waterdata.usgs.gov/nwis.

Smallmouth Bass, 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). All samples used to develop advice for Smallmouth Bass from the mainstem Yuba River were below the minimum length required for legal take (305 mm). However, as the mercury levels observed in the undersized fish were sufficient to develop no consumption advice for the sensitive population, data for this species was retained in this advisory. For black bass species, mercury concentrations are generally positively correlated with fish length. We anticipate that advice for legal-sized fish would be at least as restrictive as that based on the undersized fish samples that were available. Additionally, the advice for black bass species, such as smallmouth bass, in this advisory is consistent with advice offered for black bass species in OEHHA's Statewide Advisory for Eating Fish from California's Lakes and Reservoirs Without Site-Specific Advice.[6]

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.

TABLE 1. FISH SAMPLES EVALUATED FOR THE YUBA RIVER AND DEER CREEK ADVISORY

River	Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed[c]
Deer Creek	Brown Trout	*Salmo trutta*	10	10	USGS1	1999	Hg
			16	16	USGS2[a]	2010 - 2011	Hg
			1	1	USGS3[a]	2012	Hg
Mainstem, North and Middle Yuba Rivers	Rainbow Trout	*Oncorhynchus mykiss*	2	2	FMP	2005	Hg
			1	5	TSMP[a]	1987	Hg, Se
			36	36	UCD	1993 - 1994	Hg
	Sacramento Pikeminnow	*Ptychocheilus grandis*	2	2	CALFED[b]	1999	Hg
			5	5	FMP	2005	Hg
			2	10	TSMP[a]	1980	Hg
			2	2	UCD	1993	Hg
	Sacramento Sucker	*Catostomus occidentalis*	1	5	CALFED[b]	1999	Hg
			10	10	FMP	2005	Hg

[6] OEHHA's Statewide Advisory for Eating Fish from California's Lakes and Reservoirs can be accessed at: https://oehha.ca.gov/advisories/statewide-advisory-eating-fish-californias-lakes-and-reservoirs-without-site-specific.

River	Common Name	Scientific Name	Number of Samples	Total Number of Fish	Project	Year Collected	Contaminants Analyzed[c]
			2	11	TSMP[a]	1987	Hg, Se
	Smallmouth Bass	*Micropterus dolomieu*	9	25	TSMP[a]	1978 - 1981, 1991	Hg
South Yuba River	Brown Trout	*Salmo trutta*	1	1	SWAMP2	2011	Hg
			6	6	UCD	1995	Hg
			3	3	USGS1	1999	Hg
			12	12	USGS3[a]	2012	Hg
	Rainbow Trout	*Oncorhynchus mykiss*	1	5	SWAMP1	2008	Hg
			1	5	SWAMP2	2011	Chlordanes, DDTs, Dieldrin, Hg, PCBs, Se
			11	11	UCD	1993, 1995	Hg
			5	7	USGS1	1999	Hg
			12	12	USGS3[a]	2011 - 2012	Hg
			1	1	USGS4[a]	2012	Hg
			5	5	USGS5[a]	2002	Hg
	Sacramento Sucker	*Catostomus occidentalis*	1	5	SWAMP1	2008	Chlordanes, DDTs, dieldrin, PBDEs, PCBs, Se
			2	10	SWAMP1	2008	Hg
			6	6	USGS4[a]	2012	Hg
	Smallmouth Bass	*Micropterus dolomieu*	11	11	USGS1	1999	Hg

[a]Study report did not specify whether skin was removed from fillets prior to tissue analysis.
[b] Samples were analyzed with skin on; including these samples did not alter advice.
[c]Organic data (chlordanes, DDTs, dieldrin, or PCBs) generated prior to 2000 were 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 one or more of the following: total mercury, selenium, chlordanes, DDTs, dieldrin, PBDEs, and PCBs (53-54 congeners[7]). Among the chemicals analyzed in fish tissue samples from Yuba River and Deer Creek, only mercury levels were sufficiently high to impact consumption advice. Concentrations of PCBs were above the corresponding ATL values for daily consumption for Sacramento Sucker. Thus, all species for which PCB data were available are provided. Levels of other contaminants are not shown as they were all below the corresponding ATL value for daily consumption.

All fish samples were prepared as skinless fillets, except for the CALFED, TSMP, and USGS studies (with the exception of USGS1). For the TSMP study (Rainbow Trout, Sacramento Pikeminnow, Sacramento Sucker, Smallmouth Bass) and the USGS studies (Brown Trout, Rainbow Trout, Sacramento Sucker, and Smallmouth Bass), the fillet preparation method was not recorded. For the CALFED study, Rainbow Trout and Sacramento Pikeminnow were analyzed with skin on, but were included in the analysis to supplement the samples size and to increase the geographic distribution of samples. The addition of these samples did not affect consumption advice.

