RMP

San Francisco Estuary
Regional Monitoring Program
for Trace Substances

1998 Monitoring Results

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Introduction

Monitoring Results presents data from the Status and Trends portion of the 1998 San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP). A list of reports on Pilot and Special Studies, as well as other RMP related activities can be found at the end of this document. These reports provide perspective and insight on important contaminant issues identified by the RMP, and they describe results from projects that took advantage of RMP field operations. For a summary of the conditions of the Estuary see The Pulse . A print copy may also be ordered by contacting the San Francisco Estuary Institute (SFEI).

In 1998, the San Francisco Regional Water Quality Control Board (Regional Board) and seventy-three federal, state, and local agencies and companies participated in the RMP as funders and service providers (Table 1.1). Participants also assist in directing the Program through input or participation on the Steering and Technical Review Committees.

The RMP's overall goal is to provide data and interpretation that helps to address certain information needs of the Regional Board. In general, these efforts fall under five major objectives which provide a framework for efforts to respond to more specific management questions.

1. Describe patterns and trends in contaminant concentration and distribution.
2. Describe general sources and loadings of contamination to the Estuary.
3. Measure contaminant effects on selected parts of the Estuary ecosystem.
4. Compare monitoring information to relevant water quality objectives and other guidelines.
5. Synthesize and distribute information from a range of sources to present a more complete picture of the sources, distribution, fates, and effects of contaminants in the Estuary ecosystem.

Table 1.1. 1998 Program Participants

MUNICIPAL DISCHARGERS:

City of Benicia
Burlingame Waste Water Treatment Plant
City of Calistoga
Central Contra Costa Sanitation District
Central Marin Sanitation Agency
Delta Diablo Sanitation District
East Bay Dischargers Authority
East Bay Municipal Utility District
Fairfield-Suisun Sewer District
City of Hercules
Las Gallinas Valley Sanitation District
Millbrae Waste Water Treatment Plant
Mountain View Sanitary District
Napa Sanitation District
Novato Sanitation District
City of Palo Alto
City of Petaluma
City of Pinole
Rodeo Sanitary District
City of Saint Helena
City and County of San Francisco
City of San Jose/Santa Clara
City of San Mateo
Sausalito/Marin City Sanitation District
Sewerage Agency of Southern Marin
San Francisco International Airport
Sonoma County Water Agency
South Bayside System Authority
City of South San Francisco/San Bruno
City of Sunnyvale
Marin County Sanitary District #5, Tiburon
Union Sanitary District
Vallejo Sanitation and Flood Control District
West County Agency
Town of Yountville

INDUSTRIAL DISCHARGERS:

C & H Sugar Company
Chevron Products Company
Dow Chemical Company
Exxon Company, USA
General Chemical Corporation
Pacific Refining Company
Rhone-Poulenc
Shell Martinez Refining Company
TOSCO Refining Company, Avon Refinery
TOSCO Refining Company, S.F. Area Refinery at Rodeo
USS-POSCO Industries

COOLING WATER:

Pacific Gas and Electric

STORMWATER:

Alameda Countywide Clean Water Program
Caltrans
Contra Costa Clean Water Program
Fairfield-Suisun Urban Runoff Management Program
Marin County Stormwater Pollution Prevention Program
City and County of San Francisco
San Mateo Countywide Stormwater Pollution Prevention Program
Santa Clara Valley Urban Runoff Pollution Prevention Program
Vallejo Sanitation and Flood Control District

DREDGERS:

City of Benicia
Benicia Terminal Industries
Caltrans
Chevron Products Company
Clipper Yacht Harbor
Exxon Company, USA
Glen Cove Marina/Western Waterways
Golden Gate Bridge, Highway and Transportation District
Loch Lomond Marina
Lowrie Yacht Harbor
Port of Oakland
Port of Redwood City
Port of San Francisco
San Francisco Yacht Club
City of San Rafael
Schnitzer Steel
US Army Corps of Engineers

Monitoring Design

The RMP sampling design was based on the Bay Protection and Toxic Cleanup Program (BPTCP) Pilot Studies developed by the Regional Board (Flegal et al., 1994). The reasoning behind the original design, with stations located along the "spine" of the Estuary, was to include stations that, in a long-term monitoring program, would indicate spatial and temporal trends in toxicity and chemistry, determine background concentrations for different segments of the Estuary, and assess whether there were high levels of contaminants or toxicity. Several new stations were added in 1994 to fill spatial gaps and to begin monitoring near major tributaries (SFEI, 1995). Additionally, two stations were added in 1994 in the southern-most end of the Estuary in cooperation with the Cities of San Jose (station C-3-0) and Sunnyvale (station C-1-3) and the Regional Board as part of their National Pollutant Discharge Elimination System (NPDES) monitoring.

