

MONITORING AND ANALYSIS PLAN

Long-term Monitoring of Bass Lakes and Reservoirs in California

Bioaccumulation Monitoring Program

Surface Water Ambient Monitoring Program

Version 1

November 2022

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Background

In 2015, the Surface Water Ambient Monitoring Program’s (SWAMP’s) [Bioaccumulation Monitoring Program](#) began implementation of a [long-term monitoring plan](#) for a set of approximately 190 lakes and reservoirs where black bass are present and that were identified as priority water bodies for monitoring of contaminants in fish. To match the effort to the annual amount of funding available for SWAMP fish monitoring, the 190 lakes were divided into five subsets, or “panels”, of 38 lakes each, with one panel to be sampled every other year. The long-term plan is to sample each of the five panels, and then repeat the cycle going forward to provide updated information on each lake on a ten-year cycle. A Sampling and Analysis Plan (also known as Monitoring Plan) was published in 2015 to document the objectives and design details of the study (see the [2015 Monitoring Plan](#) for more details). The first four rounds of sampling were conducted in 2015 (Panel 1), 2017 (Panel 2), 2019 (Panel 3), and 2021 (Panel 4), and data reports summarizing the results were published in October 2019 ([2015 Data Report](#)) and November 2019 ([2017 Data Report](#)). The 2019 (Panel 3) data report will be published in late 2022. Sampling for Panel 4 was conducted in 2021 and the chemical analysis, data management, and report preparation are in progress.

Monitoring Design Updates

The Safe to Eat Workgroup (formerly known as the Bioaccumulation Oversight Group) has provided valuable input and feedback throughout the monitoring process, which has resulted in minor modifications to the monitoring design. This update to the original 2015 Monitoring Plan documents the modifications that have been made, as well as the latest status of the lakes on the Panel 5 list with regard to whether they can or will be sampled in 2023. All other aspects of the monitoring design match what was outlined in the 2015 Monitoring Plan.

The tables and figures that have been updated from the original 2015 Monitoring Plan are provided below, following the numbering used in the original Monitoring Plan. Where changes were minor, revisions to the original tables are highlighted in yellow. Revisions from the [Panel 4 Monitoring Plan](#) in 2021 are highlighted in green.

Table 6. Target species, size ranges, and processing instructions

I - process as individuals. C - process as composites. Target sizes will be adjusted as necessary based on lake-specific size limits to maintain a focus on legal sized fish. Elements revised from the original 2015 Monitoring Plan are highlighted in yellow. Updates to the 2021 Monitoring Plan are highlighted in green.

	Process for Mercury	Process for Organics and Selenium	Numbers and Size Ranges (mm)
Primary Targets: stay on location until one of these targets from both Group 1 and 2 is obtained, or collect secondary targets if primary targets are not available			
Group 1) Predator			
Black bass	I		2X(200-249), 2X(250-304), 7X(305-406), 3X(407-500)
Sacramento pikeminnow	I		3X(200-299), 7X(300-399), 3X(400-500)
Striped bass	I		2X(250-349), 2X(350-456), 7X(457-599), 3X(>600)
Group 2) Bottom feeder			
White catfish	C	C	5X(229-305)
Channel catfish	C	C	5X(375-500)
Common carp	C	C	5X(450-600)
Brown bullhead	C		5X(262-350)
Sacramento sucker	C	C	5X(375-500)
Secondary Targets: collect these if primary targets are not available			
Bluegill	C	C	5X(127-170)
Redear sunfish	C	C	5X(165-220)
Black crappie	C	C	5X(187-250)
Tilapia	C	C	5X(235-314)
Green sunfish	C	C	5X(119-159)

Table 7. Summary of sport fish analytes included in the monitoring

Selenium was not included in 2015 but was added in 2017. PCBs and legacy pesticides are analyzed in selected water bodies where the information is needed for advisory development or tracking trends for management. Elements revised from the original 2015 Monitoring Plan are highlighted in yellow.

