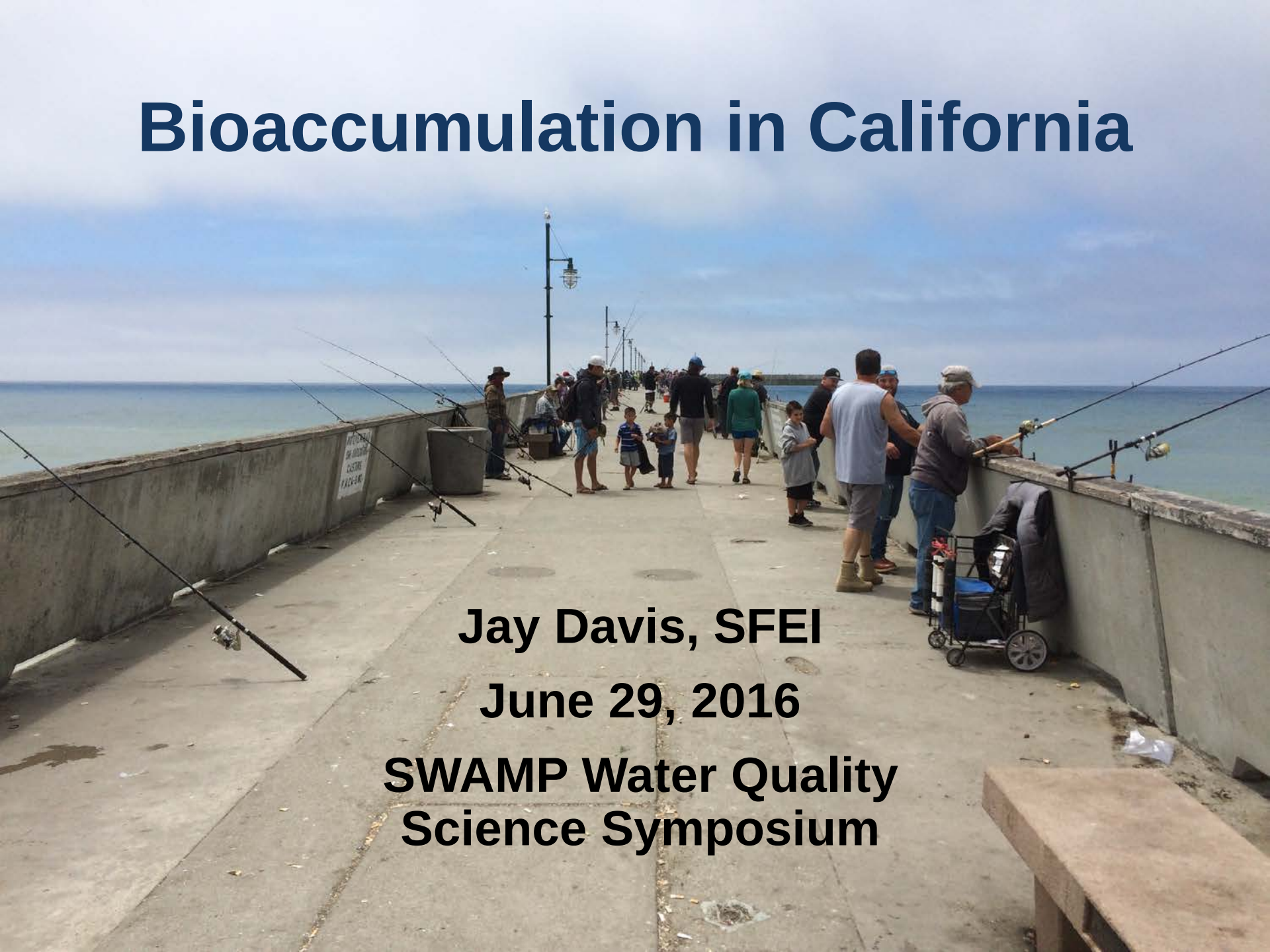
Bioaccumulation in California



Jay Davis, SFEI

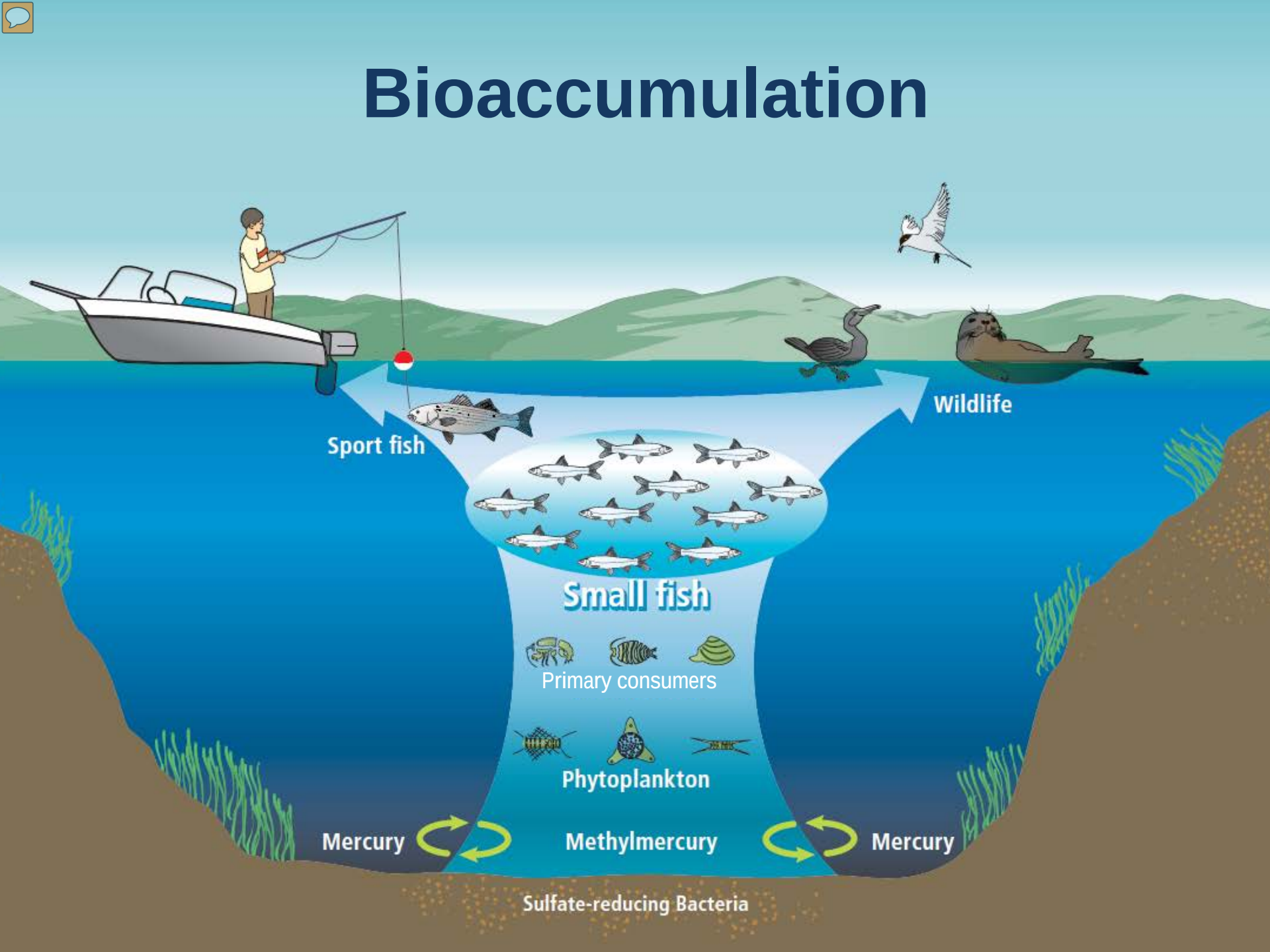
June 29, 2016

SWAMP Water Quality Science Symposium

