

**Fishing for Food  
in San Francisco Bay**

An Environmental Health and Safety Report  
from Save San Francisco Bay Association

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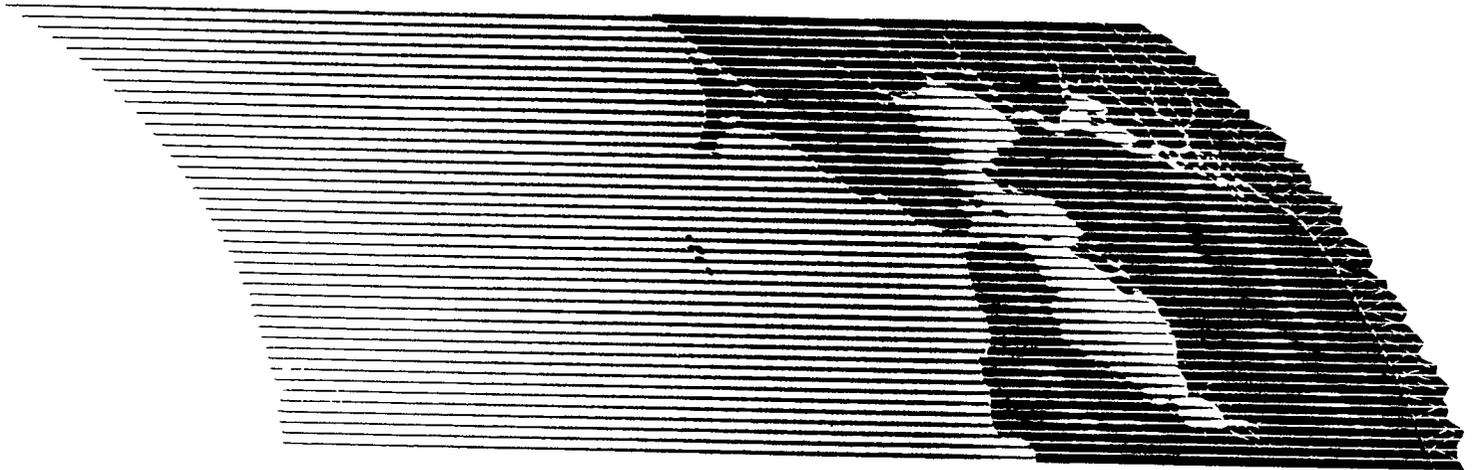
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**The Seafood  
Consumption  
Information  
Project**

was funded through  
the generous financial  
support of the following  
organizations and  
individuals.  
Save San Francisco Bay  
Association gratefully  
acknowledges their  
contributions.

**The San Francisco  
Foundation**  
*The San Francisco*  
**FOUNDATION**

**The Columbia  
Foundation**

**The Employees of  
Genentech, Inc.**

**The Environmental  
Careers  
Organization, Inc.**

**Richard and Rhoda  
Goldman Fund**

**World Wildlife  
Fund Innovation  
Grants**

and

**The Members of  
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Bay Association**

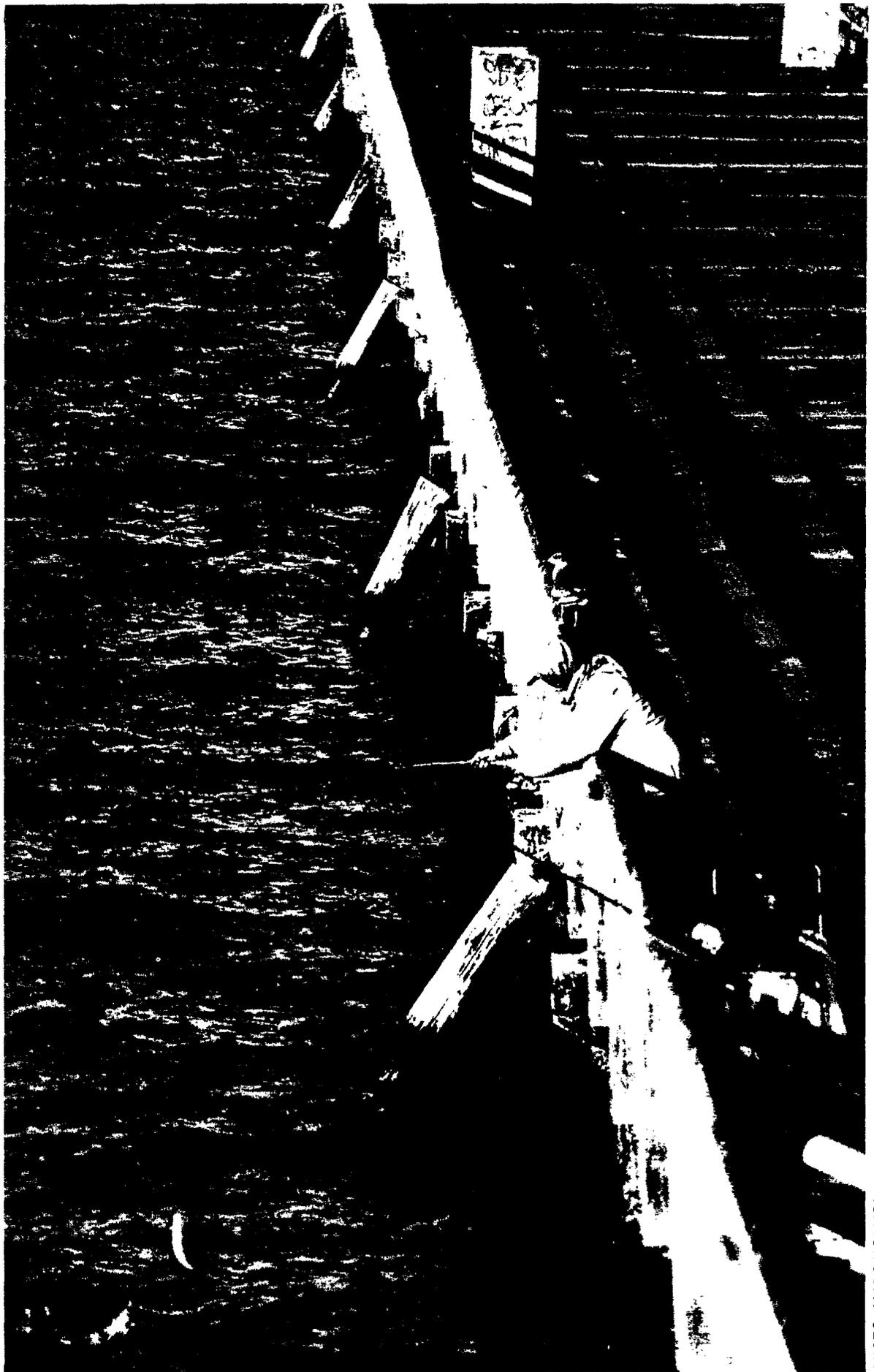


PHOTO: MARC HOLMES

## **Preface**

San Francisco Bay is regarded widely as one of the most spectacular and mesmerizing natural landscapes in the world. Millions of people visit the Bay to experience its unsurpassed beauty and to revitalize their spirits. The Bay's very existence in the midst of one of the largest urbanized regions in the nation is a constant reminder of society's unseverable dependence upon the underlying natural environment.

Many people come to the shores of the Bay not for the sumptuous spiritual feast, however, but literally to put food upon their tables. Their connection to the Bay is direct: they rely for their very sustenance on the intricate web of marine and estuarine life beneath the Bay's surface. There they find an abundance of fish, as well as other edible aquatic life such as crabs and shrimp.

Few people other than scientific researchers pay much attention to the health of these Bay organisms. Those few know, however, that San Francisco Bay is being transformed from a productive estuary that was a cornucopia of life for pre-European inhabitants into a barren marine embayment. They are concerned that the health of smelt, perch, white croaker, crabs and other Bay species is being damaged by the changes the Bay is undergoing. Among the primary causes of this transformation is the discharge of enormous quantities of pollutants into the Bay's waters.

