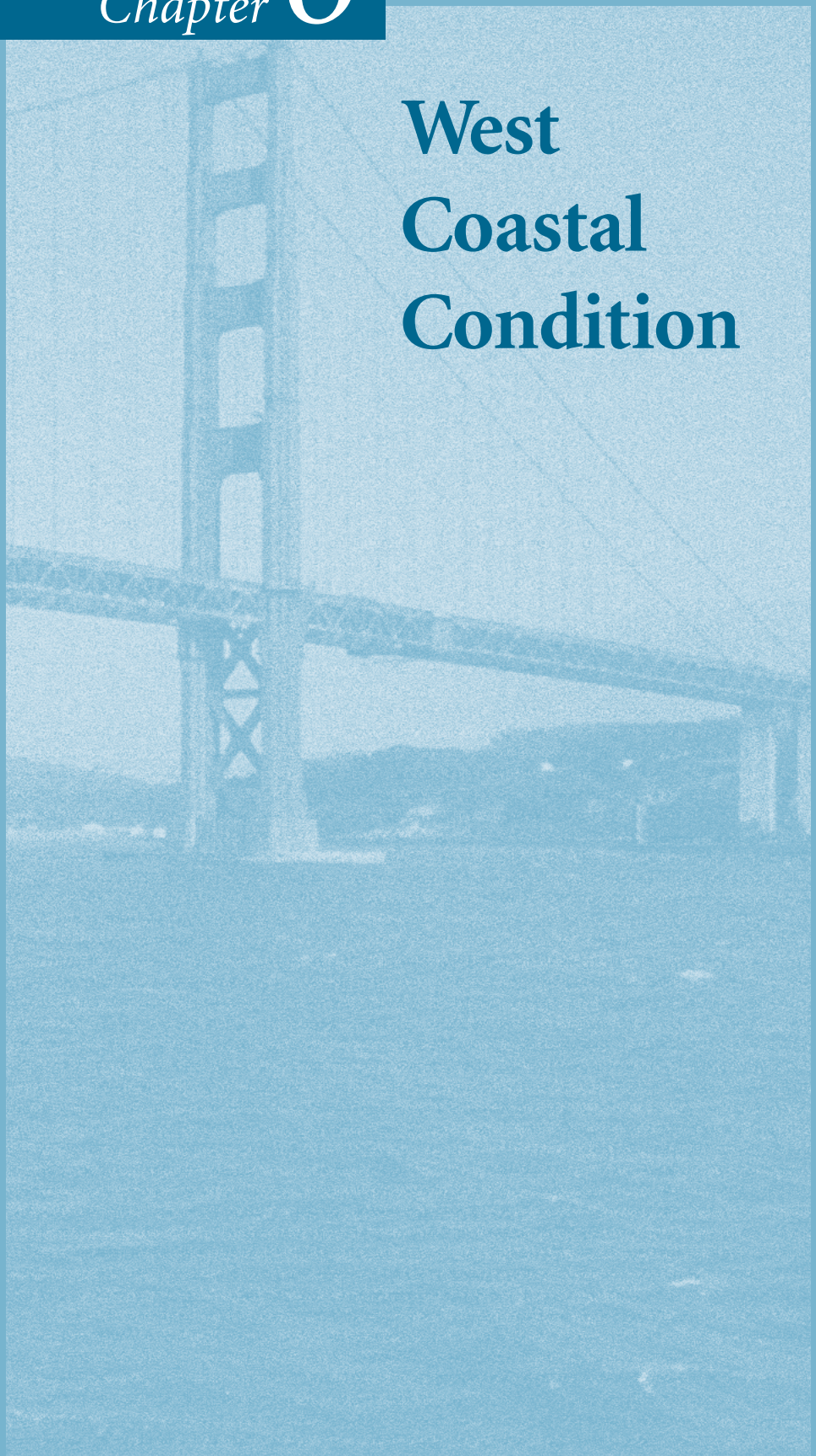
Chapter 6

West Coastal Condition



Chapter 6

West Coastal Condition

Just beyond the Golden Gate of San Francisco lies an ocean wilderness awaiting discovery (Photo: Gulf of the Farallones NMS).

Ecological conditions in western estuaries are fair, based on the information available from various monitoring efforts (Figure 6-1). The estuaries of the West Coast of the United States represent a valuable resource that contributes to the local economies of the area and enhances the quality of life for those who work in, live in, or visit there. The population of coastal counties on the West Coast increased 45% between 1970 and 1980 (U.S. Bureau of the Census, 1996). The western coastline comprises 410 estuarine systems (4,648 mi^2) although three systems—San Francisco Bay, Columbia River, and Puget Sound—make up 72% of the total surface area. Smaller estuarine systems associated with these large systems make up another 28% of the total surface area.

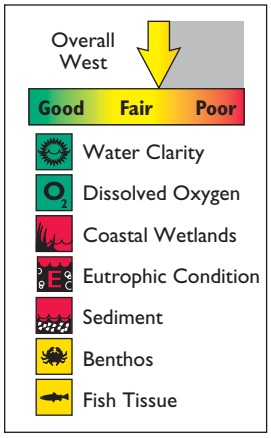
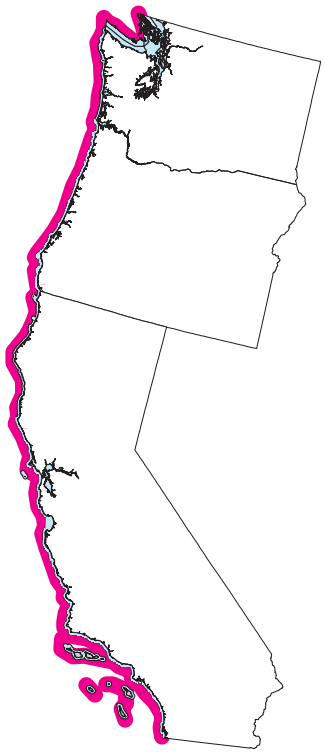


Figure 6-1. The overall condition of western estuaries is fair, although dissolved oxygen and water clarity conditions are good.

The West Coast



Probabilistic surveys like those completed for the Northeast, Southeast, and Gulf Coasts do not exist for the estuarine areas of the West Coast except in selected areas. Therefore, spatial estimates of ecological condition consistent with those described in earlier chapters cannot be determined except for the Southern California Bight and Puget Sound. However, monitoring data from other programs have been used to assess ecosystem condition to the extent possible. The Coastal 2000 program is collecting probabilistic data from all West Coast estuarine systems in 1999-2000.

A sea star uses its tube feet to feed on sediments, bivalves, fish, and even other sea stars! These active scavengers are found on both sandy bottoms and rocky reefs (Photo: Laura Francis).

Coastal Monitoring Data

Very little consistent monitoring has been completed on the West Coast to examine estuarine condition. Unlike condition estimates developed for East and Gulf Coast estuaries, there are no consistent surveys of condition in the West Coast estuaries. Limited available data have been used to provide a qualitative, but statistically unsupported, estimate of condition. Estuarine-specific surveys for San Francisco Bay and Puget Sound have been completed, and these waterbodies continue to be monitored. In 1999, the Washington Department of Ecology, Oregon Department of Environmental Quality, Southern California Coastal Water Resources Project, and California Fish and Game jointly assessed the 400 small estuaries and small tidal rivers making up the West Coast (Washington, Oregon, and California) by using a probabilistic design to sample 210 locations within these systems. Sampling was completed in 1999 for water quality, sediment quality, and biota. Information for dissolved oxygen, light penetration, and sediment toxicity is currently available. Information for sediment contaminants, tissue residues, fish community parameters, and benthic communities was collected in 2000 and will be available in 2002.

Relatively few "national" programs have monitoring stations in western estuaries. NOAA's NS&T Program and Bioeffects Surveys have data for several western locations, but these sites are not representative of all western estuaries. EMAP began sampling in western estuaries in 1999, and only a small amount of information is currently available. NOAA's National Estuarine Eutrophication Assessment examined a number of

eutrophication variables for western estuaries through the use of a survey questionnaire. In addition, EMAP-like surveys have been completed in the Southern California Bight (SCCWRP, 1998). This offshore survey represents the only probabilistic survey of ecological condition for nearshore coastal waters to date.

The following discussions will be broken into five categories—overall west, small estuaries of the West Coast, San Francisco Bay, Puget Sound, and Southern California Bight.

Overall West

Regional data were available for two of the seven indicators for the West Coast—coastal wetlands and eutrophic condition.

Coastal Wetland Loss

During the 200-year period from the 1780s to the 1980s, the West Coast experienced the greatest proportional losses of wetlands of anywhere in the United States (Figure 6-2), however, the absolute losses are not as large as in most other regions. Throughout the West Coast, wetland losses of 68% were observed, ranging from 31% in Washington to 91% in California.

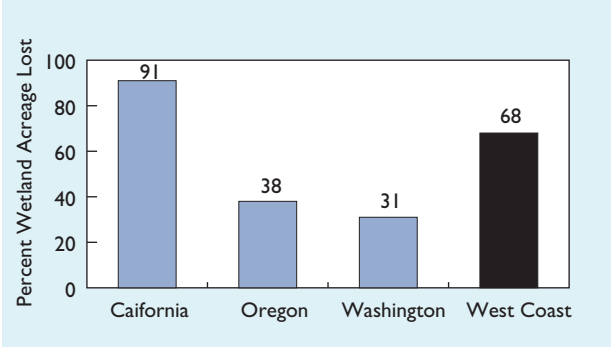


Figure 6-2. Percent wetland habitat loss from 1780 to 1980 by state and for the West Coast overall (Dahl, 1990; Turner and Boesch, 1988).

Eutrophic Condition

The condition of West Coast estuaries as measured by expression of eutrophic condition is poor. Estuaries with high expression of eutrophic condition represent 20% of the surface area of western estuaries (Figure 6-3).