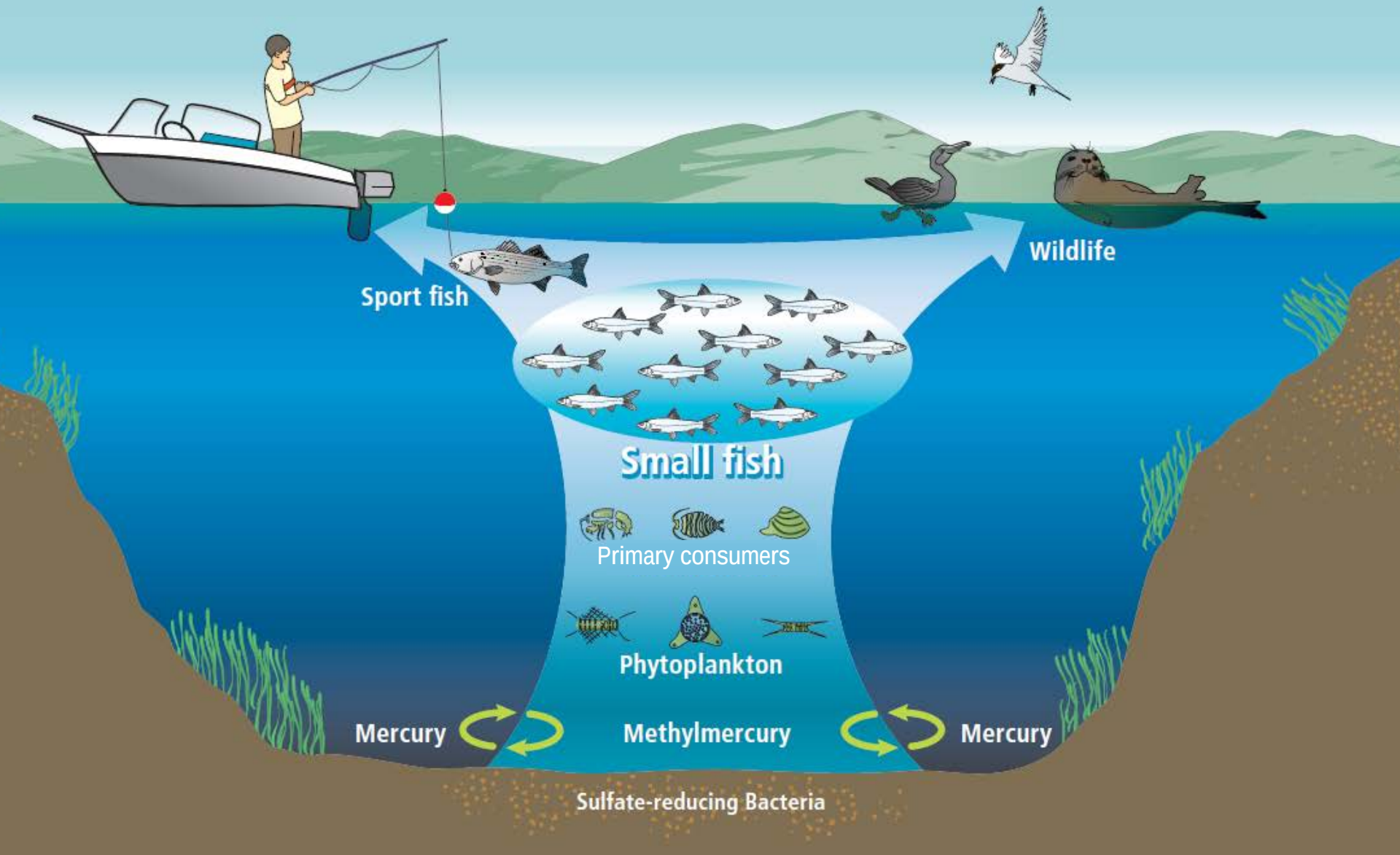
- What is bioaccumulation?
- What are the concerns in California? – Preliminary report card
- What is SWAMP doing on this issue?