The RMP station design has provided a picture of the range of conditions found in deeper parts of the Estuary, influenced by riverine, seasonal, and daily natural processes. During the re-design process, options for incorporating more near-shore stations, evaluating overall Estuary condition at statistically representative sites, or conducting intensive embayment studies will be explored.

Five types of samples were collected in the 1998 Status and Trends Program:

1. Conventional water quality and chemistry.
2. Aquatic bioassays.
3. Sediment quality and chemistry.
4. Sediment bioassays.
5. Transplanted, bagged bivalve bioaccumulation, survival, and condition.

Complete listings of all parameters measured in 1998 are included in Table 1.2. For a detailed description of methods of collection and analysis see Description of Methods. RMP data included in this report can be obtained by contacting SFEI or by accessing SFEI's on-line database at: http://www.sfei.org/rmp/data.htm.

Locations of the twenty-two RMP, two Southern Slough (C-3-0, C-1-3), and Estuary Interface sampling stations are shown in Figure 1.1; Table 1.3 lists the station names, codes, locations, and sampling dates for all 1998 stations. Water, sediment, or bioaccumulation sampling sites with the same station name may have different station codes as they are situated at slightly different locations (latitude, longitude) due to practical considerations such as sediment type or ability to deploy bivalves. For example, at the South Bay site, BA20 is the water station code and BA21 is the sediment station code.

Sampling occurred during three periods in 1998: during the wet season (January-February), a period of declining Delta outflow (April), and during the dry season (July-September). The rationale for taking seasonal "snapshots" is to relate contaminant data during hydrologically different periods of the year with higher-frequency measurements conducted by the U.S. Geological Survey (USGS)and to evaluate the influence of natural variability on the contaminant signal. As part of the RMP re-design, the use of more intensive data on tides, Delta outflow, salinity gradients, algal blooms, and other parameters will be evaluated in greater detail to minimize the natural noise around any signals of water quality improvement or degradation over time.

Not all parameters were measured at all RMP stations each sampling period. Sampling activities at each station are listed on Table 1.3.

Water and sediment samples were collected from the R/V David Johnston chartered through the University of California, Santa Cruz. Each sampling cruise starts with water sampling at all RMP stations. Sediment sampling is then conducted with a separate run though the Estuary. Each complete sampling run requires three to five days. Bivalve monitoring consisted of three parts: deployment of transplants from reference sites, maintenance, and retrieval. Most of this work was conducted aboard the R/V Questuary, owned by San Francisco State University. The California Department of Water Resources provided back-up services for bivalve cruises.

The U.S. Geological Survey took monthly measurements of five water quality parameters to supplement RMP monitoring. This additional monitoring was designed to describe the changing spatial patterns of water-quality variability from the lower Sacramento River to the southern limit of the South Bay.

Field sampling and laboratory analysis were coordinated by the RMP prime contractor, Applied Marine Sciences in Livermore, California. In addition, a group of Principal Investigators also participated in the RMP (Table 1.4).

References

Flegal, A.R., R.W. Risebrough, B. Anderson, J. Hunt, S. Anderson, J. Oliver, M. Stephenson, and R. Packard. 1994. San Francisco Estuary Pilot Regional Monitoring Program: Sediment Studies. San Francisco Bay Regional Water Quality Control Board, State Water Resources Control Board.

SFEI. 1995. 1994 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. Prepared by the San Francisco Estuary Institute, Richmond, CA. 339p.

Table 1.2. Parameters analyzed in water, sediment, and bivalve tissues during the 1998 RMP Sampling of the San Francisco Estuary.

A. Conventional Water Quality Parameters

- Conductivity
- Dissolved Organic Carbon
- Dissolved Oxygen (DO)
- Hardness (when salinity is <5 ‰)
- pH (acidity)
- Phaeophytin (a chlorophyll degradation product)
- Salinity
- Temperature
- Total Chlorophyll-*a*
- Total Suspended Solids
- Dissolved Phosphates
- Dissolved Silicates
- Dissolved Nitrate
- Dissolved Nitrite
- Dissolved Ammonia

B. Sediment Quality Parameters

- % Clay (<4 µm)
- % Silt (4 µm–62 µm)
- % Sand (63 µm–2 mm)
- % Gravel (>2 mm)
- % Solids
- pH
- Total Ammonia
- Total Organic Carbon
- Total Sulfide

