# Santa Clara Valley Water District

# Santa Clara County Angler Survey: Final Report

Mark Seelos November 28, 2018



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#### **1** Executive Summary

During the summers of 2017 and 2018, the Santa Clara Valley Water District (District) conducted a social survey at 13 lakes and reservoirs to assess public awareness of mercury-contaminated fish, risk from fish consumption, and opportunities for improving communications. District staff interviewed anglers in person, gathering data related to fishing and consumption frequency, health hazard awareness, and sociodemographics. Surveys were available in English, Spanish, Vietnamese, and Chinese, and responses were recorded and georeferenced using a handheld tablet device.

Staff completed 409 surveys over 33 field visits ranging from one to seven hours. Most respondents identified as white, Asian, or Hispanic. The majority were between the ages of 25 and 54. Forty percent were from zip codes with median annual household incomes of \$30,000 to \$60,000. Nearly all anglers interviewed were male.

Eighteen percent of anglers planned to eat their catch or give it to others. Water bodies affected by historical mercury mining had the lowest consumption rates. White anglers were less likely to consume their catch than Hispanic or Asian anglers. A higher percentage of non-English speaking anglers planned to consume their catch when compared to English-speakers. The probability of anglers consuming their catch increased with decreasing median income of the angler's zip code.

Most anglers were aware of health warnings about consuming fish from local lakes and reservoirs, and the majority of those knew that the advisories were due to mercury contamination. Over half of anglers learned about the health risks through posted signage. Anglers that were aware of the advisories were less likely to consume their catch. White anglers were more likely to be aware of the health warnings.

Most anglers who eat their catch feed it to their families. Of these, most feed it to children or women of child-bearing age. Hispanic anglers were most likely to feed their catch to their families, but no ethnicity is more likely than another to feed their catch to high-risk groups. One fifth of anglers who ever eat their catch eat more locally caught fish than store bought fish. Only four percent of anglers who ever eat their catch do so on weekly basis. Four of 409 anglers interviewed likely exceeded the EPA's recommended ingestion limit for methylmercury.

This report presents the following recommendations:

- Clarify existing advisories to avoid confusion. Some reservoirs where periodic fish consumption is acceptable contain "do not eat" advisories. Consumption advisories developed by the California Office of Environmental Health Hazard Assessment should be posted when available.
- **Post additional signage.** District staff observed only 17 fish consumption advisories at 13 water bodies. Six mercury-impaired reservoirs had no posted signage. Signage should be posted at visible locations around the reservoir, at locations where anglers were commonly interviewed, and at access points.

- **Conduct other outreach.** Because mercury ingestion by children constitutes a high risk, we recommend conducting outreach to local pediatricians, particularly those that accept Medicaid.
- Use new data to update advisories. Advisories based on old data may not be adequate to protect vulnerable individuals when fish tissue concentrations change. Reservoirs that have had significant reductions in fish tissue mercury may be unnecessarily underutilized as recreational resources. We recommend that advisories are updated regularly using new fish tissue concentration data as it becomes available.
- **Reduce mercury sources and bioaccumulation.** The District will continue to take an active role in this program by working toward methylmercury reduction. The District is currently evaluating the effectiveness of hypolimnetic oxygenation in reducing mercury bioaccumulation in four mercury-impaired reservoirs with the goal of finding effective management actions to achieve TMDL targets.
- Use survey data to develop subsistence uses. The State Water Resources Control Board adopted a resolution that approved "Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions." Subsistence use designations and associated fish tissue mercury targets require social survey data to assess the extent and frequency of subsistence fishing. The results of this survey indicate that the frequency of subsistence fishing in the lakes and reservoirs of Santa Clara County is low. This information should be considered when designating uses.

# 2 General Background

Mercury enters lakes and reservoirs through a variety of pathways. The New Almaden Mercury Mining District, located in south San Jose, operated from 1845 to 1975, liberating over 40 million kilograms of mercury from the Cinnabar Hills. Waste material from ore processing and mercury extraction affects reservoirs and creeks in the Guadalupe River Watershed. Elemental mercury released from coal burning, volcanic eruptions, and emission from terrestrial or aquatic surfaces is transported globally with atmospheric circulation. When it is oxidized in the atmosphere, mercury can be deposited back on the earth and wash into lakes, reservoirs, or the ocean. Once it is present in the aquatic environment, mercury can be converted to methylmercury by bacteria. Methylmercury, the metal's highly toxic organic form, accumulates in fish tissue, potentially causing neurological damage and developmental defects in humans and birds that consume contaminated fish. Mercury contamination in reservoirs presents substantial risks to public health and wildlife.