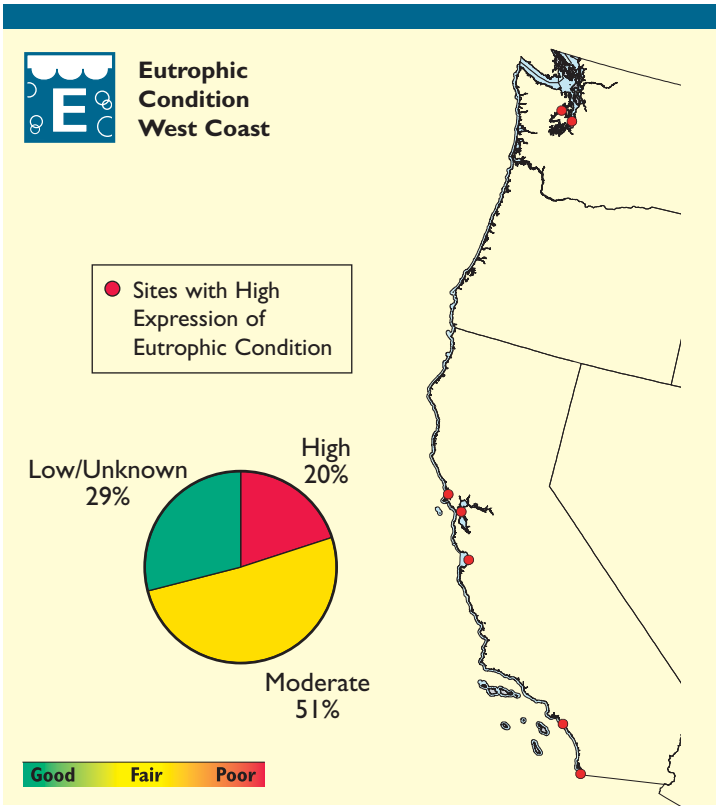


Figure 6-3. Eutrophic condition data for West Coast estuaries and locations of sites with high expression of eutrophic condition (NOAA/NOS).

Small Estuaries of the West Coast

Small estuaries along the West Coast are defined as those that are less than 97 square miles in size and are not part of Puget Sound or San Francisco Bay. These small estuaries make up about 28% of the estuarine area of the West Coast (excluding Puget Sound and its small systems, San Francisco Bay and its small systems, and the Columbia River).

Water Clarity

Water clarity in small estuaries on the West Coast is good. Light penetration was poor at only one of the 210 sites sampled, representing less than 1% of the total area of these small systems (Figure 6-4). This number represents water clarity only in late summer and does not represent high-flow springtime conditions. The poor water clarity site is located on Grass Creek, Washington.

Dissolved Oxygen

Dissolved oxygen conditions in small estuaries on the West Coast are good. Dissolved oxygen was never measured below 2.0 ppm.

Sediment Contaminants

No data are currently available for small West Coast estuaries. Sediment contaminant data were collected in 2000 and will be available in 2002.

Benthic Condition

No data are currently available for small West Coast estuaries. Benthic index data were collected in 2000 and will be available in 2002.

Sediment toxicity was determined for these small estuaries using a static 10-day acute *Ampelisca abdita* bioassay. Greater than 15% control-corrected mortality would result in a sediment's being deemed toxic. For small estuaries along the West Coast (Washington and California only), 25% of sediments were toxic to the amphipod (Figure 6-5). These toxic sediments were located largely in Grays Harbor, Willapa Bay, and Grays Bay in

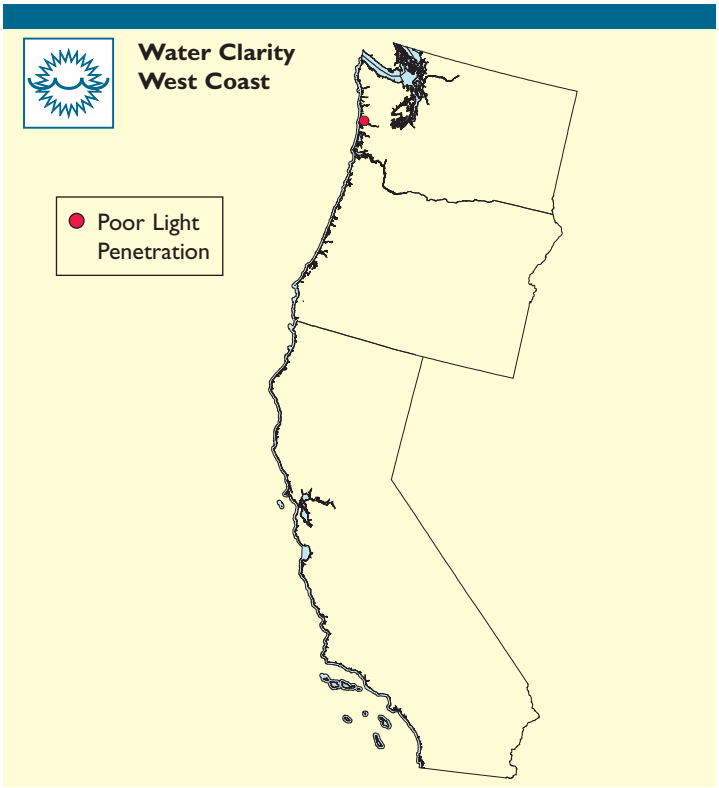


Figure 6-4. Sites with <10% light penetration along the West Coast (U.S. EPA/EMAP).

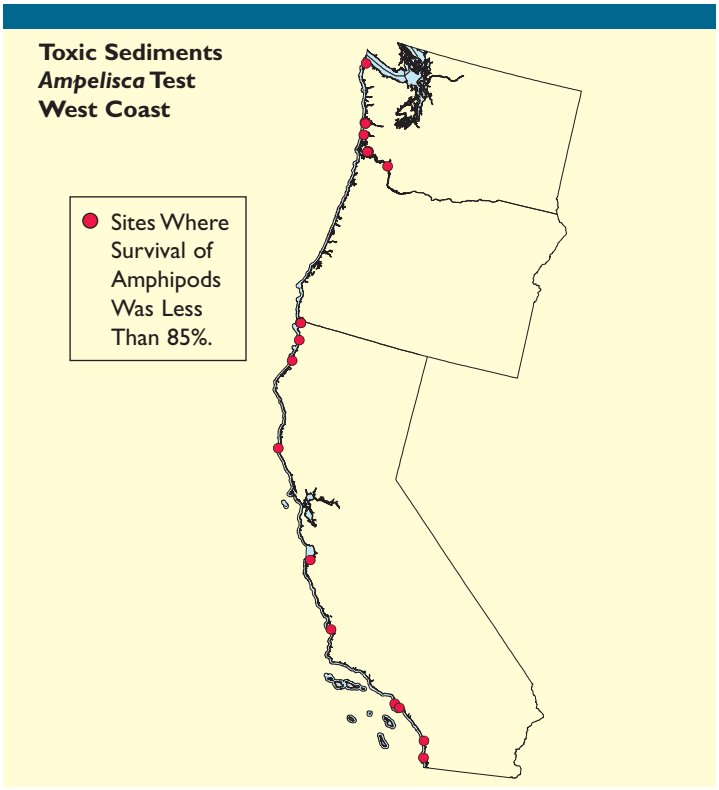


Figure 6-5. Locations with toxic sediments on the West Coast (U.S. EPA/EMAP).

Washington and in San Luis Obispo Bay, Santa Monica Harbor, and several small river systems (e.g., Smith River, Garcia River, Klamath River, Los Angeles River, and San Diego River) in California.

Southern California Bight (Offshore)

The Southern California Bight (SCB) is defined as the 186 miles of recessed coastline between Point Conception, California, and Cabo Colnett, Mexico. Figure 6-6 shows the U.S. portion of the SCB. The dramatic change in the angle of the coastline creates a large backwater eddy in which equatorial waters flow north nearshore and subarctic waters flow south offshore. This unique oceanographic circulation pattern creates a biological transition zone between warm and cold waters that contains over 500 marine fish species and more than 5,000 invertebrate species.

Human uses of the coastline and ocean waters of the Bight include recreation, tourism, aesthetic enjoyment, sport and commercial fishing, coastal development, and industry. Ocean-dependent activities contribute approximately $9 billion to the economies of coastal communities surrounding the SCB and support over 175,000 jobs. The area bordering the SCB is also home to nearly 20 million people, making it one of the most densely populated shorelines in the United States. Almost the entire SCB coastline has been subjected to development, waste discharges, or other forms of resource utilization.

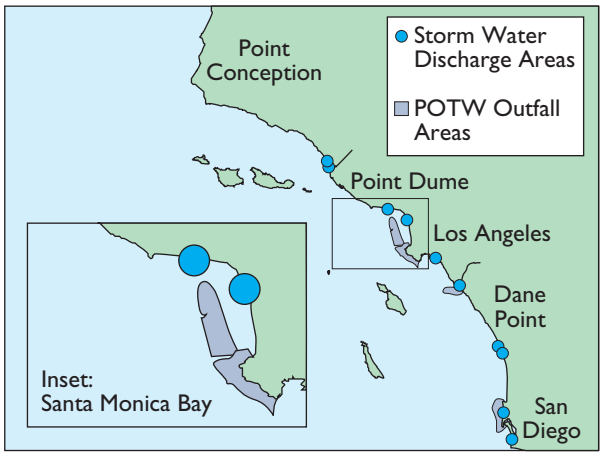


Figure 6-6. The Southern California Bight (SCB).

Prior to 1994, the Southern California Coastal Water Resources Project (SCCWRP) conducted monitoring programs at numerous sites within the SCB amounting to $10 million in monitoring annually. However, this monitoring could not address concerns about the ecological condition of the Bight and the direct effects of discharges on the SCB (only 5% of the area was represented in sampling). In 1994, recognizing the need for integrated assessment of the SCB, 12 government organizations (including the four largest municipal wastewater dischargers) collaborated to complete the first comprehensive regional monitoring survey of the SCB under the name of the Southern California Bight Pilot Project (SCBPP). SCBPP sampled 261 sites in the SCB between July and August 1994. Sampling sites included all coastal and oceanic areas within the Bight between 98 and 2,133 feet in depth.

Water Clarity

Water clarity was good throughout the SCB.

Dissolved Oxygen

Dissolved oxygen conditions in the SCB are good. Almost all of the surface waters were fully saturated with oxygen and more than

99% of SCB waters met California Ocean Plan water quality objectives for temperature, pH, light transmittance, and dissolved oxygen.

Sediment Contaminants

Sediment contaminant conditions in the Southern California Bight are poor. ERM values were exceeded in 12% of SCB sediments with most exceedances due to DDT. Over half (55%) of SCB sediments were characterized by contaminant concentrations greater than the ERL guideline but less than the ERM. With 67% of sediments having contaminants that could potentially have ecological effects, the SCB has the most contaminated sediments in the United States (Figure 6-7). Sites exceeding the ERL and ERM thresholds were widespread throughout the SCB. The constituent that had the greatest areal extent for potential biological impairment was total DDT, exceeding screening levels in 64% of SCB sediments (866 mi^2 > ERL) and 10% of sediments exceeding ERM. Total PCBs was the next constituent with greatest areal extent (1% > ERM and 15% > ERL).