C. Bivalve Tissue Parameters

- % Moisture
- Bivalve % Survival
- Total Volume
- Shell Volume
- Dry Flesh Weight
- Biological Condition Index

D. Trace Elements

	Water	Sediment	Tissue
Aluminum*		●	
Arsenic	●	●	●
Cadmium*	●	●	●
Chromium	●	●	●
Copper*	●	●	●
Iron*		●	
Lead*	●	●	●
Manganese*		●	
Mercury	●	●	●
Nickel*	●	●	●
Selenium	●	●	●
Silver*	●	●	●
Zinc*	●	●	●
Dibutyltin (DBT)			●
Monobutyltin (MBT)			●
Tributyltin (TBT)			●
Tetrabutyltin (TTBT)			●

* Near-total rather than total concentrations for water. Near-total metals are extracted with a weak acid (pH < 2) for a minimum of one month, resulting in measurements that approximate bioavailability of these metals to Estuary organisms.

Table 1.2. (cont'd) Parameters analyzed in water, sediment, and bivalve tissues during the 1998 RMP Sampling of the San Francisco Estuary.

E. Polycyclic Aromatic Hydrocarbons (PAHs)

	Water	Sediment	Tissue
2 rings			
1-Methylnaphthalene	•	•	•
2,3,5-Trimethylnaphthalene	•	•	•
2,6-Dimethylnaphthalene	•	•	•
2-Methylnaphthalene	•	•	•
Biphenyl	•	•	•
Naphthalene	•	•	•
3 rings			
1-Methylphenanthrene	•	•	•
Acenaphthene	•	•	•
Acenaphthylene	•	•	•
Anthracene	•	•	•
Dibenzothiophene	•	•	•
Fluorene	•	•	•
Phenanthrene	•	•	•
4 rings			
Benz(a)anthracene	•	•	•
Chrysene	•	•	•
Fluoranthene	•	•	•
Pyrene	•	•	•
5 rings			
Benzo(a)pyrene	•	•	•
Benzo(b)fluoranthene	•	•	•
Benzo(e)pyrene	•	•	•
Benzo(k)fluoranthene	•	•	•
Dibenz(a,h)anthracene	•	•	•
Perylene	•	•	•
6 rings			
Benzo(ghi)perylene	•	•	•
Indeno(1,2,3-cd)pyrene	•	•	•
Alkylated PAHs			
C1-Chrysenes	•	•	•
C2-Chrysenes	•	•	•
C3-Chrysenes	•	•	•
C4-Chrysenes	•	•	•
C1-Dibenzothiophenes	•	•	•
C2-Dibenzothiophenes	•	•	•
C3-Dibenzothiophenes	•	•	•
C1-Fluoranthenes/Pyrenes	•	•	•
C1-Fluorenes	•	•	•
C2-Fluorenes	•	•	•
C3-Fluorenes	•	•	•
C1-Naphthalenes	•	•	•
C2-Naphthalenes	•	•	•
C3-Naphthalenes	•	•	•
C4-Naphthalenes	•	•	•

E. PAHs (continued)

	Water	Sediment	Tissue
C1-Phenanthrenes/Anthracenes	•	•	•
C2-Phenanthrenes/Anthracenes	•	•	•
C3-Phenanthrenes/Anthracenes	•	•	•
C4-Phenanthrenes/Anthracenes	•	•	•

F. Synthetic Biocides

	Water	Sediment	Tissue
Cyclopentadienes			
Aldrin	•	•	•
Dieldrin	•	•	•
Endrin	•	•	•
Chlordanes			
alpha-Chlordane	•	•	•
cis-Nonachlor	•	•	•
gamma-Chlordane	•	•	•
Heptachlor	•	•	•
Heptachlor Epoxide	•	•	•
Oxychlordane	•	•	•
trans-Nonachlor	•	•	•
DDTs			
o,p'-DDD	•	•	•
o,p'-DDE	•	•	•
o,p'-DDT	•	•	•
p,p'-DDD	•	•	•
p,p'-DDE	•	•	•
p,p'-DDT	•	•	•
HCHs			
alpha-HCH	•	•	•
beta-HCH	•	•	•
delta-HCH	•	•	•
gamma-HCH	•	•	•
Other			
Diazinon	•		
Mirex	•	•	•
Chlorpyrifos	•		

Table 1.2. (cont'd) Parameters analyzed in water, sediment, and bivalve tissues during the 1998 RMP Sampling of the San Francisco Estuary.