The Santa Clara Valley Water District (District) and County of Santa Clara have posted signage at reservoirs warning anglers to limit fish consumption. The Clean Watersheds for a Clean Bay Project partnered with the California Department of Public Health, the Aquatic Science Center, the Office of Environmental Health Hazard Assessment (OEHHA), and the San Francisco Bay Regional Water Quality Control Board to conduct a regional outreach and education program referred to as the San Francisco Bay Fish Project. Despite these efforts, little information exists regarding public knowledge of mercury contamination in Santa Clara County Reservoirs.

## 3 Regulatory Background

Every two years, states are required to review available data and submit lists of waters that have failed to meet water quality standards to the United States Environmental Protection Agency (USEPA). Once identified, these water bodies are prioritized for development of Total Maximum Daily Load (TMDL) programs that intend to restore the impaired beneficial uses. The State Water Resources Control Board (State Board) has identified eleven lakes and reservoirs owned and operated by the District as impaired due to high mercury concentrations in fish. OEHHA has issued fish consumption advisories for six of the eleven District reservoirs listed as impaired for mercury, as well as for Vasona Lake and Camden Ponds (Table 1). The County of Santa Clara manages recreational activities, including fishing, at reservoirs open to the public.

Water Body	Impaired for Hg on 303(d) List	OEHHA Consumption Advisory
Almaden Lake	Х	
Almaden Reservoir	Х	Х
Anderson Reservoir	Х	Х
Calero Reservoir	Х	Х
Camden Ponds		Х
Chesbro Reservoir	Х	
Coyote Reservoir	Х	
Guadalupe Reservoir	Х	Х
Lexington Reservoir	Х	Х
Ogier Ponds	Х	
Stevens Creek Reservoir	Х	Х
Uvas Reservoir	Х	
Vasona Lake		Х

Table 1: Santa Clara County Mercury-Impaired Reservoirs and OEHHA Fish Consumption Advisories

The USEPA designates an acceptable fish tissue methylmercury concentration of 0.3 mg/kg (wet weight) for adults who consume 17.5 grams of fish per day [2]. However, USEPA recognizes that fish consumption varies geographically and by angler, so therefore "fish consumption data are a necessary component of population exposure assessment" [1]. Agencies can use this information to take appropriate actions for the general population that protect the most vulnerable individuals, such as subsistence fishermen [1]. The State Board approved a new beneficial use for subsistence fishing, aimed at minimizing risk to economically disadvantaged populations that rely on "the catching or gathering of aquatic resources to meet minimal needs for sustenance" [4].

#### 4 Purpose

The Santa Clara County Angler Survey program satisfies one of the ten "pollution prevention and reduction activities" required by Priority B1 of the Santa Clara Valley Water District's *Safe, Clean Water and Natural Flood Protection Program* [6]. This document fulfills reporting requirements set forth in the 2017 *Santa Clara County Reservoir Angler Survey Plan* [7].

The objectives of this study are to:

- Assess fish consumption and human health risk from mercury-impaired reservoirs;
- Assess effectiveness of existing fish consumption advisories, inform future fish consumption advisories, and direct public outreach actions; and
- Assess extent of subsistence fishing in impaired lakes and reservoirs.

### 5 Survey Methodology

Survey methodology is based on USEPA's "Guidance for Conducting Fish Consumption Surveys," published in 2016 [3]. To ensure consistency and comparability with regional studies, survey questions were based on the Sierra Fund's *Gold Country Angler Survey* [8]. The population of interest for this survey is Santa Clara County anglers and fishermen that fish in mercury-impaired reservoirs.

Trained District staff conducted interviews at the eleven impaired water bodies, and two additional water bodies with OEHHA fish consumption advisories (Figure 1). Interviews gathered data related to fishing and consumption frequency, health hazard awareness, and sociodemographics [7]. Plastic models of cooked fish fillet servings were used help anglers estimate portion sizes. Data were collected and georeferenced using handheld tablet computers equipped with Survey123 software for Esri ArcGIS. Paper surveys were available in Spanish, Chinese, and Vietnamese for non-English speakers. Illiterate anglers, or anglers speaking other languages, were not interviewed. Spanish-speaking survey staff were used when available.