Analyte	Included in Study?
Methylmercury ¹	All individuals
Selenium	All composites
PCBs	Selected composites
DDTs	Selected composites
Dieldrin	Selected composites
Aldrin	Selected composites
Chlordanes	Selected composites

¹Measured as total mercury, which provides a direct estimate of methylmercury in fish muscle.

Table 8. Parameters to be measured in sport fish

Selenium was not included in 2015 but was added in 2017. Elements revised from the original 2015 Monitoring Plan are highlighted in yellow.

Table 8 a. Fish Attributes

Fish Attributes
Total length (mm)
Fork Length (mm)
Standard Length (mm; small fish only)
Weight (g)
Sex (sport fish only)
Moisture (%)
Lipid (%; only when organics are analyzed)
Age (for black bass)*

Fish attributes are physical measurements or observations.

* Black bass scales will be archived for potential future age analysis

Table 8 b. Metals and metalloids in Tissue

Analyte	Matrix Type
Total Mercury	Whole Body Small Fish and Sport Fish fillet muscle
Total Selenium	Whole Body Small Fish and Sport Fish fillet muscle

Table 8 c. Organochlorine (OC) pesticides in Tissue

Analyte Group	Analyte	Matrix Type
Chlordanes	Chlordane, cis-	Sport Fish fillet muscle
	Chlordane, trans-	Sport Fish fillet muscle
	Heptachlor	Sport Fish fillet muscle
	Heptachlor epoxide	Sport Fish fillet muscle
	Nonachlor, cis-	Sport Fish fillet muscle
	Nonachlor, trans-	Sport Fish fillet muscle
	Oxychlordane	Sport Fish fillet muscle
DDTs	DDD(o,p')	Sport Fish fillet muscle
	DDD(p,p')	Sport Fish fillet muscle
	DDE(o,p')	Sport Fish fillet muscle
	DDE(p,p')	Sport Fish fillet muscle
	DDMU(p,p')	Sport Fish fillet muscle
	DDT(o,p')	Sport Fish fillet muscle
	DDT(p,p')	Sport Fish fillet muscle
Cyclodienes	Aldrin	Sport Fish fillet muscle
	Dieldrin	Sport Fish fillet muscle
	Endrin	Sport Fish fillet muscle
HCHs	HCH, alpha	Sport Fish fillet muscle
	HCH, beta	Sport Fish fillet muscle
Others	Dacthal	Sport Fish fillet muscle
	Endosulfan I	Sport Fish fillet muscle
	Hexachlorobenzene	Sport Fish fillet muscle
	Methoxychlor	Sport Fish fillet muscle
	Mirex	Sport Fish fillet muscle
	Oxadiazon	Sport Fish fillet muscle

Table 8 d. Polychlorinated biphenyls (PCB) in tissue

Analyte	Matrix Type
All 209 PCB congeners	Sport Fish fillet muscle

There are some details worth noting on the reporting of data on PCB congeners. The number of congeners analyzed has been increasing over the years. In 2023 the full suite of 209 congeners will be analyzed. The sums of PCBs reported will include all 209 congeners, with “not detected” values for individual congeners set to zero. For rigorous comparisons with past data a subset of common congeners can be used.

Figure 2a. Sampling design for a small lake: sport fish

This graphic was updated in April 2019 and is still accurate for 2023. For predator species, the same fish are used for the individual and composite analyses.

Small Lake
 (0 – 500 ha)

Se+(PCBs)	PCBs+Hg+Se	Hg
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Analyze organics if OEHHA criteria for joint assessment of Hg and organics are met