G. PCBs and Related Compounds

	Water	Sediment	Tissue
Hexachlorobenzene	●	●	●
PCB 008	●	●	●
PCB 018	●	●	●
PCB 028	●	●	●
PCB 031	●	●	●
PCB 033	●	●	●
PCB 044	●	●	●
PCB 049	●	●	●
PCB 052	●	●	●
PCB 056	●	●	●
PCB 060	●	●	●
PCB 066	●	●	●
PCB 070	●	●	●
PCB 074	●	●	●
PCB 087	●	●	●
PCB 095	●	●	●
PCB 097	●	●	●
PCB 099	●	●	●
PCB 101	●	●	●
PCB 105	●	●	●
PCB 110	●	●	●
PCB 118	●	●	●
PCB 128	●	●	●
PCB 132	●	●	●
PCB 138	●	●	●
PCB 141	●	●	●
PCB 149	●	●	●
PCB 151	●	●	●
PCB 153	●	●	●
PCB 156	●	●	●
PCB 158	●	●	●
PCB 170	●	●	●
PCB 174	●	●	●
PCB 177	●	●	●
PCB 180	●	●	●
PCB 183	●	●	●
PCB 187	●	●	●
PCB 194	●	●	●
PCB 195	●	●	●
PCB 201	●	●	●
PCB 203	●	●	●

Table 1.3. Summary of RMP 1998 sampling stations and activities.

