Jay Davis and John Ross, San Francisco Estuary Institute
Mike Kellogg, City and County of San Francisco
Andrew Cohen, Center for Research on Aquatic Bioinvasions
Andrew Gunther, Center for Ecosystem Management and Restoration

A WATER QUALITY REPORT CARD FOR SAN FRANCISCO BAY

HIGHLIGHTS

A new State of the Bay report summarizes progress in attaining management goals relating to habitat, water supply and quality, living resources, ecological processes, and stewardship

A water quality report card is a component of the Report that assesses whether the Bay is safe for aquatic life, whether Bay fish are safe to eat, and whether the Bay is safe for swimming

Many monitored pollutants are considered to pose very low risk to Bay aquatic life, but a few (especially methylmercury, exotic species, the toxicity of sediments, and trash) pose substantial threats

Fish from the Bay are not entirely safe to eat, due mainly to polychlorinated biphenyls (PCBs), methylmercury, and dioxins

Most Bay beaches are safe for swimming in the summer, but bacterial contamination is a concern at a few beaches in the summer, and at most beaches in wet weather

WHAT GETS TRACKED GETS DONE

An ongoing assessment of progress in improving the health of the Bay is essential. A concise assessment of Bay health can communicate the status of this highly valued resource, and present an accounting of progress in achieving the goal of protecting the integrity of the Bay. A periodic assessment of Bay health can also provide a summary of the current state of knowledge that can be used by scientists and managers as they consider new studies and findings.

The San Francisco Estuary Partnership, a coalition of resource agencies, non-profit organizations, citizens, and scientists, has sponsored production of a new State of the Bay Report (**www.sfestuary.org/StateofSFBay2011/**). The report summarizes progress in attaining established management goals relating to the following fundamental aspects of Bay health:

- habitat (baylands [tidal marsh and tidal flat], estuarine open water, watershed);
- water (freshwater inflow, water quality);
- living resources (fish, invertebrates, birds);
- ecological processes (aquatic food web, flood events); and
- stewardship (individual and community action, management action).

The Partnership plans to prepare State of the Bay reports on a periodic basis, and to refine and improve the report with each iteration.

The State of the Bay report is based on the latest and best available scientific information and is presented in a manner intended to be comprehensible to a broad audience. Providing all interested parties with an understanding of "how the Bay is doing" frames the discussion of whether we are doing enough of the right things to protect the Bay. The report is intended to encourage and inform thoughtful discussion about managing and protecting this tremendous resource, and to support continued efforts by citizens, professionals, and political leaders to protect and enhance the myriad benefits of a healthy and vibrant San Francisco Bay.

THE WATER QUALITY REPORT CARD

The water quality report card is an important element of the State of the Bay assessment. Clean water is essential to the health of the San Francisco Bay ecosystem and to many of the beneficial uses of the Bay that Bay Area residents enjoy and depend on. Billions of dollars have been invested in management of the wastewater and other pollutant sources that impact Bay water quality, and as a result the Bay is in much better condition than it was in the 1970s. Inputs of organic waste and nutrients have been greatly reduced and no longer cause fish kills or odor problems. Bacterial contamination has also been reduced. Inputs of many toxic pollutants to the Bay have also declined dramatically as a result of improved wastewater treatment and enforcement of the Clean Water Act. However, thousands of chemicals are carried into the Bay by society's waste streams, and significant and challenging water quality problems still remain.

The Bay Area is fortunate to have one of the best water quality monitoring programs in the world, the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP), to track conditions in the Bay and to provide the information that water quality managers need to address the remaining problems. The report card on Bay water quality is based largely on information generated by the RMP. Other valuable sources of information are also available and were considered as well.

The water quality data summarized in the report card were evaluated using a scheme that takes into account both **1)** the distance from the relevant guideline in terms of the estimated length of time expected to reach the desired condition and **2)** the severity of the impairment of water quality.

The water quality report card addresses the three main beneficial uses of the Bay that are affected by water pollution and protected by the Clean Water Act, answering three key questions:

- Is the Bay safe for aquatic life?
- Are fish from the Bay safe to eat?
- Is the Bay safe for swimming?

Suites of indicators were identified to answer each of these questions (**FIGURE 1**).

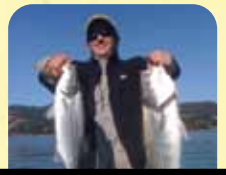
Fishing from Pier 42. Photograph by Jay Davis.

FIGURE 1

Summary of San Francisco Bay water quality, 2011. The star ratings are based on a combination of the severity of the problem and the anticipated time needed to attain water quality goals (see FIGURE 2 and 5). A five star rating indicates that regulatory goals have been met. Fewer stars indicate varying degrees of distance from regulatory goals.

Safe for Aquatic Life

Methylmercury	★
Exotic Species	★★
Sediment Toxicity	★★★
Trash	★★★
Copper	★★★★
Dissolved Oxygen	★★★★★
Silver	★★★★★
Other Priority Pollutants	★★★★★
Selenium	?
PAHs	?
PBDEs	?
PFOS	?
Emerging Contaminants	?



Safe to Eat

PCBs	★
Methylmercury	★★
Dioxins	★★
Legacy Pesticides	★★★★★
Selenium	★★★★★
PBDEs	★★★★★
Other Priority Pollutants	★★★★★
Emerging Contaminants	?

Safe to Swim

Beach Bacteria (April-October)	★★★★
Beach Bacteria (Wet Weather)	★★★

poor	★
poor to fair	★★
fair	★★★
fair to good	★★★★
good	★★★★★
goals not established	?

IS THE BAY SAFE FOR AQUATIC LIFE?

The "Safe for Aquatic Life" water quality index quantitatively considers five key pollutants, and qualitatively considers many others. This index was compared to goals set by the State of California for concentrations of chemical pollutants in water, methylmercury concentrations in the food web, and the toxicity of Bay waters and sediments in laboratory tests. Exotic species and trash are included in this water quality assessment because they are considered pollutants subject to provisions of the Clean Water Act.

Enforcement of the Clean Water Act and other environmental laws over the past 39 years has resulted in tremendous improvements in overall Bay water quality, solving serious threats to aquatic life related to reduced dissolved oxygen and elevated concentrations of silver (**FIGURE 2**). Many other pollutants are also routinely monitored and found at concentrations below regulatory goals, and are considered to pose very low risk to Bay aquatic life. However, several pollutants still pose a substantial threat to the health of aquatic life in the Bay. Methylmercury, exotic species, the toxicity of sediments, and trash are the principal concerns.

Methylmercury continues to pose significant risks to Bay wildlife (**FIGURE 3**). This problem is mainly a legacy of historic mercury pollution that resulted from gold mining in the Sierra Nevada and mercury mining in the local Coast Range. Researchers have concluded that methylmercury poses a high risk for reducing the hatching and fledging success of some species of fish-eating birds (**PAGE 78**). Methylmercury concentrations in the Bay food web have not changed perceptibly over the past 40 years, and will probably decline very slowly in the next 30 years. It may be possible, however, to tackle at least some facets of this problem. For example, one of the species at greatest risk in the Bay, the Forster's Tern, forages primarily in salt ponds. Agencies that manage these habitats may be able to manipulate factors, such as water flow through the ponds, in ways that reduce the production and accumulation of methylmercury.

Exotic species pose the greatest threat to Bay aquatic life due to their displacement of native species, disruption of communities and the food chain, and their alteration of habitat. They also can pose a nuisance for people who swim in the Bay (**SIDEBAR, PAGE 25**). Scientists consider San Francisco Bay to be one of the most highly invaded estuaries in the world, and the ecological impacts of exotic species have been immense. Successful invasions by exotic species are essentially irreversible. Achievable goals are best focused on reducing the rate of introductions, which increased in the late 1900s. Progress on reducing the rate of introductions is achievable in the near-term. State and federal ballast discharge regulations could potentially have a very significant impact on one major vector for exotic species introductions.

Toxicity of Bay sediments in standard tests is another indication of possible impacts of pollution on aquatic life (**FIGURE 4**). In every year since routine sampling began in 1993, at least 26% of the sediment samples have been determined to be toxic. In 2009, 67% of the samples were found to be toxic. Neither the causes of this toxicity or the reasons that it is so variable are understood. These results suggest that pollutant concentrations in Bay sediments may be high enough to affect the development and survival of aquatic invertebrates. This problem will persist into the future until the chemicals (or mix of chemicals) causing this toxicity can be identified and remediated.

Trash in the Bay is also a continuing threat to aquatic life. Plastic trash persists for hundreds of years in the environment and threatens wildlife largely through ingestion and entanglement. Larger trash items degrade to fragments that can have significant impacts on small aquatic life through ingestion and through exposure to chemical constituents that leach from the plastic particles or accumulate on them. Aggressive new regulatory requirements adopted in 2010 should significantly reduce the amount of trash entering the Bay in the next 30 years.

There are several other pollutants that appear to pose risks to Bay aquatic life, but for which definitive regulatory goals for the Bay have not yet been developed. A few of the most prominent examples include selenium, PAHs, and perfluorooctanesulfonate (PFOS). Efforts to evaluate these pollutants and develop appropriate goals are in progress.