Interviewers conducted themselves in a friendly, non-regulatory manner to avoid non-response bias. Intensive sampling occurred throughout the fishing season from Spring to Fall of 2017 and 2018, with surveys conducted at randomized locations, dates, and times of day. Sampling occurred on weekends and weekdays. Anglers who fished from the shore were interviewed at their location, while those that fished from boats were interviewed at launch sites. All anglers readily accessible at the lake or reservoir were interviewed. No anglers were interviewed twice throughout the duration of the study. In instances when anglers fished in groups, only one member was interviewed. Upon completion of the interview, surveyors educated anglers about the risks of consuming fish from local water bodies, provided consumption advisories, and answered questions.

**Study Limitations** Though the District made efforts to minimize potential sources of bias, some aspects of this study may affect its accuracy and generalizability. Non-adult anglers were not interviewed, so this group is not represented. Nonresponse bias may affect results, as anglers who refused to be interviewed may have different habits than those who were willing to participate in the study. Language barriers prevented some anglers from being interviewed. Self-reported data contain several potential sources of bias. These include selective memory (remembering some events and not others), telescoping (recalling that events occurred at different times than they indeed did), exaggeration, or pandering to the expectations of the interviewer.



Figure 1: Water Bodies Included in Survey

# 6 Results

During the summers of 2017 and 2018, District staff completed 409 surveys at 13 water bodies. These surveys were accomplished during 33 field visits ranging from one to seven hours. Figure 2 shows the number of surveys completed at each water body. Because staff made an effort to sample each reservoir an equal amount of visits, with randomized days and times, the proportion of anglers surveyed at each water body roughly reflects angler abundance.

## 6.1 Respondent Demographics

Thirty-eight percent of anglers interviewed identified as white (Figure 3). The United States Census Bureau estimates that 53.5% of Santa Clara County residents are white, making them underrepresented as anglers [5]. Hispanic anglers comprised 30% of anglers interviewed, which is slightly higher than the Hispanic population percentage in Santa Clara County of 25.6%. African American anglers are represented roughly the same as their county population percentage, at 3%. Asians comprise 37.5% of Santa Clara County's population, but only 26% of anglers interviewed.

Most anglers interviewed were between the ages of 25 and and 54 (Figure 4). The United

States Census Bureau estimates that persons 65 years and over comprise 13.1% of Santa Clara County's population, making this group underrepresented as anglers. Anglers under the age of 18 were observed, but not interviewed.

Seventy-nine percent of anglers interviewed reside in Santa Clara County (Figure 5). Anglers from the San Francisco Bay Area comprise 87% of anglers interviewed. Fewer than 2% of anglers interviewed reside outside of California.

Forty percent of anglers reside in zip codes where the median household income is between \$30,000 and \$60,000 (Figure 6). Eleven percent of anglers reside in zip codes with median household incomes above \$120,000.

Ninety-two percent of respondents identified as male.

#### 6.2 Fish Consumption

Eighteen percent of anglers interviewed planned to eat their catch or give it to others. Twenty-three percent of anglers interviewed have ever eaten fish caught in local lakes and reservoirs.

**Consumption by Water Body** Water bodies directly affected by historical mercury mining (Almaden and Guadalupe reservoirs, and Almaden Lake) had the lowest percentages of anglers planning to eat their catch (Figure 7). Calero Reservoir, which has received mercury-laden sediment from Almaden Reservoir through the Almaden-Calero canal, had a relatively high percentage of anglers planning to consume their catch (20%) despite signage. Coyote and Lexington reservoirs had the highest percentages of anglers planning to consume their catch, at 27%.

**Consumption by Ethnicity** Ninety-two percent of anglers interviewed who identified as white planned to release their catch (Figure 8). Twelve percent of white anglers anglers interviewed claimed to have ever eaten fish caught from local lakes or reservoirs. Seventy-three percent of Asian anglers planned to release their catch, with the same percentage claiming to never eat fish from local lakes and reservoirs. Seventy-eight percent of Hispanic anglers planned to release their catch, and 31% claimed to have ever eaten fish caught from local lakes and reservoirs. Seventeen percent of African American anglers interviewed planned to eat their catch or give it to others, but only 8% claimed to have ever eaten fish caught from local lakes and reservoirs. Asian and Hispanic anglers comprise the majority of anglers interviewed, and were more than twice as likely as white anglers to consume their catch.