Updated Apr 2019

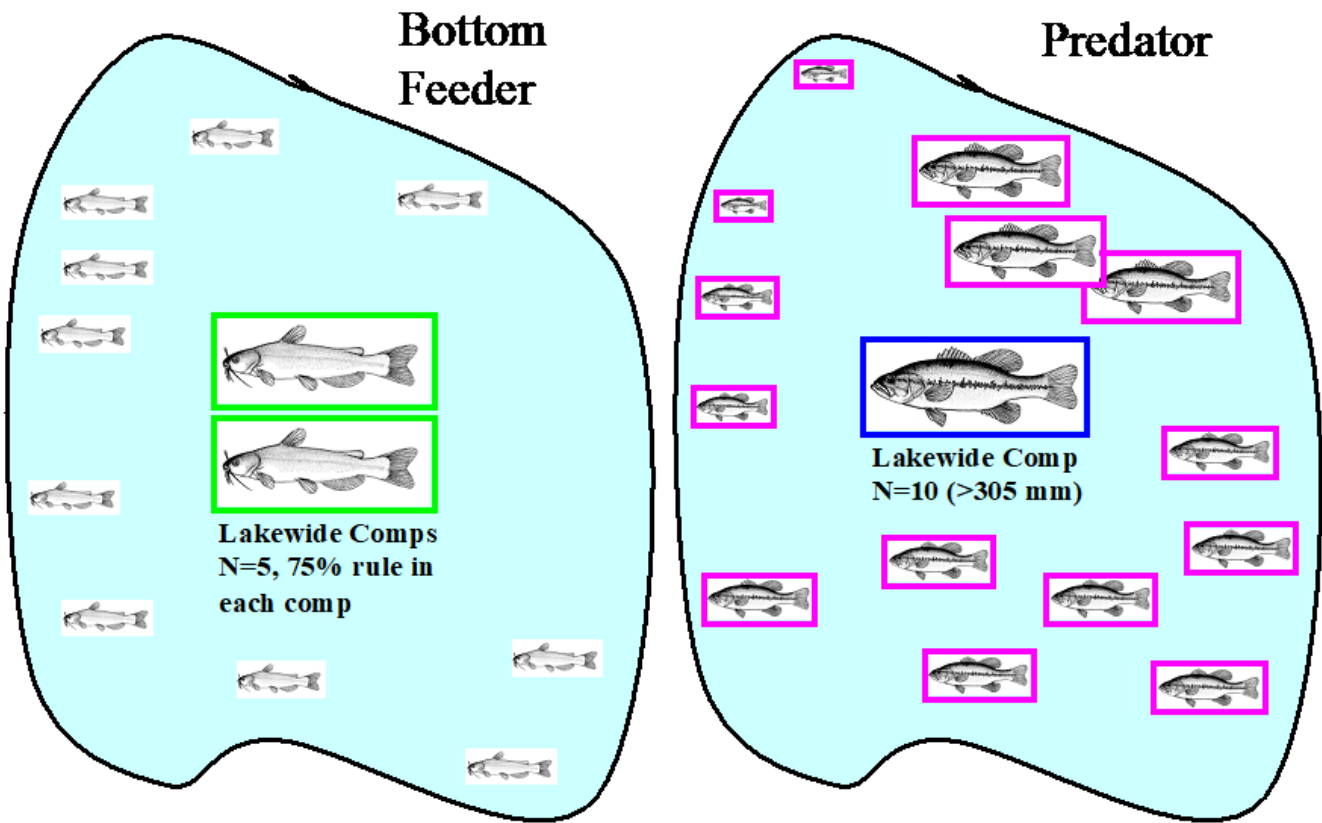


Figure 2b. Sampling design for a small lake: prey fish

The 2015 Monitoring Plan did not include a diagram for prey fish.

Small Lake
(0 – 500 ha)

Hg+Se

Updated Jan 2021

Prey Fish (25-100 mm)