SWAMP
Surface Water Ambient Monitoring Program

Bioaccumulation



Biomagnification



Bioaccumulation Report Card

SWAMP
Surface Water
Ambient Monitoring
Program

Tier I
High Concern

Tier II
Moderate Concern

Tier III
Low Concern

Tier IV
Unknown Concern

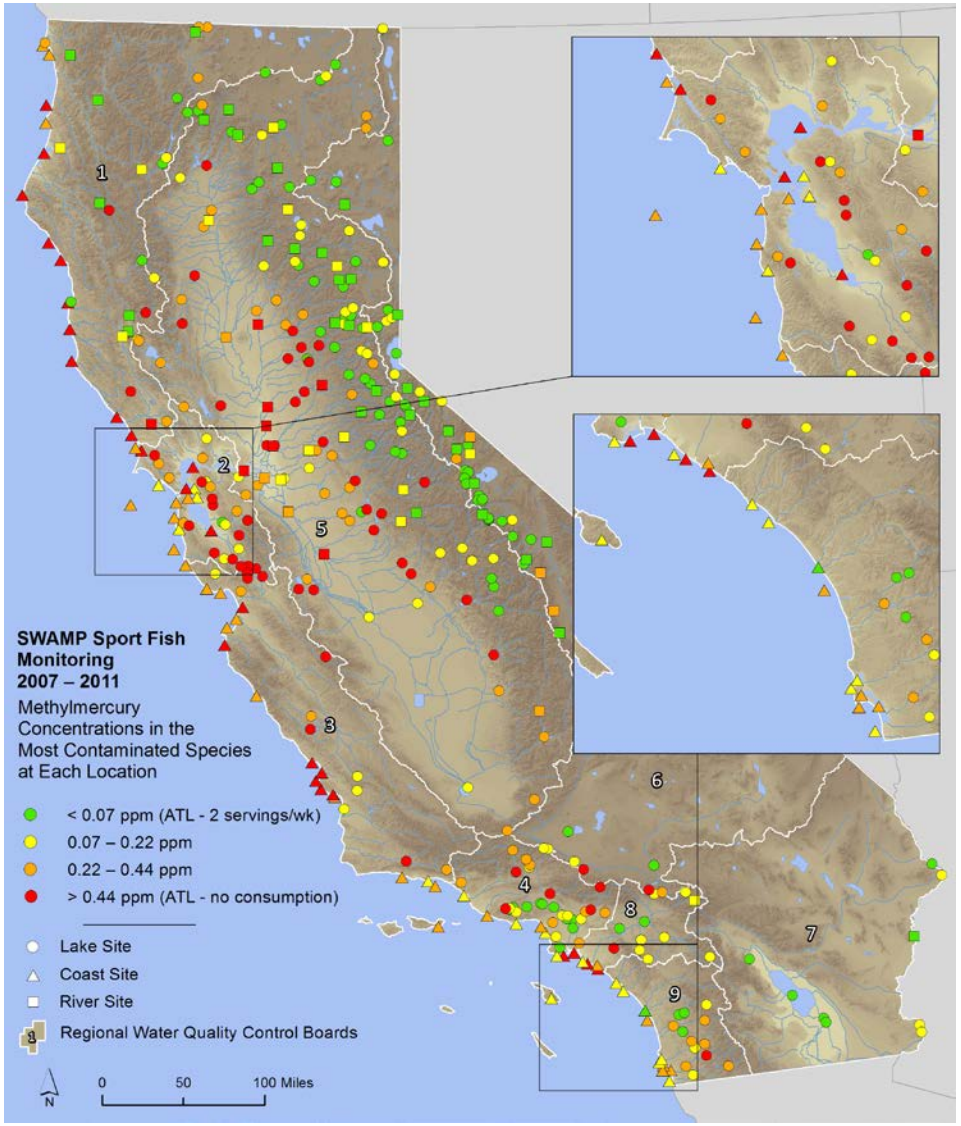
Safe for Fishing

Tier I **Methylmercury**
High Concern

Tier II
Moderate Concern

Tier III
Low Concern

Tier IV
Unknown Concern



Safe for Fishing

Tier I
High Concern

Methylmercury
Saxitoxin
Domoic Acid

Tier II
Moderate Concern

Tier III
Low Concern

Tier IV
Unknown Concern

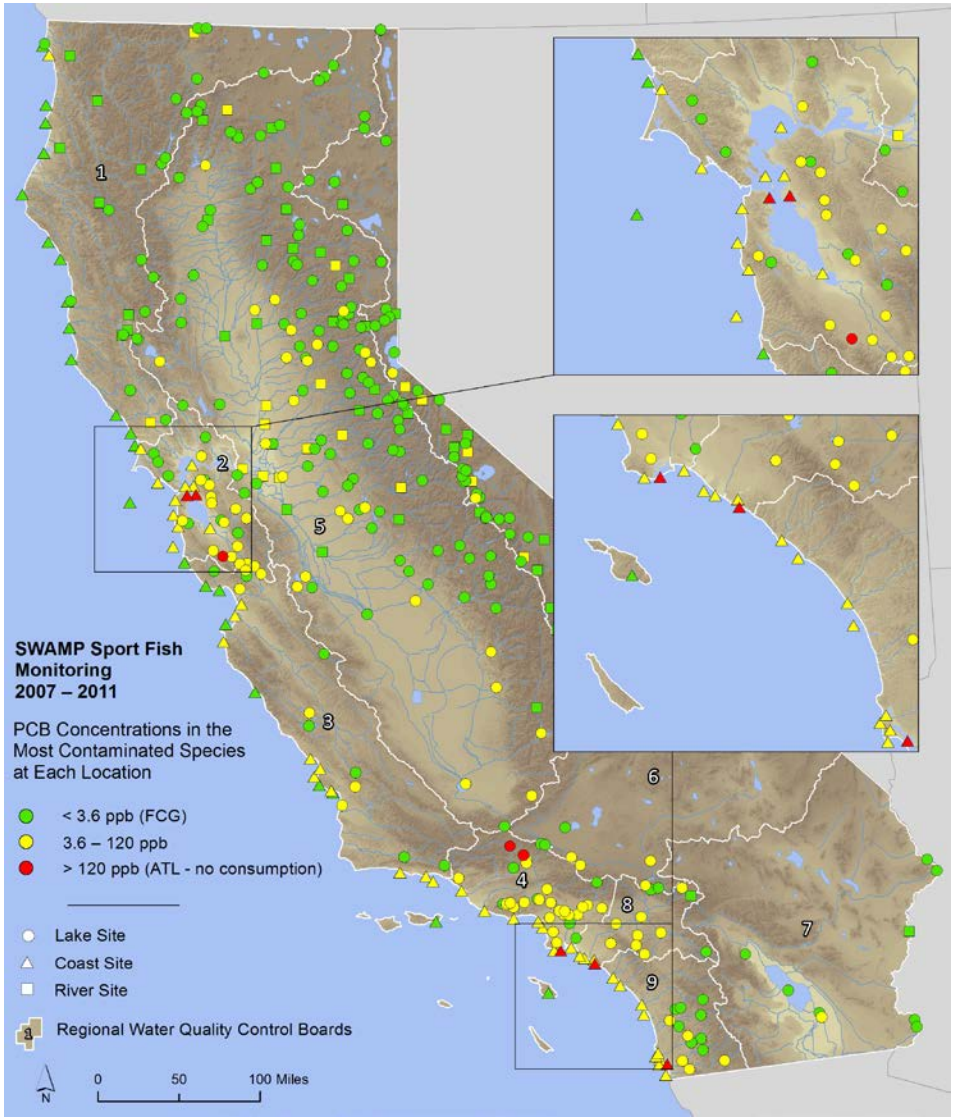
Safe for Fishing

Tier I *High Concern*
Methylmercury
Saxitoxin
Domoic Acid

Tier II *Moderate Concern*
PCBs

Tier III *Low Concern*

Tier IV *Unknown Concern*



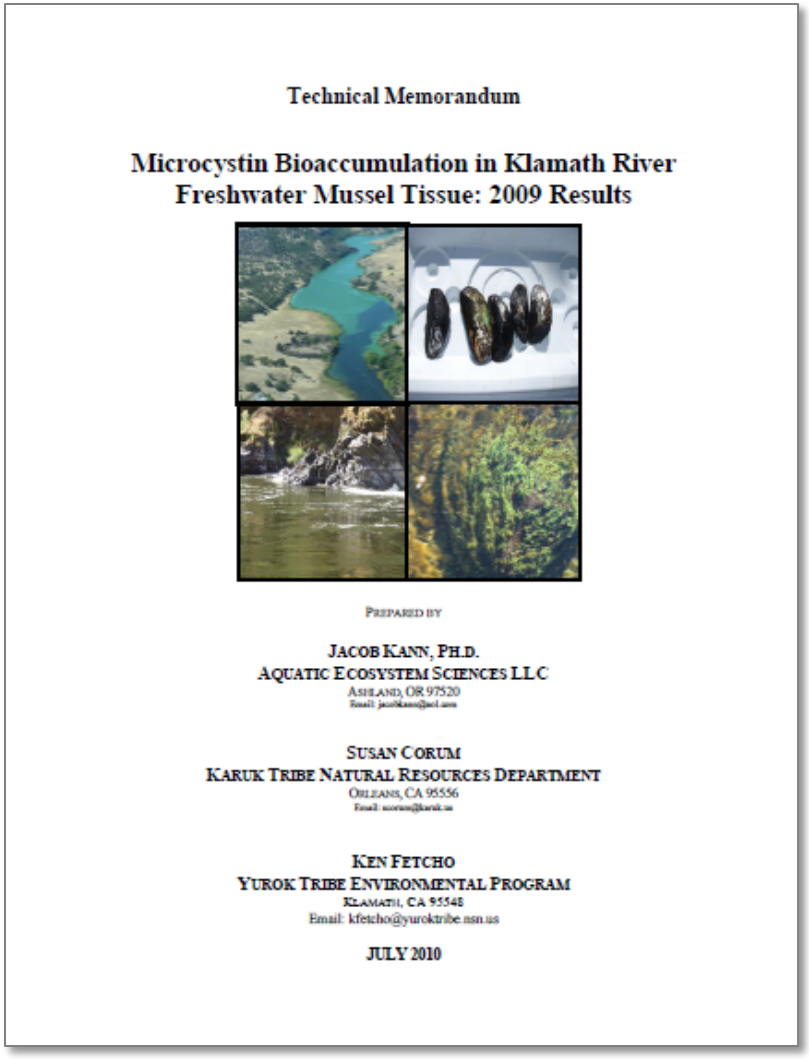
Safe for Fishing

Tier I
High Concern
Methylmercury
Saxitoxin
Domoic Acid

Tier II
Moderate Concern
PCBs
Microcystin

Tier III
Low Concern

Tier IV
Unknown Concern



Technical Memorandum

Microcystin Bioaccumulation in Klamath River Freshwater Mussel Tissue: 2009 Results

PREPARED BY

JACOB KANN, PH.D.
AQUATIC ECOSYSTEM SCIENCES LLC
ASHLAND, OR 97520

SUSAN CORUM
KARUK TRIBE NATURAL RESOURCES DEPARTMENT
ORLEANS, CA 95556

KEN FETCHO
YUROK TRIBE ENVIRONMENTAL PROGRAM
KLAMATH, CA 95548
Email: kfetcho@yuroktribe.nsn.us