Station Name	Station Code	Type of Sample	Measurements Made	Dates Sampled			Latitude			Longitude		
							deg	min	sec	deg	min	sec
Coyote Creek	BA10	water	Q,M,O,T	1/28	4/22	7/20	37	28	20	122	3	80
	BA10	sediment	Q,M,O,T	2/11		8/4	37	28	20	122	3	80
	BA10	bioaccumulation	M,O,C	4/22		9/2	37	28	20	122	3	80
South Bay	BA20	water	Q,M,O,T	1/27	4/22	7/20	37	29	69	122	5	34
	BA21	sediment	Q,M,O,T	2/10		8/4	37	29	69	122	5	34
Dumbarton Bridge	BA30	water	Q,M,O,T	1/28	4/22	7/21	37	30	90	122	8	11
	BA30	sediment	Q,M,O,T	2/10		8/4	37	30	90	122	8	11
	BA30	bioaccumulation	M,O,C	4/22		9/2	37	30	90	122	8	11
Redwood Creek	BA40	water	Q,M,O	1/27	4/22	7/20	37	33	67	122	12	57
	BA40	bioaccumulation	M,O,C	4/22		9/2	37	33	67	122	12	57
	BA41	sediment	Q,M,O,T	2/10		8/4	37	33	67	122	12	57
San Bruno Shoal	BB15	water	Q,M	1/27	4/20	7/20	37	37	0	122	17	0
	BB15	sediment	Q,M,O,T	2/10		8/4	37	37	0	122	17	0
Oyster Point	BB30	water	Q,M	1/27	4/20	7/20	37	40	20	122	19	75
	BB30	sediment	Q,M,O	2/10		8/4	37	40	20	122	19	75
Alameda	BB70	water	Q,M,O	1/29	4/20	7/22	37	44	66	122	19	30
	BB70	sediment	Q,M,O,T	2/10		8/3	37	44	66	122	19	30
	BB71	bioaccumulation	M,O,C	4/22		9/2	37	44	66	122	19	30
Yerba Buena Island	BC10	water	Q,M,O	1/29	4/20	7/22	37	49	36	122	20	96
	BC10	bioaccumulation	M,O,C	4/22		9/2	37	49	36	122	20	96
	BC11	sediment	Q,M,O,T	2/9		8/3	37	49	36	122	20	96
Golden Gate	BC20 *	water		not sampled			37	51	81	122	32	20
		water	Q,M,O		4/21		37	51	81	122	32	20
		water	Q,M,O			7/22	37	51	81	122	32	20
Horseshoe Bay	BC21	sediment	Q,M,O,T	2/9		8/3	37	49	98	122	28	43
	BC21	bioaccumulation	M,O,C	4/23		9/3	37	49	98	122	28	43
Richardson Bay	BC30	water	Q,M	1/29	4/24	7/22	37	51	81	122	28	66
	BC32	sediment	Q,M,O	2/9		8/3	37	51	81	122	28	66
Point Isabel	BC41	water	Q,M,O	1/29	4/21	7/23	37	53	30	122	20	55
	BC41	sediment	Q,M,O	2/9		8/3	37	53	30	122	20	55
Red Rock	BC60	water	Q,M,O	1/29	4/21	7/23	37	55	0	122	26	0
	BC60	sediment	Q,M,O,T	2/9		7/31	37	55	0	122	26	0
	BC61	bioaccumulation	M,O,C	4/23		9/3	37	55	0	122	26	0
Petaluma River	BD15	water	Q,M,O	2/2	4/14	7/27	38	6	66	122	29	0
	BD15	sediment	Q,M,O	2/6		7/31	38	6	66	122	29	0
	BD15	bioaccumulation		4/23		9/3	38	6	66	122	29	0
San Pablo Bay	BD20	water	Q,M,O	2/2	4/14	7/27	38	2	92	122	25	19
	BD20	bioaccumulation	M,O,C	4/23		9/3	38	2	92	122	25	19
	BD22	sediment	Q,M,O,T	2/6		7/31	38	2	92	122	25	19
Pinole Point	BD30	water	Q,M,O,T	2/2	4/21	7/27	38	1	48	122	21	65
	BD30	bioaccumulation	M,O,C	4/23		9/3	38	1	48	122	21	65
	BD31	sediment	Q,M,O	2/6		7/31	38	1	48	122	21	65
Davis Point	BD40	water	Q,M,O	2/2	4/14	7/27	38	3	12	122	16	62
	BD40	bioaccumulation	O	4/28		9/1	38	3	12	122	16	62
	BD41	sediment	Q,M,O,T	2/6		7/31	38	3	12	122	16	62
Napa River	BD50	water	Q,M,O	2/3	4/15	7/28	38	5	79	122	15	61
	BD50	sediment	Q,M,O,T	2/6		7/31	38	5	79	122	15	61
	BD50	bioaccumulation	M,O,C	4/23		9/3	38	5	79	122	15	61
Pacheco Creek	BF10	water	Q,M,O	2/3	4/15	7/28	38	3	9	122	5	80
	BF10	sediment	Q,M,O	2/5		7/30	38	3	9	122	5	80
Grizzly Bay	BF20	water	Q,M,O,T	2/3	4/15	7/28	38	6	96	122	2	31
	BF20	bioaccumulation	M,O,C	4/24		9/4	38	6	96	122	2	31
	BF21	sediment	Q,M,O,T	2/5		7/30	38	6	96	122	2	31
Honker Bay	BF40	water	Q,M,O	2/3	4/15	7/28	38	4	0	121	56	0
	BF40	sediment	Q,M,O	2/5		7/30	38	4	0	121	56	0
Sacramento River	BG20	water	Q,M,O	2/4	4/16	7/29	38	3	56	121	48	59
	BG20	sediment	Q,M,O,T	2/5		7/30	38	3	56	121	48	59
	BG20	bioaccumulation	M,O,C	4/24		9/18	38	3	56	121	48	59
San Joaquin River	BG30	water	Q,M,O,T	2/4	4/16	7/29	38	1	40	121	48	45
	BG30	sediment	Q,M,O,T	2/5		7/30	38	1	40	121	48	45
	BG30	bioaccumulation	M,O,C	2/24		9/18	38	1	40	121	48	45
San Jose	C-3-0	water	Q,M,O,T	1/28	4/23	7/21	37	27	85	122	1	60
	C-3-0	sediment	Q,M,O,T	2/11		8/5	37	27	85	122	1	60
Sunnyvale	C-1-3	water	Q,M,T	1/28	4/23	7/21	37	26	8	122	0	64
	C-1-3	sediment	Q,M,O	2/11		8/5	37	26	8	122	0	64
Standish Dam†	BW10	water	Q,M,O	2/5	4/13	7/30	37	27	10	121	55	29
	BW10	sediment	M,O	2/4			37	27	10	121	55	29
Guadalupe River†	BW15	water	Q,M,O	2/5	4/13	7/30	37	25	34	121	58	45
	BW15	sediment	M,O	2/5								

M = trace elements
O = trace organics
* location dependent on salinity
T = toxicity (aquatic and/or sediment)
Q = water and/or sediment quality
C = bivalve condition index
† Estuary Interface Pilot Station