Sediment Contaminant Criteria

ERM (Effects Range Medium) – The concentration of a contaminant that will result in ecological effects approximately 50% of the time based on literature studies.

ERL (Effects Range Low) – The concentration of a contaminant that will result in ecological effects about 10% of the time based on literature studies.

Sediment contaminants introduced by human activity were present in 89% of the SCB. The pesticide DDT was the most widespread contaminant. It was found in 82% of the SCB sediments (Figure 6-8). The highest concentrations of DDT occurred on the Palos Verde shelf. Most of the observed DDT represents DDT metabolites and is the result of chemical degradation from DDT discharges over the past 40 to 50 years. Elevated levels of PCBs and trace metals were found in approximately half of the sediments of the SCB. The highest metal concentrations were typically found in Santa Monica Bay.

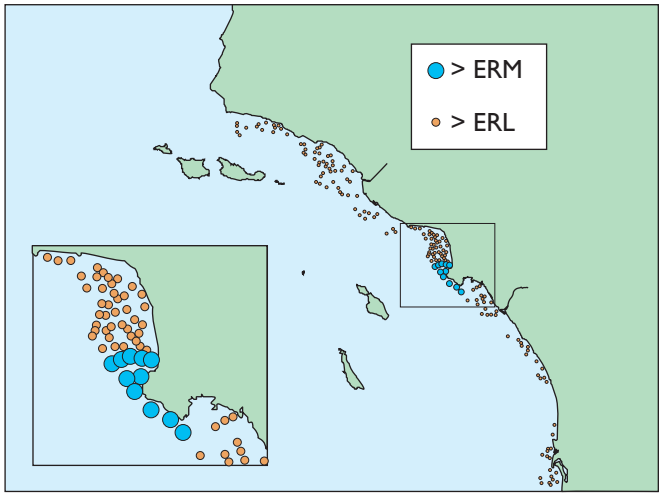


Figure 6-7. Sites exceeding ERL (small circles) and ERM (large circles) were widespread throughout the Southern California Bight (SCBPP).

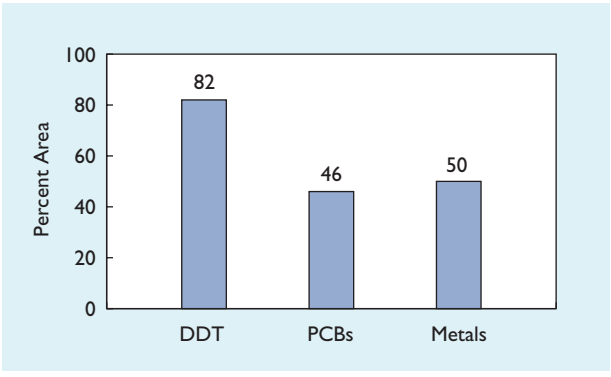


Figure 6-8. Sediment contaminants introduced by human activity were present in 89% of the Southern California Bight (SCBPP).

Benthic Condition

Benthic communities in the Southern California Bight are in good condition. Benthic communities showed degradation in only 9% of SCB sediments compared to reference sites (Figure 6-9). Of these degraded communities, most (7%) showed minor deviations representing small shifts in community composition. Only 2% showed losses in biodiversity. These observations support the toxicity findings, showing that, although the sediments are contaminated, the contamination is resulting in few biological and/or toxicological effects.

While extensive sediment contamination was observed in SCB sediments, acute toxicity tests using *Ampelisca abdita* showed none of the sediments to be significantly more toxic than control sediments. The toxicity results from the SCBPP, when compared to results from studies performed in bays and estuaries throughout the United States, indicate that the quality of the sediments in the SCB is generally higher than that in the remainder of the United States. This apparent contradiction is explained by the fact that, although the SCB sediments are among the most contaminated in the United States, they are not biologically available because of the way in which they are bound to the sediments.

Fish Tissue Contaminants

The condition of SCB as measured by fish tissue contaminants is poor. Contaminants in fish tissues were widespread—the livers of nearly all individuals of two target species of flatfish (Pacific sanddab and longfin sanddab) contained DDT and PCBs (Figure 6-10). All samples of a third flatfish, Dover sole, were contaminated by DDT. The three highest observations of DDT and PCB concentrations in fish livers occurred in fish collected from or near the Palos Verde shelf. However, both DDT and PCB concentrations found in fish livers throughout the SCB were 95% lower than those measured in the 1970s. Both DDT and PCB concentrations in fish livers from reference areas were 5% of the concentrations observed during the last two decades. No other contaminants were observed in fish tissues in 1994.

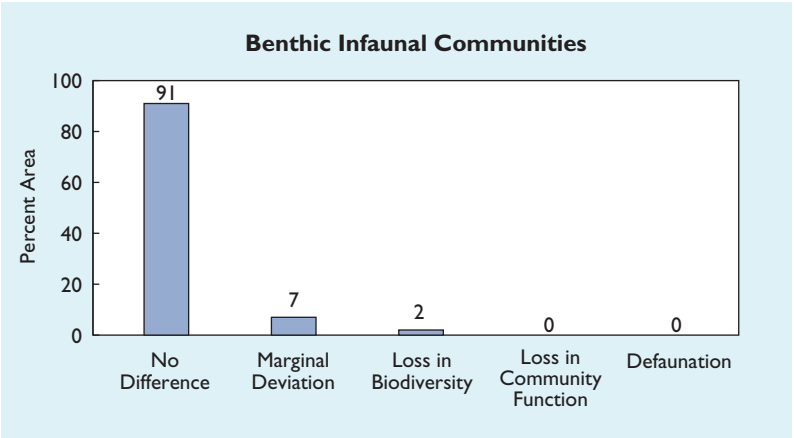


Figure 6-9. Benthic communities showed degradation in only 9% of SCB sediments compared to reference sites (SCBPP).

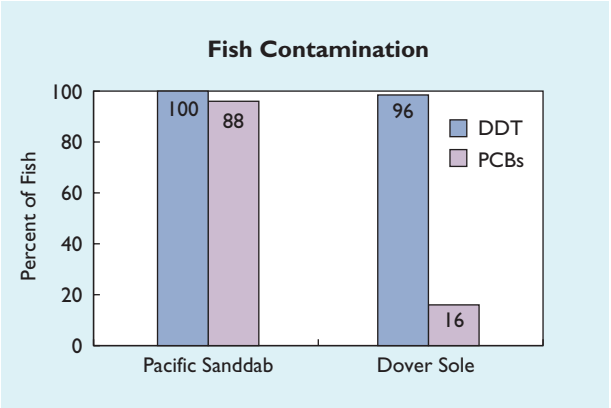


Figure 6-10. Contaminants were found in the livers of nearly all individuals of two target species of flatfish (SCBPP).

Fish communities in the SCB were largely healthy, and their status has improved noticeably over documented conditions in the 1970s. External fish diseases and pathologies were prevalent in the 1970s and were virtually absent in 1994.

San Francisco Bay

San Francisco Bay is one of the largest single estuarine resources along the western coastline of the United States. Because of its tectonic development, San Francisco Bay is unlike many estuaries in the United States and has its own, relatively unique circulation and depositional patterns and exchange rates with the Pacific Ocean. In addition, significant water withdrawal for agricultural use from the San Joaquin and Sacramento Rivers results in increased movements of high-saline waters into areas of the Bay that were traditionally mesohaline or oligohaline. Monitoring and assessment efforts in the San Francisco Bay have been active since the early 1990s. The San Francisco Estuary Institute (http://www.sfei.org), in collaboration with the San Francisco Bay Estuary Project (http://www.abag.ca.gov/bayarea/sfep), is examining and assessing water quality, sediment quality, and fish tissue residues as part of the Regional Monitoring Program (RMP) (May et al., 2000).

Water and sediment provide habitat for most of the estuary's biota, including the foundation of the estuarine food web—phytoplankton. Surveys to date have concentrated on whether water quality and sediment quality meet contaminant guidelines, the condition of benthic communities, and the tissue residue concentrations in selected fish populations. For water, the guidelines consider both laboratory studies and field observations and are aimed at protecting a particular set of qualities valued by the society. For sediment quality, guidelines were based on concentrations shown to result in adverse effects (Long et al., 1995). For fish tissue residues, guidelines were calculated by the Regional Water Quality Control Board in conjunction with EPA and are intended to protect the fish-consuming population.

Water Clarity

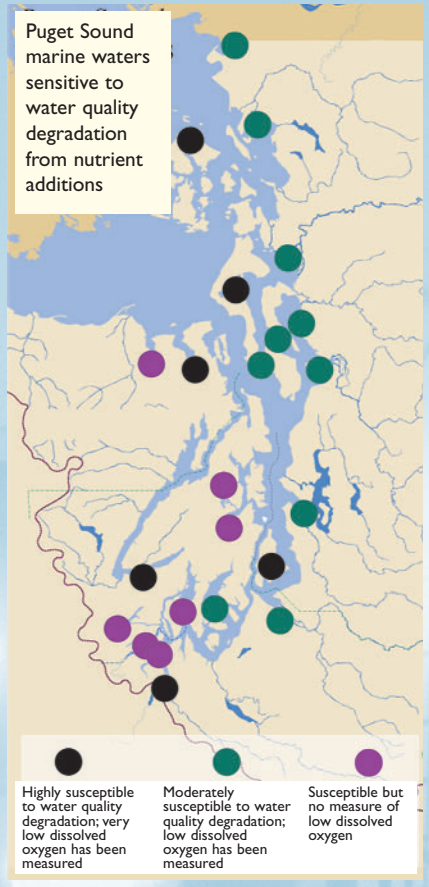
The water clarity data available for San Francisco Bay are not included in this report due to differences in the sampling design used to collect the data. These data are not comparable to the data used to establish indicators for the other coastal regions throughout the report.

Dissolved Oxygen

The dissolved oxygen data available for San Francisco Bay are not included in this report due to differences in the sampling design used to collect the data. These data are not comparable to the data used to establish indicators for the other coastal regions throughout the report.

highlight

Puget Sound Ambient Monitoring Program (PSAMP)



Areas of Puget Sound sensitive to eutrophication (PSAMP).