In part because of this pollution, San Francisco Bay virtually is dead as a commercial fishery. And although Bay seafood no longer is sold on the retail market, it still is finding its way onto the dinner tables of those who fish the Bay, most of them people of color.

At least hundreds, and perhaps thousands, of Asian, African-American, Hispanic and Pacific Islanders are consuming large quantities of contaminated San Francisco Bay seafood every week. These fishers are not protected by government regulation, either because they have no voice in the political arena, or because those who discharge pollutants actively strive to obstruct efforts to investigate the impacts of those pollutants on the health of the Bay.

The Seafood Consumption Information Project is a preliminary investigation into the make-up of this little-known population of fishers. It examines their fishing and seafood consumption habits, and explores what government is doing to address the possible health impacts of their fishing activities. Save San Francisco Bay Association undertook this investigation with the ultimate goal of restoring a safe and fishable San Francisco Bay. That right is guaranteed by State and Federal law, and it is a tragedy that it is being denied the American public.

Marc Holmes  
Program Director  
Save San Francisco Bay Association

# Executive Summary

Last year a government study<sup>1</sup> showed that toxic contaminants are routinely present in several species of fish that are caught and eaten by anglers in San Francisco Bay. However, there is relatively little information available on who is eating these fish, on what parts of these fish are eaten, and on how much of each species is eaten. Without knowledge of these factors, regulatory agencies cannot make accurate assessments of health risk, nor devise effective strategies to communicate with the public and to persuade those who are catching, preparing and eating seafood from the Bay to take steps that will reduce their health risk.

In this report we review the government programs related to this public health issue, and find that although various government agencies address limited aspects of the problem, there is no overall program that monitors, assesses and works to minimize the risk to the public from eating Bay-caught seafood.

We also report on a pilot study conducted by Save San Francisco Bay Association (SSFBA) on the harvest and consumption of Bay-caught seafood. This study involved a survey of individuals fishing from Central Bay public piers from September to October, 1993, supplemented by a more a detailed interview of three anglers.

## Results of the Survey

Sixty-nine individuals ("respondents") completed the survey. Forty-eight percent identified themselves as Asian (Chinese, Filipino, Mien, Thai or Indian), and 28 percent as African-American. Most of the respondents were residents of Oakland and San Francisco, and about half were unemployed at the time of the survey.

Just over forty percent of all respondents reported eating Bay-caught seafood in the previous 30 days, most of whom were Asian (69% of those who ate Bay-caught seafood) or African-American (14%).

### Race/Ethnicity of Survey Respondents

	NUMBER OF RESPONDENTS		RESPONDENTS WHO ATE BAY-CAUGHT SEAFOOD IN THE PAST 30 DAYS	
		PERCENT OF TOTAL		
Asian	33	[48%]	19	[69%]
African-American	19	[28%]	4	[14%]
White/non-Hispanic	8	[12%]	2	[ 7%]
Latino/Hispanic	3	[ 4%]	2	[ 7%]
Native American	1	[ 1%]	0	
Pacific Islander/Hawaiian	1	[ 1%]	0	
Other Race	2	[ 3%]	1	[ 4%]
Mixed Heritage	2	[ 3%]	0	
<b>TOTAL</b>	<b>69</b>	<b>[100%]</b>	<b>28</b>	<b>[100%]</b>

Sixteen survey respondents who ate Bay-caught seafood in the previous week reported eating an average of 81 grams (a little under 3 ounces) a day, ranging from 21 to 450 grams per day, with a median value of 43 grams per day. In contrast, the health risk assessments conducted by government agencies have assumed that people eat an average of 6.5 to 30 grams of seafood per day.

**Amount of  
Bay-Caught  
Seafood  
Eaten in  
the Previous  
Seven Days**

NUMBER OF TIMES RESPONDENT ATE BAY-CAUGHT SEAFOOD IN THE PAST 7 DAYS	AMOUNT EATEN EACH TIME (GRAMS)	AVERAGE AMOUNT EATEN PER DAY (GRAMS)	RACE/ETHNICITY OF RESPONDENT
DID NOT REPORT	75	NA	Thai
DID NOT REPORT	225	NA	Filipino
2	75	21	Chinese
1	150	21	Chinese
1	150	21	Filipino
1	150	21	African-American
1	150	21	White/non-Hispanic
1	227	32	Chinese
2	150	43	Chinese
2	150	43	Chinese
2	150	43	Chinese
1	300	43	African-American
1	300	43	White/non-Hispanic
4	99	57	Chinese
1	450	64	African-American
2	227	65	Chinese
7	300	300	Chinese
21	150	450	Filipino
<hr/>			
AVERAGE: 3	193	81	

**Bay-Caught  
Fish Eaten  
in the  
Previous  
30 Days**

	NUMBER OF RESPONDENTS THAT:				GAVE FISH TO FAMILY OR FRIENDS TO EAT
	ATE FISH	ATE FISH SKIN	ATE FISH HEAD	ATE FISH GUTS	
white croaker (kingfish)	15	11	2	0	12
topsmelt or jacksmelt	15	9	3	0	14
surfperch	7	5	1	0	6
anchovy	7	-	-	-	10
leopard shark	6	2	1	0	8
smoothhound or sand shark	5	2	1	0	6
bat ray	5	2	1	0	8
rock cod	5	-	-	-	7
halibut	4	-	-	-	3
crab	3	-	-	1	1
striped bass	2	-	-	-	4
salmon	1	-	-	-	0
flounder	1	-	-	-	0
mackerel	1	-	-	-	0
sturgeon	0	-	-	-	1

Fifteen species of fish and crab were eaten. Survey respondents who ate Bay-caught fish in the previous 30 days reported eating the skin 58 percent of the time and the head 17 percent of the time. None of the respondents reported eating fish intestines or other internal organs, although one reported eating crab intestine. In interviews, however, Lao-Mien fishermen reported that in their community people routinely ate fish organs and boiled whole fish for soups and stews.

Many of the respondents were unaware of government health warnings about Bay-caught seafood. Knowledge of these warnings was language-dependent and declined with age. More than half of the English-speaking respondents, but only about a third of the non-English speakers, reported hearing a health warning. Only three of the respondents, all native English speakers, could accurately recall the health warning for the Bay. Eleven people, all English speakers, reported that they changed their eating habits after hearing a health warning, but 26 others who were aware of a health warning did not change their eating habits. Many reported practices were contrary to the government's health advisory recommendations on harvesting, preparing and consuming Bay fish.

**Knowledge  
of Health  
Warnings  
about  
Eating Fish  
or Shellfish  
from San  
Francisco Bay**

	HAD HEARD A HEALTH WARNING	HAD NEVER HEARD A HEALTH WARNING
English speakers	33	25
non-English speakers	4	7
all respondents	37	32

**Conclusions**

1. *There is little information available on contaminant levels in many types of seafood harvested from the Bay, or on the resultant health risk.*
2. *The information that is available indicates that there may be a significant health risk from consuming Bay seafood.*
3. *Although several government agencies investigate various aspects of seafood contamination, these investigations are not coordinated and do not constitute an adequate program for monitoring and assessing contaminants in Bay-caught seafood.*
4. *Many of those fishing in the Bay consume types and quantities of Bay seafood that could expose them to larger amounts of chemical contaminants than previously estimated.*
5. *Many of those eating Bay seafood are people of color.*
6. *Health advisories on contaminants in Bay fish may not be reaching Bay anglers, especially those at greatest risk.*
7. *Consumers of Bay fish generally are not employing the methods recommended by the Office of Environmental Health Hazard Assessment to reduce their exposure to chemical contamination.*

**6**

## **Recommendations**

Recent assessments of contaminant levels in Bay fish and the SSFBA study of fish consumption, taken together, suggest that some consumers of Bay-caught seafood are being exposed to previously unsuspected levels of toxic contaminants, and that government efforts to monitor and minimize the health risk from Bay-caught seafood have been inadequate and ineffective. SSFBA urges that immediate action be taken in two areas:

**1. *The monitoring and management of health risks from eating Bay-caught seafood must be coordinated by a single agency.***

There currently is no overall program which monitors, assesses and works to minimize the risk to the public from eating Bay-caught seafood. An effective program should include: a research and monitoring element to assess the level of risk; an education and outreach element to inform the fishing public about health risks and about practices that could minimize risk; and a remediation element to reduce the potential for contamination and exposure. It is essential that a single agency take responsibility for this issue and coordinate the activities of the various government agencies that impinge on this problem. SSFBA recommends that the San Francisco Bay Regional Water Quality Control Board take the lead in this effort.