Thirty-five percent of non-English speakers planned to eat their catch (n = 6). Eighty-six percent of non-English speaking anglers who planned to eat their catch or give it to others spoke Chinese. Non-English speakers were more likely to consume their catch, with Chinese-speakers being particularly vulnerable.

**Consumption by Age** Thirty-eight percent of anglers between the ages of 55 and 64 have eaten fish caught from local lakes and reservoirs (Figure 9). Twenty-five percent of anglers between the ages of 25 and 34 eat fish caught from local lakes and reservoirs. Anglers older than 65 were the least likely to consume locally caught fish.

**Consumption by Likely Income Bracket** The median household income of the angler's zip code appears to correlate with the likelihood of consuming fish caught from local lakes and reservoirs, with anglers from lower income areas being more likely to consume their catch (Figure 10).

#### 6.3 Awareness

Advisory Awareness Seventy-three percent of anglers interviewed were aware of health warnings about consuming fish from local lakes and reservoirs. Of these, Seventy-one percent were aware of mercury contamination in fish. Fifty-four percent of anglers who were aware of fish consumption advisories learned of them from posted signs (Figure 11). Only 2% of anglers claimed that posted signs were their preferred source of health information, with the majority getting health information from their health care provider or the internet.

Fifty-four percent of anglers who have ever eaten fish from local lakes and reservoirs are unaware of the consumption advisories, while 78% of those that never eat locally caught fish were aware of the consumption advisories. Half of the anglers who planned to eat their catch on the day they were interviewed were unaware of the consumption advisories.

**Ethnicity and Advisory Awareness** Eighty-four percent of white anglers had heard health warnings about consuming fish from local lakes and reservoirs. Fourteen percent fewer Asian anglers, and 19% fewer Hispanic anglers were aware of the advisories. Advisory awareness appears to correlate with fish consumption rates by ethnicity, with consumption of locally caught fish decreasing with advisory awareness.

Thirteen percent of white anglers who were aware of the advisories have eaten fish from local lakes and reservoirs (Figure 13). Twenty-two percent of Hispanic anglers and 25% of Asian anglers who were aware of advisories still consume their catch. White anglers were more likely to take consumption advisories seriously.

District staff interviewed 17 non-English speakers, 18% of whom did not respond to the question about advisory awareness. Forty percent were aware of the advisories, and 41% were unaware. Advisory awareness is considerably lower among non-English speakers. Six of seven non-English speakers that were not aware of the advisories spoke Chinese.

Age and Advisory Awareness Anglers between the age of 18 and 24 were the least aware of consumption advisories, with 66% having heard health warnings about eating locally caught fish (Figure 14). Eighty-seven percent of anglers between the ages of 65 and 74 were aware of the consumption advisories. Age doesn't seem to be a predictor of advisory awareness. Anglers age 55 to 64 were the least likely to take the consumption advisories seriously, with 24% eating locally caught fish despite advisory awareness (Figure 15).

Likely Income Bracket and Advisory Awareness Anglers from zip codes with median household incomes between \$90,000 and \$120,000 were the most likely to be aware of consumption advisories (Figure 16). Anglers from zip codes with median household incomes between \$60,000 and \$90,000 were the least likely to be aware of consumption advisories. Zip code median income isn't a strong indicator of advisory awareness. However, anglers from lower income zip codes are less likely to take the consumption advisories seriously, with the percentage of anglers who eat fish despite knowledge of advisories decreasing with income (Figure 17).

Signage Presence and Consumption District staff observed 17 fish consumption advisory signs posted at the water bodies (Table 2). All signs were "Do Not Eat" advisories posted either by the District, City of San Jose, or County of Santa Clara. With the inclusion of Almaden Lake, there was a negative correlation between signage density and fish consumption that was nearly significant (p=0.11), with fewer anglers planning to eat their catch at reservoirs with a higher density of signs (Figure 18). However, with Almaden Lake removed, there was no relationship (p=0.96). The lack of correlation between sign density and consumption is likely due to many water bodies with no posted signage. Removing these water bodies, the correlation is still not significant.