JULY 2010

Safe for Fishing

Tier I
High Concern

Methylmercury
Saxitoxin
Domoic Acid

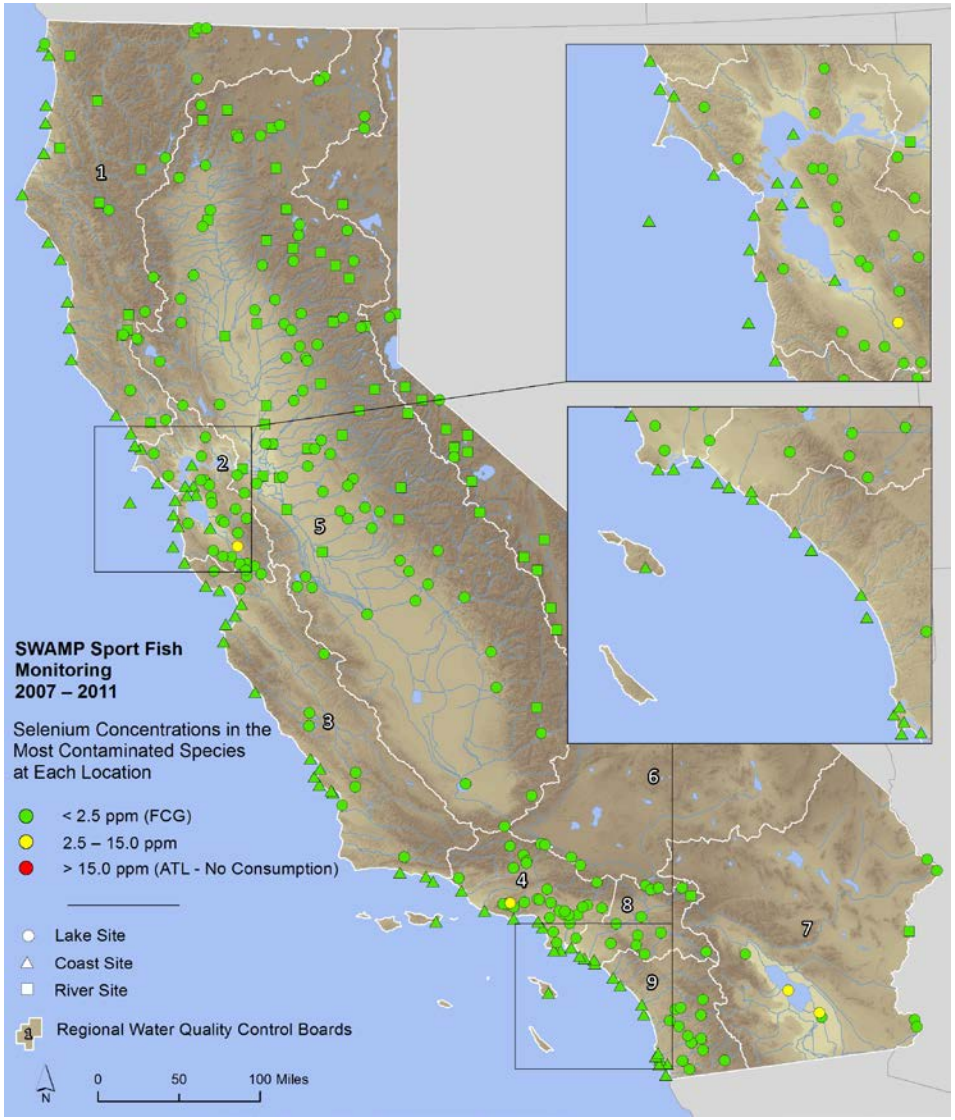
Tier II
Moderate Concern

PCBs
Microcystin

Tier III
Low Concern

PBDEs DDTs
Dieldrin Chlordanes
Selenium
Many others

Tier IV
Unknown Concern



Safe for Fishing

Tier I
High Concern

Methylmercury
Saxitoxin
Domoic Acid

Tier II
Moderate Concern

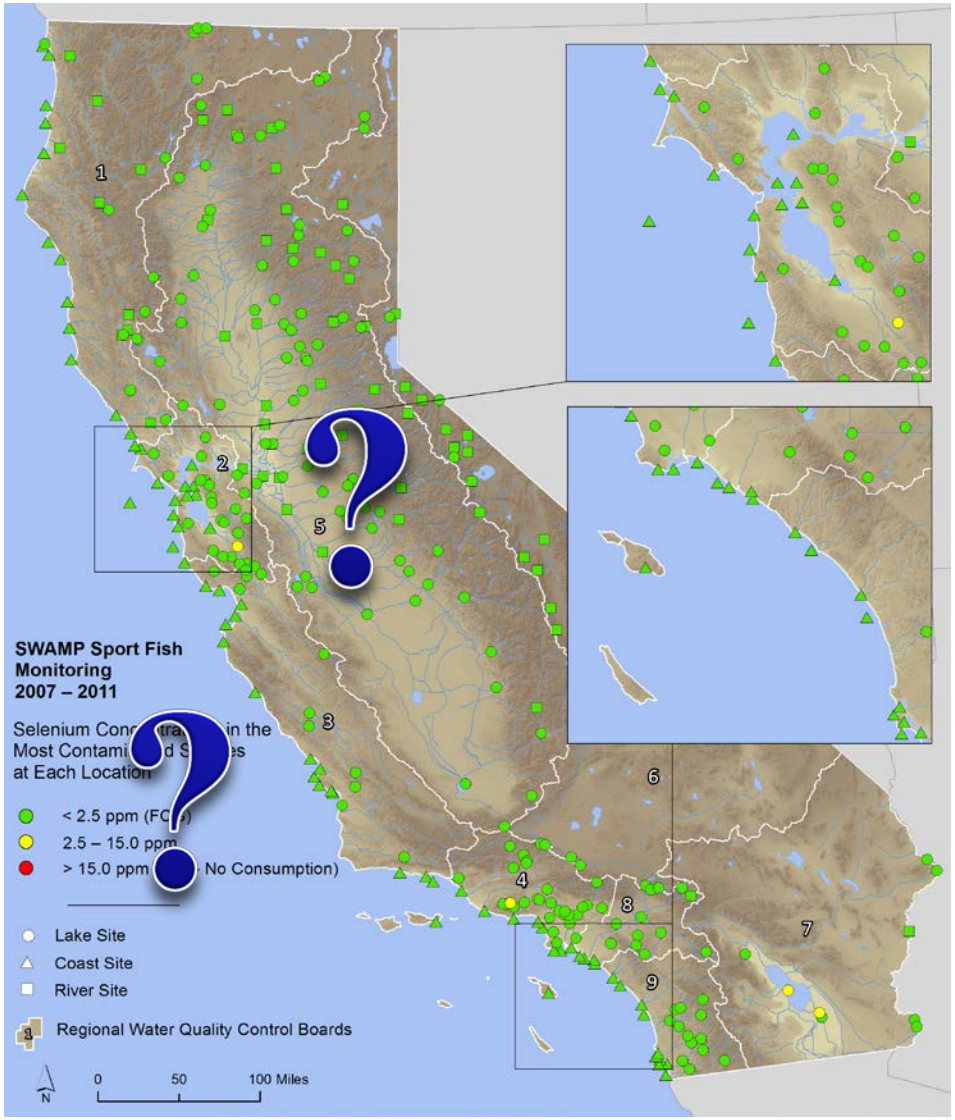
PCBs
Microcystin

Tier III
Low Concern

PBDEs DDTs
Dieldrin Chlordanes
Selenium
Many others

Tier IV
Unknown Concern

Dioxins
PFCs
CECs



Safe for Aquatic Life

Tier I **Methylmercury**
High Concern

Tier II
Moderate Concern

Tier III
Low Concern

Tier IV
Unknown Concern

Safe for Aquatic Life

Tier I
High Concern

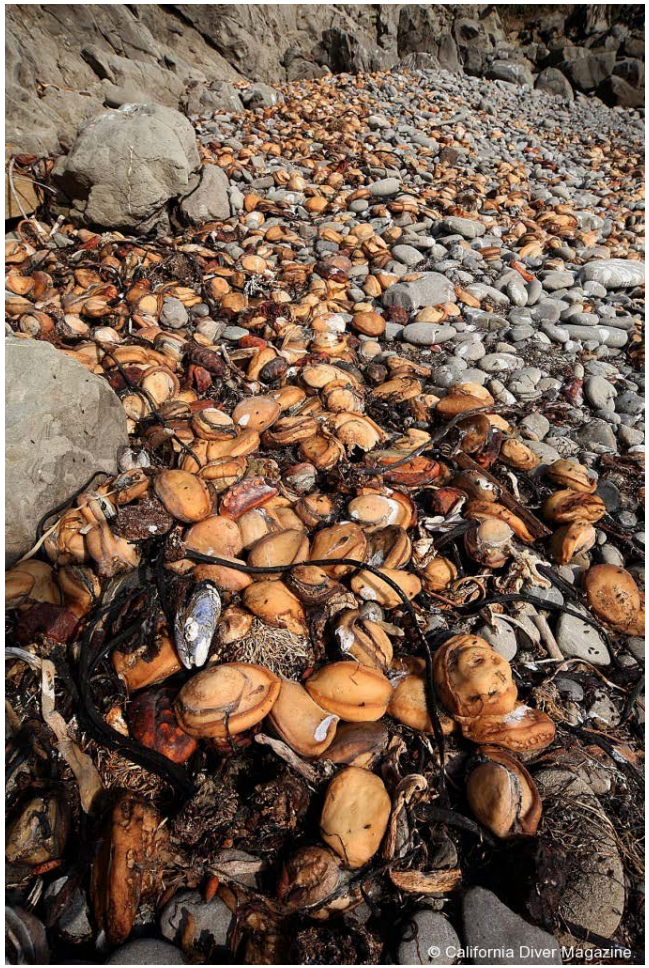
Methylmercury
Microcystin

Tier II
Moderate Concern

Tier III
Low Concern

Tier IV
Unknown Concern

Safe for Aquatic Life



Tier I
High Concern

Methylmercury
Microcystin
Other biotoxins

Tier II
Moderate Concern

Tier III
Low Concern

Tier IV
Unknown Concern

Safe for Aquatic Life

Tier I
High Concern

Methylmercury
Microcystin
Other biotoxins

Tier II
Moderate Concern

Selenium

Tier III
Low Concern

Tier IV
Unknown Concern

Safe for Aquatic Life

Tier I *High Concern*	Methylmercury Microcystin Other biotoxins
Tier II *Moderate Concern*	Selenium **DDTs**
Tier III *Low Concern*	
Tier IV *Unknown Concern*	

Safe for Aquatic Life

Tier I
High Concern

Methylmercury
Microcystin
Other biotoxins

Tier II
Moderate Concern

Selenium
DDTs
PCBs

Tier III
Low Concern

Tier IV
Unknown Concern

Safe for Aquatic Life

