The Fish Mercury Project

Highlights from a Mid-term Report

THE FULL REPORT contains the following articles:

Topic	*Lead Author*	*Email*
Project Overview	Jay Davis	jay@sfei.org
Sport Fish Monitoring	Letitia Grenier	letitia@sfei.org
Safe Eating Guidelines	Margy Gassel	MGASSEL@oehha.ca.gov
Stakeholder Involvement and Risk Communication	Alyce Ujihara	Alyce.Ujihara@cdph.ca.gov
Small Fish Biosentinel Monitoring	Darell Slotton	dgslotton@ucdavis.edu

CONTRIBUTION NO. 538
NOVEMBER 2007

San Francisco Estuary Institute • www.sfei.org

THIS FACT SHEET presents highlights from a report produced by the Fish Mercury Project, the most comprehensive study to date on mercury contamination of fish in the Bay-Delta watershed and a ground-breaking effort to reduce mercury exposure through communicating safe eating guidelines to people who enjoy consuming fish from the Delta region. The report is a mid-point review of the Project's work, which began in 2004 and will be completed in 2008. The full report is available upon request from the San Francisco Estuary Institute (contact Jay Davis: jay@sfei.org) or from the Project website: www.sfei.org/cmr/fishmercury.

FACT SHEET

A Mid-term Report

The Fish Mercury Project (FMP) is a groundbreaking $4.7 million effort funded by CALFED (www.calwater.ca.gov) and conducted by a team of scientists led by the San Francisco Estuary Institute (SFEI – www.sfei.org). The FMP's near-term goal is reduction of human exposure to mercury in the Delta region through increased public awareness of fish contamination. The FMP also is providing information to water quality managers pursuing the ultimate, long-term solution to the mercury problem – reducing mercury accumulation in the food chains of our aquatic ecosystems.

To attain these goals, the FMP has developed innovative approaches to monitoring mercury in fish. Sport fish monitoring is being coordinated with the development of consumption advice, public outreach activities and educational materials. Members of the communities most affected by fish contamination are providing an unprecedented amount of input into these efforts, making this the first major water quality monitoring effort in California to incorporate environmental justice principles.

The FMP also is employing small fish as "biosentinels" to track the entry points of mercury into the food web. This innovative approach is advancing our understanding of mercury dynamics in the region's waters to help ecosystem managers reduce the movement of mercury into the food web.

This Fact Sheet summarizes an 80 page report on progress made by the Project at its midway point. The full report provides a non-technical summary that is intended to give decision-makers, environmental managers, county agency staff, community leaders and the public information they need to understand and ultimately solve the mercury problem. The FMP began in late 2004 and will end in the summer of 2008.

Overview of the Project. The report begins with an article providing background on the mercury problem in the Bay-Delta watershed and an overview of the Project. The watershed includes thousands of miles of rivers and streams and thousands of lakes and reservoirs. This vast region supports a large and growing human population (currently over 9 million). Many of these people catch and eat fish from the watershed.

Unfortunately, fish contamination in the watershed is a serious environmental and public health concern. Intensive gold and mercury mining across the watershed has left a legacy of mercury contamination; as a result, many fish populations are tainted with mercury. In the Bay-Delta and surrounding areas, the contamination is among the most extensive in the state. An additional cause for concern relates to the ambitious habitat restoration programs underway in the Bay-Delta system. CALFED and others are investing considerable resources in restoring wetlands and other aquatic habitats, a process certain to provide substantial benefits for fish and wildlife populations. However, exacerbation of the existing mercury problem is a potential side effect of restoration activities because wetlands and newly flooded habitats can accelerate mercury uptake into the food chain.

Integrated Monitoring. Project scientists coined the term "integrated monitoring" to describe the FMP's approach to sport fish monitoring (PAGE 3). Integrated monitoring consists of three components: monitoring mercury levels in fish, developing consumption advice and communicating risk. All three activities are influenced by input from stakeholders – e.g., communities affected by fish contamination. In developing monitoring plans, information is solicited from stakeholders on the places they fish and the species they consume. A high priority is then placed on sampling these species and locations. This targeted monitoring information is then used to develop consumption advice. Agencies involved in risk communication then work with stakeholders to convey this consumption advice back to the fishing communities.