**2. *Health risk assessments must incorporate realistic assumptions about seafood consumption by the most at-risk populations.***

There is substantial evidence from SSFBA's survey that some anglers and their families eat Bay-caught seafood in larger amounts than is assumed in the health risk models used by government agencies. Most of these models also assume that only muscle tissue is eaten, but the results of the study indicate that various parts and organs of fish and shellfish, which may contain higher concentrations of contaminants than muscle tissue, are commonly eaten in some communities. Agencies should re-analyze the health risk of eating Bay-caught seafood using more realistic assumptions about seafood consumption rates and the types of tissue consumed.

Finally, although improved monitoring and health risk assessments, along with more comprehensive efforts to inform the public of health risks, are essential, they should not stand in lieu of efforts to control the sources of contamination. The ultimate goal is not simply to prevent people from eating contaminated fish, but to ensure that the Bay's fish are safe to eat.

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<sup>1</sup>Contaminant Levels in Fish Tissue from San Francisco Bay, San Francisco Bay Regional Water Quality Control Board, Oakland, Final Draft Report (December 1994).

# Introduction and Recommendations

Studies of San Francisco Bay have documented elevated levels of a variety of contaminants in the waters and sediments of the Bay and in some of the Bay's biota.<sup>1</sup> Recent studies have revealed toxic contaminants at levels of concern in commonly caught fish near specific contaminated sites<sup>2</sup> and throughout the Bay.<sup>3</sup> However, there is relatively little information available on who is eating fish and shellfish from the Bay, on what parts of these organisms are eaten, and on how much of each species is eaten. Without knowledge of these factors, regulatory agencies cannot make accurate assessments of health risk, nor devise effective strategies to communicate with the public and to persuade those who are catching, preparing and eating seafood from the Bay to take steps that will reduce their health risk.

In this report we review the government programs related to this public health issue, and report on a study conducted by Save San Francisco Bay Association (SSFBA) on the harvest and consumption of Bay-caught seafood. The recent studies of contaminant levels in fish<sup>4</sup> and the SSFBA survey of fish consumption, taken together, suggest that some consumers of Bay-caught seafood are being exposed to previously unsuspected levels of toxic contaminants, and that government efforts to monitor and minimize the health risk from Bay-caught seafood have been inadequate and ineffective. SSFBA urges that immediate action be taken in two areas:

**1. *The monitoring and management of health risks from eating Bay-caught seafood must be coordinated by a single agency.***

There is currently no overall program which monitors, assesses and works to minimize the risk to the public from eating Bay-caught seafood. An effective program should include: a research and monitoring element to assess the level of risk; an education and outreach element to inform the fishing public about health risks and about practices that could minimize risk; and a remediation element to reduce the potential for contamination and exposure. It is essential that a single agency take responsibility for this issue and coordinate the activities of the various government agencies that impinge on this problem. SSFBA recommends that the San Francisco Bay Regional Water Quality Control Board take the lead in this effort.

**2. *Health risk assessments must incorporate realistic assumptions about seafood consumption by the most at-risk population.***

There is substantial evidence from the study conducted by SSFBA that some anglers and their families eat Bay-caught seafood in larger amounts than is assumed in the health risk models used by government agencies. Most of these models also assume that only muscle tissue is eaten, but the survey and interview indicate that various parts and organs of fish and shellfish, which may contain higher concentrations of contaminants than muscle tissue, are commonly eaten in some communities. Agencies should re-analyze the health risk of eating Bay-caught seafood using more realistic assumptions about seafood consumption rates and the types of tissue consumed.

Finally, although improved monitoring and health risk assessments, along with more comprehensive efforts to inform the public of health risks, are essential, they should not stand in lieu of efforts to control the sources of contamination. The ultimate goal is not simply to prevent people from eating contaminated fish, but to ensure that the Bay's fish are safe to eat.

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<sup>1</sup>Davis, J. A., Gunther, A. J., Richardson, B. J., O'Conner, J. M., Spies, R. B., Wyatt, E., Larson, E. & Melorin, E. C., *Status and Trends Report on Pollutants in the San Francisco Estuary*, San Francisco Bay-Delta Aquatic Habitat Institute, Richmond (March 1991). *Staff Report, Bay Protection and Toxic Cleanup Program*, Sacramento (November 1993), pp. 69-76, 147.

<sup>2</sup>*Fish Contamination in Richmond Channel*, Environmental Health Investigations Branch, California Department of Health Services, Emeryville (March 1994).

<sup>3</sup>*Contaminant Levels in Fish Tissue from San Francisco Bay*, San Francisco Bay Regional Water Quality Control Board, Oakland, Final Draft Report (December 1994).

<sup>4</sup>*Ibid.*

# The Regulatory Context

Over the years, many laws, regulations and policies have been enacted to protect people from the harm caused by a polluted environment.<sup>5</sup> Currently there are several state agencies that address elements of the problem of the health risk posed by the consumption of Bay-caught seafood.

## **California Environmental Protection Agency- Office of Environmental Health Hazard Assessment (OEHHA)**

California EPA's OEHHA<sup>6</sup> analyzes data on environmental contamination and its health impacts, provides technical advice on the design of contamination studies, and is planning to develop a statewide database for the evaluation of chemical contaminants in sport fish. OEHHA has conducted evaluations of the toxicity of fish and wildlife, but since OEHHA does not generally collect data itself,<sup>7</sup> its analyses are limited to the information it receives from other agencies.

On the basis of these analyses, OEHHA may issue health advisories regarding fish and shellfish in California waters. The California Department of Fish and Game (CDFG) must include these advisories in its handbook of sportfishing regulations, and on their authority may order the closure of waters for commercial fishing.<sup>8</sup> Besides publication in CDFG's handbook (which is printed only in English), OEHHA distributes its warnings about contamination in fish to the press and has posted warning signs at selected sites on the Bay.

OEHHA has issued or revised over ten fish advisories since 1985, including a 1993 advisory on striped bass in the Bay and Delta (updating a 1970s striped bass advisory), and a 1993 warning against eating croaker, surfperch, gobies, bullheads, or shellfish collected within the Richmond Harbor Channel. In December 1993, OEHHA issued an advisory which provided suggestions about ways of catching, preparing and cooking fish from the Bay that would minimize the risk of exposure to chemical contamination.<sup>9</sup>

In December 1994, OEHHA issued an "interim consumption advisory" that superseded the 1993 striped bass advisory. This warning, based on a preliminary review of data from the study, *Contaminant Levels in Fish Tissue from San Francisco Bay* (see below), recommended limiting consumption of most Bay-caught fish to one or two meals a month, and avoiding some large fish. It also repeated the December 1993 advisory's suggestions on catching, preparing and cooking fish.<sup>10</sup>

## **San Francisco Bay Regional Water Quality Control Board**

The State Water Resources Control Board (SWRCB) and the Central Valley and San Francisco Bay Regional Water Quality Control Boards (RWQCBs) are responsible for the regulation of water quality in the Bay and Delta,<sup>11</sup> and are specifically charged with setting water quality objectives to protect the beneficial uses of these waters.<sup>12</sup> The California Water Code defines beneficial uses to include the "preservation and enhancement of fish, wildlife and other aquatic resources,"<sup>13</sup> and state policy has further defined beneficial uses to include marine habitat, estuarine habitat, shellfish harvesting, and ocean commercial and sport fishing.<sup>14</sup>

In 1994, the San Francisco Bay RWQCB coordinated a pilot study of contaminant levels in the tissue of several species of commonly caught fish from 13 discrete sites and three regions in the Bay. This was the first general attempt to sample contamination in the Bay fish species that are caught and eaten by people fishing from piers. Several agencies participated in this effort: SWRCB's Bay Protection and Toxic Cleanup Program provided funding; CDFG coordinated the collection of tissue samples and the analysis of contaminants; OEHHA will use the data to prepare a health risk assessment.