Tier I *High Concern*	Methylmercury Microcystin Other biotoxins
Tier II *Moderate Concern*	Selenium DDTs PCBs
Tier III *Low Concern*	**PBDEs Dieldrin** **Chlordanes Dioxins** **Many others**
Tier IV *Unknown Concern*	

Safe for Aquatic Life

Tier I *High Concern*	Methylmercury Microcystin Other biotoxins
Tier II *Moderate Concern*	Selenium DDTs PCBs
Tier III *Low Concern*	PBDEs Dieldrin Chlordanes Dioxins Many others
Tier IV *Unknown Concern*	**PFCs** **CECs**

Safe for Fishing

Tier I *High Concern*	Methylmercury Saxitoxin Domoic Acid
Tier II *Moderate Concern*	PCBs Microcystin
Tier III *Low Concern*	PBDEs DDTs Dieldrin Chlordanes Selenium Many others
Tier IV *Unknown Concern*	Dioxins PFCs CECs

Safe for Aquatic Life

Tier I *High Concern*	Methylmercury Microcystin Other biotoxins
Tier II *Moderate Concern*	Selenium DDTs PCBs
Tier III *Low Concern*	PBDEs Dieldrin Chlordanes Dioxins Many others
Tier IV *Unknown Concern*	PFCs CECs

SWAMP Bioaccumulation Monitoring Program

- Under the guidance of the Bioaccumulation Oversight Group (BOG)

SWAMP
Surface Water Ambient Monitoring Program

SWAMP Bioaccumulation Monitoring: Lakes

Monitoring

- 2007-2008
- Wildlife Study 2012-2013
- Clean Lakes Study 2014
- Long-term Bass Lake Monitoring 2015+
- More Lakes 2016

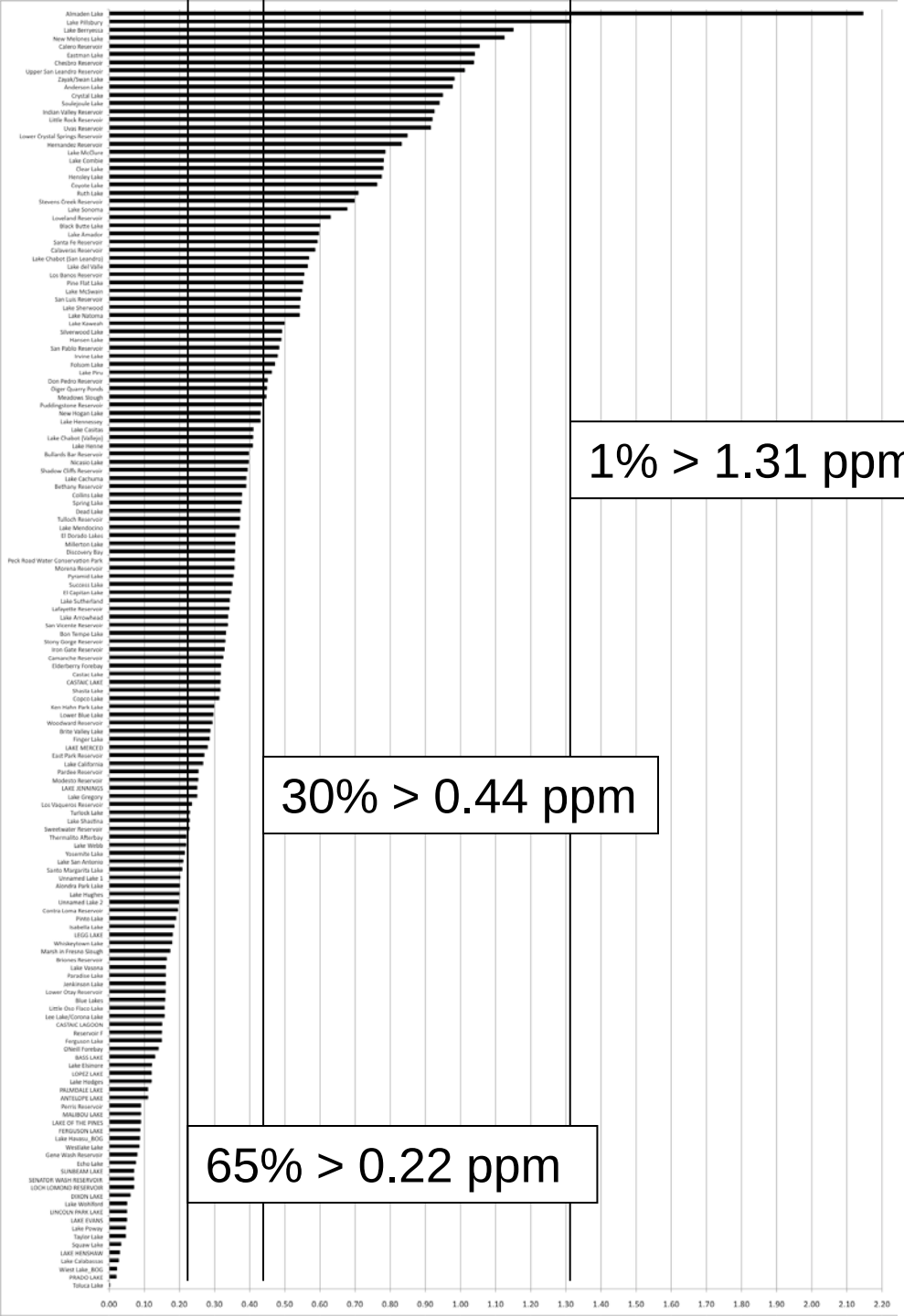
Outcomes

- 303(d) listings
- Statewide TMDL for mercury in reservoirs
- Statewide consumption advice for lakes
- Updates of specific advisories

SWAMP
Surface Water Ambient Monitoring Program

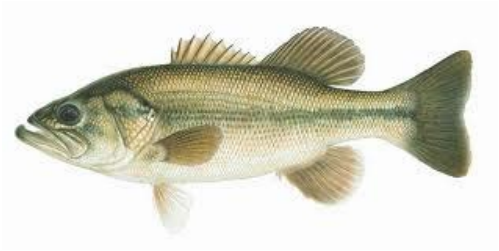
Fish Mercury in Lakes with Length-Adjusted Largemouth Bass