The FMP is conducting the most extensive monitoring to date of mercury in sport fish in the Delta region. In 2005, the FMP and other smaller programs collected over 2000 fish from 22 species and 69 popular fishing locations. Mercury concentrations in fish varied significantly among species, locations, and with fish size. Overall, largemouth bass was the most contaminated of the target species, and bluegill and redear sunfish were the least (PAGE 4). The least contaminated locations sampled in 2005 were mainly in the central and southern Delta (PAGE 5). The most contaminated locations were along the mainstem and tributaries of the Sacramento and San Joaquin Rivers, as well as the Cosumnes River. For many species (including largemouth bass, Sacramento sucker, and Sacramento pikeminnow), larger and older fish had higher concentrations of mercury.

Safe Eating Guidelines. To support development of safe eating guidelines, the FMP team divided the very large study area into three parts. The San Joaquin River and South Delta (south of the San Joaquin River) were the focus during the first year. After a thorough evaluation, the Office of Environmental Health Hazard Assessment (OEHHA – www.oehha.ca.gov) found that mercury levels in many types of fish from the South Delta area were quite low. These fish included bluegill and redear sunfish, catfish, clams, crayfish, crappie, carp, sucker, and even largemouth bass. Consumption of up to two meals per week (a total of six ounces cooked) of all of these species in this region is considered safe for all fish consumers (PAGE 7). In comparison, some of the same species found in the San Joaquin River south of Stockton contained higher levels of mercury. The higher levels of mercury in largemouth bass from the San Joaquin River (south of the Port of Stockton) could be a concern for pregnant women and children. The safe eating guidelines for this region recommend that women of childbearing age and children avoid eating largemouth bass and other black bass (PAGE 8).

Variation in mercury concentrations provides opportunities for consumers to reduce their mercury exposure by targeting fish with low concentrations. Consumers can still obtain the numerous health benefits provided by a diet that includes fish. Fish are a good source of protein and also contain "good fats" – omega-3 fatty acids – which support healthy hearts and brain development. Safe eating guidelines developed by OEHHA provide information on risks and benefits of eating fish that allow consumers to minimize their exposure to mercury and other pollutants while maintaining fish in their diets.

Risk Communication. Although fishing for food is a significant activity in the Bay-Delta watershed, anglers generally are not very aware of fish contamination issues and effective health protection measures. In the FMP, the California Department of Public Health (CDPH - www.cdph.ca.gov) is working with community-based organizations and county agency staff (comprising the "Local Stakeholder Advisory Group," or LSAG) to develop and implement strategies for informing the public about the benefits and risks of fish consumption.

CDPH has gathered information on fishing and risk communication from multiple sources across the watershed, through meetings with county agencies and other groups in 23 counties, discussions with anglers in focus groups (including over 100 anglers from Lao, Cambodian, Hmong, Vietnamese, Latino, Russian, African American, and Native American communities), surveys, interviews with fish and game wardens, and other sources. A major effort guided by the LSAG led to the posting of multi-language signs with safe fish eating guidelines in about 60 locations throughout the five Delta counties. The LSAG also guided the development, translation, and distribution of fish contamination educational materials, including printed cards, brochures, flyers, and posters; these materials were produced in multiple languages and a variety of literacy levels. Additionally, CDPH established a program providing small grants to community-based organizations to conduct outreach and education activities aimed at raising awareness in their communities.

Monitoring Restoration Projects. Darell Slotton from UC Davis is another partner in the FMP and is performing the most extensive monitoring ever conducted of small fish in the watershed. These "biosentinels" are being collected from 50 sites throughout the watershed, especially near large wetland restoration projects. Encouraging results were obtained from the Napa Marsh area, the site of some of the most extensive wetland restoration activities in the watershed, including projects initiated in 1995, 2002, and 2006 (PAGE 6). Biosentinel fish collected in 2006 from a Napa Marsh salt pond that was opened to tidal action earlier that year had the lowest mercury observed for the indicator species across the entire watershed. Fish from other locations in this area also had low concentrations in both 2005 and 2006.