The protected marine waters of Puget Sound provide valuable habitat for fish and wildlife, and they also support one of the leading trade centers on the West Coast. The region's natural and economic resources have led to booming population growth, which places increasing stress on Puget Sound. As pressures on the environment of the Sound become greater, the need for a coordinated monitoring program to direct management goals and actions is clear. The Puget Sound Ambient Monitoring Program (PSAMP) is a long-term effort to investigate environmental trends and to improve environmental management decision-making. PSAMP is conducted by local, state, and federal agencies including the Washington State Departments of Ecology, Fish and Wildlife, and Health and Natural Resources; EPA; and the National Marine Fisheries Service. Through PSAMP studies, data on marine and fresh waters, fish, sediments, and shellfish in Puget Sound have been collected since 1989; surveys of nearshore habitat have been conducted since 1991; marine bird populations have been surveyed since 1992; and marine bird contamination has been studied since 1995.

PSAMP releases a report on the status and trends of Puget Sound environmental variables every 2 years. According to the 2000 Puget Sound Update report (available at www.wa.gov/puget_sound on the Internet), 23 areas of Puget Sound (representing 54% of the areas that are monitored) show either low dissolved oxygen or susceptibility to eutrophication (see figure), although general water quality is considered to be improving. The 2000 report identifies pollution, loss of habitat, and continuing development as the greatest threats to the health of the Sound. Despite improvements such as the reopening of several commercial shellfishing areas and the declining trend of PCBs found in harbor seals, a number of indicators show that the health of the Sound remains threatened. For instance, the levels of fecal coliform bacteria violate the state standards at more than half of the river and stream monitoring stations in the basin, and the populations of many fish species living in the Sound, such as Pacific herring and chinook salmon, are in peril. In 1999, chinook salmon in Puget Sound were listed as "threatened" under the Endangered Species Act.

Lower Columbia River

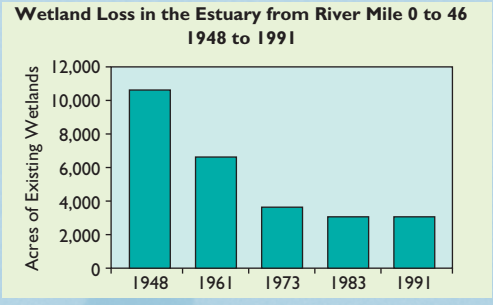
http://www.lcrep.org

The Lower Columbia River

The Lower Columbia River is home to some of the most spectacular scenery on the North American continent. Over 2.5 million people live and work in this region. This area is extremely rich in living resources including shellfish, Dungeness crabs, sturgeon, anadromous fish, and nearly 175 species of shorebirds. The Columbia River also supports the world's largest hydroelectric system and the second largest port area on the West Coast. Six major pulp and paper mills line the lower Columbia River. The Lower Columbia River Estuary Program has developed a management plan designed to balance human interests while safeguarding this area's wealth of natural resources.

Human activity over the last century has strained the natural resources. The lower 46 miles of the Columbia River have lost as much as 70% of their tidal wetland acreage since 1948 (see chart). Resource managers estimate that salmon stocks are currently less than 10% of their historic size, and artificial stocks make up 75% of the returning salmon. Twelve species of anadromous fish, including five species of salmon, are either threatened or endangered in the Lower Columbia River. In all, the Lower Columbia River system contains 25 threatened or endangered species. Current trends suggest that the human population in this region will increase 30% by 2010. Accommodating human population growth while preserving this area's natural wealth is a challenge for resource managers.

The Lower Columbia River Estuary Program has developed a management plan to address these issues. The Comprehensive Conservation and Management Plan emphasizes habitat restoration, education, and environmental monitoring. The Management Plan calls for 16,000 acres to be restored or protected by 2020. The Program also places priority on education programs for young citizens. By building the capacity of existing education activities, the Program hopes to fill information gaps about the river. To measure the health of the river over time, the Program is also implementing a long-term monitoring program.



Loss of wetland acreage in the lower 46 miles of the Columbia River since 1948 (Lower Columbia River Estuary Program).

Sediment Contaminants

Sediment contaminant conditions in San Francisco Bay are poor. All samples taken from 1993 to 1998 at each of 16 sites within San Francisco Bay exceeded sediment guidelines for at least one contaminant (Figure 6-11). These exceedances generally occur for 10% to 35% of contaminants measured in sediments (about 30 contaminants at each site) (Figure 6-12). Of sediment quality parameters measured, 39% exceeded levels set by sediment quality guidelines.

Using the same approach, 40% to 100% of samples (6 to 16 samples) taken from San Francisco Bay from 1993 to 1998 exceeded water quality guidelines (Figure 6-13) for one or more contaminants. Figure 6-14 shows the percentage of measurements (45 contaminants measured at each site) that were over guideline values. Approximately 5% to 20% of all contaminant measurements in water exceeded guidelines in the period 1993 to 1998.

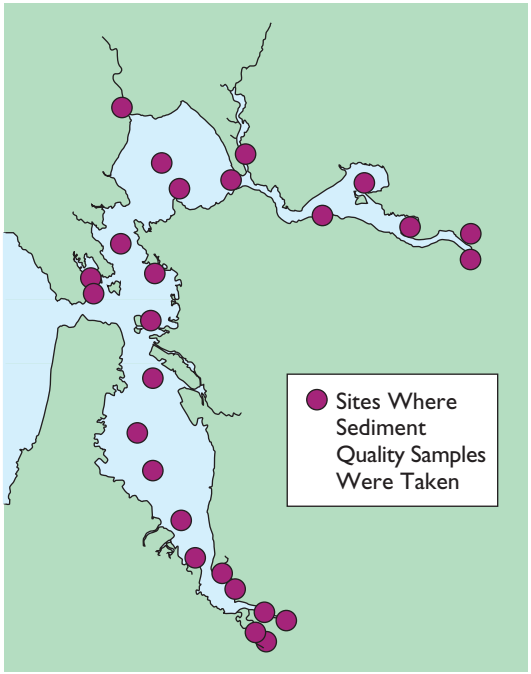


Figure 6-11. All samples taken from 1993 to 1998 at each of the 16 sites within San Francisco Bay exceeded sediment guidelines for at least one contaminant. Four to 12 samples were taken at each site (from San Francisco Bay RMP, May et al., 2000).

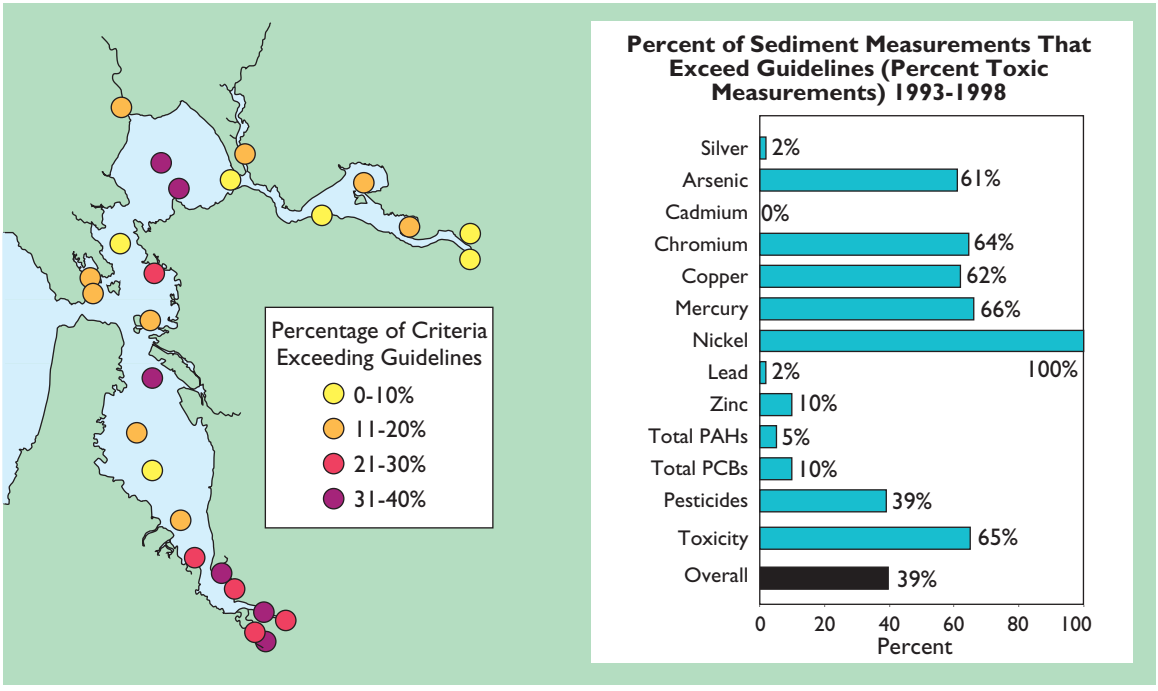


Figure 6-12. The percentage of sediment quality parameters that exceeded guideline values. A total of 119 to 354 measurements were taken at each site (from San Francisco Bay RMP, May et al., 2000).

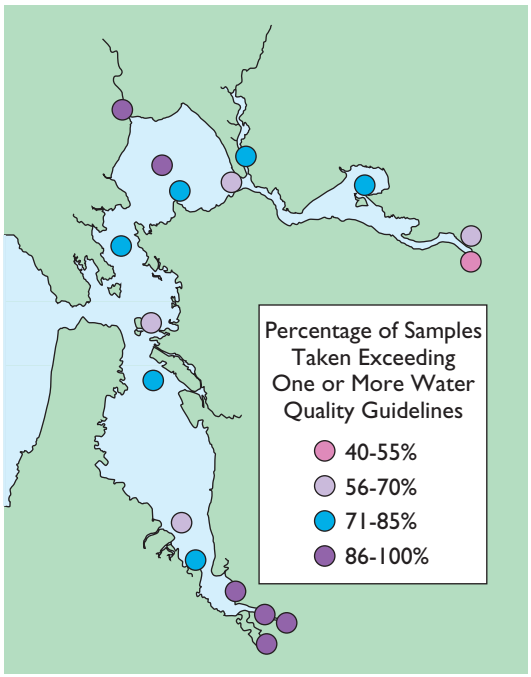


Figure 6-13. Of samples taken from 1993 to 1998 at each of 16 sites within San Francisco Bay, 40% to 100% exceeded water quality guidelines for at least one contaminant. Six to 18 samples were taken at each site (from San Francisco Bay RMP, May et al., 2000).

Figure 6-14 shows the percentage of water quality parameters that exceeded guidelines for water for each of the major contaminants examined. Of water quality parameters measured, 18% exceeded levels set by water quality guidelines. Table 6-1 shows the trend in the percentage of contaminants meeting the guidelines.