Water Body	Signs Posted	Posting Agency
Almaden Lake	3	SCVWD, City of SJ
Almaden Reservoir	1	SCVWD
Anderson Reservoir	2	SCVWD
Calero Reservoir	4	SCVWD
Camden Ponds	0	NA
Chesbro Reservoir	0	NA
Coyote Reservoir	1	Santa Clara County
Guadalupe Reservoir	1	SCVWD
Lexington Reservoir	0	NA
Ogier Ponds	0	NA
Stevens Creek Reservoir	5	SCVWD
Uvas Reservoir	0	NA
Vasona Lake	0	NA

Table 2: Fish Consumption Advisory Signage at Water Bodies

#### 6.4 Health Risk

**High-Risk Groups** Among anglers who have ever consumed their catch, 62% have fed it to their family. Of these, 52% have fed fish to children under the age of 18, and 73% have fed it to women between the ages of 18 and 49. Eight percent (n = 4) of anglers who feed fish to their family have ever fed it to women expecting a child (Figure 19).

Hispanic anglers were most likely to feed their catch to others in their household, with 69% of those who eat their catch feeding it to their family. Sixty-one percent of white anglers, and 54% of Asian anglers who have ever eaten their catch feed it to their family. Forty-four percent of white anglers, 43% of Hispanic anglers, and 46% of Asian anglers who feed fish to people in their households do so to children under the age of 18. Eighty-five percent of Asian anglers who feed fish to people in their household have fed it to women between the ages of 18 and 49. Seventy-eight percent white anglers and 67% of Hispanic anglers who feed fish to people in their household have fed it to women of child-bearing age. Eleven percent of white anglers, 10% of Hispanic anglers, and 8% of Asian anglers who feed fish to members of their household have fed it to women expecting

a child. No ethnic group is considerably more likely than another to feed their catch to high-risk groups.

**Subsistence** Thirty-two percent of anglers who have ever eaten their catch don't eat fish (locally caught or commercially-bought) on a monthly basis. Forty-eight percent of anglers who have ever eaten their catch eat more commercially-bought fish than locally caught fish. Twenty percent of anglers who have ever eaten their catch eat more fish caught in local lakes and reservoirs than commercially-bought fish (Figure 20).

Seventy-one percent of anglers who have ever eaten their catch claimed to have not eaten fish caught from local lakes and reservoirs in the last month. Twenty-five percent of anglers who have ever eaten their catch ate it between one and three times in the last month, and 4% ate it four or more times (Figure 21).

Seventy-four percent of anglers who have ever eaten their catch ate it none of the times that they fished in the previous month. Nine percent of anglers who have ever eaten their catch ate it 0-24% of the time that they fished. Six percent of anglers ate their catch between 25 and 75% of the times they fished, and 10% ate fish 75% or more of the times they fished in the previous month. These 10 percent of anglers (n = 8) represent people whose goal is likely to be fish consumption, as opposed to recreation (Figure 22).

**Reference Doses** The Environmental Protection Agency's reference dose for methylmercury is 0.1 ug MeHg/kg of body weight per day. This represents the level of exposure to methylmercury that is likely to be without appreciable risk of adverse health effects. Using angler responses for fish consumption rates, species, portion sizes, and locations of catch, District staff calculated methylmercury ingestion rates for anglers who reported having consumed fish during the previous month. Fish tissue mercury concentrations used in this analysis are referenced in Table 3.

Fourteen percent of anglers who consumed locally caught fish during the previous month (n = 4) likely exceeded the EPA's reference dose for methylmercury (Figure 23). This considers only locally caught, and not store-bought fish. This group represents less than one percent of all anglers surveyed. The average methylmercury ingestion rate for the group that exceeds the reference dose is 0.29 ug MeHg/kg per day, nearly three times what is considered safe.