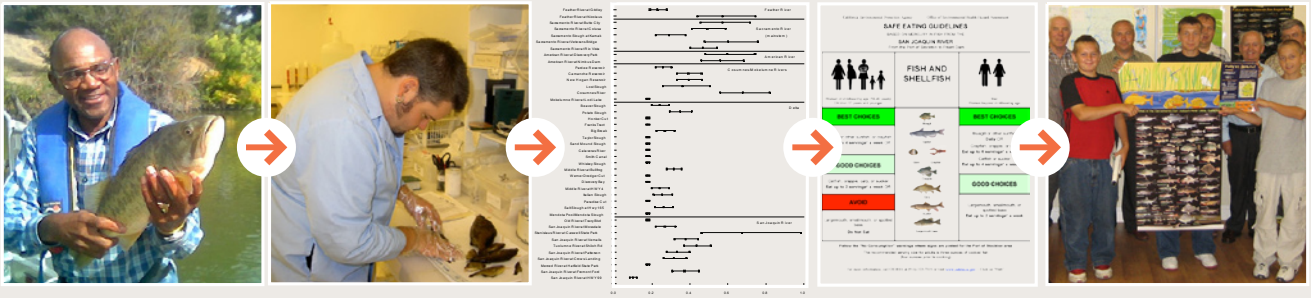
These findings indicate that some restoration projects may be associated with reduced, rather than increased, mercury accumulation in the food chain. Other significant findings from the biosentinel work to date include the observation that seasonal variation in mercury uptake seems associated with episodic flooding of normally dry soils, documentation of significant year-to-year variation, and an improved general understanding of the spatial pattern of accumulation across the watershed.

Completing the Project. FMP activities will continue through August 2008. Reports to be completed at the end of the project will document the results of extensive monitoring in 2006 and 2007, safe eating guidelines for the Sacramento River and North Delta, and additional efforts to reduce mercury exposure in the near-term through effective communication of risk information to fish consumers. ●

Integrated Monitoring

An innovative aspect of the FMP is the integration of sport fish monitoring with stakeholder involvement, advisory development, and risk communication – a procedure known as "integrated monitoring." This process begins and ends with the stakeholders. In developing monitoring plans, information is solicited from stakeholders on the places where they fish and the species they eat. Monitoring plans also take into consideration development of consumption advice and risk communication information. Ultimately, this collaborative approach – involving stakeholders, researchers, risk assessors and risk communicators – generates information that is technically sound and useful to stakeholders. In the final step of the integrated monitoring process, the agencies involved in risk communication work with stakeholders to disseminate essential information back to the fishing communities.