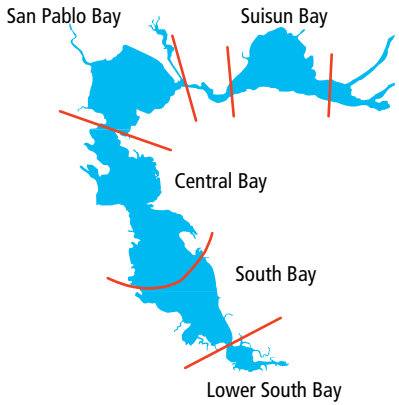
Overall, despite great progress in reducing threats to the health of the Bay's aquatic life, several key pollutants remain problematic. Although these pollutants present management challenges, significant progress appears attainable in several important areas, including reducing trash inputs to the Bay, stemming the influx of exotic species, and reducing methylmercury production in specific habitats.

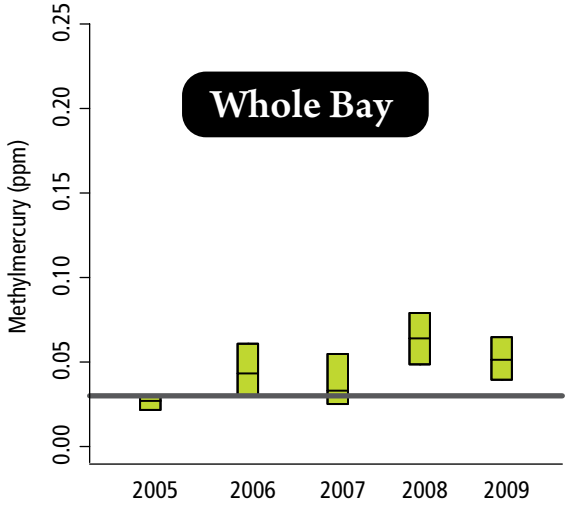
FIGURE 2

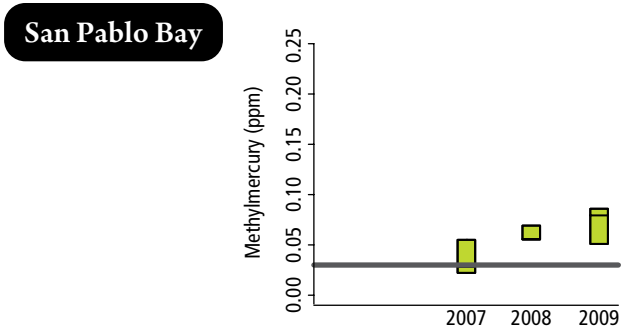
Summary assessment related to the "safe for aquatic life" question. The two key dimensions of water quality problems are their severity (degree of concern) and how quickly the Bay is anticipated to respond to pollution prevention actions (whether rapid progress is likely or not). The assessment scores in **FIGURE 1** are based on a combination of these two factors.

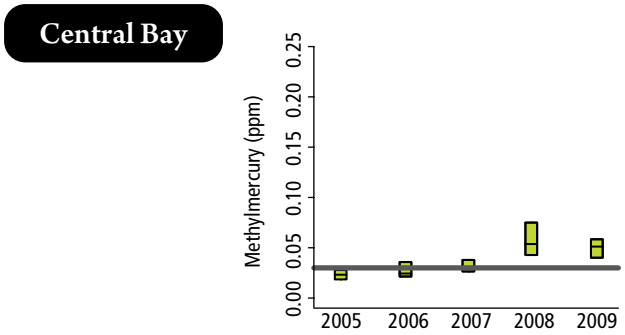
FIGURE 3

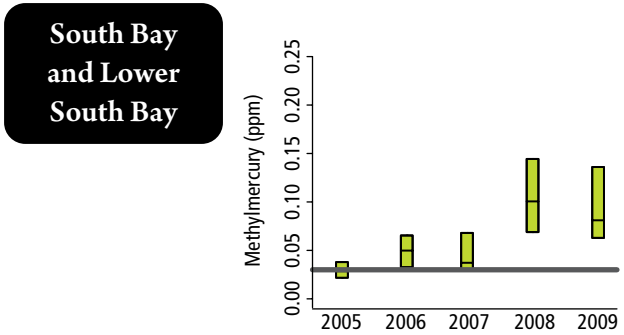
Methylmercury concentrations in small fish frequently exceed the 0.030 ppm target in the Mercury TMDL for protection of fish-eating birds. In the most recent sampling year, methylmercury concentrations in prey fish exceeded the 0.03 ppm target in approximately 95% of the samples collected. Similar results were obtained in 2008, the other year with a larger sample size. Results from a pilot study in 2005-2007 were lower, but the distributions for those years are based on a very small sample size. The Bay-wide median concentration in 2009 was 0.051 ppm.







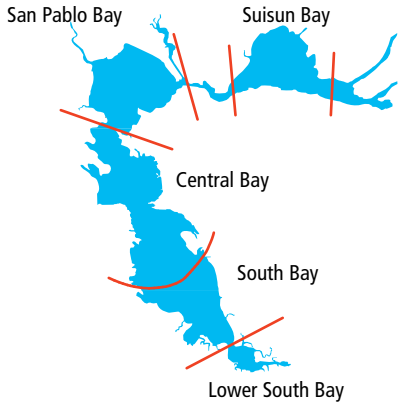


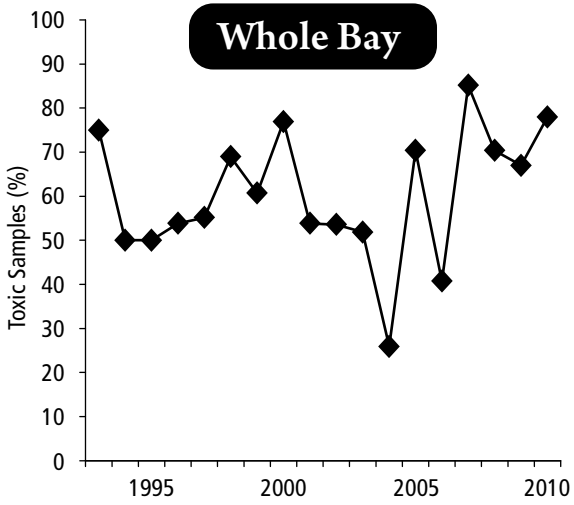


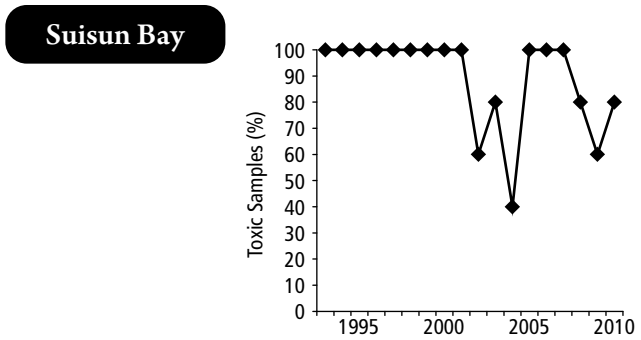
Footnote: Box plots indicate the 25th, 50th, and 75th percentiles. Data for Mississippi silversides and topsmelt in the 3-5 cm size range specified in the Mercury TMDL. The RMP did not specifically target this size range, therefore sample sizes for each year are limited. Reference line is the 0.030 ppm target from the Mercury TMDL.

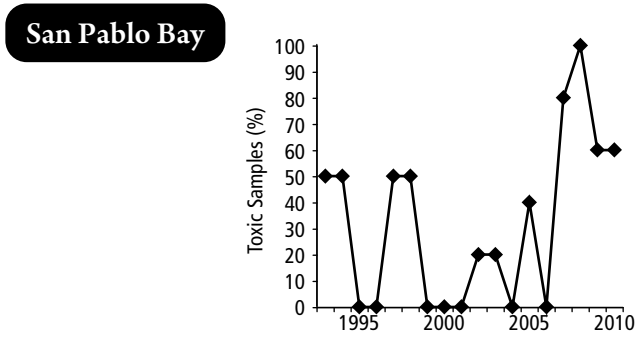
FIGURE 4

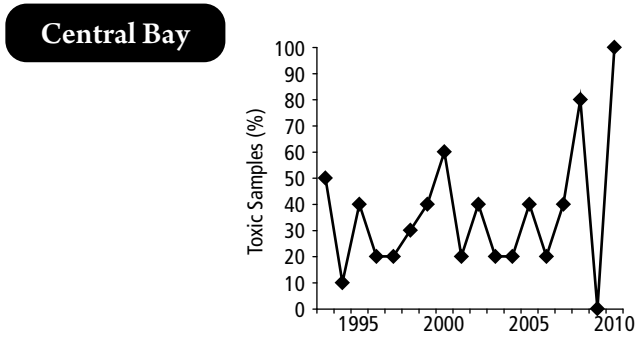
The frequent and continuing toxicity of Bay sediments in standard tests is an important indicator of impacts of pollution on aquatic life. In every year since routine sampling began in 1993, at least 26% of each year's sediment samples have been determined to be toxic. In 2010, 78% of the samples were found to be toxic. The occurrence of toxic samples is greatest in Suisun Bay and South Bay. These results indicate that pollutant concentrations in Bay sediments are high enough to affect the development and survival of aquatic invertebrates. This problem will persist into the future until the chemicals (or mix of chemicals) causing this toxicity can be identified and remediated.