Table 6-1. Contaminants Meeting Water Quality Guidelines from 1994 to 1998

Contaminant	1994 (%)	1995 (%)	1996 (%)	1997 (%)	1998 (%)
Chromium	94	91	93	85	82
Copper	83	85	88	90	97
Mercury	79	80	87	67	75
Nickel	83	83	85	81	84
Lead	96	94	96	90	92
Selenium	100	100	100	97	99
Zinc	96	98	99	92	92
PAHs	61	69	53	59	25
Diazinon	93	100	94	100	100
Dieldrin	80	96	94	55	87
Chlordanes	100	93	84	87	89
DDTs	98	92	90	88	91
PCBs	7	13	8	19	20

Source: May et al., 2000.

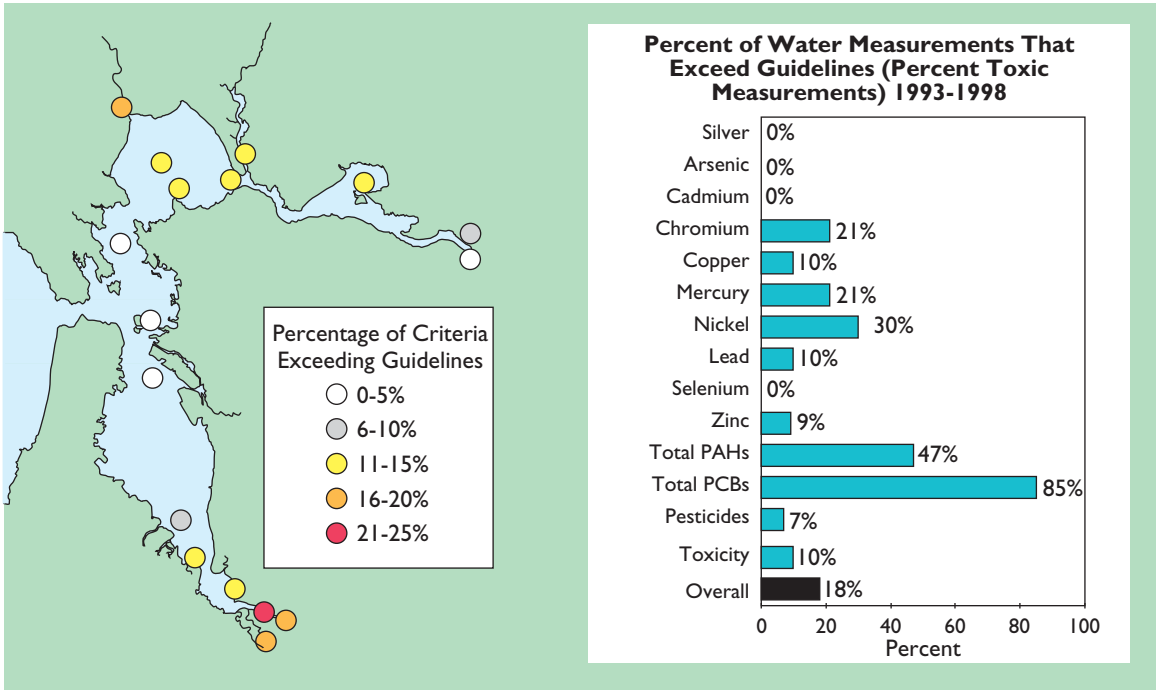


Figure 6-14. The percentage of water quality parameters that exceeded guideline values (from San Francisco Bay RMP, May et al., 2000).

Benthic Condition

The benthic condition data available for San Francisco Bay are not included in this report due to differences in the sampling design used to collect the data. These data are not comparable to the data used to establish indicators for the other coastal regions throughout the report.

Fish Tissue Contaminants

The condition of San Francisco Bay in terms of fish contaminants is poor. In 1997, the RMP examined over 300 fish for contaminant residues. The fish in the estuary contain several contaminants at levels high enough to raise concern for the health of both humans and wildlife (e.g., harbor seals). Exceedance of the "screening values" (developed to reflect the potential for human health concerns and a need for further study) showed that over 50% of fish examined exceeded these values for mercury and PCBs (Figure 6-15). Seven fish were subsampled to analyze for dioxin concentrations, and 100% of those fish examined exceeded the dioxin screening value. Screening values for DDT, chlordane, and dieldrin were exceeded in 15% to 37% of the fish sampled. PCBs and pesticides were highest in white croaker and shiner surfperch, while mercury was highest in striped bass and leopard sharks. The fish collected from the Oakland Harbor region contained the highest concentrations of contaminants.

Some estuarine contaminants in San Francisco Bay are clearly reduced from peak levels seen in earlier decades (May et al., 2000). Nevertheless, there are several indications that the level of contamination is still high enough to impair the health of the San Francisco Bay estuary. As a whole, the estuary would be assessed as being moderately contaminated. Overall, the sites in the lower South Bay, the Petaluma River mouth, and San

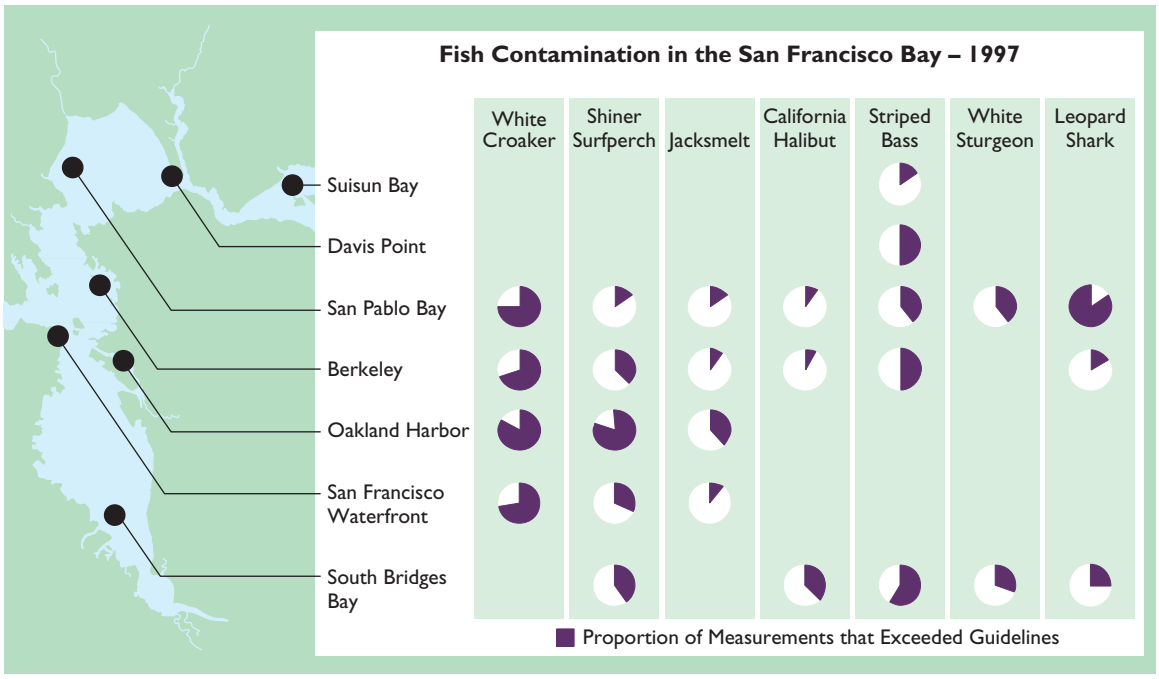


Figure 6-15. The fish in the estuary contain several contaminants at levels high enough to raise concern for the health of both humans and wildlife (from San Francisco Bay RMP, May et al., 2000).

Pablo Bay are more contaminated than other Bay sites. Of the contaminants measured by the RMP, mercury, PCBs, diazinon, and chlorpyrifos are of the highest concern, followed by copper, nickel, zinc, DDT, chlordane, dieldrin, dioxins, and PAHs. In 2000, the RMP initiated an intensive characterization of the water quality, sediments, and biota of the estuary with EPA. One hundred eighty locations will be examined during this characterization.

Puget Sound (Northern Sound Only)

Washington's Department of Ecology (WDOE— http://www.ecy.wa.gov) and the Puget Sound Ambient Monitoring Program (PSAMP—http://www.wa.gov/puget_sound/Programs/PSAMP.htm) have been monitoring Puget Sound using fixed stations since 1989 and using probabilistic sites for the benthic triad since 1997. The PSAMP monitoring effort (1989-1995) sampled 34 sites annually and 42 additional sites on a 3-year rotational basis. Sediments were analyzed to determine the extent of chemical contamination, sediment toxicity, and the structure of macroinvertebrate communities. In 1997, WDOE, jointly with NOAA, examined the bioeffects associated with toxicants in Puget Sound with 100 sites sampled annually using a stratified random sampling approach. This monitoring effort was divided into three 1-year efforts—north Puget Sound (1997) (Figure 6-16), mid-Puget Sound (1998), and south Puget Sound (1999) (Figure 6-17). Results from the north Puget Sound have been completed (Long et al., 1999), and results from the remaining areas will be completed by 2001.

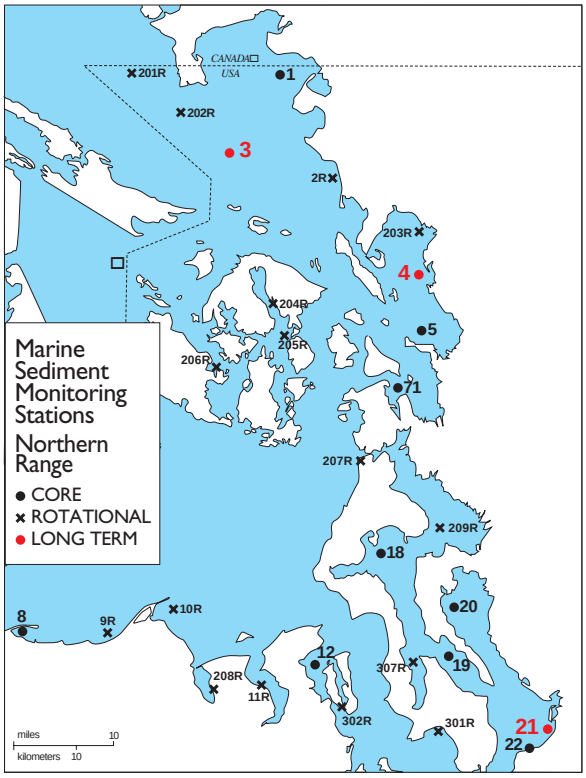


Figure 6-16. Marine sediment monitoring stations in the northern range of Puget Sound.