The study analyzed a total of 66 composite tissue samples consisting of muscle tissue samples without skin for shark, striped bass, sturgeon and halibut, and muscle tissue samples with skin intact for smaller fish.<sup>15</sup> Screening values<sup>16</sup> for each contaminant tested were

based on a consumption rate for a 70 kilogram (154 pound) individual of 30 grams (about an ounce) per day of fish, and were calculated as follows: (1) for non-carcinogens, the screening level was set at a concentration that would produce a contaminant dose equal to the U. S. Environmental Protection Agency' (US EPA) suggested oral reference dose; (2) for carcinogens, the screening level was set at a concentration that would produce a contaminant dose resulting in a 1-in-100,000 risk from 70 years of consumption, based on the US EPA's suggested oral slope factor. For contaminants considered to be both carcinogens and non-carcinogens, the carcinogen screening value (which was lower in each case) was used.<sup>17</sup> Six chemicals or chemical groups exceeded their respective screening values (Tables 1 & 2): PCBs (as total Aroclors), total dioxin/furans-TEQs, total DDTs, dieldrin, total chlordanes, and mercury.

TABLE 1:  
1994 San Francisco Bay RWQCB Study Concentrations and Screening Values for Six Contaminants

	PCBS (ppb)	DIOXIN / FURANS (ppt)	DDTS (ppb)	DIELDRIN (ppb)	CHLORDANES (ppb)	MERCURY (ppm)
screening value:	3	0.15	69	1.5	18	0.14
concentrations in tissue samples:	17-638	0.12-1.75	4.9-156	ND-4.2	0.5-36.1	0.068-1.26
concentration ÷ screening value:	5.7-213	0.8-11.7	0.07-2.3	0-2.8	0.03-2.0	0.48-9.0

Source: Contaminant Levels in Fish Tissue from San Francisco Bay, San Francisco Bay Regional Water Quality Control Board, Final Draft Report (December 1994), p. 11.

(ppm = parts per million; ppb = parts per billion; ppt = parts per trillion)

- PCB concentrations exceeded the screening value in all 66 samples, ranging from about 6 times to over 200 times the screening value.
- Due to the high cost of analysis, dioxins were tested in only 19 samples. Dioxin concentrations exceeded screening values in 84 percent of the tested samples, ranging from slightly under to nearly 12 times the screening value.
- Mercury concentrations exceeded the screening value in 61 percent of the samples, ranging from about half to 9 times the screening value. Mercury concentrations tended to be higher in larger fish, including large white croaker (also known as kingfish), and exceeded screening values in all shark, striped bass, sturgeon and halibut samples. The highest reported concentrations (in 3 leopard shark samples) slightly exceeded the Action Levels at which the U. S. Food and Drug Administration takes legal action to remove contaminated fish from the market.<sup>18</sup>
- DDTs, dieldrin and chlordanes exceeded their respective screening values less frequently, with the highest concentrations about 2 to 3 times the screening value.

Fish with high lipid content (white croaker and shiner surfperch) generally had higher concentrations of organic contaminants. Leopard shark and brown smoothhound shark had the highest mercury and arsenic<sup>19</sup> concentrations. Overall, white croaker exhibited the most frequent contamination and highest contaminant concentrations of the species tested.

The study did not evaluate the human health risk from these contaminant levels, noting that the issue would be addressed in detail by OEHHA. The report also noted several limitations of the study, including the failure to collect enough jacksmelt—the most commonly caught fish in the Bay—to make up an adequate tissue sample. It recommended further research on bioaccumulation in different species and age classes; on the seasonality of contamination levels; on the concentration of organic contaminants in organs, such as liver and gonads, with high lipid content (including shark liver); and on contaminant levels in other species that are caught and consumed from the Bay.<sup>20</sup>

TABLE 2:  
**1994 San Francisco Bay RWQCB Study**  
**Frequency of Exceeding Screening Values for Six Contaminants**

	NO. OF SITES	NO. OF TISSUE SAMPLES	NUMBER [PERCENTAGE] OF SAMPLES IN WHICH CONCENTRATIONS EXCEEDED THE SCREENING VALUE					
			PCB'S	DIOXIN/FURANS (a)	DDT'S	DIELDRIN	CHLOR-DANES	MERCURY
white croaker	9	25	25 [100%]	9 [100%]	8 [32%]	20 [80%]	6 [24%]	12 [48%]
shiner surfperch	8	14	14 [100%]	3 [100%]	1 [7%]	7 [50%]	0	3 [21%]
white surfperch	1	3	3 [100%]	-	0	0	0	2 [67%]
walleye surfperch	1	1	1 [100%]	-	0	0	0	0
brown smoothhound	5	7	7 [100%]	-	0	0	0	7 [100%]
leopard shark	4	5	5 [100%]	1 [33%]	0	0	0	5 [100%]
striped bass	5	9	9 [100%]	2 [100%]	0	7 [78%]	1 [11%]	9 [100%]
white sturgeon	1	1	1 [100%]	1 [100%]	0	1 [100%]	0	1 [100%]
halibut	1	1	1 [100%]	0	0	0	0	1 [100%]

(a) Due to the high cost of analysis, only 19 tissue samples were tested for dioxin: white croaker (9), shiner surfperch (3), leopard shark (3), striped bass (2), white sturgeon (1), halibut (1).

Source: Contaminant Levels in Fish Tissue from San Francisco Bay, San Francisco Bay Regional Water Quality Control Board, Final Draft Report (December 1994), pp. 11, 32, 52, 77.

### State Water Resources Control Board (SWRCB)

In 1989 the California Legislature established the Bay Protection and Toxic Cleanup Program (BPTCP) as a program of the SWRCB.<sup>21</sup> The program's main task is to identify and develop cleanup plans for toxic hot spots in the bays and estuaries of the state. Toxic hot spots are defined in the California Water Code as:

"...sites where hazardous substances have accumulated in the water or sediment to levels which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries, or human health, or (2) may adversely affect the beneficial uses of the bay, estuary, or ocean waters as defined in water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives"<sup>22</sup>

BPTCP has noted that the strict application of this definition "potentially could result in the designation of large portions (if not all) of California's coastline as a toxic hot spot."<sup>23</sup> Staff of the SWRCB and RWQCBs instead developed a "working definition" which identifies several conditions which would cause a site to be designated as a known toxic hot spot, one of which is:

"When [a] health warning against the consumption of edible organisms has been issued by OEHHA or DHS, on a site, the site is automatically classified a 'known' toxic hot spot."<sup>24</sup>

BPTCP further states that:

"Acceptable tissue concentrations are [to be] measured either as muscle tissue (preferred) or whole body residues. Residues in liver tissue alone are not considered a suitable measure for known toxic hot spot designation."<sup>25</sup>

BPTCP's role has been and apparently will continue to be that of promoting, funding, guiding and co-ordinating efforts by the RWQCBs, rather than testing or cleaning up toxic hot spots itself.