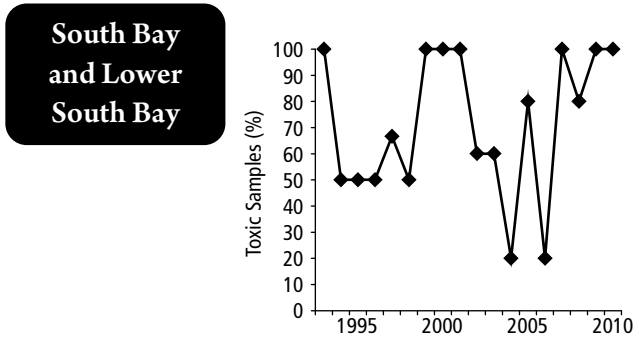












Footnote: Percent of Bay sediment samples exhibiting toxicity in laboratory assays. Sediment samples are tested in the RMP using amphipods and mussel larvae.

← Fishing on Fort Baker Pier. Photograph by Jay Davis.

ARE FISH FROM THE BAY SAFE TO EAT?

The "Safe to Eat" quantitatively considers eight key pollutants, and considers qualitatively the impact of many others. Pollutant concentrations in fish can be compared to goals established by the State of California to protect public health. It is important to note that the comparisons presented in this assessment are general indications of levels of concern, and are not intended to represent consumption advice. Consumers can exercise caution and reduce their exposure to these contaminants by following safe eating guidelines for the Bay developed by the Office of Environmental Health Hazard Assessment (OEHHA), which have just been updated this year (**SIDEBAR, PAGE 16**).

Pollutants in fish from the Bay pose a health concern (**FIGURE 5**) due mainly to polychlorinated biphenyls (PCBs) (**FIGURE 6**), methylmercury (**FIGURE 7**), and dioxins, which are generally found in Bay fish at moderate concentrations. Many other toxic pollutants (e.g., arsenic, cadmium, chlorpyrifos, diazinon, dieldrin, DDTs, polycyclic aromatic hydrocarbons, or "PAHs", polybrominated diphenyl ethers, or "PBDEs", and selenium) are found at concentrations too low to pose concerns.

Contamination in Bay fish varies by species. Striped bass, for example, have relatively high concentrations of methylmercury, while jacksmelt are relatively low in this contaminant. Shiner surfperch have relatively high concentrations of PCBs, and California halibut have relatively low concentrations. The safe eating guidelines for the Bay (**SIDEBAR, PAGE 16**) highlight the key differences among species to allow fish consumers to reduce their exposure. For example, the guidelines indicate that PCB concentrations in one group of species – surfperch – are high enough that OEHHA recommends no consumption.

While moderate contamination is generally found in fish throughout the Bay, PCBs in shiner surfperch are seen at levels that pose a greater concern in the Central Bay than in San Pablo Bay or South Bay (**FIGURE 6**). This exception to the pattern is due to the tendency of shiner surfperch to spend their lives in localized nearshore areas, which can result in greater accumulation when these areas are contaminated with PCBs. This finding suggests that identifying and cleaning up contaminated hotspots along the edges of the Bay could hasten the reduction of contamination at selected locations.

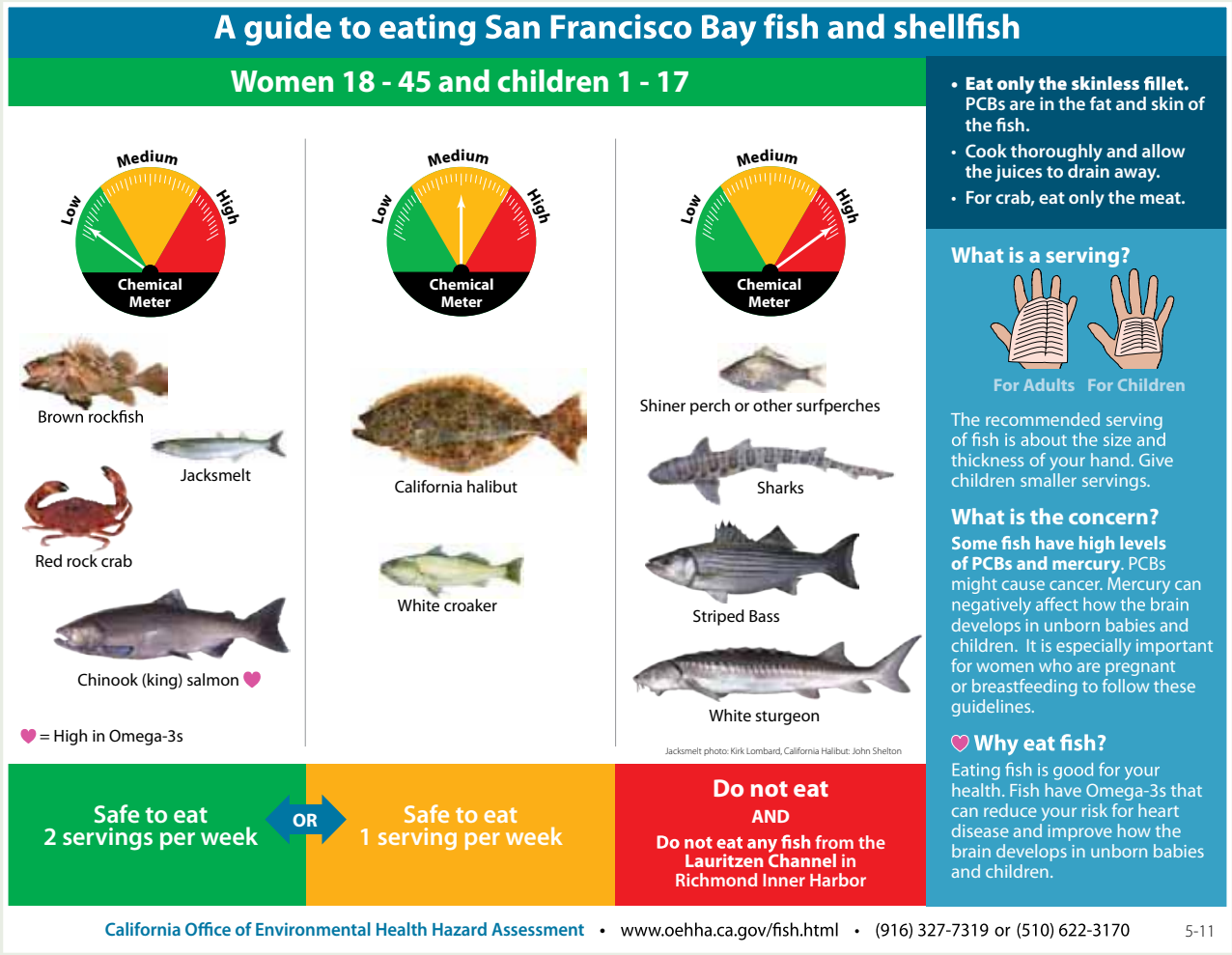
The risk we face today from consuming Bay fish is in large part a legacy of unregulated discharges of pollutants in the past. For example, even though a ban on the sale and production of PCBs went into effect in 1979, these persistent chemicals have become thoroughly spread across the Bay watershed and mixed throughout the Bay, creating a widespread pool of contamination that will dissipate very slowly. Monitoring of trends in fish contamination from 1994 to the present has found no indication of declines for PCBs, methylmercury, and dioxins. Attaining goals for these pollutants in sport fish will take many decades.