# 7 Discussion

#### 7.1 Respondent Demographics

White and Asian people were underrepresented as anglers when compared to Santa Clara County census data, and Hispanic people were slightly over-represented. This is likely due to the high concentration of reservoirs in south Santa Clara County, where the Hispanic population is higher. Cultural differences in recreational activity choice and fish consumption patterns may also contribute to the discrepancy in ethnicities observed. The median age of anglers interviewed was 40 years. This is consistent with the Santa Clara County census median age of 37 years. Seventy-one percent of anglers surveyed were between the ages of 25 and 54, but this group comprises only 45.5% of Santa Clara County's population. Forty percent of anglers interviewed reside in a zip

Water Body	Species	Avg. Hg Conc. (ug/kg WW)	Source
ALMADEN LAKE	Largemouth bass	520	District
ALMADEN RESERVOIR	Black Crappie	470	District
	Bluegill	580	District
	Largemouth bass	920	District
ANDERSON RESERVOIR	Black Crappie	315	SWAMP
	Bluegill	279	SWAMP
	Channel catfish	1019	SWAMP
	Common carp	422	SWAMP
	Largemouth bass	1114	SWAMP
CALERO RESERVOIR	Black Crappie	110	District
	Bluegill	100	District
	Largemouth bass	160	District
CAMDEN PONDS	Bluegill	109	SWAMP
	Channel catfish	161	SWAMP
	Common carp	77	SWAMP
	Goldfish	101	SWAMP
	Largemouth bass	165	SWAMP
CHESBRO RESERVOIR	Common carp	530	SWAMP
	Largemouth bass	1040	SWAMP
COYOTE RESERVOIR	Common carp	760	SWAMP
GUADALUPE RESERVOIR	Black Crappie	1310	District
	Bluegill	1000	District
	Largemouth bass	1320	District
LEXINGTON RESERVOIR	Bluegill	142	SWAMP
	Channel catfish	365	SWAMP
	Largemouth bass	608	SWAMP
OGIER PONDS	Largemouth bass	450	SWAMP
STEVENS CREEK RESERVOIR	Black Crappie	250	District
	Bluegill	170	District
	Largemouth bass	210	District
UVAS RESERVOIR	Largemouth bass	920	SWAMP
VASONA LAKE	Bluegill	109	SWAMP
	Channel catfish	161	SWAMP
	Common carp	77	SWAMP
	Goldfish	101	SWAMP
	Largemouth bass	165	SWAMP
other	Bluegill	346	Estimate
	Largemouth bass	422	Estimate

 Table 3: Mercury Concentrations Used for Exposure Calculations

code with a median household income of between 30,000 and 60,000. This may reflect the use of fishing as a low-cost recreational option. Ninety-two percent of anglers interviewed were male.

#### 7.2 Fish Consumption

The percentage of anglers who planned to eat their catch on the day they were interviewed was similar to the percentage of anglers who ever eat their catch, at 18% and 23%, respectively. This suggests that there are two groups of anglers, those who fish for recreation and those who fish for consumption, with little intersection. With the exception of Calero Reservoir, anglers seem to be aware of the dangers of consuming fish from water bodies affected by the New Almaden Mining District. White anglers were considerably less likely to consume their catch than Asian or Hispanic anglers, likely due to socioeconomic and cultural reasons. Thirty-five percent of non-English speakers planned to eat their catch, which may be due to a communication barrier regarding health risk. The majority of non-English speakers that planned to consume their catch spoke Chinese, a language currently not included in posted signage. Though they comprise a relatively small percentage of anglers interviewed (12%), 38% of anglers between the ages of 55 and 64 planned to consume their catch. The probability of anglers consuming their catch increases with decreasing median income of their zip code, suggesting that those that eat their catch may do it for financial reasons.

#### 7.3 Advisory Awareness

Most anglers were aware of health warnings about consuming fish from local lakes and reservoirs, and the majority of those aware knew that the advisories were due to high mercury concentrations in fish. Though over half of the anglers who were aware of the advisories learned about them through posted signage, only 2% described signs as their preferred form of health information. More effective outreach could target preferred sources of information, which were usually health care providers and the internet. About half the anglers who ever consume their catch were aware of the advisories, and 78% of those that never consume their catch were aware of the advisories. This emphasizes the importance of public awareness in achieving risk reduction.

White anglers were considerably more aware of the consumption advisories than non-white anglers. Ethnicities that were less aware of the consumption advisories were more likely to consume their catch. Though this may be due to language and/or cultural barriers, considerably more Asian and Hispanic anglers who were aware of the advisories still consumed their catch when compared to white anglers. Targeted outreach could encourage non-white anglers to take the consumption advisories more seriously. Age is not a good predictor of advisory awareness. Despite higher consumption rates among anglers from low-income zip codes, the median income of the angler's zip code did not correlate with advisory awareness. However, anglers from lower-income zip codes are less likely to take the advisories seriously, with the percentage of anglers who consume fish despite knowledge of advisories decreasing with income. This suggests that lower-income anglers may eat fish out of economic necessity, even though they may be aware of the risk involved.