The SWRCB operates two other programs addressing the toxic contamination of fish and shellfish in the Bay. The Toxic Substances Monitoring program collects and analyzes contamination levels in fish from all over the state. Although primarily focussing on freshwater fish, it has examined white sturgeon, starry flounder and striped bass from Suisun Bay.<sup>26</sup> The State Mussel Watch Program, in existence for over 15 years, provides the only relatively long-term database on contamination in the Bay's biota. The data on contaminants in bay mussels indicate that DDTs, chlordanes and PCBs have significantly declined, but that mercury concentrations have remained steady.<sup>27</sup>

### **California Department of Health Services (DHS)**

DHS is responsible for assuring the safety of all food in California. Among other activities it oversees the safety of commercial fish and shellfish, issues health warnings dealing with the sport harvesting of shellfish<sup>28</sup>, and investigates the contamination of fish at Superfund sites. An example of the latter is the United Heckathorn site along the Lauritzen Canal in Richmond Harbor where for approximately twenty years several different companies had processed and packaged chemicals including DDT and dieldrin<sup>29</sup>. Both the land and water were severely contaminated, and a federally funded health risk assessment determined that fish at this site were unsafe to eat. The shore of the Lauritzen Canal was fenced off and posted with "No Fishing" warnings in Spanish and English, but the canal remains accessible by boat.

After the site was designated a Superfund site in 1990, DHS conducted further studies, including a 1993 survey of 27 anglers in the Richmond Harbor Channel and sampling and testing of white croaker and surfperch that they had caught. These studies revealed that the fish in this area were also contaminated, and OEHHA issued a warning against eating croaker, surfperch, gobies, bullheads, or shellfish collected within the Richmond Harbor Channel, including the Santa Fe Channel and Parr-Richmond Canal.<sup>30</sup>

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<sup>5</sup>Among those related to the current study are: the *Federal Water Pollution Control Act of 1972* (usually referred to as the *Clean Water Act*), 33 USC §1251, Sec. 101; and California's *Porter-Cologne Water Quality Control Act*.

<sup>6</sup>Prior to 1991, OEHHA was a part of the California Department of Health Services. Clark, V., *Memorandum: Agency Mandates for Testing and Warning About Contaminated Fish* (May 4, 1994), p. 9.

<sup>7</sup>Using special state funds appropriated in 1986, OEHHA did conduct studies of chemical contaminants in fish tissues in Southern California and in Monterey Bay.

<sup>8</sup>Clark, V., *op. cit.*, p. 9; Gerald Pollock, pers. comm.

<sup>9</sup>*General Advisory on Catching and Eating Fish in the San Francisco Bay/Delta Area*, Office of Environmental Health Hazard Assessment, Sacramento (December 14, 1993).

<sup>10</sup>*Health Advisory on Catching and Eating Fish; Interim Sport Fish Advisory for San Francisco Bay*, Office of Environmental Health Hazard Assessment, Sacramento (December 1994).

<sup>11</sup>*Porter-Cologne Water Quality Control Act*, Chapter 1, §13001.

<sup>12</sup>California Government Code §66646.1.

<sup>13</sup>California Water Code §13050(f).

<sup>14</sup>*Water Quality Control Plan for the San Francisco Area Basin* (December 1986), p. II-3-4. Clark, V. *Memorandum: Agency Mandates for Testing and Warning About Contaminated Fish* (May 4, 1994), p. 2.

<sup>15</sup>*Contaminant Levels in Fish Tissue from San Francisco Bay*, San Francisco Bay Regional Water Quality Control Board, Oakland, Final Draft Report (December 1994).

<sup>16</sup>The US EPA defines screening values as "concentrations of target analytes in fish or shellfish that are of potential public health concern and that are used as standards against which levels of contamination in similar tissue collected from the ambient environment can be compared." *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol. 1: Fish Sampling and Analysis*, U. S. Environmental Protection Agency (1993), p. 5-1. The US EPA bases its screening values on a consumption rate of 6.5 grams per day. Since the San Francisco Bay RWQCB used a higher consumption rate (30 grams per day) in its study, the screening values were lower (between 1/4 and 1/5 of the US EPA's).

<sup>17</sup>*Contaminant Levels in Fish Tissue from San Francisco Bay*, San Francisco Bay Regional Water Quality Control Board, Oakland, Final Draft Report (December 1994), pp. 10, 97-98.

<sup>18</sup>*Ibid.*, pp. 11, 95-96.

<sup>19</sup>*Ibid.*, p. 42. Arsenic concentrations ranged from about 1 to 6 ppm in the shark tissue samples. Since the US EPA hasn't designated a screening value for arsenic, it was not included in the tables in this report.

<sup>20</sup>*Ibid.*, pp. 44-45.

<sup>21</sup>California Water Code, Division 7, Chapter 5.6, Bay Protection and Toxic Cleanup, §§ 13390-13396.5 (established by Stats. 1989, Chapter 269, SB 475, Torres; Stats. 1989, Chapter 1032, AB 41, Wright; Stats. 1990, Chapter 1294, SB 1845, Torres).

<sup>22</sup>California Water Code, Division 7, Chapter 5.6, §13391.5 (e).

<sup>23</sup>*Staff Report*, Bay Protection and Toxic Cleanup Program, Sacramento (November 1993), p. 9.

<sup>24</sup>*Ibid.*, p. 22. Based on this definition, BPTCP preliminarily listed all of Suisun Bay as a known toxic hot spot due to health warnings for diving ducks, scaup and scoter, and preliminarily listed all of the Bay and Delta as a known toxic hot spot due to health warnings for striped bass (*ibid.* p. 70). However, this definition is under revision, and the new definition will likely involve additional chemical and biological screenings before a site is designated a known toxic hot spot. BPTCP currently considers the Bay and Delta to be a candidate toxic hot spot (Karen Taberski, Peter Otis, pers. comm.)

<sup>25</sup>*Ibid.*, p. 22.

<sup>26</sup>*Toxic Substances Monitoring Program: Ten Year Summary Report 1978-1987*, State Water Resources Control Board, Sacramento (January 1993), pp. E-7 to E-8. Karen Taberski, pers. comm.

<sup>27</sup>*Contaminant Levels in Fish Tissue from San Francisco Bay*, San Francisco Bay Regional Water Quality Control Board, Oakland, Final Draft Report (December 1994), pp. 42-43.

<sup>28</sup>For historic reasons, OEHHA has generally issued the health warnings on fish and DHS has generally issued the health warnings on shellfish. Alyce Ujihara, pers. comm.

<sup>29</sup>*Fish Contamination in Richmond Channel*, Environmental Health Investigations Branch, California Department of Health Services, Emeryville (March 1994).

<sup>30</sup>*Ibid.*



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PHOTO: MARC HOLMES

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# Fishing Pier Survey Methods

SSFBA conducted a survey of individuals fishing from Central Bay public piers from September to October, 1993.<sup>31</sup> The survey was designed to solicit preliminary information regarding fishing and fish consumption patterns, as well as demographic information, such as age and ethnicity, of those fishing. Specifically, we wished to learn:

- *Who catches and eats fish and shellfish from the piers?*
- *What parts of what fish do they eat, and how much do they eat?*
- *What do they know of the possible health risks of eating seafood from the Bay?*

The survey design was based in part on a study conducted in Santa Monica Bay from 1991 to 1992.<sup>32</sup> The University of California Survey Research Center provided advice on survey design, and the final questions were developed after trial runs at fishing sites. Questionnaires were printed in English and translated by surveyors as needed into Cantonese, Toisanese, Vietnamese, Mandarin or Spanish. The complete survey text is available from Save San Francisco Bay Association.

Surveyors administered the survey orally to people fishing or crabbing at ten Central Bay public fishing piers.<sup>33</sup> Sites were surveyed between 8:00 AM and 5:00 PM during high tides, the time when most people were observed to fish, on both weekdays and weekends. Surveyors were instructed to count and approach all people fishing or crabbing who appeared to be 13 years of age or older. It took an average of 12 minutes to administer a survey.

The survey used the following visual aids: maps of the Bay and Estuary with survey sites marked; six line drawings of fish commonly caught at the piers; and a piece of styrofoam sized to represent a 150 gram (5¼ ounce) fish fillet, used for estimating the amount of fish eaten at a meal.