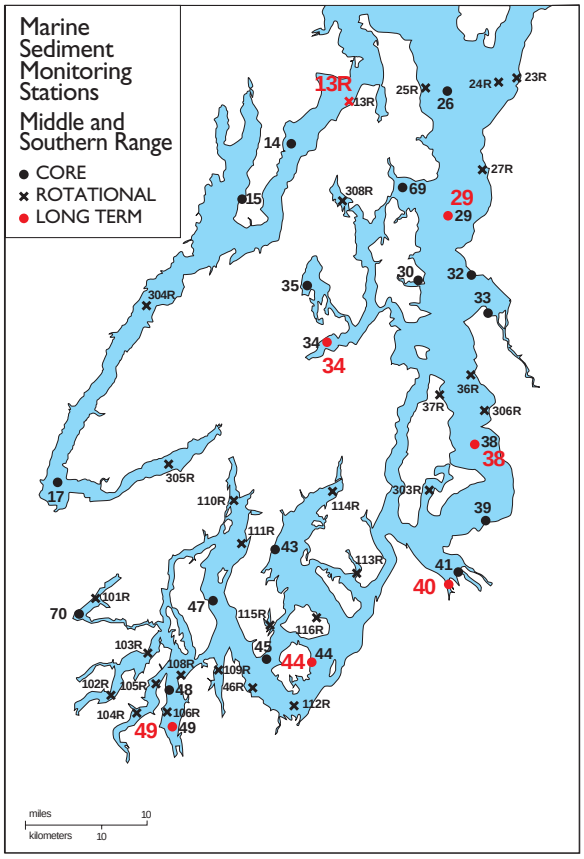


Figure 6-17. Marine sediment monitoring stations in mid-Puget Sound and south Puget Sound.

In 1999-2000, the WDOE, in conjunction with EPA and NOAA, resampled a subset of the 1997-1999 Puget Sound sites and approximately 40 additional sites to examine water quality, fish community structure, and tissue residues. In addition, in 1999, WDOE sampled 50 non-Puget Sound sites throughout coastal Washington to examine water quality, sediment quality, and biotic conditions. These data will be available in 2001-2002.

Water Clarity

The water clarity data available for Puget Sound are not included in this report due to differences in the sampling design used to collect the data. These data are not comparable to the data used to establish indicators for other coastal regions throughout the report.

Dissolved Oxygen

The dissolved oxygen data available for Puget Sound are not included in this report due to differences in the sampling design used to collect the data. These data are not comparable to the data used to establish indicators for other coastal regions throughout the report

Sediment Contaminants

The condition of Puget Sound as measured by sediment contaminant concentrations is good. Chemical analyses of sediments at these sites indicated a relatively wide range of concentrations across the sampled area. However, only a small proportion of the samples had elevated concentrations of pesticides/PCBs (Figure 6-18). Overall, chemical concentrations were highest in sediments from the two most urbanized embayments in northern Puget Sound—Everett Harbor and Bellingham Bay. This pattern was evident for several trace metals and two classes of PAHs. Lower concentrations of PAHs (greater than ERL) were found in Fidalgo Bay.

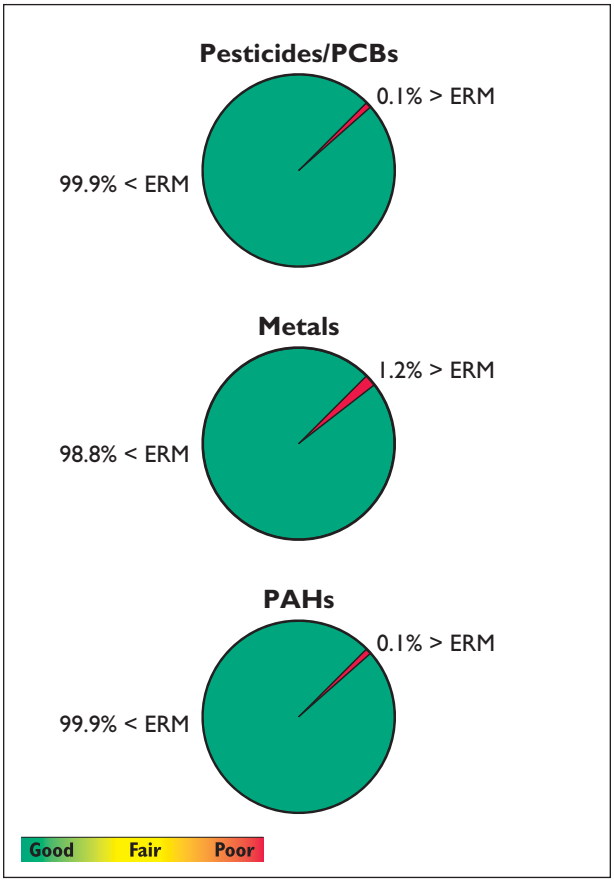


Figure 6-18. Sediment concentration in Northern Puget Sound.

Benthic Condition

Benthic index scores in Puget Sound are generally very good, with only isolated pockets of degraded conditions. Benthic community composition indicated a wide variety of abundance and diversity throughout the 100 sampling locations. Several indices of benthic structure showed strong relationships to sediment contaminant concentrations and sediment toxicity.

Results from four sediment toxicity tests using macroinvertebrate survival rates indicated that a very small proportion (5%) of the northern Puget Sound survey area was highly toxic. Everett Harbor showed the greatest toxicity. Drayton Harbor, Whatcom Waterway, portions of Bellingham Bay, inner Padilla Bay, March Point, Fidalgo Bay, Port Susan, and Port Gardner showed less severe sediment toxicity.

Fish Tissue Contaminants

The fish tissue contaminant data available for Puget Sound are not included in this report due to the differences in the sampling design used to collect the data. These data are not comparable to the data used to establish indicators for other coastal regions throughout the report.

Assessments and Advisories

Clean Water Act Section 305(b) and 303(d) Assessments

The states on the West Coast assessed 3,413 (83%) of their 4,118 estuarine square miles for their 1998 305(b) reports. Of the assessed estuarine miles on the West Coast, 32% fully support their designated uses, 1% are threatened for one or more uses, and 67% are impaired by some form of pollution or habitat degradation (Figure 6-19). Individual use support for the West Coast estuaries is shown in Figure 6-20.

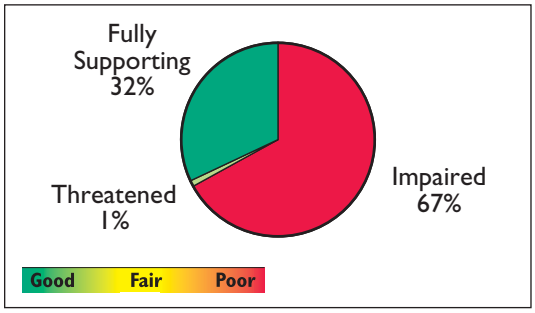


Figure 6-19. Water quality in assessed West Coast estuaries (U.S. EPA).

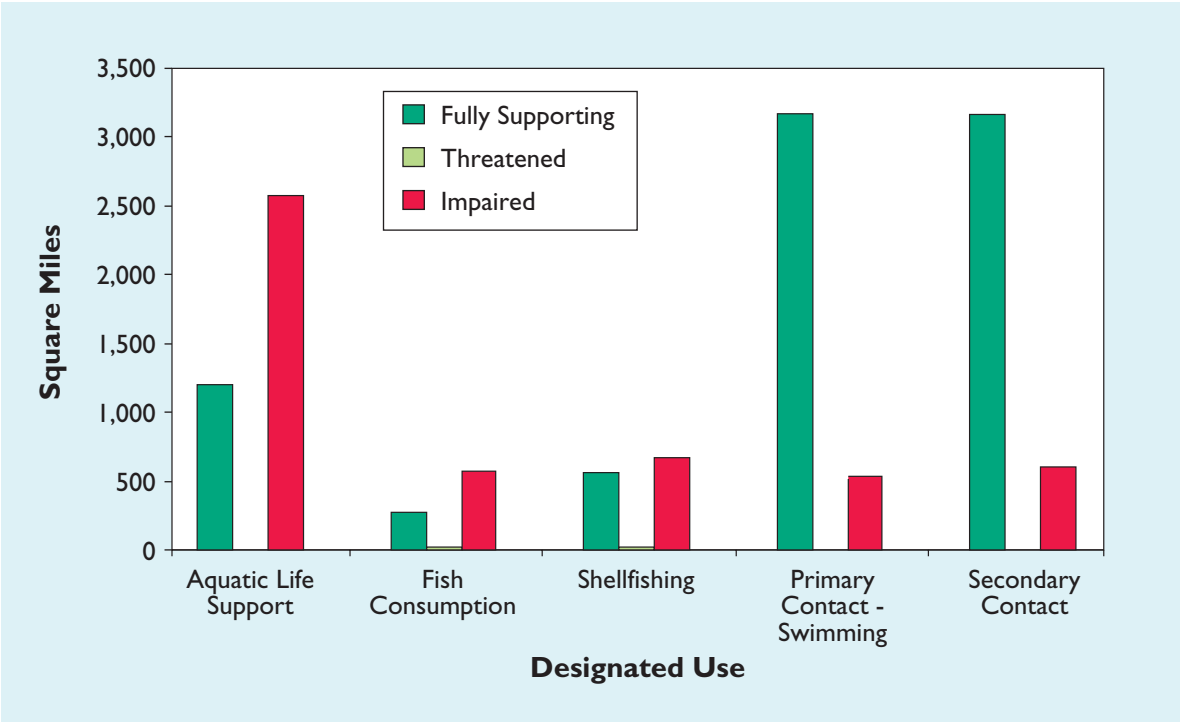


Figure 6-20. Use support for West Coast assessed estuaries (U.S. EPA).

The West Coast states assessed 919 (43%) of their 2,134 shoreline miles. Eighty-seven percent of the assessed shoreline miles fully support their designated uses, no uses are reported as being threatened, and 13% of the shoreline is impaired by some form of pollution or habitat degradation (Figure 6-21). Individual use support for the West Coast shoreline miles is shown in Figure 6-22.