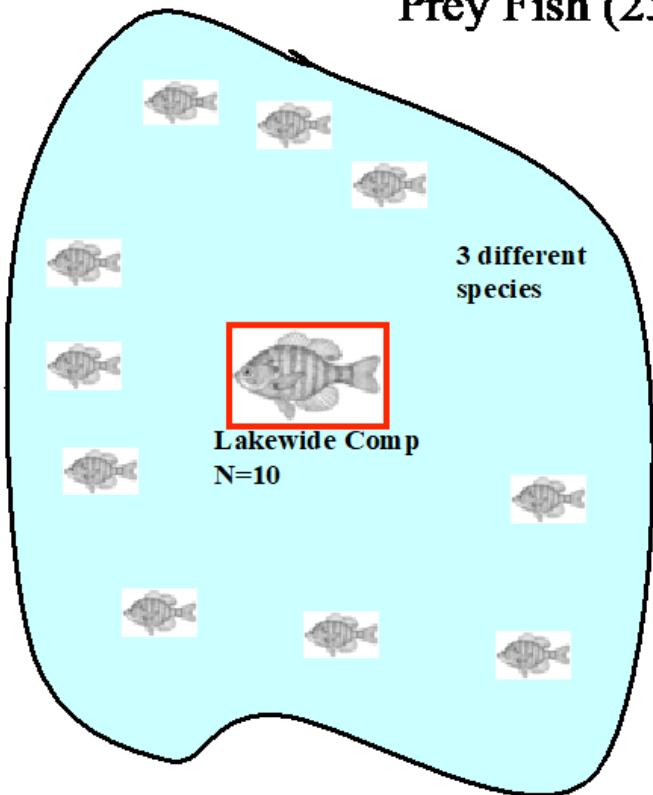


Figure 3a. Sampling design for a medium lake: sport fish

This graphic was updated in April 2019 and is still accurate for 2023. For predator species, the same fish are used for the individual and composite analyses.

Medium Lake
 (500 – 1000 ha)

Se+(Orgs)	Orgs+Hg+Se	Hg
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Analyze organics if OEHHA criteria for joint assessment of Hg and organics are met