Table 1.4 Rmp contractors and principal investigators

Prime Contractors	Dr. Bob Spies and Dr. Andrew Gunther Applied Marine Sciences, Livermore, CA
Trace Element Chemistry	Dr. Russ Flegal, UC Santa Cruz, CA Dr. Eric Prestbo, Brooks-Rand, Seattle, WA
Trace Organic Chemistry	Dr. Bob Risebrough, Bodega Bay Institute, CA Dr. José Sericano, Texas A&M University, TX Dr. Walter Jarman, UC Santa Cruz, CA
Sediment Trace Metals and Trace Organics	Ms. Patti TenBrook East Bay Municipal Utility District, Oakland, CA
Water Hardness	Ms. Lynda Taylor Union Sanitary District, Fremont, CA
Water Toxicity Testing	Dr. Scott Ogle Pacific Eco-Risk Laboratories, Martinez CA
Sediment Toxicity Testing	Mr. John Hunt and Mr. Brian Anderson Marine Pollution Lab, Granite Canyon, CA
Bagged Bivalve Sampling	Mr. David Bell Applied Marine Sciences, Livermore, CA
Bivalve Trace Metals	Mr. Lonnie Butler City and County of San Francisco, CA
Bivalve PAHs and PCBs	Mr. Phil Snyder Central Contra Costa Sanitary District, Martinez, CA
USGS Water Quality	Dr. James Cloern, USGS, Menlo Park, CA
USGS Sediment Transport	Dr. David Schoellhamer, USGS, Sacramento, CA
Pilot Study on Benthic Macrofauna	Dr. Bruce Thompson San Francisco Estuary Institute, Richmond, CA Ms. Heather Peterson Dept. of Water Resources, Sacramento, CA
Fish Contamination Pilot Study	Dr. Jay Davis San Francisco Estuary Institute, Richmond, CA
Estuary Interface Pilot Study	Dr. Rainer Hoenicke San Francisco Estuary Institute, Richmond, CA Mr. Dane Hardin Applied Marine Sciences, Livermore, CA

Figure 1.1


RMP Sampling Stations
Petaluma River
Grizzly Bay
Sacramento River
Napa River
Honker Bay
San Pablo Bay
Davis Point
Pacheco Creek
Pinole Point
San Joaquin River
Red Rock
Richardson Bay
Point Isabel
Horseshoe Bay
Yeba Buena Island
Golden Gate
Alameda
Oyster Point
San Bruno Shoal
Redwood Creek
Dumbarton Bridge
South Bay
San Jose
Coyote Creek
Standish Dam
Sunnyvale
Guadalupe River
Water
Sediment
Bivalve Tissue
Deep Bay/ Ocean
Shallow Bay
N
San Francisco Estuary Institute
EcoAtlas

Water Monitoring

2.1 Background

This chapter presents a graphical and narrative summary of the Regional Monitoring Program (RMP) water monitoring results for 1998. This chapter also includes articles contributed by RMP investigators that provide interpretive summaries of specific water monitoring activities.

Water quality was monitored at twenty-two RMP Base Program stations. Parameters measured included conventional water quality parameters (salinity, temperature, total suspended solids; Figures 2.1-2.3), trace elements, trace organic contaminants, and toxicity (Figures 2.4-2.22). Two additional stations were sampled in 1998 for an Estuary Interface Pilot Study at Standish Dam (BW10) and Guadalupe River (BW15). Water was also sampled at two stations in the southern end of the Estuary in cooperation with the cities of San Jose (station C-3-0) and Sunnyvale (station C-1-3). In addition, the U.S. Geological Survey monitored conventional water quality parameters at shorter time scales to complement RMP monitoring activities.

Station locations are shown in Figure 1.1 in the Introduction. Water samples were collected in January, April, and July. Sampling dates and parameters measured at each station are shown in Table 1.3 in the Introduction. For trace elements, dissolved (0.45 µm filtered) and total (arsenic, chromium, mercury, and selenium) or near-total (cadmium, copper, lead, nickel, silver, and zinc) concentrations are presented in Figures 2.4-2.13. Dissolved (1 µm filtered) and total concentrations of trace organic contaminants are also presented in Figures 2.14-2.21. In addition, long-term trends in trace element and trace organics for each Estuary reach are provided in Figures 2.23-2.40. Detailed methods of collection and analysis are included the Description of Methods.

In order to compare water monitoring results among the major segments of the Estuary, the RMP stations are separated into six groups based on similarities in geography, water chemistry, and hydrodynamics: the Estuary Interface (BW10 and BW15), Southern Sloughs (C-1-3 and C-3-0), South Bay (seven stations, BA10 through BB70), Central Bay (five stations, BC10 through BC60), Northern Estuary (eight stations, BD15 through BF40), and the Rivers (BG20 and BG30).

2.2 Water Quality Objectives and Criteria

In this report, comparisons to guidelines are made to provide a context for evaluating the condition of the Estuary in terms of contamination, and not for any regulatory purpose. Guidelines were selected based on guidance from the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Lynn Suer, personal communication).