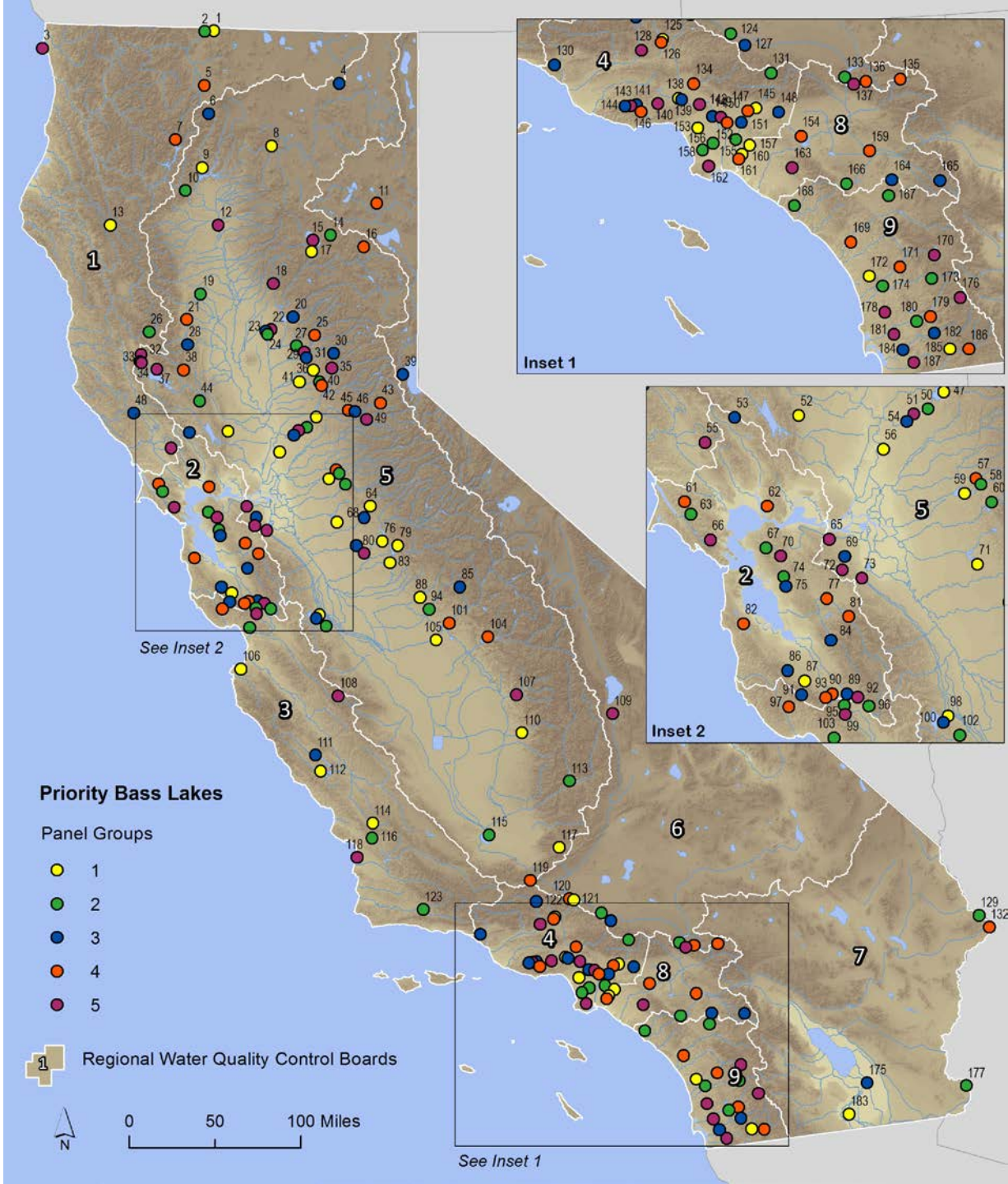
- 157 lakes sampled to date



Bass Lake Sampling Plan

- ~190 lakes
- 10 year update cycle for each lake
- Statewide trend





Wildlife Study

- 2012-2013
- Mercury
- Grebes and fish
- 25 lakes
- Significant risk at many lakes
- Prey fish as a monitoring tool

SWAMP Bioaccumulation Monitoring: Coast

Monitoring

- 2009-2010

Outcomes

- Statewide consumption advice for the coast (coming soon)

SWAMP
Surface Water Ambient Monitoring Program

SWAMP Bioaccumulation Monitoring: Rivers and Streams

Monitoring

- 2011

Outcomes

- 303(d) listing
- TMDL implementation

SWAMP
Surface Water Ambient Monitoring Program

Fact Sheet

Long-Term Monitoring

of Pollutants in Fish and Mussels Documents Major Improvements and Persistent Problems

"... Present concentrations of pollutants in fish collected from many California water bodies are high enough to cause concern for possible effects on human health ..."

Overview

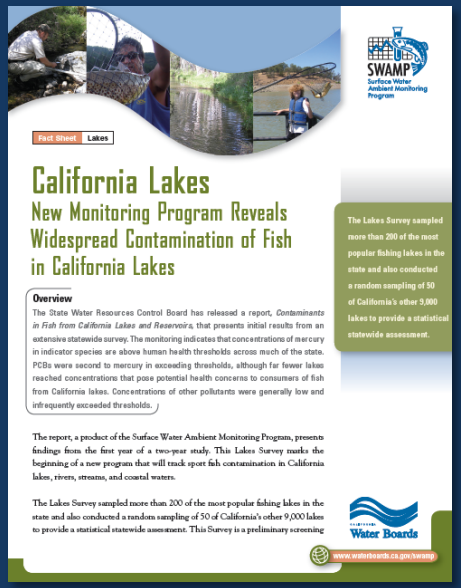
Bioaccumulation of Pollutants in California Waters: A Review of Historic Data and Assessment of Impacts on Fishing and Aquatic Life, an important report recently released by the State Water Resources Control Board, offers both reason for celebration and cause for concern. The review assessed the current status of bioaccumulation in waters of the state and set the stage for improved monitoring in the future.

Of the 390 sites sampled between 1998 and 2003, 32 percent fell into the "low" contamination category. These sites were scattered throughout the state, with a particular prevalence in the Sierra Nevada and the area north of San Diego. Unfortunately, the Delta region had relatively few sites with low concentration of pollutants. In general, PCB and DDT levels in fish and mussels across California have declined greatly since the 1970s, and many species have bounced back in response to the decline in DDT levels.

However, the report also found that present concentrations of pollutants in fish collected from many California water bodies are high enough to cause concern for possible effects on human health and to have a significant impact on the fishing beneficial use. The report found that fish in 68 percent of the water bodies sampled have "moderate to very high levels of mercury or persistent organics (such as PCBs and organochlorinated pesticides like DDT)." Consumption advisories exist for only a fraction of the water bodies likely to need them. Many water bodies with elevated contaminant levels in fish are near population centers and are popular for fishing. Furthermore, subsistence fishing is increasing, and consumption of contaminated fish is an environmental justice issue.

A Brief History of California Monitoring

Bioaccumulation refers to the uptake of toxic chemicals by animal species. In California waters, many chemicals of concern bioaccumulate in fish. As these chemicals reach high levels in species at the top of the food chain, they threaten the health of humans and wildlife.



Fact Sheet Lakes

California Lakes

New Monitoring Program Reveals Widespread Contamination of Fish in California Lakes

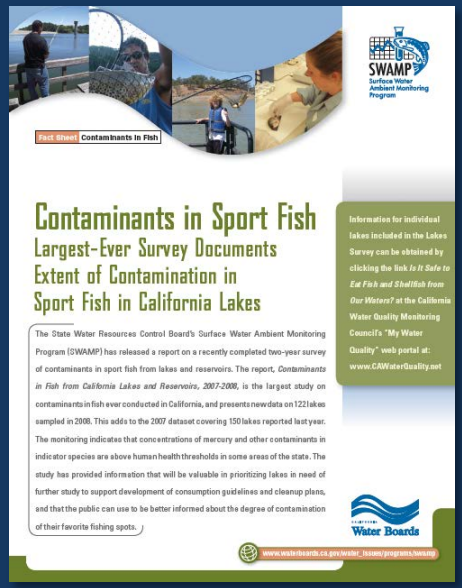
The Lakes Survey sampled more than 200 of the most popular fishing lakes in the state and also conducted a random sampling of 50 of California's other 9,000 lakes to provide a statistical statewide assessment.