## Individual Interviews

In addition to the fishing pier survey, SSFBA and DHS interviewed three Lao-Mien fishermen from Richmond and Oakland (hereafter referred to as the "interviewees"). This interview allowed for informal discussion with individuals representing a class of anglers who, because of language barriers, mistrust of authority or other reasons, might not participate in the more formal protocol of the pier survey.

The one-hour interview was arranged with the help of a community representative who also served as interpreter, and was conducted at a Lao community center. Interviewees were asked where they fished, what species they caught, and how much they and their families ate. Photographs<sup>34</sup> and maps were used to identify fish and locate fishing sites. A yellow fin croaker weighing two pounds was prepared by the interviewees, and the weight of the portion described as a usual meal was estimated.

## Results Who Fishes?

Sixty-nine individuals completed the survey questionnaire (hereafter referred to as "respondents"), and 65 individuals who were approached either declined to be surveyed or could not be surveyed because of language barriers. Forty-eight percent of respondents identified themselves as Asian (Chinese, Filipino, Mien, Thai or Indian), and 28 percent as African-American (Table 3). Sixty-nine percent of those approached but not surveyed spoke a language other than English.

The respondents ranged in age from 11 to 77 years, and averaged 40 years. Eighty-six percent were male. Most were residents of Oakland and San Francisco, and about half were unemployed at the time of the survey.

TABLE 3:

**Race/Ethnicity  
of Survey  
Respondents**

	NUMBER OF RESPONDENTS	PERCENT OF TOTAL	RESPONDENTS WHO ATE BAY-CAUGHT SEAFOOD IN THE PAST 30 DAYS	
Asian	33	[48%]	19	[69%]
Chinese	17		12	
Filipino	11		6	
Mien	3		0	
Other Asian	2		1	
African-American	19	[28%]	4	[14%]
White/non-Hispanic	8	[12%]	2	[ 7%]
Latino/Hispanic	3	[ 4%]	2	[ 7%]
Native American	1	[ 1%]	0	
Pacific Islander/Hawaiian	1	[ 1%]	0	
Other Race	2	[ 3%]	1	[ 4%]
Mixed Heritage	2	[ 3%]	0	
<b>TOTAL</b>	<b>69</b>	<b>[100%]</b>	<b>28</b>	<b>[100%]</b>

TABLE 4:

**English  
Language  
Abilities and  
Age of Survey  
Respondents**

	UP TO 17 YEARS	18 -55 YEARS	56 YEARS OR OLDER
number of respondents	10	44	15
non-English speaking	0	3	8
non-English reading	0	5	8

TABLE 5:

**Average  
Number of  
Times Fished  
in the  
Previous  
30 Days**

	CHINESE	AFRICAN- AMERICAN	WHITE/ NON-HISPANIC	FILIPINO
in San Francisco Bay	8.5	5.1	3.7	3.2
at survey site	7.4	2.6	0.6	2.8
elsewhere in the Bay	1.1	2.5	3.1	0.4
	UP TO 17 YEARS	18 -55 YEARS	56 YEARS OR OLDER	
in San Francisco Bay	3.3	3.4	9.7	
at survey site	2.1	2.0	7.4	
elsewhere in the Bay	1.2	1.4	2.3	

Age and a person's English language abilities were related in the survey sampling (Table 4). Most of the younger respondents could speak and read English, but about half of the respondents 56 years of age and older could not.

### Fishing and Fish Consumption Practices

Chinese and African-American respondents reported fishing more often than others. Chinese and Filipino respondents tended to fish at the survey site repeatedly, while White respondents tended to fish at other San Francisco Bay sites more frequently than the survey site (Table 5). Respondents 56 years and older fished nearly three times more often than younger respondents, and were more likely to fish at the survey site repeatedly.

Just over forty percent of all respondents reported eating Bay-caught seafood in the previous 30 days (Table 3), mainly Asians (accounting for 69% of those who ate Bay-caught seafood) and African-Americans (14%). Of 49 respondents that were asked, 22 said that some of their catch from the previous 30 days was eaten by their family and friends.

In all, 15 types of Bay-caught fish and shellfish were eaten (Tables 6). In general, the consumers of larger amounts of fish, especially the Chinese respondents, reported catching and eating a wider variety of fish and shellfish. More than 50 percent of African-American, Asian and White respondents who ate Bay-caught fish reported eating white croaker. All of the respondents who reported eating bat ray, and most of those who reported eating anchovies, were Chinese.

TABLE 6:  
Bay-Caught  
Fish  
Reported  
Eaten  
in the  
Previous  
30 Days

	NUMBER OF RESPONDENTS THAT:				GAVE FISH TO FAMILY OR FRIENDS TO EAT
	ATE FISH	ATE FISH SKIN	ATE FISH HEAD	ATE FISH GUTS	
white croaker (kingfish)	15	11	2	0	12
topsmelt or jacksmelt	15	9	3	0	14
surfperch	7	5	1	0	6
anchovy	7	-	-	-	10
leopard shark	6	2	1	0	8
smoothhound or sand shark	5	2	1	0	6
bat ray	5	2	1	0	8
rock cod	5	-	-	-	7
halibut	4	-	-	-	3
crab	3	-	-	1	1
striped bass	2	-	-	-	4
salmon	1	-	-	-	0
flounder	1	-	-	-	0
mackerel	1	-	-	-	0
sturgeon	0	-	-	-	1

TABLE 7:  
Catch  
Observed  
During  
Survey  
...of 47  
anglers  
whose  
catch was  
identified

	NUMBER OF ANGLERS WITH FISH	NUMBER OF FISH
white croaker (kingfish)	23	90
topsmelt or jacksmelt	19	132
surfperch	10	59
anchovy	2	2
leopard shark	3	3
smoothhound or sand shark	2	3
rock cod	3	3
halibut	2	2
crab	2	2
sculpin	1	6

Sixteen survey respondents who ate Bay-caught seafood in the previous week reported eating an average of 81 grams (a little under 3 ounces) a day, ranging from 21 to 450 grams per day, with a median value of 43 grams per day (Table 8). Respondents 56 years and older reported eating over three times as much as younger respondents.

The three Lao-Mien fishermen who were interviewed reported eating up to two meals a day of recreationally-caught fish (including fish caught in the Delta and Nicasio Lake) in the previous week and 11 ounces (312 grams) of fish per meal, and fishing four to five months a year. Assuming 312 grams of fish per day for four-and-a-half months each year, this works out to an average consumption on an annual basis of 117 grams of recreationally-caught fish per day.

**TABLE 8:**  
**Amount of Bay-Caught Seafood Eaten in the Previous 7 Days**

NUMBER OF TIMES RESPONDENT ATE BAY-CAUGHT SEAFOOD IN THE PAST 7 DAYS	AMOUNT EATEN EACH TIME (GRAMS)	AVERAGE AMOUNT EATEN PER DAY (GRAMS)	RACE/ETHNICITY OF RESPONDENT
DID NOT REPORT	75	NA	Thai
DID NOT REPORT	225	NA	Filipino
2	75	21	Chinese
1	150	21	Chinese
1	150	21	Filipino
1	150	21	African-American
1	150	21	White/non-Hispanic
1	227	32	Chinese
2	150	43	Chinese
2	150	43	Chinese
2	150	43	Chinese
1	300	43	African-American
1	300	43	White/non-Hispanic
4	99	57	Chinese
1	450	64	African-American
2	227	65	Chinese
7	300	300	Chinese
21	150	450	Filipino
<b>AVERAGE: 3</b>	<b>193</b>	<b>81</b>	

Survey respondents who ate Bay-caught fish in the previous 30 days reported eating the skin 58 percent of the time and the head 17 percent of the time. None of the respondents reported eating fish intestines or other internal organs, although one reported eating crab intestine (Table 6). The Lao-Mien fishermen, however, reported that in their community people routinely ate fish organs and boiled whole fish for soups and stews.

### Knowledge of Health Risk

Many of those surveyed were unaware of health warnings about Bay-caught seafood that had been issued by the OEHHA (Table 9). Knowledge of these warnings was language-dependent and declined with age. Recall of health warnings that had appeared on television was poor.