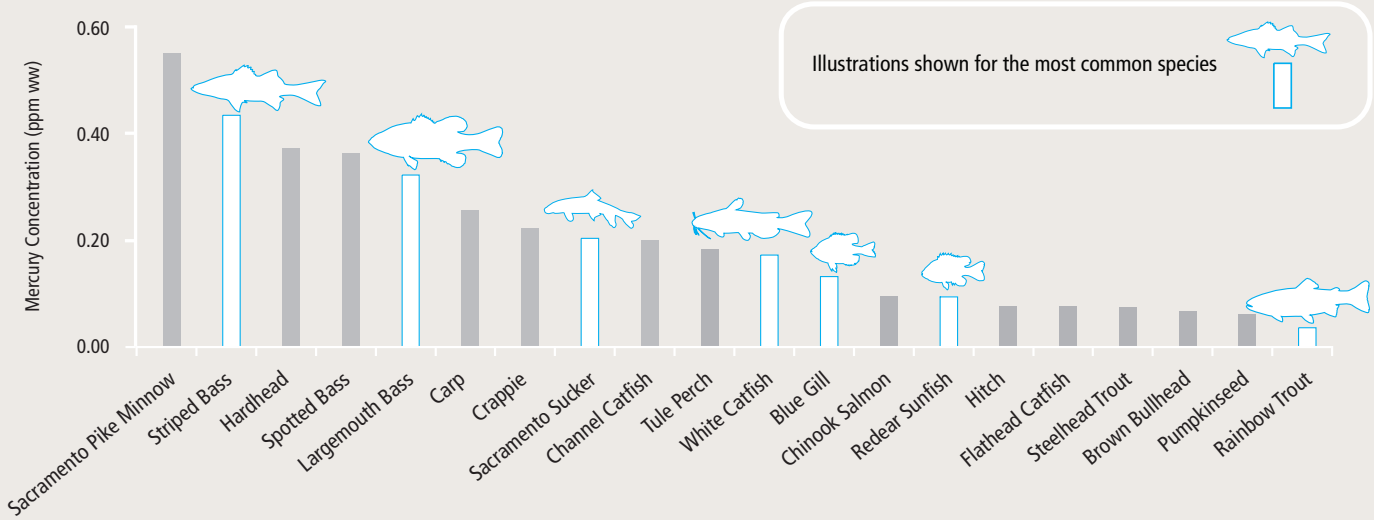
From Monitoring to Risk Communication



Field Sampling → Laboratory Analysis → Data Analysis → Advisory Development → Risk Communication

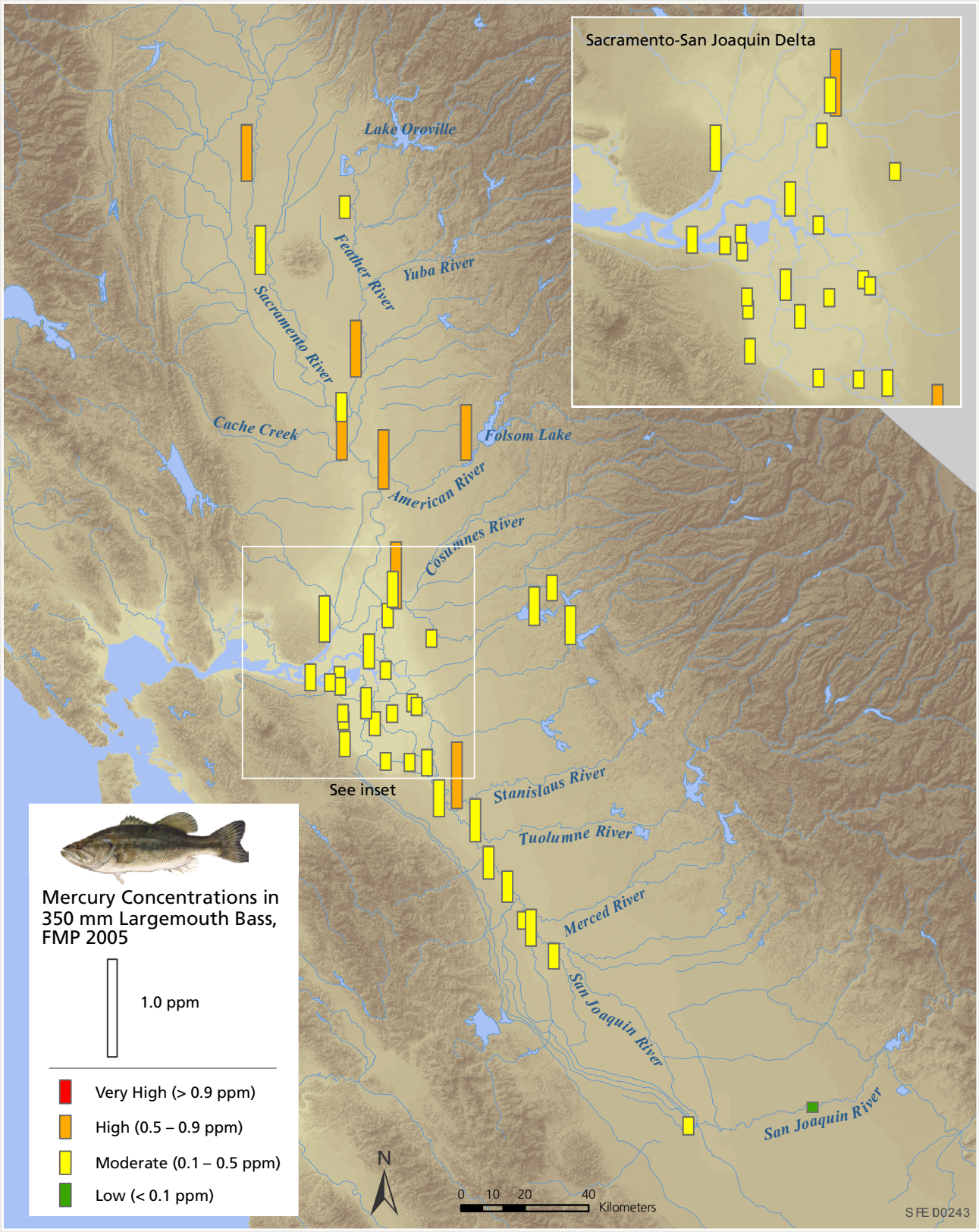
Once sport fish are collected and analyzed for mercury, the Office of Environmental Health Hazard Assessment (OEHHA) uses the data in combination with other information to determine recommendations for safe fish consumption. This advice specifies fish species, size and fishing locations. It also addresses the health benefits of eating fish and the hazards associated with other fish contaminants. The California Department of Public Health then works with stakeholders on outreach programs to circulate these safe eating guidelines throughout the fishing community.