On August 5, 1997, the U.S. Environmental Protection Agency (U.S. EPA) published its proposed numeric water quality criteria for priority toxic pollutants for the State of California to fulfill the requirements of section 303(c)(2)(B) of the Clean Water Act (CWA). The U.S. EPA proposed this rule to fill a gap in California water quality standards that was created in 1994, when a State Court overturned the State's water quality control plans which contained water quality criteria for priority toxic pollutants. This left the State without numeric water quality criteria for many priority toxic pollutants as required by the CWA, necessitating action by the U.S. EPA.

Water quality guidelines for this report were taken from the U.S. EPA's proposed California Toxics Rule (U.S. EPA, 1997; CTR), and the Regional Water Quality Control Plan, San Francisco Basin (SFBRWQCB, 1995; Basin Plan). Criteria for the dissolved trace elements and the total organic compounds (dissolved + particulate fractions) were taken from the CTR. Objectives for total trace elements were obtained from the Basin Plan. These guidelines are listed in Table 2.1.

Different objectives and criteria apply to saltwater, estuarine, and freshwater portions of the Estuary. As defined by the Basin Plan, sites are defined as 1) freshwater when their salinity is below 5 parts per thousand (ppt) more than 75% of the time; 2) saltwater when their salinity is greater than 5 ppt more than 75% of the time; and 3) estuarine if salinity is intermediate, if estuarine organisms are present for significant periods, or based on an evaluation by the SFBRWQCB.

For estuarine locations, the Basin Plan specifies that the lower of the freshwater and saltwater objectives apply. RMP stations were classified as freshwater, estuarine, or saltwater based on an evaluation by the

SFBRWQCB (Kim Taylor, 1998) of long-term data at RMP stations. The following stations were classified as estuarine: Sunnyvale (C-1-3), San Jose (C-3-0), South Bay (BA20), Petaluma River (BD15), San Pablo Bay (BD20), Pinole Point (BD30), Davis Point (BD40), Napa River (BD50), Pacheco Creek (BF10), Grizzly Bay (BF20), Honker Bay (BF40), Sacramento River (BG20), and San Joaquin River (BG30).

Water quality guidelines for six trace elements are calculated based on water hardness. In the RMP, hardness data are only collected at stations where the salinity is less than 5. For these trace elements, freshwater guidelines were calculated assuming a hardness of 100 mg/L for the designated estuarine stations where hardness data were not collected. Fresh water guidelines for these compounds are represented on the charts using a hardness value of 100 mg/L.

Selenium criteria are region-specific criteria for total recoverable selenium that apply to the entire Estuary (National Toxics Rule, U.S. EPA, 1995). A criterion for diazinon was not included in the proposed CTR, but a guideline developed by the California Department of Fish and Game (Menconi and Cox, 1994) was used in this report to evaluate the degree of contamination in the Estuary.

For some contaminants multiple guidelines exist that apply to different target organisms (aquatic life or humans) or different lengths or routes of exposure (e.g., 1 hour or 4 days). For this report, RMP contaminant data were compared to the lowest guideline for each contaminant. In general, trace element concentrations were compared to 4-day average guideline for aquatic life. This is considered appropriate by the SFBRWQCB since RMP data are probably indicative of conditions that persist longer than one day. Trace organic contaminant concentrations were compared to human health criteria based on consumption of organisms only, since RMP stations are all seaward of drinking water intakes in the Delta.

2.3 Aquatic Bioassays

Laboratory bioassays using Estuary water were conducted at six RMP stations (Figure 2.22) during the wet-season sampling (January-February) and again in the dry-season sampling (July). Bioassays were conducted by exposing Mysids (Mysidopsis bahia) to Estuary water for seven days where percent survival was the endpoint. Detailed methods are included in the Description of Methods. Significant toxicity was determined by statistical comparison (t-tests) of field samples with controls.

2.4 Water Trends

This section will be updated shortly.

2.5 Discussion

2.5.1 Discussion

El Niño storms of 1998 delivered exceptionally heavy precipitation and high streamflow to the San Francisco Bay watershed. The resulting hydrologic conditions in 1998 were typical of wet years in the Bay area. The distribution of contaminants in the Bay generally followed similar spatial and temporal patterns that were established in the first five years of RMP, as described in the 1996 Annual Report. However, extreme weather conditions persisted unusually late in the year and had a significant impact on the water quality conditions in both the April and July sampling periods.