Thirty-seven of the 69 respondents reported hearing a health warning about eating fish or shellfish in San Francisco Bay. More than half of the English-speaking respondents, but only about a third of the non-English speakers, reported hearing a health warning.

Eighteen people had heard a warning on television and seven people had read about a warning in the newspapers. Only three of the respondents, all native English speakers, could accurately recall the health warning for the Bay. Two of the three appeared to have read the warning found in the California Department of Fish and Game Fishing Regulations.

TABLE 9:  
**Knowledge  
of Health  
Warnings  
about Eating  
Fish or Shellfish  
from San  
Francisco Bay**

	HAD HEARD A HEALTH WARNING	HAD NEVER HEARD A HEALTH WARNING
English speakers	33	25
non-English speakers	4	7
all respondents	37	32

Eleven people, all English speakers, reported that they changed their eating habits after hearing a health warning, but 26 others who were aware of a health warning did not change their eating habits. Most White respondents, but fewer than half of the other respondents, changed their eating habits after hearing a warning.

One person reported accurately that mercury had been found in the flesh of fish in the Bay, but did not change his eating habits because he had heard from some of the older fishermen at the piers that mercury collects in fish scales and therefore poses no risk. Others said that they did not eat enough fish to pose a risk, but were unclear about what amount would be unsafe.

Other people reported hearing rumors about contamination in fish. Six respondents, three African-American and three White, said they did not like to eat fish or shellfish from the Bay because it might be unsafe. Some respondents had concluded that all Bay shellfish were unsafe, possibly on the basis of the annual paralytic shellfish poison warnings issued by the Department of Health Services.<sup>35</sup>

## Discussion Previous Studies

We are aware of few previous studies on the harvest or consumption of recreationally caught seafood from the Bay.

From March to June, 1980, James Sutton conducted a survey of shellfish collecting on the East Bay shore from Oakland to Richmond.<sup>36</sup> He observed 690 shellfish collectors and interviewed 103. Seventy-two percent of the observed collectors and 69 percent of the interviewed collectors were judged to be Asian, 9 percent of the observed and 20 percent of the interviewed were White, and 3 percent of the observed and 6 percent of the interviewed were African-American. Fifty-five collectors reported eating the Japanese littleneck clam *Venerupis philippinarum* (= *Tapes japonica*), 5 reported eating the Atlantic soft-shell clam *Mya arenaria*, 5 reported eating the bay mussel *Mytilus* sp., and one reported eating the native oyster *Ostrea lurida*. Fifty-one shellfish eaters reported depurating the shellfish, but 46 of these used Bay water taken from the shellfish beds. Most cooked their shellfish by boiling them in soup, others steamed them, made them into chowder, baked them, fried them, or boiled and then fried them; one reported eating them raw. Only 4 of 33 collectors indicated any general awareness of mussel quarantines, and only 2 of 37 were aware of DHS' 1980 mussel quarantine order or clam consumption warning.<sup>37</sup>

**19** In 1993, DHS surveyed 27 anglers in the Richmond Harbor Channel. All of the survey

respondents were African-American or Asian (Lao). All were unaware of chemical contamination problems at the site. Although one-third of the people surveyed reported having heard a health warning about eating seafood from the Bay, none could repeat the existing warning about striped bass.<sup>38</sup>

### Consumption Estimates in Human Health Risk Assessment

The quantity of fish that an individual consumes is a significant factor in his or her exposure to contaminants that may be present in the fish. However, estimating such consumption may be problematic for agencies attempting health risk assessments. Such entities typically rely on assumptions about average consumption rates which may be very inaccurate for some populations of consumers.

Table 10 lists fish consumption rates assumed in health risk assessments or used in risk models to set screening or advisory levels that range from 6.5 to 30 grams of fish per day. In contrast, in the SSFBA survey those who ate Bay-caught seafood reported eating 21 to 450 grams of fish or shellfish per day, with an average of 81 grams per day. Thus, these risk models may be underestimating the health risk to the Bay's pier-fishing population.

TABLE 10:  
Some Fish  
Consumption  
Estimates

Consumption rates assumed in risk assessments or in setting screening levels	GRAMS / DAY
Consumption assumed by SWRCB in setting Maximum Tissue Residue Levels for screening fish tissue data (a)	6.5
Consumption assumed for a 70 kg adult to set health advisory levels in Great Lakes (a)	7.4
Consumption assumed in Southern California health risk assessment (b)	23
Consumption assumed for a 70 kg adult to set screening values in the 1994 San Francisco Bay study (a)	30
Consumption rates reported by various studies	GRAMS / DAY
Average consumption by U. S. population (c)	14
Lowest consumption in SSFBA survey by those eating seafood from the Bay	21
Average consumption by U. S. anglers (c)	30
Mean consumption by all individuals in Santa Monica Bay survey (d)	46
Average consumption in SSFBA survey by those eating seafood from the Bay	81
Average consumption by three Lao-Mien fishermen in SSFBA interviews	117
Average consumption by U. S. "subsistence" anglers (90th percentile of anglers) (c)	140
Highest consumption in SSFBA survey	450

(a) Contaminant Levels in Fish Tissue from San Francisco Bay, San Francisco Bay Regional Water Quality Control Board, Final Draft Report (December 1994), pp. 95-97.  
 (b) A Study of Chemical Contamination of Marine Fish from Southern California, Office of Environmental Health Hazard Assessment (1991), p. 100.  
 (c) Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol. 1: Fish Sampling and Analysis, U. S. Environmental Protection Agency (1993), p. 5-6.  
 (d) Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992, Santa Monica Bay Restoration Project, Final Data Report (August 1993), pp. 17, 23.

### Compliance with the OEHHA Advisory

20 As noted above, OEHHA issued a health advisory in December of 1993 that recommended certain approaches to harvesting, preparing and cooking fish from the Bay in order to mini-

mize one's health risk.<sup>39</sup> We describe below how the behavior reported by the survey respondents and the three Lao-Mien fishermen who were interviewed relate to the recommendations in the advisory.

**OEHHA Recommendation 1:** *Vary the sites in which you fish.*

Many respondents focused their fishing efforts at one site. Asians and people over the age of 56 especially tended to fish at the survey site more frequently than at other sites.

**OEHHA Recommendation 2:** *Vary the species that you catch.*

Respondents who ate a lot of fish reported eating a greater variety of fish species than people who ate less fish.

**OEHHA Recommendation 3:** *Eat only fillet portions, trim visible fat. Don't eat guts and livers.*

Most people reported eating the skin and some ate portions of the head of the fish that they caught, including such species as white croaker, smelt, surfperch, shark and bat ray. One of three respondents who ate Bay-caught crab reported eating the intestines (known as tomalley). None of the respondents reported eating intestines or other internal organs of fish.

The Lao-Mien fishermen reported cooking and eating the intestines, livers, and eggs from striped bass, sturgeon, and occasionally white croaker. They stated that this was common practice in their community, where throwing away these parts was considered wasteful.

**OEHHA Recommendation 4:** *Cook fish by baking, broiling, grilling, steaming, or other methods that allow the juices to drain away from the fish, then discard those juices.*

The Lao-Mien fishermen reported using fish carcasses for soups or stews, and cooking and eating fish in their own juices.

**OEHHA Recommendation 5:** *Cook fish and shellfish.*

None of the survey respondents reported eating raw Bay-caught fish, but the Lao-Mien fishermen reported eating raw, skinned flesh of striped bass and sturgeon.

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<sup>31</sup>The survey was not adjusted for seasonal variations. The Marine Recreational Fishery Statistics Survey administered through the California Department of Fish and Game reports relatively little seasonal variation in the fishing activity as measured by the percentage of fishing households.

<sup>32</sup>*Santa Monica Bay Seafood Consumption Study, September 1991 to August 1992*, Santa Monica Bay Restoration Project, Monterey Park, Final Data Report (August 1993).