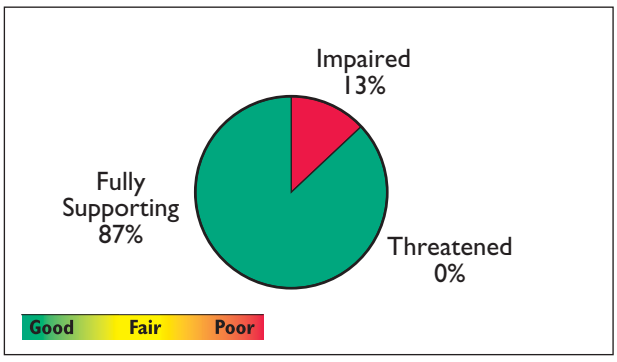


Figure 6-21. Water quality of the assessed shoreline on the West Coast.

The states reported individual use support for their assessed estuarine and coastal waters as shown in Table 6-2.

Table 6-2. Individual Use Support for Assessed Coastal Waters Reported by West Coast States under Section 305(b) of the Clean Water Act

Individual Uses	Assessed Estuaries Impaired, mi^2	Assessed Shoreline Impaired, mi
Aquatic Life	2,571 (68%)[a]	51 (6%)[a]
Fish Consumption	595 (68%)	88 (14%)
Shellfish Harvesting	672 (54%)	55 (7%)
Swimming	541 (15%)	116 (14%)
Secondary Contact	615 (16%)	55 (7%)

[a]Represents percent of assessed waters impaired for each individual use.

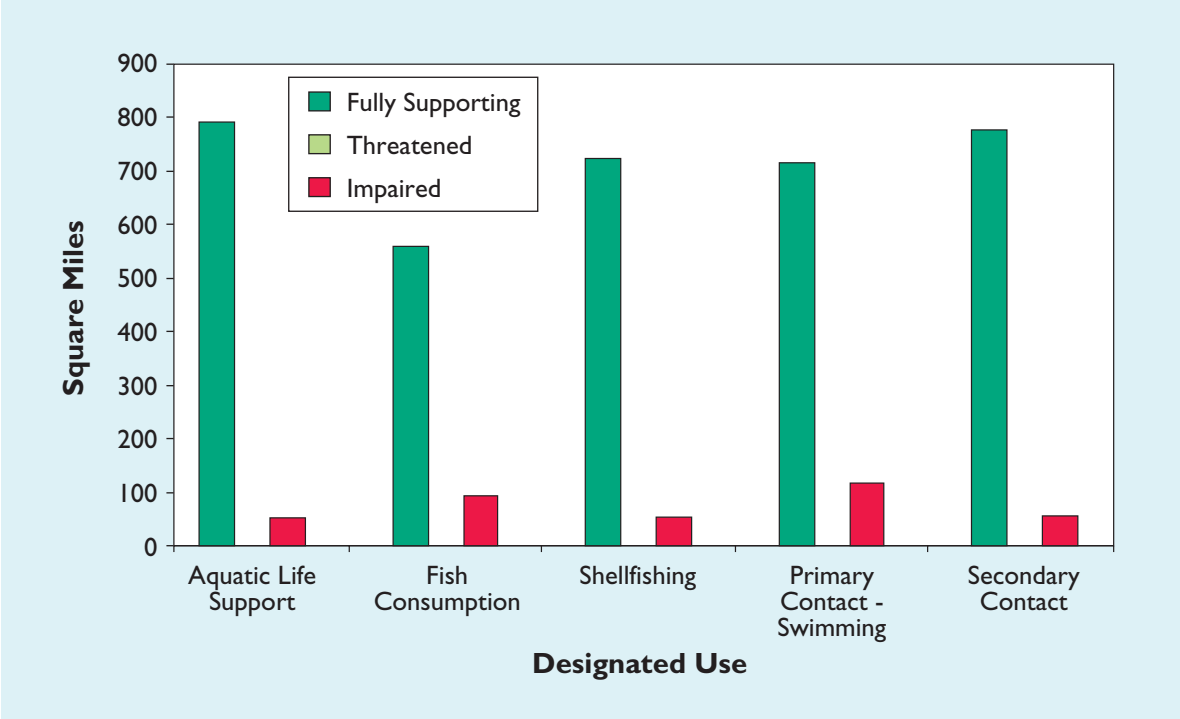


Figure 6-22. Individual use support for assessed shoreline on the West Coast (U.S. EPA).

There are 340 waters on the West Coast that are listed as impaired under Section 303(d) of the Clean Water Act. The percentage of listed waters impaired by each of the major pollutant categories is shown in Figure 6-23.

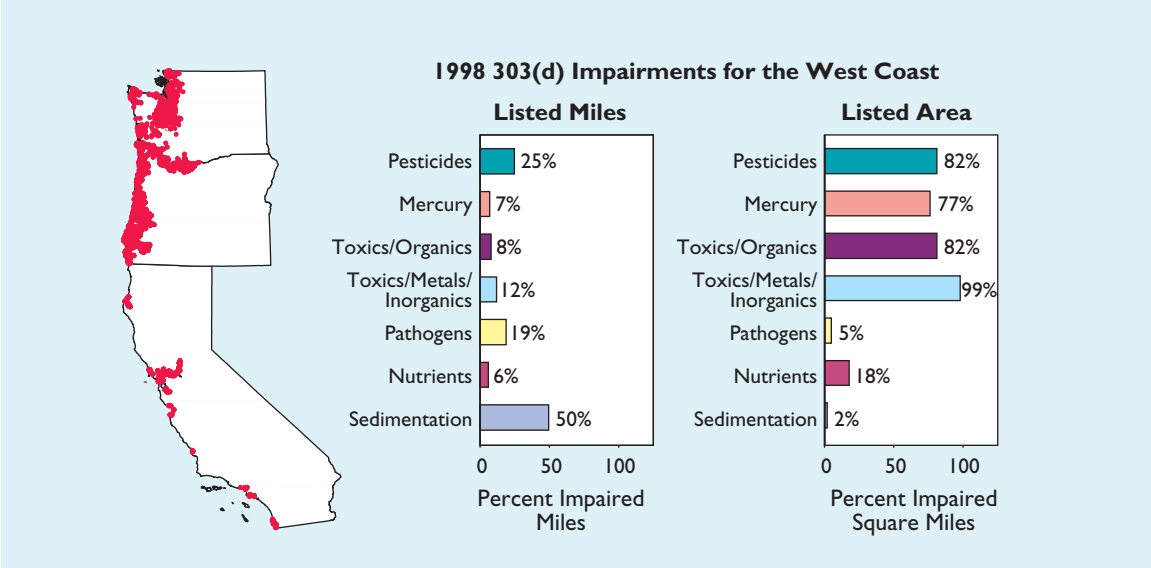


Figure 6-23. 303(d) listed waters on the West Coast and the percentage of listed waters impaired by the major pollutant categories (note that a listing may be impaired by multiple pollutants) (U.S. EPA).

State Fish Consumption Advisories

There were 43 fish consumption advisories active in 2000 for the estuarine and coastal waters of the West Coast (Figure 6-24). Only 9.5% of the coastal miles were under advisory, with half of these miles located in southern California and the other half coastal shoreline in Washington's Puget Sound. A total of 29.8% of the estuarine square miles of the West Coast was under advisory in 2000, and all of the estuarine area under advisory was located within the San Francisco Bay/Delta region or within Puget Sound. None of the West Coast states (California, Oregon, or Washington) had statewide coastal advisories in effect in 2000. Oregon did not list any fish consumption advisories for estuarine or coastal waters.

There were 13 different contaminants or groups of contaminants responsible for West Coast fish advisories in 2000, and 10 of those contaminants (representing 32% of advisories) were listed only in the waters of Puget Sound and bays emptying into the Sound (dioxins, chlorinated pesticides, creosote, industrial and municipal discharge, metals, PAHs, pentachlorophenol, tetrachloroethylene, vinyl chloride, and VOCs). PCBs in California and Washington were responsible for 35% of advisories (Figure 6-25). Twelve advisories for DDT (28%), all in California, were active in 2000.

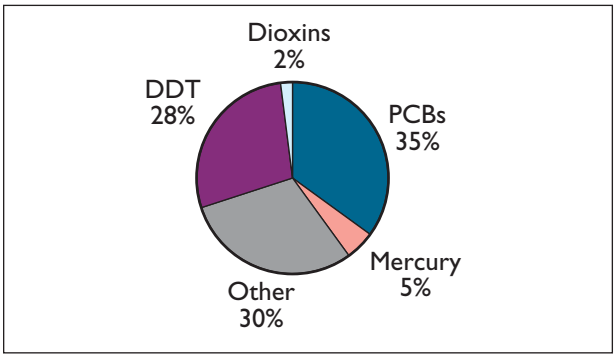


Figure 6-25. Contaminants responsible for fish consumption advisories in the waters of the West Coast in 2000 (U.S. EPA NLFWA, 2000c).

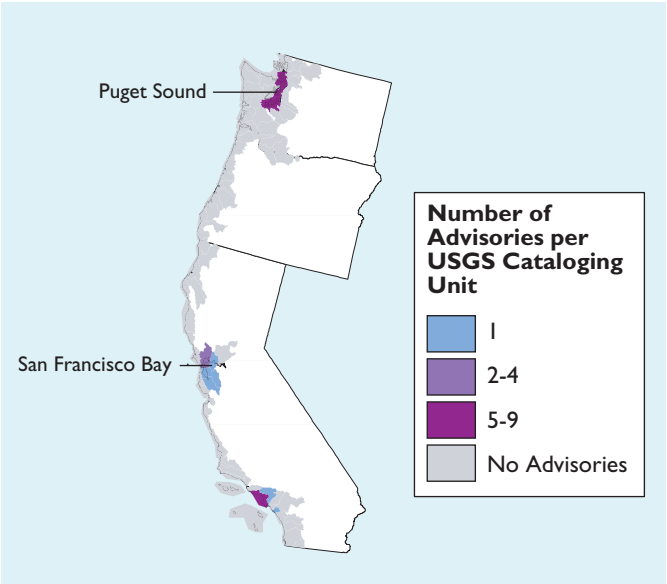


Figure 6-24. The number of fish consumption advisories per USGS cataloging unit for the West Coast (U.S. EPA NLFWA, 2000c).