Choosing Safer Species



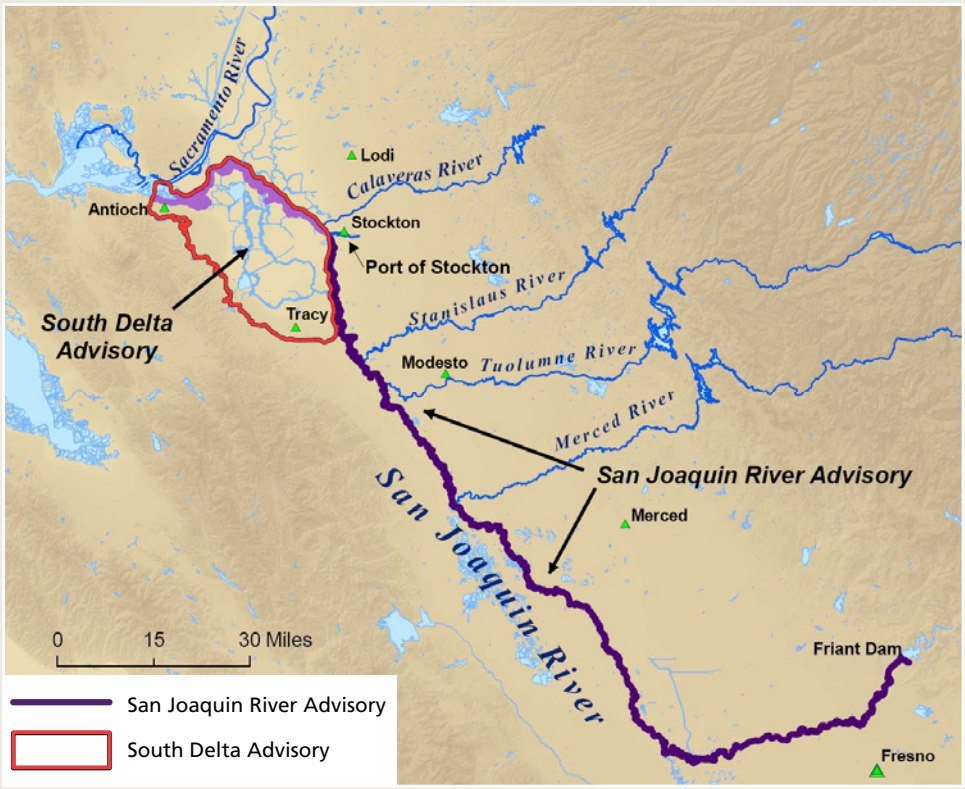
Some species of fish tend toward higher mercury levels, while others usually have lower levels. The species consumers choose can greatly affect the amount of mercury ingested. Predatory fish that eat other fish – such as striped bass and largemouth bass – tend to have higher mercury levels than fish such as trout and redear sunfish, which consume invertebrates, forage species that are lower in the food web. Driving this phenomenon is "biomagnification": the higher the position a species inhabits in the food chain, the greater the mercury load. Most fishing locations support a variety of fish species, each representing a relatively better or worse consumption choice in regard to mercury. Safe eating guidelines from OEHHA specify these choices for particular fishing locations. This figure shows the average mercury concentration for each species based on the monitoring conducted throughout the region in 2005.