<sup>33</sup>Municipal Pier, Pier 7, Double Rock Pier, Candlestick Park Pier, Agua Vista Pier, Warm Water Cove Pier and Islais Creek Pier in San Francisco; Berkeley Pier in Berkeley; Port View Pier and Fruitvale Pier in Oakland.

<sup>34</sup>The photographs used were from *Marine Sportfish Identification: California*, California Department of Fish and Game, Sacramento (1987).

<sup>35</sup>DHS' annual mussel quarantine applies to all bays, inlets, and harbors and to all non-commercially harvested mussels, to protect against paralytic shellfish poison (PSP). PSP is a potentially fatal nerve poison acquired by eating bivalves, usually mussels, which have fed on a toxic planktonic organism that is often abundant between May and October.

<sup>36</sup>Sutton, J. *Shellfish Resources of Eastern San Francisco Bay: Distribution, Abundance, Public Access and Use*, report prepared for East Bay Municipal Utility District, Special District No. 1, Oakland (March 1981). pp. 106-133.

<sup>37</sup>In 1980 DHS imposed a quarantine on mussels all along the California coast including San Francisco Bay from May 1 to October 14, and warned that "clams should be cleaned and thoroughly washed before cooking [and] all dark parts of clams should be discarded" *Ibid.*, pp. 124, 131, Appendix C.

<sup>38</sup>*Fish Contamination in Richmond Channel*, Environmental Health Investigations Branch, California Department of Health Services, Emeryville (March 1994).

<sup>39</sup>*General Advisory on Catching and Eating Fish in the San Francisco Bay/Delta Area*, Office of Environmental Health Hazards Assessment, Sacramento (December 14, 1993).

## Conclusions

*1. There is little information available on contaminant levels in many types of seafood harvested from the Bay, or on possible health risks resulting from consumption of Bay fish.*

Fish and invertebrate tissue data currently are collected primarily for the purpose of monitoring water quality trends or to assess the health and reproductive success of specific species in the Bay, and not for the purpose of assessing human health risk from consumption. Existing monitoring programs cover only a few species, not including several that are commonly caught and consumed from the Bay. For example, jacksmelt (the most commonly caught fish in the Bay) have apparently never been tested for contamination.

*2. The information that is available indicates that there may be a significant health risk from consuming Bay seafood.*

The 1994 study, *Contaminant Levels in Fish Tissue from San Francisco Bay*, found significant contamination by several chemicals and chemical groups in a wide variety of commonly eaten fish from throughout the Bay. Every tissue sample tested had concentrations of at least one contaminant that substantially exceeded screening values. Mercury concentrations in three samples exceeded the Action Levels at which the U. S. Food and Drug Administration will take legal action to remove contaminated fish from the market. These and other findings resulted in an interim OEHHA health advisory warning against eating certain types, sizes and amounts of fish from the Bay and a listing of the entire Bay and Delta as a candidate toxic hot spot by BPTCP.

*3. Although several government agencies investigate various aspects of seafood contamination, these investigations are not coordinated and do not constitute an adequate program for monitoring and assessing contaminants in Bay-caught seafood.*

OEHHA, the RWQCBs, SWRCB, and DHS each address limited matters relating to the human health impacts of consumed fish. The 1994 Contaminant Level study coordinated by the San Francisco Bay RWQCB indicates that these agencies can work together to deal with this issue. However, none of the agencies has taken on the overall responsibility for planning or coordinating this work. This has left substantial gaps in the basic monitoring of contamination levels in commonly consumed fish and shellfish, in the assessment of health risk, in the research program needed to identify contamination pathways and develop remedies, and in efforts to inform the public of findings. Indeed, no identifiable "program" exists at all. Coordination is needed for a comprehensive research and educational process that addresses all steps in the process of identifying, assessing, and analyzing chemical contamination, and that properly informs potentially affected individuals.

*4. Many of those fishing in the Bay consume types and quantities of Bay-caught seafood that could expose them to larger amounts of chemical contaminants than previously estimated.*

Current assumptions used by government agencies to establish risk thresholds may underestimate consumption and fail to provide accurate assessments of health risk for the recreational and subsistence angling population surveyed by SSFBA. Respondents in the pier-fishing survey consumed an average of 81 grams per day of Bay-caught fish in the week prior to being surveyed. Since agencies have generally assumed lower consumption rates (e.g. 6.5 to 30 grams per day) in developing exposure scenarios for chemical contaminants in seafood, the fishing population's exposure to contaminants may be greater than previously thought.

Additionally, government health risk assessments are typically based on contaminant concentrations in muscle fillets trimmed of fat and skin, or in some cases muscle fillets with

skin intact. However, SSFBA's survey found that people eating fish from the Bay commonly ate the skin and sometimes portions of the heads of fish. SSFBA's interview with Lao-Mien fishermen suggests that people in the Lao community regularly eat the intestines, livers and eggs of fish and boil fish carcasses to make soups or stews. Because some chemical contaminants accumulate at greater concentrations in organs and fatty tissues,<sup>40</sup> people who eat these parts could be exposing themselves to higher contaminant doses.

**5. Many of those eating Bay-caught seafood are people of color.**

In the pier-fishing survey nearly 70 percent of the people who reported eating Bay-caught seafood in the past 30 days were Asian and 14 percent were African-American.

**6. Health advisories on contaminants in Bay fish may not be reaching Bay anglers, especially those at greatest risk.**

Most anglers in the study were unaware, or only vaguely or inaccurately aware, of existing health warnings about eating fish or shellfish from the Bay. English speakers were more likely than non-English speakers to have heard a health warning, to remember it accurately, and to change their behavior as a result of it. Sixty-four percent of those who reported eating Bay-caught fish did not speak or read English.

**7. Consumers of Bay fish generally are not employing the methods recommended by OEHHA to reduce their exposure to chemical contamination.**

SSFBA's pier-fishing survey and interview suggests that many people who eat considerable amounts of Bay-caught fish do not vary their fishing site, do not limit their consumption to muscle fillets but instead frequently eat skin and head parts and sometimes liver and intestines, and do not drain and discard juices when cooking fish; and that a few people may, on occasion, eat raw fish.

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<sup>40</sup>Contaminant Levels in Fish Tissue from San Francisco Bay, San Francisco Bay Regional Water Quality Control Board, Oakland, Final Draft Report (December 1994), p. 45.

# **The Seafood Consumption Information Project**

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Survey Questionnaire and Results:

Available on request from Save San Francisco Bay Association

## **Acknowledgements**

Many people contributed important advice and assistance that enabled the Project to be completed. We gratefully acknowledge their contributions.

Christine Arnesen, Anna Fan, Karen Kan and Gerald Pollock at the Office of Environmental Health Hazard Assessment

Karen Taberski and Peter Otis at the San Francisco Bay Regional Water Quality Control Board

Eleanor Blake, Diana Lee, Tivo Rojas and Alyce Ujihara at the California Department of Health Services

Jennifer Countiss, Joshua Kaneko, Rick Parmer and Gail Roper at the California Department of Fish and Game

Selma Monsky and Tom Piazza at the University of California Survey Research Center

Patricia Velez at the Santa Monica Bay Restoration Project

Vicky Clark and Alan Ramo at the Environmental Law and Justice Clinic, Golden Gate University

Ron Garrison at the Candlestick Point State Recreation Area

Yaochan Chao at Lao Family Services, Inc.

Abby Eaton, Ginette Geer, Arlene Gemmill and Debbie Kramer provided technical assistance on data compilation and analysis.

Assistance in developing the survey questionnaire and research methodology, or comments on earlier versions and various drafts of this report, were provided by John Beutler, Arnold Den, Abby Eaton, Ginette Geer, Ruth Gravanis, Greg Karras, Diana M. Lee, Trish Mulvey, Nancy Nadel, Gerald Pollock, Donna Schaffer, Doris Sloan, Karen Taberski and Alyce Ujihara.

**24** The San Francisco Estuary Institute generously provided use of its library.

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