Some reservoirs that are included on the 303(d) list for mercury do not have official OEHHA advisories (Chesbro, Coyote, Uvas, Ogier Ponds). However, these reservoirs don't have higher rates of fish consumption, likely due to lack of posted advisories at many reservoirs. Some reservoirs (Anderson and Stevens Creek) contain contradictions between posted signage (which warns to not eat any fish) and OEHHA advisories (which warn to limit consumption of certain species). These discrepancies cause confusion that may result in anglers taking the advisories less seriously.

#### 7.4 Health Risk

The majority of anglers who eat their catch feed it to their families. Of these, most feed it to children, and women of child-bearing age. A small number of anglers who feed fish to their families

have fed it to women expecting a child. Hispanic anglers were the most likely to feed their catch to their families, followed by white and Asian anglers. This discrepancy is likely socioeconomic, as the Census Bureau estimates in the American Community Survey that Hispanic families in Santa Clara County are 5% more likely to be living in poverty than white or Asian families. Though Hispanic anglers are more likely to feed their catch to their families, no ethnicity is considerably more likely than another to feed their catch to high-risk groups like children, women of child-bearing age, or women expecting a child.

Twenty percent of anglers who ever eat their catch eat more locally caught than store-bought fish. Seventy-one percent of those who ever eat their catch had not eaten it in the past month. Only 25% of anglers who ever eat their catch had eaten it between one and three times in the past month, and 4% ate it on a weekly basis. There is not strong evidence that many anglers subsist on fish caught from local lakes and reservoirs.

Four of 409 anglers interviewed exceeded the EPA's reference dose for methylmercury, with the average ingestion rate exceeding the reference dose nearly three-fold. Despite this, the vast majority of anglers are not exposed to concentrations of methylmercury that would be considered harmful. Public health risk from anglers eating fish caught in Santa Clara County Reservoirs is likely to be low, with fewer than 1% of anglers at risk.

## 8 Recommendations

Though public health risk from consumption of fish caught in Santa Clara County lakes and reservoirs is likely low, perhaps the result of years of previous outreach efforts, this report presents various options for improving outreach and reducing risk to vulnerable individuals.

**Clarifying Existing Advisories** Water bodies are included on the EPA's 303(d) list if fish tissue methylmercury concentrations exceed the EPA criterion of 0.3 mg/kg. This criterion ensures that a 150 pound person that eats one six-ounce serving of fish per week does not exceed the reference dose of 0.1 ug/kg/day. OEHHA uses this criterion in developing their advisories. Five water bodies are listed on the 303(d) list, but do not have OEHHA consumption advisories: Almaden Lake, Chesbro Reservoir, Coyote Reservoir, Ogier Ponds, and Uvas Reservoir. The District should encourage OEHHA to develop advisories for these water bodies. Vasona Lake and Camden Ponds have OEHHA consumption advisories, but are not yet included on the 303(d) list. Anderson and Stevens Creek Reservoirs have OEHHA advisories that allow for periodic consumption of certain fish species. However, the District posted "do not eat" signage at these reservoirs. OEHHA promotes certain fish species as nutritious, "heart healthy" dietary additions that provide health benefits. Posting "do not eat" advisories contradicts this message, and this inconsistency may cause confusion. We recommend that the messages of signage be made consistent among all communications, and are modeled after the official OEHHA advisories when available.

**Post Additional Signage** District Staff observed only 17 fish consumption advisory signs at 13 water bodies. Six mercury-impaired reservoirs had no posted signage. The signage, when posted, always consisted of "do not eat" warnings that often contradicted OEHHA advisories. Signage should be posted at visible locations around the reservoir, at all locations where anglers were commonly interviewed, and at lake and reservoir access points. When OEHHA advisories are available, they should be posted in English, Chinese, Spanish, and Vietnamese. When no OEHHA advisory is available, "do not eat" signage may be posted until proper advisories are developed.