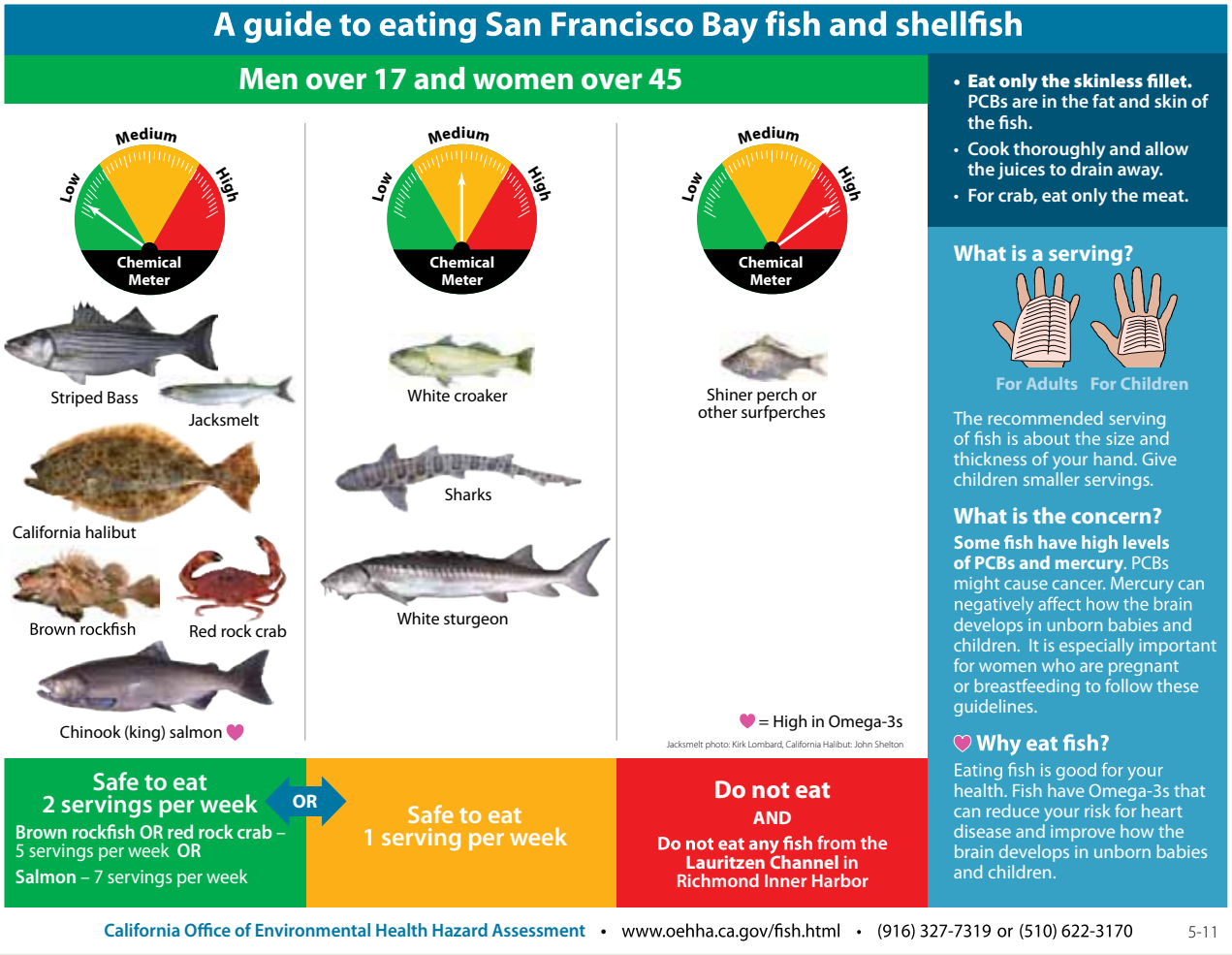
SIDEBAR

UPDATED FISH ADVISORY FOR SAN FRANCISCO BAY

In May 2011 the Office of Environmental Health Hazard Assessment (OEHHA) released an updated health advisory and safe eating guidelines for fish and shellfish caught from San Francisco Bay. The guidelines state that Bay Area anglers should eat a variety of different kinds of fish, avoid fish known to have high amounts of mercury and other contaminants, and properly prepare and cook fish. The advisory also provides special advice for women of childbearing age and children.

The advisory and guidelines replace an earlier 1994 advisory, and draw on over a decade of more recent data, primarily from the RMP, showing San Francisco Bay fish contain mercury and polychlorinated biphenyls (PCBs). They also incorporate nutrition science showing that fish provide dietary protein and essential nutrients, including omega-3 fatty acids that promote heart health and support neurological development.



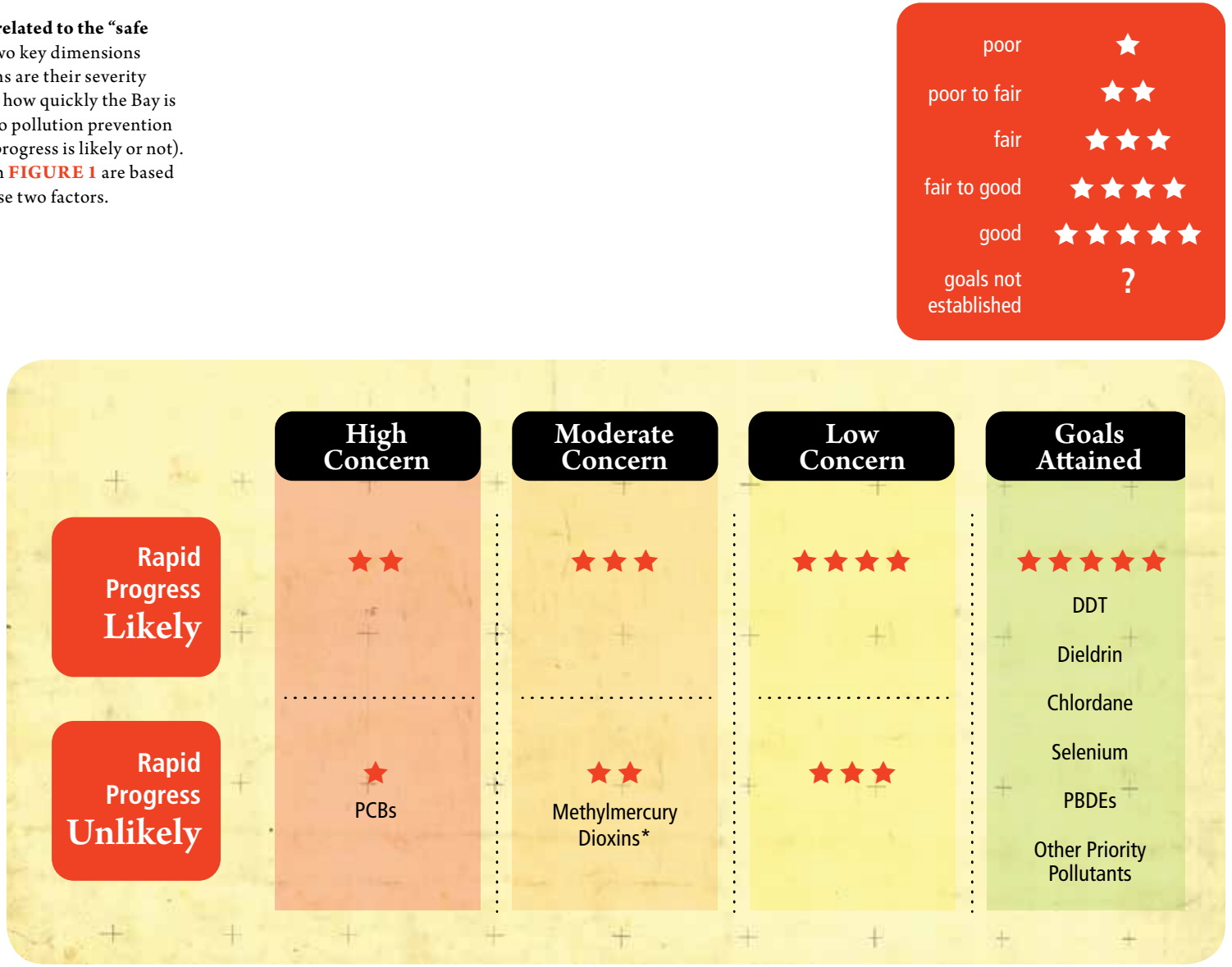


Some kinds of fish have more mercury and PCBs than others. Sharks have the highest levels of mercury, and shiner perch have the most PCBs. High exposures to methyl-mercury (the form of mercury prevalent in fish) can affect the nervous system and harm learning ability, language skills and memory. PCBs are common contaminants known to build up in fish. They have been found to cause cancer in animals and also cause health problems in young children and adults.

Complete information on the new advisory is available at: oehha.ca.gov/fish/general/sfbaydelta.html