Updated Apr 2019

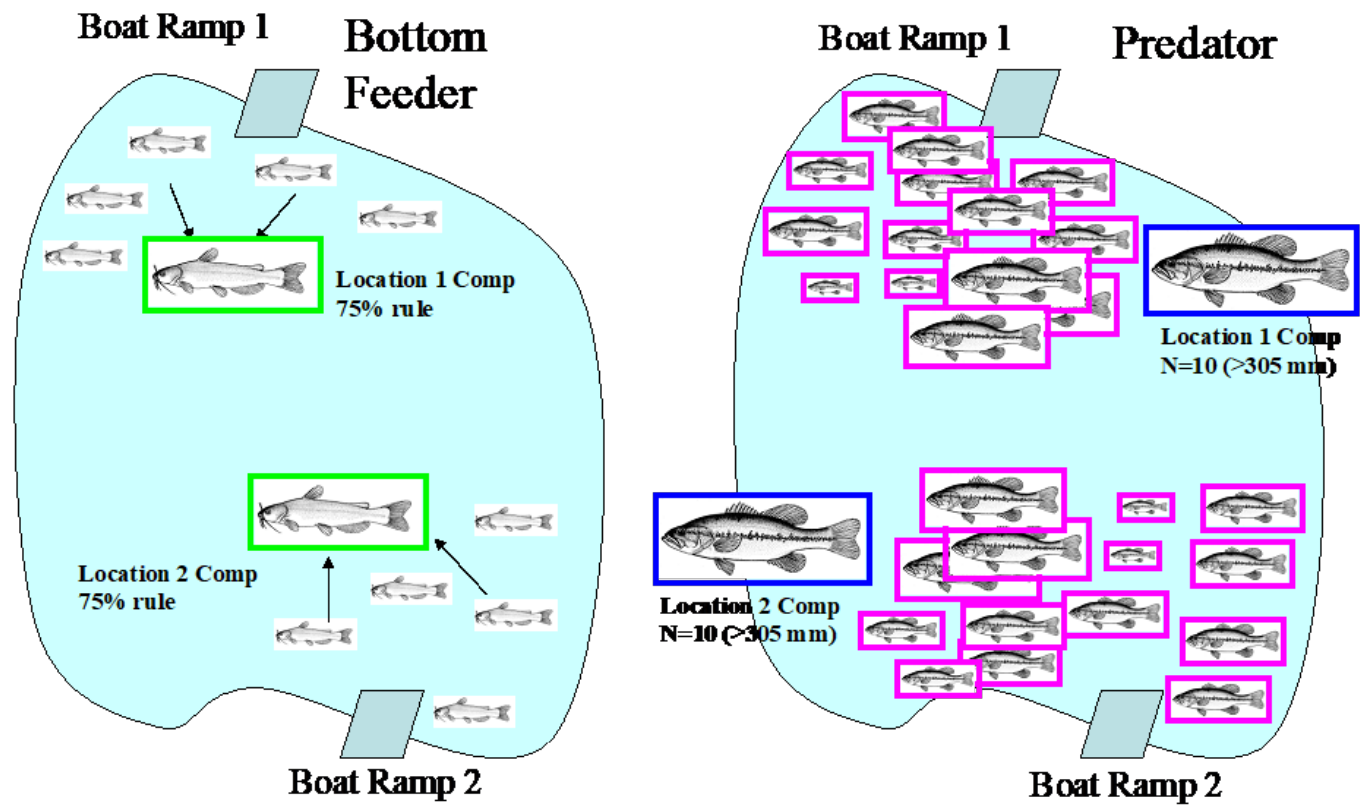


Figure 3b. Sampling design for a medium lake: prey fish

The 2015 Monitoring Plan did not include a diagram for prey fish.

Medium Lake
(500 – 1000 ha)

Hg+Se

Updated Jan 2021

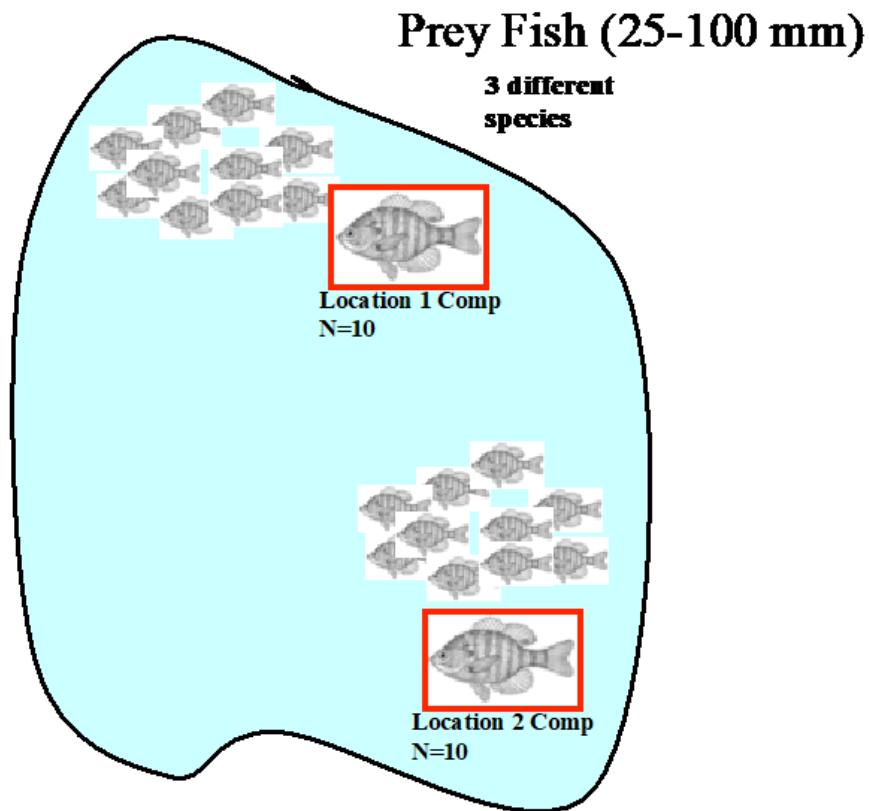


Table A. Final list of lakes to be sampled in 2023

Table A includes information as of November 2022 on accessibility for sampling. Several lakes on the Panel 5 list will not be sampled because they were either already sampled recently or have water levels that are too low.