**Other Outreach** Over half of anglers who fed their catch to members of their household did so to children. Mercury exposure to children presents a risk for developmental defects and neurological damage. Most respondents get health information that they trust from their doctor, health care provider, or the internet. We recommend conducting outreach to local pediatricians, particularly those that accept Medicaid, to emphasize the dangers of ingesting mercury-contaminated fish. Also, we recommend that the District and Santa Clara County Department of Parks and Recreation include consumption advisories on reservoir web pages.

Use New Data to Update Advisories The Santa Clara County OEHHA advisories use fish tissue data collected over ten years ago, except for Camden Ponds and Vasona Reservoir, which use data that were collected in 2011. Methylmercury in fish varies annually, and in response to source, climate, food web, and chemical factors. Advisories based on old data may not be adequate to protect vulnerable individuals when fish tissue concentrations change. Reservoirs that have had significant reductions in fish tissue mercury may be unnecessarily underutilized as recreational resources. We recommend that advisories are updated regularly using new fish tissue concentration data as it becomes available.

**Reduce Mercury Sources and Bioaccumulation** The State Water Resources Control Board is currently developing the *Statewide Mercury Control Program for Reservoirs*, which includes most of the water bodies described in this study. This program intends to protect human and ecosystem health by testing and implementing methods to reduce methylmercury in fish. The District will continue to take an active role in this program by working toward methylmercury reduction. The District is currently evaluating the effectiveness of hypolimnetic oxygenation in reducing mercury bioaccumulation in four mercury-impaired reservoirs with the goal of finding effective management actions to achieve TMDL targets.

Use Survey Data to Develop Subsistence Listings and Target Concentrations On May 2, 2017, the State Water Resources Control Board adopted Resolution 2017-0027, which approved "Part 2 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California - Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions." Subsistence use designations and associated fish tissue mercury targets require social survey data to assess the extent and frequency of subsistence fishing. The results of this survey indicate that the frequency of subsistence fishing in the lakes and reservoirs of Santa Clara County is low. This information should be considered when designating uses.

# 9 Acknowledgments

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# References

- [1] United States Environmental Protection Agency. Guidance for assessing chemical contaminant data for use in fish advisories, 2000.
- [2] United States Environmental Protection Agency. Water quality criterion for the protection of human health: methylmercury, 2001.
- [3] United States Environmental Protection Agency. Guidance for conducting fish consumption surveys, 2016.
- [4] California State Water Resources Control Board. Proposed provisions for draft part 2 of the water quality control plan for inland surface waters, enclosed bays, and estuaries of californiatribal and subsistence fishing beneficial uses, 2016.
- [5] United States Census Bureau. 2010 census. U.S. Department of Commerce, Feb 2011.
- [6] Santa Clara Valley Water District. Safe, clean water and natural flood protection program, 2012.
- [7] Santa Clara Valley Water District. Santa clara county angler survey plan, 2017.
- [8] Sierra Fund. Gold country angler survey, 2011.

#### 10 Figures



Figure 2: Surveys Conducted at Each Water Body



Figure 3: Ethnicities of Anglers Interviewed

Figure 4: Ages of Anglers Interviewed





Figure 5: Counties of Residence of Anglers Interviewed









Percentages describe catch and release response.



#### Figure 8: Ethnicity and Plan for Catch

Percentages describe catch and release response.

Figure 9: Age and Plan for Catch





Figure 10: Consumption by Median Income of Zip Code

Figure 11: Information Sources where Anglers Learned of Advisories





#### Figure 12: Awareness of Health Advisories by Ethnicity

Figure 13: Health Advisory Awareness and Fish Consumption by Ethnicity



Ethnicity



Figure 14: Awareness of Health Advisories by Age

Figure 15: Health Advisory Awareness and Fish Consumption by Age





#### Figure 16: Health Advisory Awareness by Income

Percentages describe "yes" response.

Figure 17: Health Advisory Awareness and Fish Consumption by Income





Figure 18: Sign Density and Fish Consumption

Figure 19: Anglers who Feed Catch to High-Risk Groups





Figure 20: Local vs. Commercial Fish Consumption of Anglers who have Ever Eaten Catch

Figure 21: Monthly Consumption of locally caught Fish by Anglers who have Ever Eaten Catch







Figure 22: Percentage of Times Fished vs. Times Eaten Catch in Previous Month

Figure 23: MeHg Ingestion Rates of Anglers who Ate Their Catch in the Previous Month