FIGURE 5

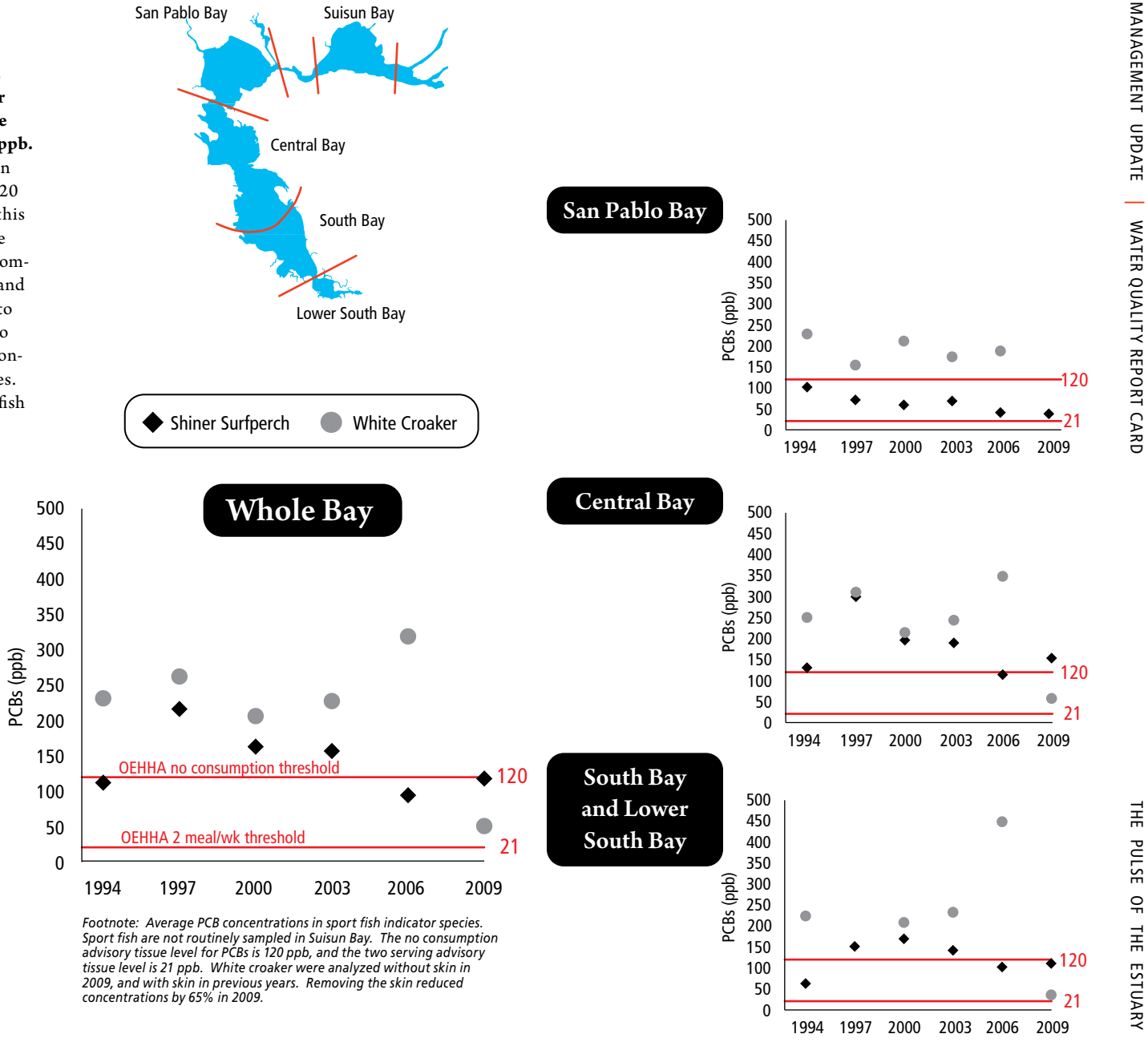
Summary assessment related to the "safe to eat" question. The two key dimensions of water quality problems are their severity (degree of concern) and how quickly the Bay is anticipated to respond to pollution prevention actions (whether rapid progress is likely or not). The assessment scores in **FIGURE 1** are based on a combination of these two factors.



*Footnote: * Dioxins were assessed using a San Francisco Bay Regional Water Quality Control Board target, rather than the Office of Environmental Health Hazard Assessment thresholds used for the other pollutants.*

FIGURE 6

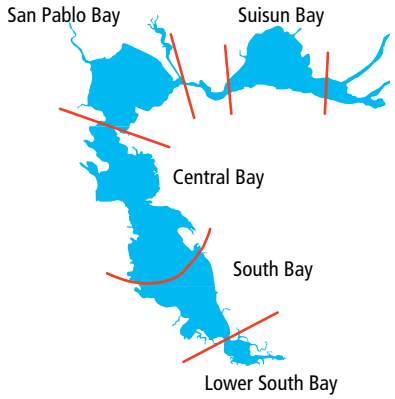
In the most recent sampling year (2009), both of the PCB indicator species (shiner surfperch and white croaker) had average concentrations between 21 ppb and 120 ppb. The Bay-wide average for shiner surfperch in 2009 (118 ppb) was just below OEHHA's 120 ppb no-consumption threshold. Based on this long-term dataset, the recently updated safe eating guidelines for San Francisco Bay recommend no consumption of shiner surfperch and other surfperch species. This corresponds to the "high concern" category in Figure 5. No clear pattern of long-term decline in PCB concentrations has been evident in these species. The summary rating for PCBs in Bay sport fish is therefore one star.

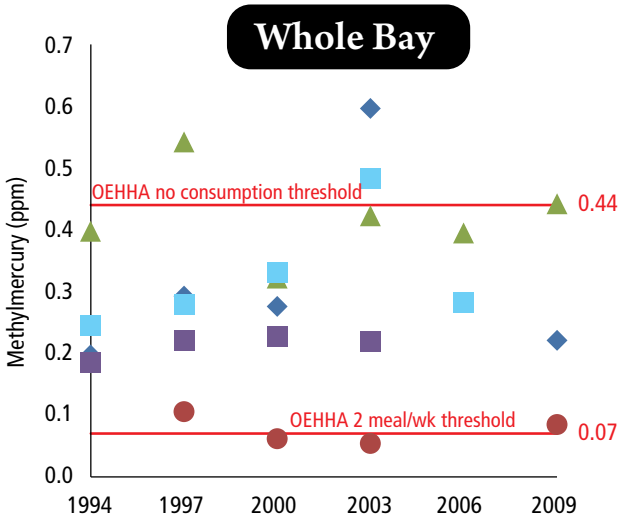


Footnote: Average PCB concentrations in sport fish indicator species. Sport fish are not routinely sampled in Suisun Bay. The no consumption advisory tissue level for PCBs is 120 ppb, and the two serving advisory tissue level is 21 ppb. White croaker were analyzed without skin in 2009, and with skin in previous years. Removing the skin reduced concentrations by 65% in 2009.

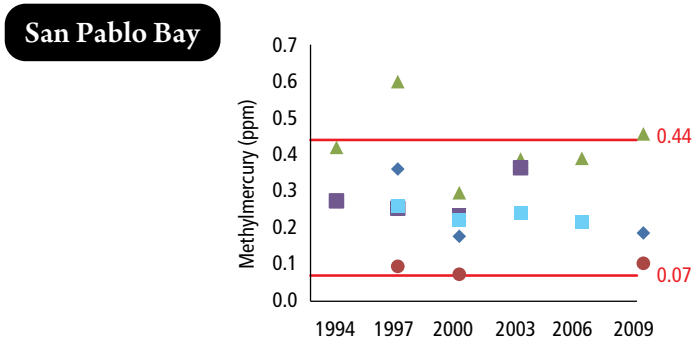
FIGURE 7

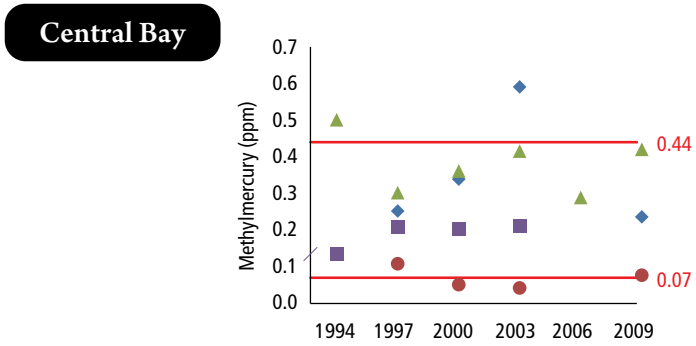
The methylmercury indicator species sampled in 2009 had average concentrations between 0.44 ppm (striped bass) and 0.08 ppm (jacksmelt). Concentrations in these species in recent years mostly fell between the no consumption advisory tissue level of 0.44 ppm and the two serving per week advisory tissue level of 0.07 ppm; this corresponds to the "moderate concern" category in **FIGURE 5**. Methylmercury concentrations in the Bay food web have not changed perceptibly over the past 40 years, and it is not anticipated that they will decline significantly in the next 30 years. The summary rating for methylmercury in Bay sport fish is therefore two stars.

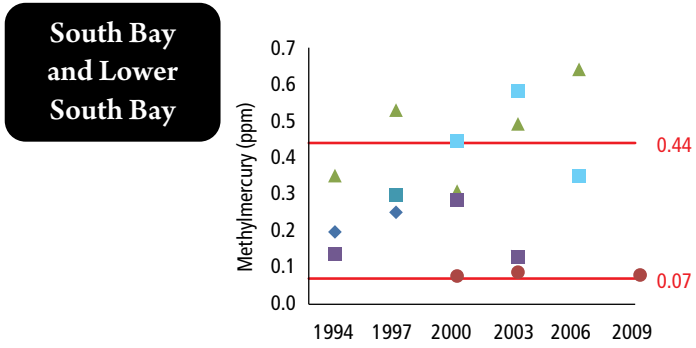




Footnote: Average mercury concentrations in sport fish indicator species. Averages for striped bass based on concentrations for individual fish normalized to 60 cm. Averages for other species based on composite samples. Sport fish are not routinely sampled in Suisun Bay. The no consumption advisory tissue level for mercury is 0.44 ppm, and the two serving advisory tissue level is 0.07 ppm.







IS THE BAY SAFE FOR SWIMMING?

The "Safe to Swim" water quality index is based on measurements of bacteria in water at popular Bay beaches. To protect beach users from exposure to fecal contamination, California has adopted standards for high use beaches that apply from April through October at beaches that are adjacent to a storm drain that flows in the summer. Heal the Bay, a Santa Monica-based non-profit, provides comprehensive evaluations of over 400 California bathing beaches in both Annual and Summer Beach Report Cards as a guide to aid beach users' decisions concerning water contact recreation (**SIDEBAR, PAGE 22**). Overall, the latest beach report card covering the summer of 2010 indicates that most Bay beaches are safe for swimming in the summer, but that bacterial contamination is a concern at a few beaches in the summer, and at most beaches in wet weather.