Note Table A is split into two parts below: Sampling Details (pages 12 – 16) and Request Details (pages 16 – 22). See the spreadsheet source file for full notations. Email Jay Davis (jay@sfei.org) to request a copy of the spreadsheet.

Additional lakes requested by the Regional Boards that may be sampled if budget allows are listed at the end of each part of Table A.

Sampling Details

Region	Station Code	Lake Name	Publicly Accessible?	Include PCBs?	Include OC Pesticides?	Notes
PANEL 5 LAKES						
1	103PDE006	Dead Lake	Yes, ramp			None
1	114PLM149	Mendocino, Lake	Yes, ramp			None
1	114PSP009	Spring Lake	Yes, small ramp			None
2	205PAD016	Anderson Lake				DELETED: water level lowered due to high seismic risk, won't be refilled for a decade or more
2	201PBT189	Bon Tempe Lake	Yes, ramp			None
2	207PLF001	Lafayette Reservoir	Yes, ramp	X		DELETED: sampled in 2021, including PCBs

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Region	Station Code	Lake Name	Publicly Accessible?	Include PCBs?	Include OC Pesticides?	Notes
3	305PHR112	Hernandez Reservoir	No, bank launch			None
3	312POF158	Oso Flaco Lake	Yes, bank launch	X	X	Not sampled previously by SWAMP
3	305PUR072	Uvas Reservoir	Yes, ramp			None
4	412CALBLK	Calabosas Lake	No, ramp	X		None
4	411HARBLK	Harbor Lake (Machado Lake)	Yes, NO FISHING ALLOWED due to Machado Lake Habitat Restoration			DELETED: sampled in 2019, fishing not currently allowed due to restoration
4	412LINPRK	Lincoln Park Lake	Yes, ramp	X		PCBs 22 ppb in carp in 2014
4	403PIRULK	Piru, Lake	Yes, ramp			None
4	412TOLULK	Toluca Lake	No, small ramp			None
4	404WESTLK	Westlake Lake	No, small ramp			None
5	518PLA165	Almanor, Lake	Yes, ramp			None
5	543BETRES	Bethany Reservoir	Yes, ramp			None
5	508TU0081	California, Lake	No, small ramp			None

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Region	Station Code	Lake Name	Publicly Accessible?	Include PCBs?	Include OC Pesticides?	Notes
5	513PCL173	Clear Lake	Yes, ramp	X		PCBs 13 ppb in carp in 2008
5	543PCL017	Contra Loma Reservoir	Yes, ramp			None
5	517PHE065	Englebright Lake	Yes, ramp	X		PCBs 18 ppb in sucker in 2008
5	532PJL096	Jenkinson Lake	Yes, ramp			only trout sampled for PCBs to date
5	553PLK054	Kaweah, Lake	Yes, ramp	X		PCBs 13 ppb in carp in 2008
5	543PLV220	Los Vaqueros Reservoir	Yes, ramp			None
5	513TB0186	Lower Blue Lake (Lake County)	Yes, ramp			None
5	521PPL170	Paradise Lake	Yes, ramp			None
5	515ROBNPD	Robinson Pond	No, bank launch	X	X	DELETED: not really lake/reservoir habitat, not good fish habitat (per email from Anna Holder on 11-16-22, relaying email from Lauren Smitherman)
5	516PRR201	Rollins Reservoir	Yes, ramp	X		PCBs 13 ppb in sucker in 2008
5	519SJANPD	San Juan Pond	No, bank launch	X	X	Not sampled previously by SWAMP