The following species were under advisory in at least some part of the coastal waters of the West Coast in 1999:

Kelp bass	White croaker	Sculpin
Striped bass	Black croaker	Shark
Bullhead	Gobies	Shellfish
Corbina	Queenfish	Crab
Croaker	Rockfish	Surfperch

Classified Shellfish-Growing Waters

On the West Coast, 423,000 acres (2% of the national total) of shellfish waters were classified for shellfish harvest in 1995. Of those classified, 49% were approved and 51% were harvest-limited. Nationally, the West Coast ranks last in the total amount of classified waters, with only 29% of the waters classified, as shown in Figure 6-26. Of the classified acreage, 84% is located in estuarine waters and 16% in nonestuarine waters. The top three pollution sources affecting harvest limitation are upstream sources, agricultural runoff, and individual wastewater treatment systems.

The top three shellfish species (rated high or medium in abundance) on the West Coast are softshell clams (55,625 acres), Pacific oysters (42,212 acres), and native littleneck clams (25,049 acres). Softshell clams are found at high or medium relative abundance in 13% of the region's shellfish-growing waters, Pacific oysters in 10%, and native littleneck clams in 6%. Eighty-seven percent (48,575 acres) of softshell clams, 13% (5,607 acres) of Pacific oysters, and 24% (6,069 acres) of native littleneck clams are located in waters that do not allow direct harvesting (i.e., restricted, conditionally restricted, and/or prohibited).

Total acreage of approved waters decreased from 52% in 1990 to 49% in 1995. Both Oregon and Washington reported increases in the total amount of classified acreage; however, the biggest change occurred in California, where total classified acreage decreased from 130,000 acres in 1990 to 24,000 acres in 1995.

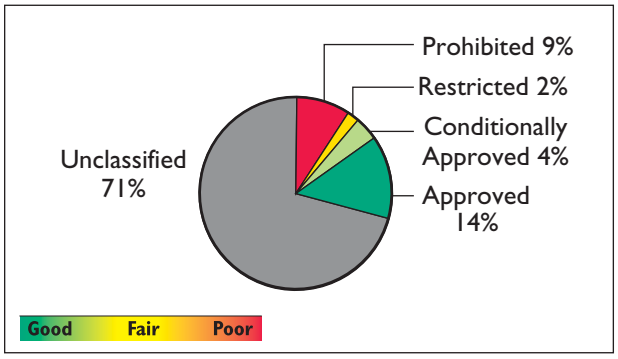


Figure 6-26. The majority of shellfish-growing waters on the West Coast were unclassified (1995 National Shellfish Register, NOAA, 1997).

Beach Closures

Of the three West Coast states, only California and Washington submitted beach monitoring and closing information to EPA in 1999. Ninety-eight percent of the West Coast beaches reporting are in California. There is no regular water quality monitoring of ocean and bay recreational beaches for swimming or for other water contact activities in Oregon.

Of 243 beaches in California that reported information to EPA, 59 (24%) were closed at least once during 1999. The two counties with 50% of the closed beaches were San Diego and Los Angeles Counties (Figure 6-27).

All but five of the California beaches responding to EPA's survey reported the existence of beach monitoring programs in 1999. Beach closings were primarily the result of sewage and elevated bacteria levels caused by pipeline breaks and storm water or other unknown causes.

Kids experience the fun of body boarding in the surf of the Gulf of the Farallones Sanctuary (Photo: Gulf of the Farallones NMS).

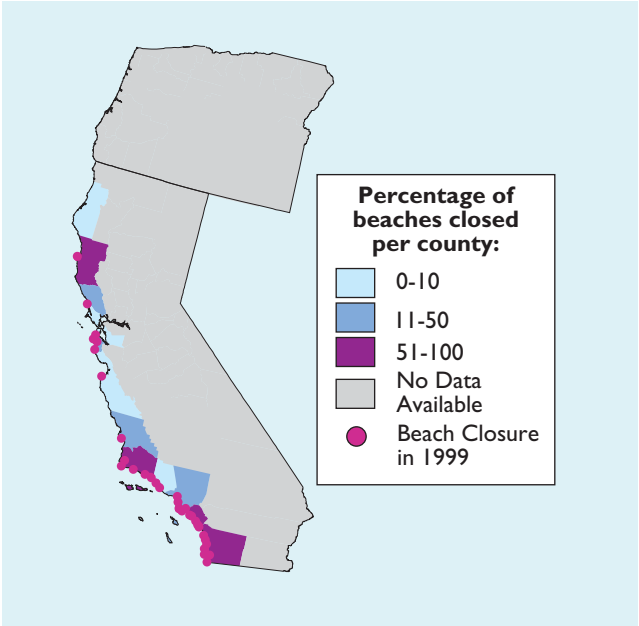


Figure 6-27. Percentage of beaches, of those reporting to EPA, that were closed at least once in 1999.

Washington did not report monitoring information for any beaches in 1998. However, in 1999, Washington reported the existence of water quality monitoring programs for five beaches. None of these beaches experienced closures in 1999.

Summary

Based on available data, ecological conditions in western estuaries are fair (Figure 6-28). Although currently data are not available for all estuarine systems, consistent information throughout western estuarine systems (like that shown earlier for East Coast and Gulf of Mexico estuaries) will be available in 2002. The available data indicate that the primary problem in western estuaries and the Southern California Bight in the 1990s is sediment contamination. Over 25% of sediments are enriched or exceed ERL/ERM guidelines. While problems with sediment contamination are decreasing, the potential for benthic community degradation and fish contamination in selected estuaries is increasing. Concentrations of contaminants in fish tissue in some western estuaries are elevated, creating poor conditions. Dissolved oxygen conditions (except in some isolated regions of Puget Sound) and water clarity are considered good for western estuaries. Contaminant concentrations in fish tissue, benthic community condition, and eutrophic condition are fair in these estuaries but appear to be worsening. Clearly, this is a region of the country where increasing population pressures (particularly in the Seattle-Tacoma region, San Francisco Bay, and southern California) require continued environmental awareness and programs to correct existing problems and to ensure that environmental indicators in fair condition do not worsen.

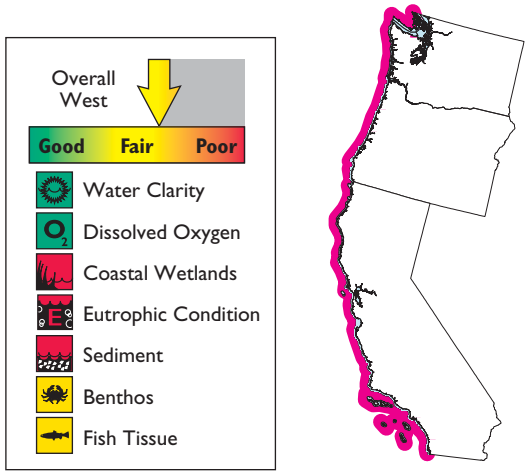


Figure 6-28. Overall ecological condition of estuaries on the West Coast.

San Francisco Bay Estuary Project

http://www.abag.ca.gov/bayarea/sfep

The San Francisco Bay-Delta Estuary is a rich and treasured resource. It is the largest estuarine system on the west coasts of North and South America and includes the waters of San Francisco Bay, San Pablo Bay, Suisun Bay, and the Sacramento-San Joaquin River Delta. The Estuary drains over 40% of California's land, provides drinking water to two-thirds of California's 34 million people, and irrigates 4.5 million acres of farmland and ranches.

Because of its highly dynamic and complex environmental conditions, the estuary supports an extraordinarily diverse and productive ecosystem. Half of the birds migrating along the Pacific Flyway use the estuary's wetlands for wintering. In certain seasons, the estuary's mudflats and saltflats support more than 1 million shorebirds. Hundreds of thousands of native and hatchery-bred salmon migrate through the Bay-Delta waters on their way to spawning grounds upriver. The Bay-Delta also supports many important economic activities including commercial and sport fishing, shipping, industry, agriculture, recreation, and tourism.

The San Francisco Bay-Delta Estuary has been described as the major estuary in the United States most modified by human activity. The San Francisco Estuary Project (SFEP) was created by EPA's National Estuary Program to develop a more coordinated approach to dealing with the estuary's varied management issues such as intensified land use, decline of biological resources, freshwater diversions, and altered flow regime. The SFEP has enacted a long-term management plan calling for stronger planning, improved regulation, and increased acquisition and restoration of wetlands in the Bay area.

Since its inception, the SFEP has developed a network of demonstration projects for watershed protection and is fast growing into a model of how to make local actions have regional impact. The most notable improvements include declining rate of wetland loss, reduced pollutant loads of municipal and industrial sources, and improved regulation of dredging. Over 26,000 acres of wetlands have been acquired and over 28,000 acres of wetlands restored since 1993. Urban expansion, however, continues to deplete the stock of valuable upland wildlife habitats, wetlands, and riparian areas and to increase loadings of many point and nonpoint pollutants. Population growth fuels the increasing demand for fresh water. Water development projects continue to influence the estuary's primary productivity and habitat quality and to adversely affect populations of valuable commercial and sport fish and other species.

Northwest Indian Fisheries Commission

http://www.nwifc.wa.gov

During the past 2 decades there has been a steady decline of many wild salmon stocks originating from Puget Sound and the Washington coast, brought about in part by the loss of critical wild salmon spawning and rearing habitat. As a result of the decline in wild salmon stocks, in 1999 the National Marine Fisheries Service listed Puget Sound chinook salmon, Lake Ozette sockeye, and Hood Canal summer chum stocks as "threatened" under the federal Endangered Species Act (ESA).

The Northwest Indian Fisheries Commission (NWIFC), an organization of the treaty Indian tribes in western Washington, responded to the salmon ESA listings by intensifying their watershed recovery efforts through the state/tribal cooperative Wild Stock Restoration Initiative (WSRI) program. The aim of the effort is to inventory local salmon stocks and habitat, then develop guidelines to restore the most critical stocks and habitats. Indian tribes and the Washington Department of Fish and Wildlife (WDFW) have cooperatively developed a joint assessment of the status of salmon and steelhead stocks in Washington State in response to concerns about declining populations.

The tribes and WDFW created the Wild Stock Restoration Initiative in 1991 in response to wild salmon and steelhead stock concerns. The following approach was established to address wild stock status and recovery:

- Inventory status of stocks and their habitat
- Review management strategies (harvest, habitat, and hatcheries)
- Develop recovery and management plans
- Monitor and evaluate.

Tribal, state, and federal governments and their fisheries managers realize the need for a more focused approach to protect, restore, and manage this resource. Fisheries managers have responded to salmon declines with historic cutbacks in fisheries—as much as 80% in the last decade. But fishery closures and reductions have resulted in severe economic hardship for tribal fishermen on reservations, where unemployment runs as high as 80%.