The frequency of beach closures is another informative metric for evaluating how safe the Bay is for swimming (**FIGURE 8**). Based upon the number of days beaches were closed or posted by counties with advisories warning against water contact recreation, Bay beaches were open 80% to 100% of the time during the prime beach season of April through October from 2006 through 2010.

A variety of approaches can be taken to make the Bay safer for swimming. Sanitary surveys can be conducted to identify and mitigate contamination sources where possible. Low impact design installations may be possible at some sites to retain and treat stormwater before it reaches beaches. Diversion of storm water away from bathing beaches where possible may provide another solution. Repair and replacement of defective and aging sanitary sewer systems will be necessary in many instances before human fecal sources are considered controlled.

A STEP FORWARD

Thanks to considerable investment in infrastructure and the diligent efforts of water quality managers, the Bay is much safer for fishing, aquatic life, and swimming than it was in the 1960s. Substantial control efforts that began in the 1970s, in response to provisions of the 1972 Clean Water Act, solved most of the obvious problems of the 1960s and set the Bay on a course for gradual recovery for many pollutants. The general pace of water quality improvement, however, has slowed in the past three decades, due primarily to a lack of major new initiatives to control inputs to the Bay and the naturally decelerating trajectory of recovery dictated by the dynamics of sediment mixing in the ecosystem.

Preventing the entry of problematic pollutants into this vulnerable ecosystem is the ideal way to protect Bay water quality. We use thousands of chemicals in our homes and businesses, including pesticides, industrial chemicals, and chemicals in consumer products, and many of these enter the Bay. A lack of information on the chemicals present in commercial products, their movement in the environment, and their toxicity hinders efforts to track and manage the risk posed to people and aquatic life by these emerging contaminants. Numeric goals to assess our environmental measurements for emerging contaminants are not yet available, but should be part of future assessments of Bay health. The occurrence of emerging contaminants also underscores the importance of "green chemistry" efforts to prevent potentially problematic chemicals from entering the Bay in the first place so that they do not become additional legacies of health risk for future generations of Bay and Bay Area residents.

↑ Photograph courtesy of Swim Across America, raising money and awareness for cancer research, prevention and treatment: www.swimacrossamerica.org

This summary of Bay water quality highlights several pollutants that continue to pose substantial water quality concerns, and facets of these problems where progress seems attainable. Hopefully this summary will serve as a step forward in effective communication of progress in achieving water quality goals and a foundation for future improvements in reporting and management of Bay water quality.

SIDEBAR

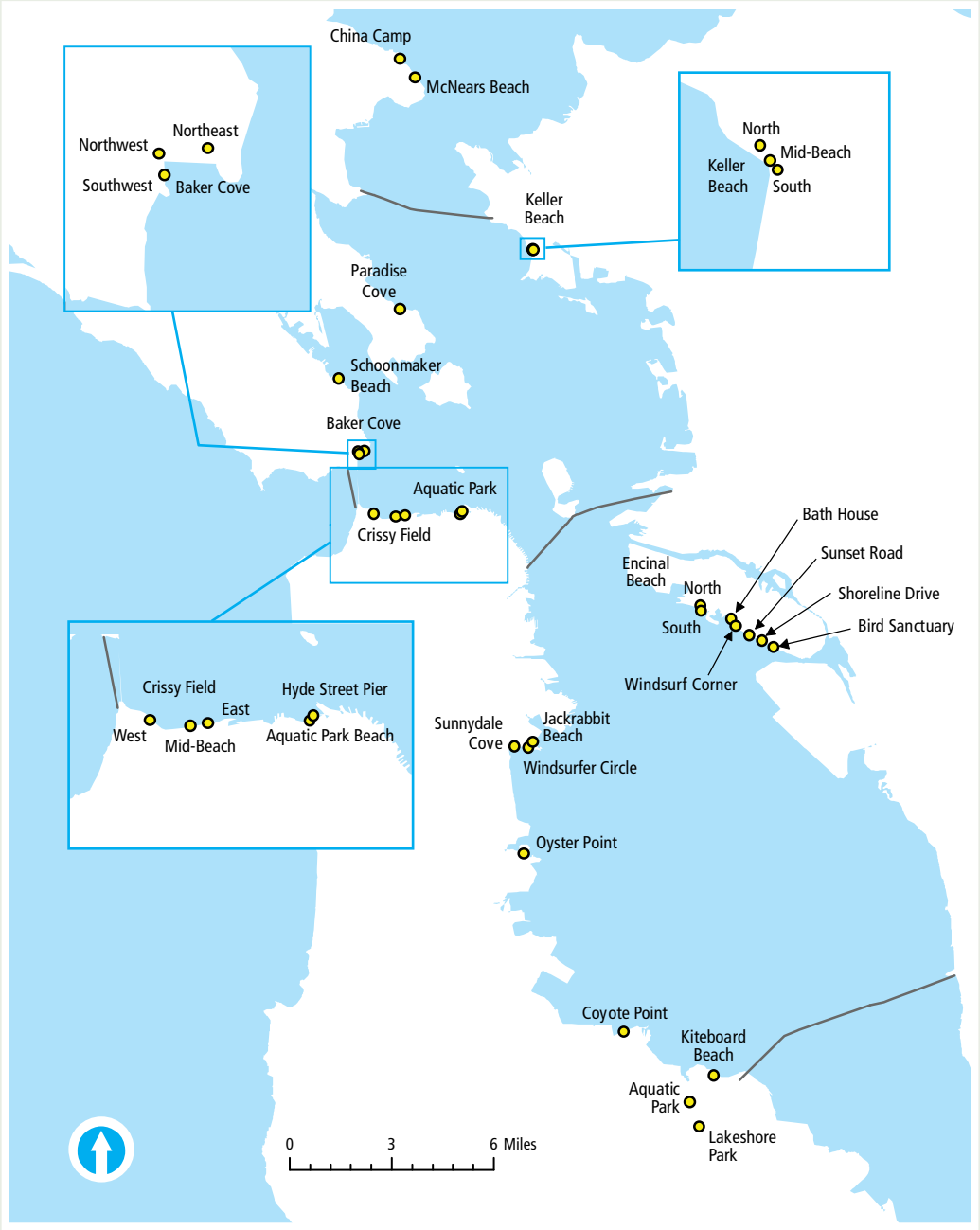
A BEACH REPORT CARD

Heal the Bay, a Santa Monica-based non-profit, provides comprehensive evaluations of over 400 California bathing beaches in both Annual and Summer Beach Report Cards as a guide to aid beach users' decisions concerning water contact recreation. Grades from these report cards, which use the familiar "A to F" letter grade scale, provide a valuable and easily accessible assessment of how safe Bay waters are for swimming.

Overall, the latest monitoring data from 2010 indicate that most Bay beaches are safe for swimming in the summer, but that bacterial contamination is a concern at a few beaches in the summer, and at most beaches in wet weather.

For the summer beach season in 2010, 19 of the 26 monitored beaches received an A or A+ grade, reflecting minimal exceedance of standards. Ten of these beaches received an A+: Coyote Point, Alameda Point South, Bath House, Windsurf Corner, Sunset Road, Shoreline Drive, Hyde Street Pier, Crissy Field East, Crissy Field West, and Schoonmaker Beach. Most Bay beaches, therefore, are quite safe for swimming in the summer. Seven of the 26 beaches monitored in the summer in 2010 had grades of B or lower, indicating varying degrees of exceedance of bacteria standards. Keller Beach North and Keller Beach Mid-Beach were the two beaches receiving an F. Five beaches received a D, including one in Contra Costa County, two in San Mateo County, and two in San Francisco County. These low grades indicate an increased risk of illness or infection. Overall, the average grade for the 26 beaches monitored from April-October was a B.

During wet weather, which mostly occurs from November-March, water contact recreation is less popular but is still enjoyed by a significant number of Bay Area residents. Bacteria concentrations are considerably higher in wet weather making the Bay less safe for swimming. This pattern is evident in Heal the Bay report card grades for wet weather. In wet weather, only five of 22 beaches with data received an A. Six of these 22 beaches, on the other hand, received an F. The average grade for these beaches in wet weather was a C+.