Composites were prepared from equal amounts of tissue from several similarly sized individual fish of a species. Ideally, for composite samples, the total length of the smallest fish in a composite sample is at least 75% of the length of the largest fish in the sample (US EPA, 2000a). This information is not available for samples collected for the TSMP or USGS studies; however, OEHHA assumes that the data complies with the 75% rule. Where reported, all composite samples from the Yuba River and Deer Creek met this requirement, except for a single composite of five Rainbow Trout collected from the South Yuba River, where the length of the shortest fish in the sample was 73% of the length of the longest fish in the sample. The inclusion of these samples provided a more robust sample for mercury, and contributed the only PCB data available for Rainbow Trout collected from the South Yuba River. For this reason, and because all five Rainbow Trout met OEHHA's minimum length requirement of 200 millimeters (mm) for this species, OEHHA elected to include this sample in the dataset.

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 collected under the FMP (Grenier et al., 2007), SWAMP1, and SWAMP2 studies 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

[7] Congeners are related compounds with similar chemical forms. Of the 209 possible PCB congeners, 54-55 are generally reported.

(MLML). The DMA method utilizes thermal decomposition and atomic absorption. Where reported, the DMA method detection limit (MDL)[8] and the reporting limit (RL)[9] for total mercury were 12 and 12 or 36 parts per billion (ppb), respectively. Fish samples collected for the UCD study utilized cold vapor atomic absorption spectrometry, as described in Slotton et al. (1997). Fish samples collected for the USGS3 study (Stumpner et al., 2017) were analyzed for mercury using a Perkin-Elmer Flow Injection Mercury System (FIMS) at UCD. FIMS is a dedicated mercury system that combines flow injection cold vapor mercury generation with a highly sensitive mercury detector. Analytical methodology for the remaining studies was not reported. The MDL and RL for the remaining studies was likewise not reported; however, mercury was detected at commonly found concentrations in all studies. 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[10], as well as mercury concentrations in each fish species.

PCBs, PBDEs, and Pesticides

Some composite samples from the South Yuba River were analyzed for PCBs, PBDEs, and the legacy pesticides (chlordanes, DDTs, and dieldrin). Pesticides, PBDEs and PCBs were analyzed by gas chromatography at the CDFW Water Pollution Control Laboratory. 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 relatively low (≤ 5 ppb), 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 2 shows the averages and ranges for total length, as well as PCB concentrations for the two species in which it was analyzed.

Selenium

The CDFW MLML analyzed species collected from the mainstem, North, and Middle Yuba Rivers, along with the South Yuba River, for selenium. Samples were analyzed as composites. The SWAMP1 and SWAMP2 studies used 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.

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[8] The MDL is the lowest quantity of a chemical that can be distinguished (as greater than zero) in a sample.

[9] The RL is the lowest quantity of a chemical that can be accurately quantified in a sample.

[10] 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 analytical methodology, MDL, and RL for selenium was not reported for the TSMP study, although selenium was detected at commonly found concentrations.

TABLE 2. MERCURY AND PCB CONCENTRATIONS IN FISH FROM THE YUBA RIVER AND DEER CREEK

River	Common Name	Number of Samples	Total Number of Fish	Mean* Total Length (mm)	Range of Total Lengths** (mm)	Mercury (ppb)	
						Mean*	Range**
Deer Creek	Brown Trout	27	27	259	202 – 383	214	60 – 390
Mainstem, North and Middle Yuba Rivers	Pikeminnow	11	19	344	276 – 520	666	188 – 1582
	Rainbow Trout	39	43	330	208 – 429	109	0 – 240
	Sacramento Sucker	13	26	398	241 – 491	306	109 – 729
	Smallmouth Bass	9	25	228	162 – 271	430	260 – 720
South Yuba River	Brown Trout	22	22	246	200 – 315	66	41 – 90
	Rainbow Trout	36	46	241	200 – 352	113	44 – 300
	Sacramento Sucker	8	16	390	221 – 531	451	113 – 660
	Smallmouth Bass	11	11	324	305 – 358	674	530 – 960
						PCBs	
South Yuba River	Rainbow Trout	1	5	252	210 – 289	2	n/a
	Sacramento Sucker	1	5	481	436 – 508	18	n/a

*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 YUBA RIVER AND DEER CREEK

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[11] "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.

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) and "Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California

[11] "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).

Sport Fish: Polybrominated Diphenyl Ethers (PBDEs)" (OEHHA, 2011). 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 concentrations, and PCB concentrations when available, detected in the tissue 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 individual fish 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 Sacramento Sucker and did not affected advice. Advice for all species in this advisory was 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[12] 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.

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

CONSUMPTION ADVICE FOR FISH FROM THE YUBA RIVER AND DEER CREEK

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 mainstem, Middle and North Yuba Rivers, the sample size criterion was met for Rainbow Trout, Sacramento Pikeminnow, Sacramento Sucker, and Smallmouth Bass. For the South Yuba River, the sample size criterion was met for Brown Trout, Rainbow Trout, Sacramento Sucker, and Smallmouth Bass. For Deer Creek, the sample size criterion was met for Brown Trout. There were not sufficient data to evaluate other species that may be found in these water bodies.