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Region	Station Code	Lake Name	Publicly Accessible?	Include PCBs?	Include OC Pesticides?	Notes
5	535PTL004	Turlock Lake	Yes, ramp			None
6	628PGL147	Gregory, Lake	Yes, ramp			None
6	624TH0187	Haiwee Reservoir	No, small ramp			None
8	801PSR210	Irvine Lake	Yes, ramp	X		PCBs requested by Heather Boyd Region 8
9	907CUYRES	Cuyamaca, Lake	Yes, ramp			DELETED: sampled in 2022 as part of Realignment, and in 2016
9	903PLH214	Lake Henshaw	Yes, bank launch			None
9	910PLO182	Lower Otay Reservoir	Yes, ramp	X		PCBs carp 22 ppb in 2007
9	906PLM142	Miramar Reservoir	Yes, ramp	X	X	Not sampled previously by SWAMP
9	907LKMURR	Murray Reservoir	Yes, ramp	X		PCBs channel catfish 26 ppb in 2016
ADDITIONAL REQUESTS						
7	723ARGRB1	Alamo River Outlet			X	None
7	723NROTWM	New River Outlet			X	None

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Region	Station Code	Lake Name	Publicly Accessible?	Include PCBs?	Include OC Pesticides?	Notes
8		Jenks Lake	No power boats allowed; open end of April through Labor Day.	X	X	None
8	801CGP100	Cucamonga - Guasti Regional Park		X	X	None
8	801GHLLL1	Glen Helen Regional Park		X	X	None
8	801YRPML1	Yucaipa Regional Park		X	X	None
9	905PLH070	Lake Hodges				Chad Loflen (Region 9) will arrange for fish collection with CDFW. Supporting mercury oxygenation study.

Request Details

Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
PANEL 5 LAKES				
1	103PDE006	Dead Lake	2 additional species (not black bass): 9 individuals of 2 additional species.	None

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Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
1	114PLM149	Mendocino, Lake	Could add species: 5 Channel Cats, 7 RT, 4 Threadfin Shad, 2 Striped Bass (current advice for SB based on n=7)	None
1	114PSP009	Spring Lake	9 individuals of 1 additional species (not black bass or sunfish).	None
2	205PAD016	Anderson Lake	None	Carrie Austin (11-13-20): Anderson Reservoir, has had its water level lowered to dead pool due to high seismic risk, and likely to be perhaps even a decade before dam is reconstructed and reservoir is refilled
2	201PBT189	Bon Tempe Lake	9 individuals of 1 additional species (not black bass or sunfish). RT reportedly caught here.	None
2	207PLF001	Lafayette Reservoir	None	Requested by Carrie Austin 6-18-15
3	305PHR112	Hernandez Reservoir	None	May be deleted due to low water levels (per Melissa Daugherty)
3	312POF158	Oso Flaco Lake	1 additional species: 1 black bass, or 9 individuals of another species (not sunfish or Goldfish)	None

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Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
3	305PUR072	Uvas Reservoir	2 additional species (not sunfish): 2 black bass and 9 individuals of 1 additional species. CCATs and Carp are reportedly caught here.	None
4	412CALBLK	Calabasas Lake	9 individuals of two additional species (not black bass)	None
4	411HARBLK	Harbor Lake (Machado Lake)	None	None
4	412LINPRK	Lincoln Park Lake	Enough species for advisory. Could add species with 9 individuals (not black bass, Carp, or sunfish)	None
4	403PIRULK	Piru, Lake	4 Goldfish	None
4	412TOLULK	Toluca Lake	None	None
4	404WESTLK	Westlake Lake	None	None
5	518PLA165	Almanor, Lake	Could add species to current advisory: 3 Brown Bullhead or 9 Brown Trout. Could also add 4 Sac Sucker to confirm advice.	None
5	543BETRES	Bethany Reservoir	Could add species with 5 Sac Sucker or 9 individuals of another species (not sunfish or LMB). Reports of Striped Bass and CCATs being caught here.	None
5	508TU0081	California, Lake	None	None
5	513PCL173	Clear Lake	9 Sacramento Sucker, Pikeminnow, Brown Trout, and/or Goldfish	None