Location Makes a Difference



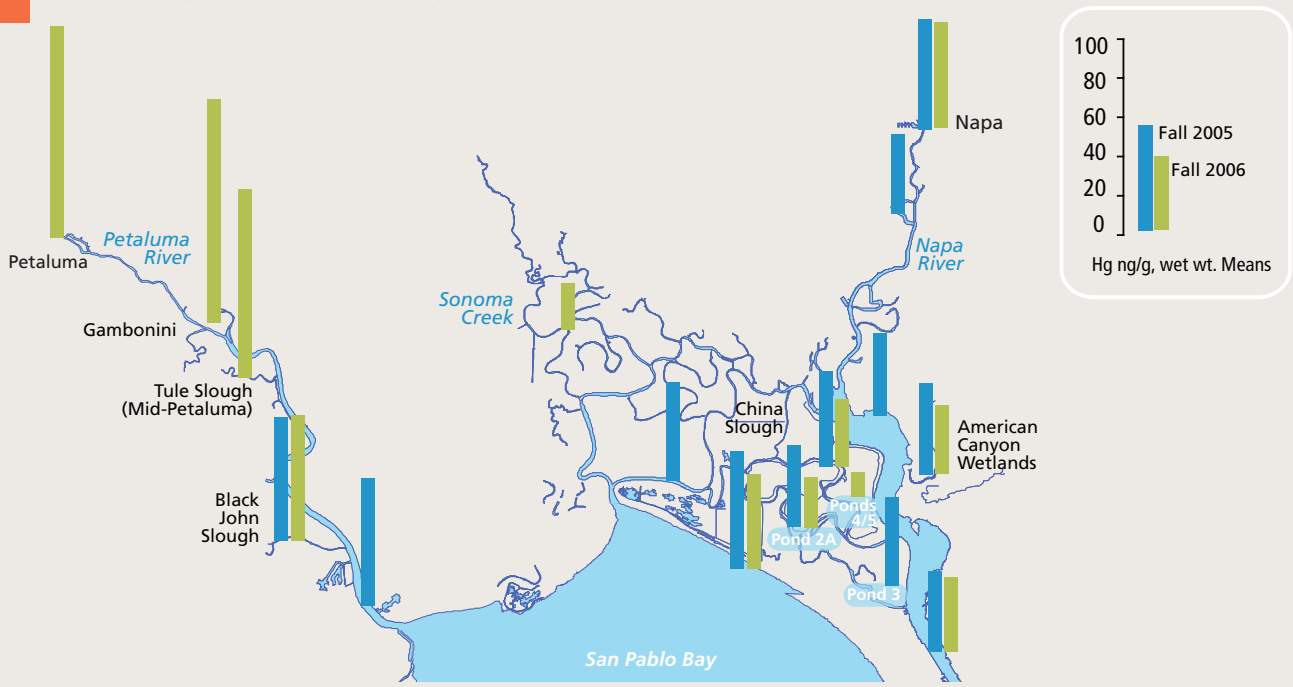
The amount of mercury in fish varies depending on location. For example, largemouth bass from the Sacramento River tend to have higher mercury levels than largemouth bass from the central Delta. The general pattern illustrated here for largemouth bass tends to be similar for many other sport fish species, including white catfish, channel catfish, carp and bluegill. The reasons for this phenomenon are not well understood, and researchers are trying to determine the environmental factors that can cause these regional fluctuations in mercury uptake.

Draft Safe Eating Guidelines for the South Delta and San Joaquin River



The FMP is drafting Safe Eating Guidelines for each of the study regions. This map defines the two advisory regions for which guidelines have recently been developed. The South Delta Region includes the San Joaquin River from the Sacramento River to the Port of Stockton and other rivers, sloughs and flooded tracts south of the San Joaquin River. The San Joaquin River Region runs from the Port of Stockton to Friant Dam.

Monitoring the Local and Regional Impacts of Wetland Restoration



Analyses of small biosentinel fish provide accurate snapshots of mercury trends, and are central to the FMP's work. Biosentinel sampling of North Bay locales in 2005 and 2006 found that the Napa-Sonoma Marsh contained lower fish mercury levels than adjacent aquatic habitats. The Petaluma Marsh demonstrated elevated exposure, possibly linked to episodic flooding of the area's extensive high marsh.