MAINSTEM, NORTH AND MIDDLE YUBA RIVERS

BLACK BASS SPECIES (SMALLMOUTH BASS)

Based on the mean mercury concentration of 430 ppb of the undersized (total length: 162 - 271 mm) Smallmouth Bass, OEHHA recommends no consumption of black bass species from the mainstem, North and Middle Yuba Rivers for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of one serving a week for the general population (women 46 years and older, and men 18 years and older). This advice is more stringent than that provided in the Advisory Tissue Levels table in APPENDIX I because the measured mean mercury concentration of 430 ppb is very close to the cut-off level of 440 ppb, and higher mercury levels are likely to be found in black bass species of legal size.

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 Smallmouth Bass to other black bass species, including Largemouth, Redeye, and Spotted Bass.

RAINBOW TROUT

The mean mercury concentration in Rainbow Trout from the mainstem, North and Middle Yuba Rivers was 109 ppb. OEHHA recommends a maximum of two servings a week of Rainbow Trout for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of six servings a week for the general population (women 46 years and older, and men 18 years and older), based on mercury.

Sacramento Pikeminnow

The mean mercury concentration in Sacramento Pikeminnow from the mainstem, North and Middle Yuba Rivers was 666 ppb. OEHHA recommends no consumption of Sacramento Pikeminnow for the sensitive population (women 18 to 45 years and children 1 to 17 years), 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 mercury.

Sacramento Sucker

The mean mercury concentration in Sacramento Sucker from the mainstem, North and Middle Yuba Rivers was 306 ppb. OEHHA recommends a maximum of one serving a week of Sacramento Sucker for the sensitive population (women 18 to 45 years and children 1 to 17 years), 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 mercury.

SOUTH YUBA RIVER

Black Bass Species (Smallmouth Bass)

Based on the mean mercury concentration of 674 ppb of Smallmouth Bass, OEHHA recommends no consumption of black bass species from the South Yuba River for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of one serving a week for the general population (women 46 years and older, and men 18 years and older).

For the reasons noted above, OEHHA extends the consumption advice for Smallmouth Bass to other black bass species, including Largemouth, Redeye, and Spotted Bass.

Brown Trout

The mean mercury concentration in Brown Trout from the South Yuba River was 66 ppb. OEHHA recommends a maximum of three servings a week of Brown Trout for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of seven servings a week for the general population (women 46 years and older, and men 18 years and older), based on mercury.

Rainbow Trout

The mean mercury and PCB concentrations in Rainbow Trout from the South Yuba River were 113 ppb and 2 ppb, respectively. Based on the concentration of mercury, OEHHA recommends a maximum of two servings a week of Rainbow Trout for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a

maximum of five servings a week for the general population (women 46 years and older, and men 18 years and older). PCBs did not impact the advice.

SACRAMENTO SUCKER

The mean mercury and PCB concentrations in Sacramento Sucker from the South Yuba River were 451 ppb and 18 ppb, respectively. Based on the concentration of mercury, OEHHA recommends no consumption of Sacramento Sucker for the sensitive population (women 18 to 45 years and children 1 to 17 years), and a maximum of one serving a week for the general population (women 46 years and older, and men 18 years and older). PCBs did not impact the advice.

DEER CREEK

BROWN TROUT

The mean mercury concentration in Brown Trout from Deer Creek was 214 ppb. OEHHA recommends a maximum of one serving a week of Brown Trout for the sensitive population (women 18 to 45 years and children 1 to 17 years), 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 mercury.

RECOMMENDED MAXIMUM NUMBER OF SERVINGS

The recommended maximum numbers of servings per week for fish from the mainstem, North and Middle Yuba Rivers, the South Yuba River, and Deer Creek are shown in Table 3.

TABLE 3. RECOMMENDED MAXIMUM NUMBER OF SERVINGS PER WEEK FOR FISH FROM THE YUBA RIVER AND DEER CREEK

Fish Species	**Women 18–45 years and Children 1-17 years**			**Women 46 years and older and Men 18 years and older**		
	Mainstem, North and Middle Yuba Rivers	*South Yuba River*	*Deer Creek*	*Mainstem, North and Middle Yuba Rivers*	*South Yuba River*	*Deer Creek*
Black Bass Species	0	0	-	1	1	-
Brown Trout	-	3	1	-	7	3
Rainbow Trout	2	2	-	6	5	-
Sacramento Pikeminnow	0	-	-	1	-	-
Sacramento Sucker	1	0	-	2	1	-

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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[13] 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 Yuba River and Deer Creek are followed, exposure to chemicals in fish from the Yuba River and Deer Creek 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
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.

[13] 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.