Overview

The State Water Resources Control Board has released a report, *Contaminants in Fish from California Lakes and Reservoirs*, that presents initial results from an extensive statewide survey. The monitoring indicates that concentrations of mercury in indicator species are above human health thresholds across much of the state. PCBs were second to mercury in exceeding thresholds, although far fewer lakes reached concentrations that pose potential health concerns to consumers of fish from California lakes. Concentrations of other pollutants were generally low and infrequently exceeded thresholds.

The report, a product of the Surface Water Ambient Monitoring Program, presents findings from the first year of a two-year study. This Lakes Survey marks the beginning of a new program that will track sport fish contamination in California lakes, rivers, streams, and coastal waters.

The Lakes Survey sampled more than 200 of the most popular fishing lakes in the state and also conducted a random sampling of 50 of California's other 9,000 lakes to provide a statistical statewide assessment. This Survey is a preliminary screening



Fact Sheet Contaminants in Fish

Contaminants in Sport Fish

Largest-Ever Survey Documents Extent of Contamination in Sport Fish in California Lakes

Information for individual lakes included in the Lakes Survey can be obtained by clicking the link *Is It Safe to Eat Fish and Shellfish from Our Waters?* at the California Water Quality Monitoring Council's "My Water Quality" web portal at: www.CAWaterQuality.net

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released a report on a recently completed two-year survey of contaminants in sport fish from lakes and reservoirs. The report, *Contaminants in Fish from California Lakes and Reservoirs, 2007-2008*, is the largest study on contaminants in fish ever conducted in California, and presents new data on 122 lakes sampled in 2008. This adds to the 2007 dataset covering 150 lakes reported last year. The monitoring indicates that concentrations of mercury and other contaminants in indicator species are above human health thresholds in some areas of the state. The study has provided information that will be valuable in prioritizing lakes in need of further study to support development of consumption guidelines and cleanup plans, and that the public can use to be better informed about the degree of contamination of their favorite fishing spots.

Fact Sheet Contaminants in Fish

Contaminants in Sport Fish

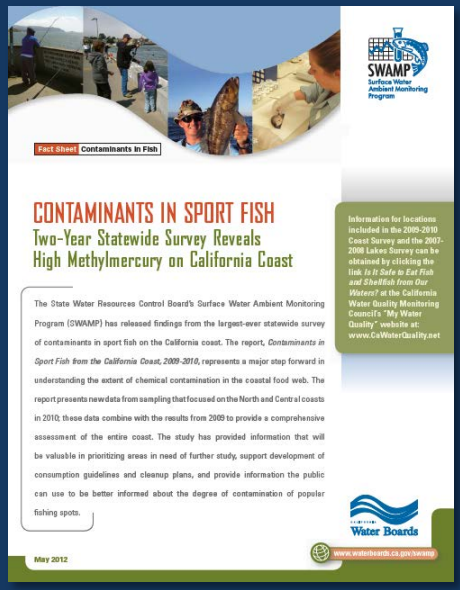
Two-Year Statewide Survey Begins with Focus on Urban Coastal Areas

Information for locations included in the 2009-2010 Coast Survey and the 2007-2008 Lakes Survey can be obtained by clicking the link *Is It Safe to Eat Fish and Shellfish from Our Waters?* at the California Water Quality Monitoring Council's "My Water Quality" web portal at: www.CaWaterQuality.net

Overview

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released a report on results from the first year of a two-year statewide screening survey of contaminants in sport fish from California coastal waters. The report, *Contaminants in Sport Fish from the California Coast, 2009*, represents a major step forward in understanding the extent of chemical contamination in sport fish on the California coast. Monitoring in 2009 focused on areas near Los Angeles and San Francisco, including San Francisco Bay. The study has provided information that will be valuable in prioritizing areas in need of further study, support development of consumption guidelines and cleanup plans, and provide information the public can use to be better informed about the degree of contamination of their favorite fishing spots.

May 2011



Fact Sheet Contaminants in Fish

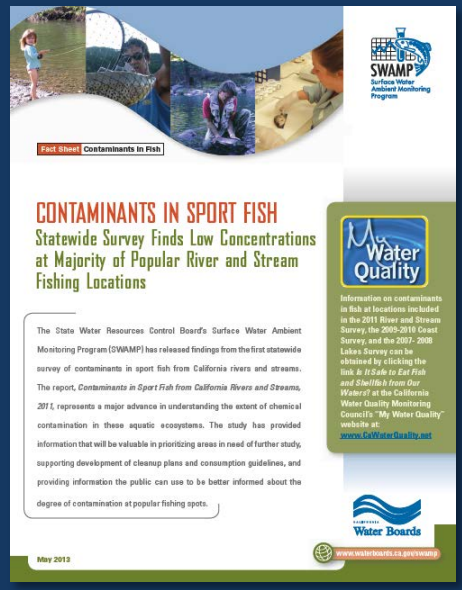
CONTAMINANTS IN SPORT FISH

Two-Year Statewide Survey Reveals High Methylmercury on California Coast

Information for locations included in the 2009-2010 Coast Survey and the 2007-2008 Lakes Survey can be obtained by clicking the link *Is It Safe to Eat Fish and Shellfish from Our Waters?* at the California Water Quality Monitoring Council's "My Water Quality" website at: www.CaWaterQuality.net

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released findings from the largest-ever statewide survey of contaminants in sport fish on the California coast. The report, *Contaminants in Sport Fish from the California Coast, 2009-2010*, represents a major step forward in understanding the extent of chemical contamination in the coastal food web. The report presents new data from sampling that focused on the North and Central coasts in 2010; these data combine with the results from 2009 to provide a comprehensive assessment of the entire coast. The study has provided information that will be valuable in prioritizing areas in need of further study, support development of consumption guidelines and cleanup plans, and provide information the public can use to be better informed about the degree of contamination of popular fishing spots.

May 2012



Fact Sheet Contaminants in Fish

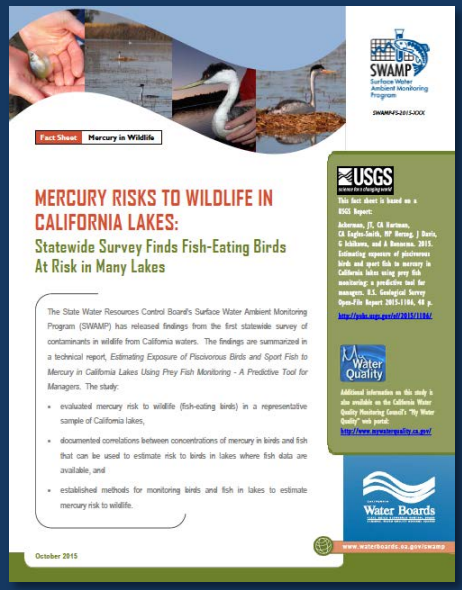
CONTAMINANTS IN SPORT FISH

Statewide Survey Finds Low Concentrations at Majority of Popular River and Stream Fishing Locations

Information on contaminants in fish at locations included in the 2011 River and Stream Survey, the 2009-2010 Coast Survey, and the 2007- 2008 Lakes Survey can be obtained by clicking the link *Is It Safe to Eat Fish and Shellfish from Our Waters?* at the California Water Quality Monitoring Council's "My Water Quality" website at: www.CaWaterQuality.net

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released findings from the first statewide survey of contaminants in sport fish from California rivers and streams. The report, *Contaminants in Sport Fish from California Rivers and Streams, 2011*, represents a major advance in understanding the extent of chemical contamination in these aquatic ecosystems. The study has provided information that will be valuable in prioritizing areas in need of further study, supporting development of cleanup plans and consumption guidelines, and providing information the public can use to be better informed about the degree of contamination at popular fishing spots.