HEAL THE BAY ANNUAL BEACH REPORT CARD GRADES

	APRIL - OCTOBER					DRY WEATHER, YEAR-ROUND					WET WEATHER, YEAR-ROUND				
	2006	2007	2008	2009	2010	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11
SAN MATEO COUNTY															
Oyster Point		A	A	B	A		A		A	A		C		F	D
Coyote Point		A	A+	A+	A+		A		A	A+		A		B	C
Aquatic Park		A	B	F	D		B		F	D		F		F	F
Lakeshore Park		A	D	D	D		C		D	D		F		F	F
Kiteboard Beach			B						A					F	
ALAMEDA COUNTY															
Alameda Point North			A	A+	A			A	A+	A			A+	A	C
Alameda Point South			A	A	A+			A	A	A			A+	A	A
Crown Beach Bath House		A	A	B	A+		A	C	B	A+		C	A+	A	A
Crown Beach Windsurf Corner		A	A	A	A+		A	A	A	A+		A	A+	B	B
Crown Beach Sunset Road		A	A+	A	A+		A	A	A	A+		F	A	B	B
Crown Beach Shoreline Drive		A	A	A+	A+		A	A	A	A		F	A+	C	B
Crown Beach Bird Sanctuary		A	A	B	A		C	A	B	A		F	B	D	C
CONTRA COSTA COUNTY															
Keller Beach North		B	F	D	F		B	D	D	F		A	A	B	A
Keller Beach Mid-Beach		B	C	D	F		B	C	D	F		B	B	B	A
Keller Beach South		A	C	D	D		A	C	D	D		A	B	C	B
SAN FRANCISCO COUNTY															
Crissy Field Beach West			A+	A+	A+			A+	A+	A			A	C	B
Crissy Field mid-Beach	A	A+				A	A+				B	A			
Crissy field Beach East	A	A	A	A	A+	C	A	B	A	B	D	A	B	B	C
Aquatic Park Beach	A	B	A	A	A	A	C	B	A	B	B	A	C	A	B
Hyde Street Pier	A	A	A	A+	A+	A	A	A	A	A	A	A	A+	A	A
Jackrabbit Beach	A	A	A	A	A	A	A	A	A	A	A	F	D	C	B
CPSRA Windsurfer Circle	A	A	A	A	D	A	A	B	A	F	F	F	F	F	F
Sunnydale Cove	A	A	A	B	D	A	C	A	C	C	F	F	F	F	F
MARIN COUNTY															
Horseshoe Cove NE	A	A	A	A+	A										
Horseshoe Cove NW	A	B	A	A	A										
Horseshoe Cove SW	A	A	A	A	A										
Schoonmaker Beach	A	A+	A+	A	A+										
Paradise Cove	A	A	A+												
China Camp	D	A+	A+	A	A										
McNears Beach	C	A	A												
OVERALL GPA	3.64	3.88	3.61	3.30	3.23	3.71	3.44	3.31	3.12	2.91	2.14	2.05	3.11	2.14	2.38
OVERALL GRADE	B+	A-	B+	B	B	A-	B+	B+	B	B-	C	C	B	C	C+

(year-round = April 1 - March 31)

SOURCES OF INFORMATION ON BACTERIA MONITORING AT BAY BEACHES

ALAMEDA COUNTY

website: www.ebparks.org/stewardship/water

hotline: 510-567-6706 (Crown Beach)

CONTRA COSTA COUNTY

website: www.ebparks.org/stewardship/water

CITY AND COUNTY OF SAN FRANCISCO

website: http://beaches.sfwater.org

hotline: 415-242-2214 or 1-877-SFBEACH (732-3224) toll free

MARIN COUNTY

website: www.co.marin.ca.us/ehs/water/beach_monitoring.cfm

hotline: 415-473-2335

SAN MATEO COUNTY

website: www.smhealth.org/environ/beaches

hotline: 650-599-1266

HEAL THE BAY BEACH REPORT CARDS

website: www.beachreportcard.org

CALIFORNIA SAFE TO SWIM WEB PORTAL

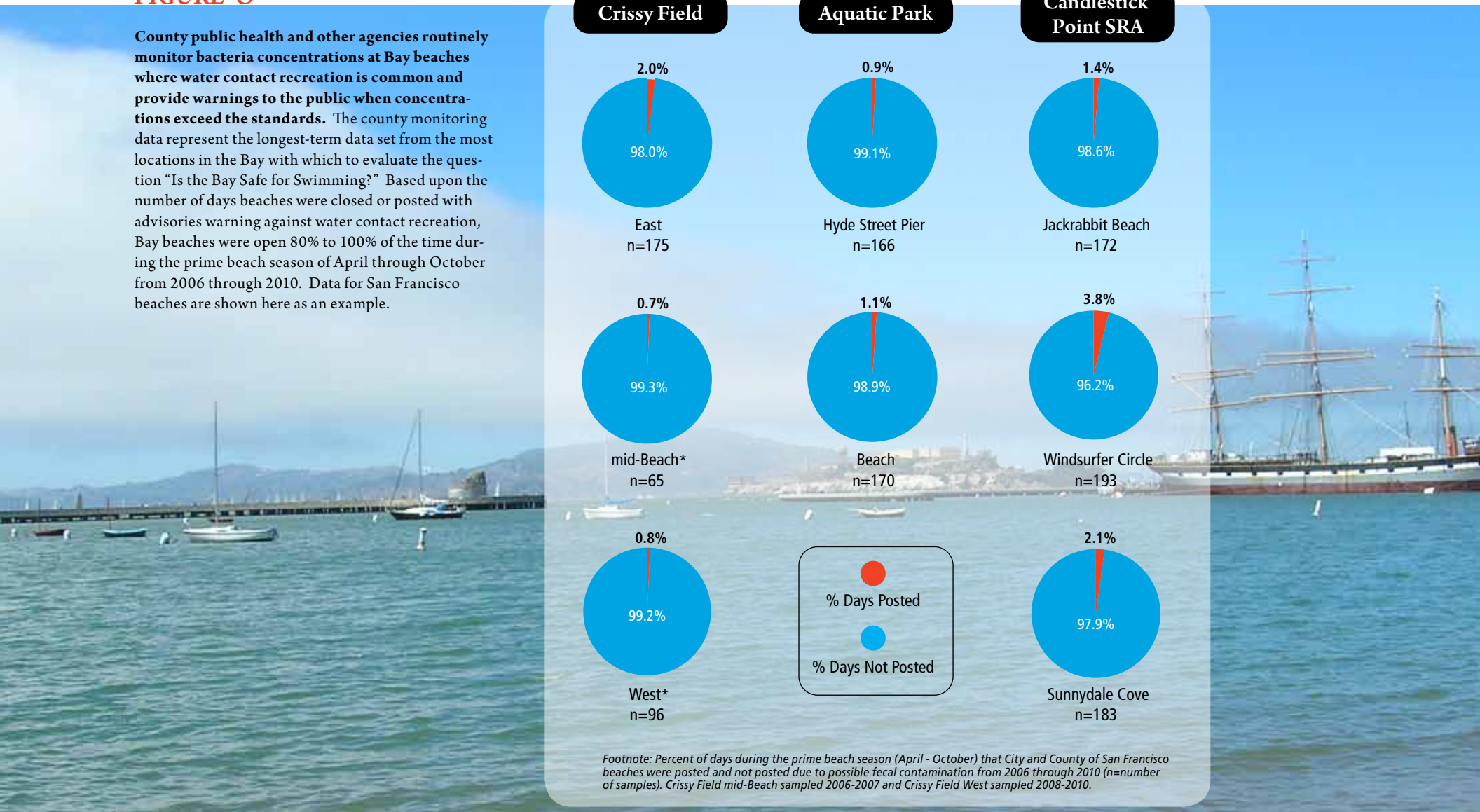
website: www.waterboards.ca.gov/mywaterquality/safe_to_swim

CALIFORNIA BEACH WATER QUALITY INFORMATION PAGE

website: www.swrcb.ca.gov/water_issues/programs/beaches/beach_water_quality/index.shtml

FIGURE 8

County public health and other agencies routinely monitor bacteria concentrations at Bay beaches where water contact recreation is common and provide warnings to the public when concentrations exceed the standards. The county monitoring data represent the longest-term data set from the most locations in the Bay with which to evaluate the question "Is the Bay Safe for Swimming?" Based upon the number of days beaches were closed or posted with advisories warning against water contact recreation, Bay beaches were open 80% to 100% of the time during the prime beach season of April through October from 2006 through 2010. Data for San Francisco beaches are shown here as an example.



Footnote: Percent of days during the prime beach season (April - October) that City and County of San Francisco beaches were posted and not posted due to possible fecal contamination from 2006 through 2010 (n=number of samples). Crissy Field mid-Beach sampled 2006-2007 and Crissy Field West sampled 2008-2010.

Swimmer at Aquatic Park Beach. Photograph by Jay Davis.

SIDEBAR

SWIMMER'S ITCH AND EXOTIC SPECIES

Exotic species, one of the greatest threats to aquatic life in the Bay, also pose a nuisance for people who swim in the Bay. Swimmer's itch, common in some freshwater ponds and lakes, is caused when a parasitic flatworm that normally develops in a water snail and then burrows through the skin and into the circulatory system of a water bird (where it matures and mates) instead burrows into a human swimmer or wader. Symptoms are similar to those caused by exposure to poison oak, with an itchy, red rash that can last for weeks. It is generally unknown in Pacific coastal waters except for a few outbreaks associated with exotic organisms.