California Environmental Protection Agency Office of Environmental Health Hazard Assessment

SAFE EATING GUIDELINES

BASED ON MERCURY IN FISH FROM THE

SOUTH DELTA

*INCLUDING THE SAN JOAQUIN RIVER FROM ITS CONFLUENCE WITH THE SACRAMENTO RIVER TO ITS CONFLUENCE WITH THE CALAVERAS RIVER, AND RIVERS, SLOUGHS, AND FLOODED TRACTS IN THE DELTA SOUTH OF THE SAN JOAQUIN RIVER

Women of childbearing age (18-45 years) Children 17 years and younger	**FISH AND SHELLFISH**	Men Women beyond childbearing age
BEST CHOICES	Bluegill	**BEST CHOICES**
Bluegill or other sunfish, catfish, clams, or crayfish **Eat up to 4 servings* a week** OR	Catfish	Bluegill or other sunfish **Daily** OR
GOOD CHOICES	Clam Crayfish	Clams, crayfish, crappie, or carp **Eat up to 6 servings* a week** OR
Crappie; carp; sucker; largemouth, smallmouth, or spotted bass **Eat up to 2 servings* a week**	Crappie	Catfish; sucker; largemouth, smallmouth, or spotted bass **Eat up to 4 servings* a week**
AVOID	Carp	**AVOID**
Striped bass (18-27 inches) or sturgeon **No more than 2 servings* a month**	Sucker Largemouth bass	Striped bass(18-35 inches) or sturgeon **No more than 4 servings* a month**
Striped bass over 27 inches **Do Not Eat**	Striped bass	Striped bass over 35 inches **Do Not Eat**

Follow the "No Consumption" warnings where signs are posted for the Port of Stockton area

The recommended serving size for adults is three ounces of cooked fish (four ounces prior to cooking)

For more information, call OEHHA at (916) 323-7319 or visit www.oehha.ca.gov – Click on "Fish"

California Environmental Protection Agency Office of Environmental Health Hazard Assessment

SAFE EATING GUIDELINES

BASED ON MERCURY IN FISH FROM THE

SAN JOAQUIN RIVER

From the Port of Stockton to Friant Dam

Women of childbearing age (18-45 years) Children 17 years and younger	**FISH AND SHELLFISH**	Men Women beyond childbearing age
BEST CHOICES	Bluegill Catfish Clam Crayfish Crappie Carp Sucker Largemouth bass	**BEST CHOICES**
Bluegill or other sunfish, or crayfish **Eat up to 4 servings* a week** OR		Bluegill or other sunfish **Daily** OR Crayfish, crappie, or carp **Eat up to 6 servings* a week** OR Catfish or sucker **Eat up to 4 servings* a week** OR
GOOD CHOICES		**GOOD CHOICES**
Catfish, crappie, carp, or sucker **Eat up to 2 servings* a week** OR		Largemouth, smallmouth, or spotted bass **Eat up to 2 servings* a week**
AVOID		
Largemouth, smallmouth, or spotted bass **Do Not Eat**		

Follow the "No Consumption" warnings where signs are posted for the Port of Stockton area

The recommended serving size for adults is three ounces of cooked fish
(four ounces prior to cooking)

For more information, call OEHHA at (916) 323-7319 or visit www.oehha.ca.gov – Click on "Fish"

Credits and Acknowledgments

Authors: Jay Davis, Glen Martin

Illustrations: Jay Davis, Letitia Grenier, Shira Bezalel, Aroon Melwani, Margy Gassel, Sue Roberts, Darell Slotton, Joanne Cabling

Project Management: Jennifer Hunt

Design: Linda Wanczyk

Printing: Alonzo Printing www.alonzoprinting.com

Funding provided by the CALFED Ecosystem Restoration Program, grant #ERP-02D-P67. The investigators acknowledge the state of California, CALFED, the Resources Agency, the California Bay-Delta Authority, the California Department of Fish and Game, the California Department of Water Resources, and all of CALFED's cost sharing partners, and thank Carol Atkins, Donna Podger, Mary Menconi, and Leann Androvich for project support.

San Francisco Estuary Institute • www.sfei.org • 7770 Pardee Lane, Oakland, CA 94621 • p: 510-746-SFEI (7334), f: 510-746-7300