May 2013



Fact Sheet Mercury in Wildlife

MERCURY RISKS TO WILDLIFE IN CALIFORNIA LAKES:

Statewide Survey Finds Fish-Eating Birds At Risk in Many Lakes

This fact sheet is based on a USGS Report:

Ackerman, JT, CA Hartman, CA Eagles-Smith, MP Herring, J Davis, C Feddersen, and A Bonnema. 2015. Estimating exposure of piscivorous birds and sport fish in mercury in California lakes using prey fish monitoring: a predictive tool for managers. U.S. Geological Survey Open-File Report 2015-1184, 48 p.

http://pubs.usgs.gov/of/2015/1184/

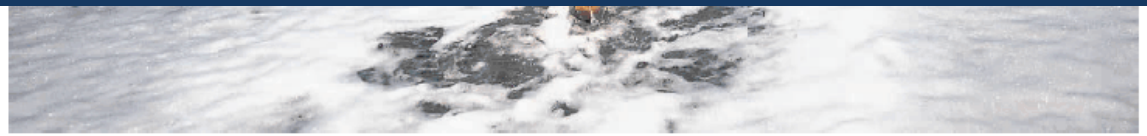
Additional information on this study is also available on the California Water Quality Monitoring Council's "My Water Quality" web portal:

http://www.mywaterquality.ca.gov/

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released findings from the first statewide survey of contaminants in wildlife from California waters. The findings are summarized in a technical report, *Estimating Exposure of Piscivorous Birds and Sport Fish to Mercury in California Lakes Using Prey Fish Monitoring - A Predictive Tool for Managers*. The study:

- evaluated mercury risk to wildlife (fish-eating birds) in a representative sample of California lakes,
- documented correlations between concentrations of mercury in birds and fish that can be used to estimate risk to birds in lakes where fish data are available, and
- established methods for monitoring birds and fish in lakes to estimate mercury risk to wildlife.

October 2015



Photos by Michael Short / Special to The Chronicle

Angella Miller of Chicago walks out into the water to skip rocks at Baker Beach, one of two beaches in San Francisco that received top honors in the annual water-quality survey. The other is Ocean Beach.

By Carolyn Jones

Dry weather and stricter regulations have boosted water quality at Bay Area beaches to their cleanest level in years, a report released Thursday found.

Nearly every beach in the Bay Area, and throughout the state, had dramatically lower levels of bacteria and pollution than last year, according to an annual survey of 650 West Coast beaches by Heal the Bay, a Santa Monica environmental group.

Water quality is also better at popular Candlestick Point in S.F.

"This is one of our best years yet," said Amanda Griesbach, a water-quality scientist at Heal the Bay, which compiled its data from weekly water-quality checks throughout the year along the California coast. "Especially with summer coming, people should be happy that beaches in California are clean."

Six local beaches earned top honors, including four in San Mateo County and two in San Francisco: Sharp Park and Rockaway

Water continues on A12

Species of fish dictates level of mercury

By Demian Bulwa

A sweeping state survey of contaminants in sport fish that were hooked, netted or speared in 68 spots on the California coast underscores a lesson for seafood lovers: Choose well your next fillet.

In general, mercury levels in the fish — caught during 2009 and 2010 — were of "high concern," particularly along the North and Central coasts, said a report released Thursday by the State Water Resources Control Board.

Fish reports

- The state study on contaminants in California sport fish is at links.sfgate.com/ZLKL
- The state provides advisories and guidelines on safe fish consumption at links.sfgate.com/ZLKM

But while San Francisco Bay and other urban spots showed higher mercury pollution, the key driver of the contamination wasn't location but type of fish.

Long-living predators such as sharks and some forms of rockfish were found to have the highest levels of methylmercury, the type that becomes concentrated in fish tissue, wherever they were caught.

Fish continues on A12

ing

SENTINEL

n teen

M

cl

STATE STUDY

High levels of mercury found in some state sport fish

By AARON KINNEY
Bay Area News Group

A new report by California's water quality agency shows that certain fish species tend to contain moderate to high levels of methymercury, a toxin that damages the nervous system of humans, no matter where they are caught off the coast.

The findings reflect the global spread of mercury pollution and yield new information for anglers and consumers on which wild-caught species tend to accumulate the substance, the study's chief scientist said. Overall, the data show that methymercury and polychlorinated biphenyls, or PCBs, continue to be a concern in fish caught in California waters.

The report identifies seven species of

SEE **FISH** ON **A2**

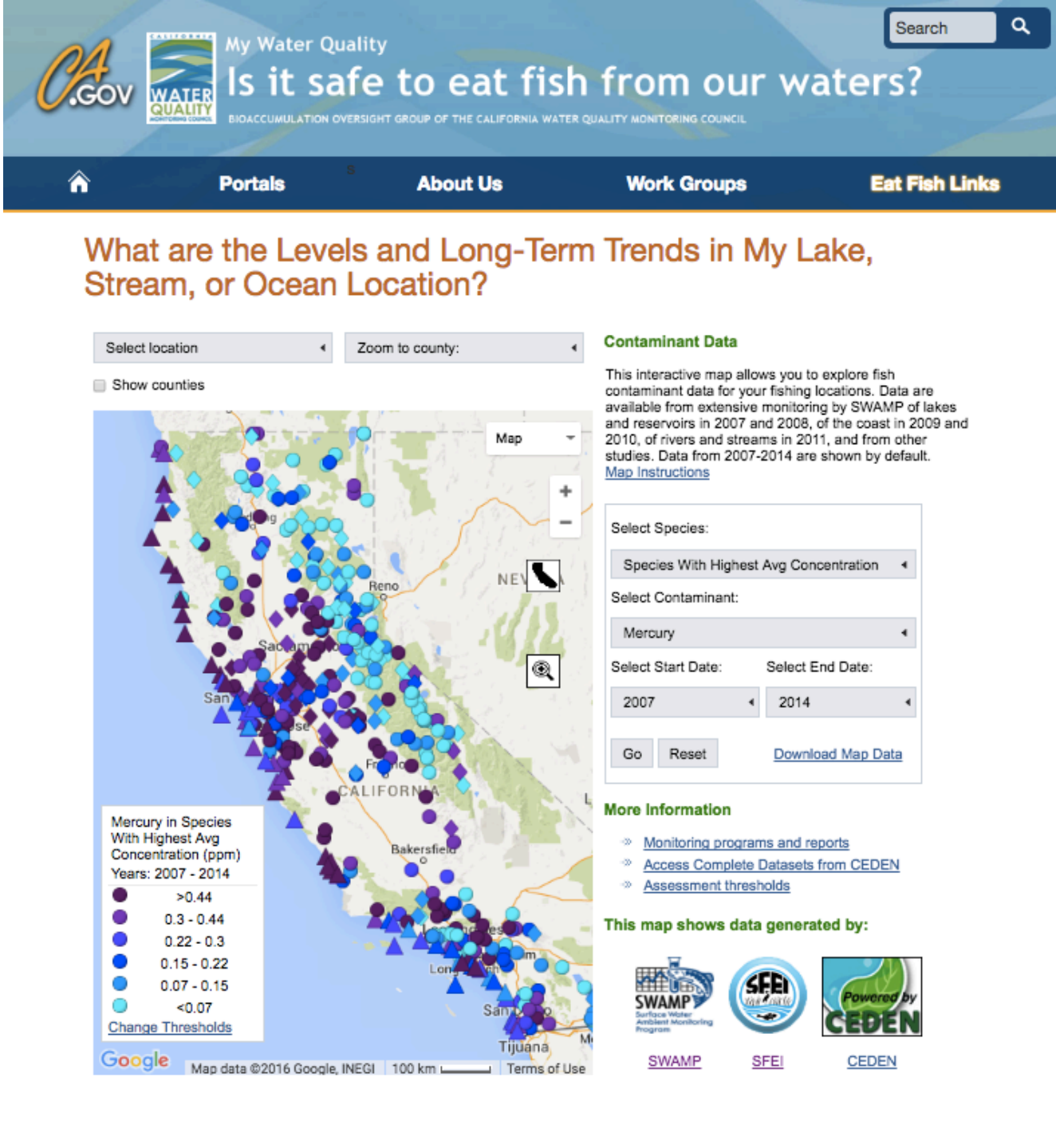
Only in The Chronicle

Stories with this logo in today's Chronicle can be found only in The Chronicle's print

Index

My Water Quality:

“Safe to Eat” Portal



More Information

- Google “Bioaccumulation Oversight Group” – SWAMP web site
- Email jay@sfei.org to be added to the BOG email distribution list
- www.mywaterquality.ca.gov