An outbreak at Crown Beach in Alameda in the 1950s and another in Surrey, British Columbia that started in 2002 were both caused by an Atlantic Coast flatworm (*Austrobilharzia variglandis*) carried by an introduced Atlantic mudsnail (*Ilyanassa obsoleta*) (Grodhaus & Keh 1958; Leighton et al. 2004). Then in June 2005, approximately 90 elementary school children developed swimmer's itch after a class outing to Crown Beach during the last week of school. Warnings about the new outbreak were issued by the Alameda County Environmental Health Department and posted at the beach, and cases have been reported each spring and summer since.

Naturally, it was initially thought that this outbreak was due to the same exotic snail and flatworm as had caused the previous outbreaks, but this time the carrier turned out to be a recently introduced Japanese bubble snail (*Haminoea japonica*) and the parasite a previously unknown flatworm in the genus *Gigantobilharzia* (Brant et al. 2010). The bubble snail had been reported from a few sites in Washington in the 1980s, probably imported with Japanese oysters, and was found in southwestern San Francisco Bay in 1999. Interestingly, around the same time that a population of the Japanese oyster *Crassostrea gigas* became established in the South Bay, though it's unclear whether there's a connection. In 2003 the snail was discovered on the eastern side of the Bay just south of Crown Beach, and by 2005 it was the most abundant snail at the Beach.

Contact: Andrew Cohen, Center for Research on Aquatic Bioinvasions, acohen@bioinvasions.com

↑ Atlantic mudsnails. Photograph by Andrew Cohen.

↑ Crown Beach, Alameda, California. Photograph by Amy Franz.

Literature Cited

Grodhaus G. and B. Keh. 1958. The marine dermatitis-producing cercaria of Austrobilharzia variglandis in California (Trematoda: Schistosomatidae). Journal of Parasitology 44: 633-638.

Leighton B.J., D. Ratzlaff , C. McDougall, G. Stewart, A. Nadan and L. Gustafson. 2004. Schistosome dermatitis at Crescent Beach, preliminary report. Environmental Health Review 48: 5-13.

Brant, S.V., A.N. Cohen, D. James, L. Hui, A. Hom and E.S. Loker. 2010. Cercarial dermatitis transmitted by exotic marine snail. Emerging Infectious Diseases 16(9): 1357-1365.

THE RV ENDEAVOR

The RMP gratefully acknowledges the significant contribution made by the Bureau of Reclamation to the program through the generous donation of the research vessel, RV Endeavor, and Captain Nick Sakata. Dr. Erwin Van Nieuwenhuyse, Chief of the Science Division of Reclamation's Bay-Delta Office, is Reclamation's coordinator for the Interagency Ecological Program (IEP). Similar to the RMP, the IEP is a consortium of federal and state agencies that monitors and conducts special studies on the physical, chemical, and biological properties of the Bay-Delta to meet the requirements of Biological Opinions and state water right permit conditions that govern the long term operation of the Central Valley Project and the State Water Project. The IEP has recently devoted significant resources to determining the cause of the Pelagic Organism Decline (PAGE 68). The RMP is extremely pleased to have Reclamation's team assisting us in understanding Bay water quality.

MORE INFORMATION ON THE 303(d) LIST AND TMDLS IS AVAILABLE FROM THE FOLLOWING WEBSITES

303(D) LIST FOR REGION 2 (which includes the Estuary)
www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/303dlist.shtml

TMDLs
www.swrcb.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/

THE 303(D) LIST

Section 303(d) of the 1972 Federal Clean Water Act requires that states develop a list of water bodies that do not meet water quality standards, establish priority rankings for waters on the list, and develop action plans, called Total Maximum Daily Loads (TMDLs), to improve water quality.

The list of impaired water bodies is revised periodically (typically every two years). The RMP is one of many entities that provide data to the State Water Board to compile the 303(d) List and to develop TMDLs. The process for developing the 303(d) List for the Bay includes the following steps:

- development of a draft List by the San Francisco Bay Regional Water Board;
- adoption by the State Water Board; and
- approval by USEPA.

In August 2010, the State Water Board adopted the 2010 303(d) List. The 2010 List was approved by USEPA.

The Regional Water Board and State Water Board are now working developing the draft 2012 303(d) List. The primary pollutants/stressors for the Estuary and its major tributaries on the 2010 303(d) List include:

Trace elements
Mercury and Selenium
Pesticides
Dieldrin, Chlordane, and DDT
Other chlorinated compounds
PCBs, Dioxin and Furan Compounds
Others
Exotic Species, Trash, and Polycyclic Aromatic Hydrocarbons (PAHs)

↑ The RV Endeavor. Photograph by Jay Davis.

Regulatory Status of Pollutants of Concern

POLLUTANT	STATUS
Copper	Site-specific objectives approved for entire Bay San Francisco Bay removed from 303(d) List in 2002
Dioxins / Furans	TMDL in early development stage
Legacy Pesticides (Chlordane, Dieldrin,and DDT)	Under consideration for delisting
Mercury	Bay TMDL and site-specific objectives approved in 2008 Guadalupe River Watershed TMDL approved in 2010
Pathogens	Richardson Bay TMDL adopted in 2008 Bay beaches (Aquatic Park, Candlestick Point, China Camp, and Crissy Field) added to 303(d) List in 2006
PCBs	TMDL approved in 2009
Selenium	TMDL in development – completion projected for 2013
Trash	Central and South Bay shorelines added to the 2010 303(d) List

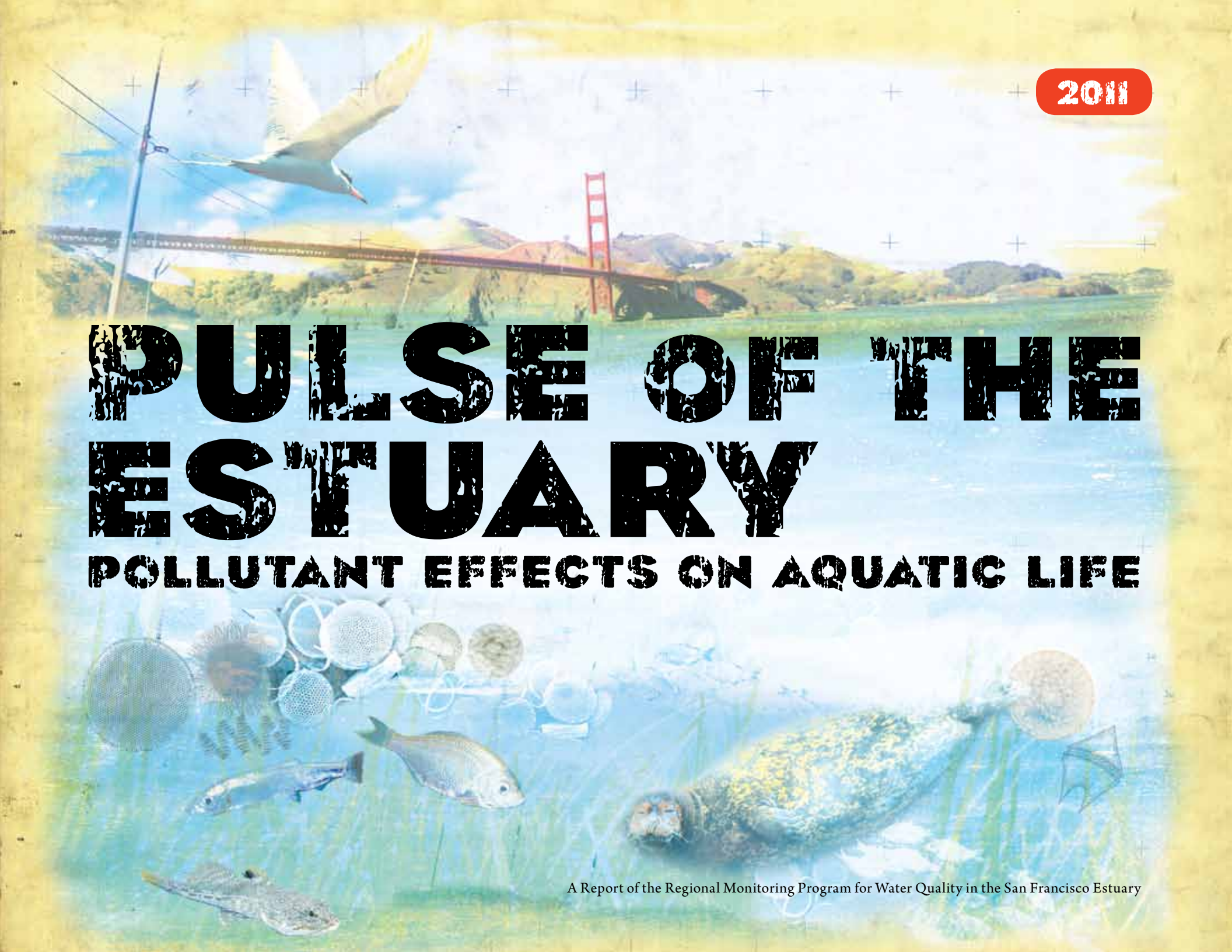
Approved: State Board and USEPA approval

↑ Ducks in San Leandro Bay. Photograph by Jay Davis.

2011

PULSE OF THE ESTUARY

POLLUTANT EFFECTS ON AQUATIC LIFE



A Report of the Regional Monitoring Program for Water Quality in the San Francisco Estuary