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Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
5	543PCL017	Contra Loma Reservoir	9 individuals of 2 additional species (not black bass)	None
5	517PHE065	Englebright Lake	Could add species to current advisory: 9 Brown Trout, 8 Common Carp or 9 Kokanee. PCBs in Carp.	None
5	532PJL096	Jenkinson Lake	Mackinaw and Brown Trout are reportedly caught here (don't need LMB, sunfish, or RT)	None
5	553PLK054	Kaweah, Lake	9 individuals of 1 additional species (not black bass or Common Carp)	None
5	543PLV220	Los Vaqueros Reservoir	9 individuals of 1 additional species (not black bass or Sac Sucker). Catfish, Rainbow Trout and Striped Bass are reportedly caught here.	None
5	513TB0186	Lower Blue Lake (Lake County)	2 additional species (not Common Carp): 2 black bass and 9 individuals from another species	None
5	521PPL170	Paradise Lake	9 individuals of 2 additional species (not black bass). Rainbow Trout reported to be caught here.	None
5	515ROBNPD	Robinson Pond	9 individuals from 3 species	DELETED: not really lake/reservoir habitat, not good fish habitat (per email from Anna Holder on 11-16-22, relaying email from Lauren Smitherman)

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Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
5	516PRR201	Rollins Reservoir	Could add species with: 6 Black Crappie, 5 Brown Trout, 8 Rainbow Trout, 2 sunfish, or 4 Sac Sucker (don't need CCATs or LMB)	None
5	519SJANPD	San Juan Pond	9 individuals from 3 species	None
5	535PTL004	Turlock Lake	1 additional species (not black bass or Common Carp): 5 Brown Bullhead or 5 Rainbow Trout	None
6	628PGL147	Gregory, Lake	Could add species to current advisory: 8 Brown Trout or 8 Rainbow Trout, 1 more crappie to confirm advice (don't need bullhead, carp, or LMB)	None
6	624TH0187	Haiwee Reservoir	Subject to fishing access: 9 individuals from 3 species (have 6 SMB from 1991 only, newer samples preferable)	None
8	801PSR210	Irvine Lake	9 individuals from 2 additional species (not Common Carp): 1 black bass, 1 sunfish, or 9 of another species	PCBs requested by Heather Boyd Region 8
9	907CUYRES	Cuyamaca, Lake	Could add species: 4 Brown Bullhead and 1 black bass (don't need RT, sunfish, carp, crappie)	Monitored in 2022 during San Diego Realignment Process. Chad Loflen Region 9 is fine with deletion.

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Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
9	903PLH214	Lake Henshaw	Could add species: 1 Black Crappie (don't need sunfish, CCATs, Carp, LMB, or Threadfin Shad)	None
9	910PLO182	Lower Otay Reservoir	9 individuals from 1 additional species (don't need LMB or Carp)	None
9	906PLM142	Miramar Reservoir	9 individuals from 3 species	None
9	907LKMURR	Murray Reservoir	1 additional species (not Ccat or sunfish): 2 black bass or 9 individuals from 1 additional species. Black Crappie and RBT reportedly caught here.	None

Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
ADDITIONAL REQUESTS				
7	723ARGRB1	Alamo River Outlet	None	Requested by Jeff Geraci 09-01-22
7	723NROTWM	New River Outlet	None	Requested by Jeff Geraci 09-01-22
8		Jenks Lake	None	Requested by Heather Boyd 08-31-22: never been sampled for analytes in fish tissue, collect stocked as well as natives
8	801CGP100	Cucamonga - Guasti Regional Park	None	Requested by Heather Boyd 08-31-22: never been sampled for analytes in fish tissue, collect stocked as well as natives
8	801GHLLL1	Glen Helen Regional Park	None	Requested by Heather Boyd 08-31-22: never been sampled for analytes in fish tissue, collect stocked as well as natives
8	801YRPML1	Yucaipa Regional Park	None	Requested by Heather Boyd 08-31-22: never been sampled for analytes in fish tissue, collect stocked as well as natives

Region	Station Code	Lake Name	OEHHA Requests	Regional Board Requests & Comments
9	905PLH070	Lake Hodges	None	Requested by Carrie Austin 07-27-22: related to oxygenation study "Speece cone in Lk Hodges has already been up and running for a few years. Prof Marc Beutel UC Merced is best contact for Hg in Lk Hodges." Interest in YOY and adult LMB. Region 9 will arrange for fish collection.