A series of storms in early 1998 provided twice the monthly average precipitation in January and three times the monthly average for February (Roos 1998). During this time, the Sacramento-San Joaquin Delta outflow to the Bay peaked above 9,000 m3/s. The winter months were then followed by unusually wet weather in spring. The average precipitation for April was exceeded within the first two weeks, while four times the monthly average fell in May (CDWR 1998a, CDWR 1998b). Extended heavy rainfall in spring led to the highest monthly average Delta outflow in April, June, and July since the beginning of RMP. The extreme hydrologic conditions had a distinct impact on conventional water quality parameters during the April and July sampling periods. In late January and early February, surface salinity dropped from 28-30 psu (~17 % freshwater) in the South Bay and Central Bay to about 10 psu (~70 % freshwater) (Cloern 1999). In April, surface salinities were still around 10-16 psu in the South and Central Bay (Cloern 1999). Large loads of suspended solids (TSS), which often coincide with increased streamflow, entered the Bay well into the summer. In April, the Baywide mean TSS concentration peaked at 114 mg/L, the highest recorded average concentration for any cruise since RMP began. In addition, the average TSS concentration recorded during the July sampling exceeded all previously measured concentrations of TSS in summer RMP cruises.

2.5.2 The Effect of El Niño on Contaminant Concentrations

In 1998, contaminant concentrations tended to follow similar spatial and seasonal patterns observed in previous years of RMP water monitoring. High-flow conditions and associated high TSS concentrations that lasted unusually late in the year had a noticeable effect on some particle-associated contaminants, such as total trace elements. Similarly, high stream flows mobilized and transported above average concentrations of some dissolved contaminants to the Bay throughout the entire RMP sampling year.

2.5.3 Dissolved Trace Elements

Dissolved concentrations of many contaminants, including mercury, chromium, lead, selenium, and zinc, were generally elevated throughout the duration of the 1998 RMP study. Dissolved chromium reached average concentrations in April (0.54 µg/L) and July (0.30 µg/L) that exceeded all previous RMP results for those respective seasons. Similarly, the July sampling for lead, selenium, and zinc yielded average Baywide concentrations (0.057 µg/L, 0.58 µg/L, and 2.18 µg/L, respectively) that were higher than all of the previous summer sampling cruises in the RMP.

Average concentrations of dissolved mercury were elevated in January in the Estuary Interface (0.0093 µg/L) and Northern Estuary (0.0044 µg/L). The third and fourth highest concentrations of dissolved mercury in RMP history were measured in January at the Guadalupe River (BW15, 0.015 ug/L) and the Petaluma River (BD15, 0.014 ug/L). The average concentrations of dissolved zinc in January (3.2 µg/L) and July (2.18 µg/L) were elevated due to high concentrations in the Southern Sloughs, with maximum concentrations measured at the San Jose site (C-3-0) during both seasons. Similarly, the dissolved lead concentration in July (0.057 µg/L) was caused by a high average in the Southern Sloughs (0.26 µg/L), the highest concentration of lead measured in any of the reaches in 1998.

A few trace elements were heavily influenced by high concentrations measured in the Estuary Interface stations, which were included in the RMP beginning in 1996. Comparisons of 1998 data to previous years must be made with consideration of the influence of concentrations from these sites during the last three years. The average concentration of dissolved selenium in July (0.58 µg/L) was the highest recorded for this element since the beginning of RMP. This value was largely influenced by high concentrations in the Estuary Interface (4.14 µg/L) and Southern Sloughs (1.18 µg/L), exceeding 1997's average (0.50 µg/L) and almost doubling the average selenium concentration measured in 1996 (0.32 µg/L). These sites also had higher concentrations of dissolved selenium in January and April compared to all of the other reaches in the Bay. Dissolved chromium concentrations in July (0.30 µg/L) were influenced by high concentrations in the Rivers and Southern Sloughs, while April concentrations (0.54 µg/L) were mostly influenced by high concentrations in the Northern Estuary and Estuary Interface stations. Chromium concentrations in April more than doubled the average Baywide concentration measured in the spring of 1996 (0.19 µg/L) and 1997 (0.24 µg/L).

2.5.4 Total Trace Elements

The extreme weather conditions during the January sampling led to the highest Baywide average concentration (0.058 µg/L) of total mercury since RMP began. In fact, the highest recorded mercury concentration (0.73 µg/L) in RMP history was measured in the Guadalupe River (BW15) in January. High flow conditions and associated TSS loads also had a significant impact on total concentrations of nickel, copper, chromium, lead, and zinc, which were consistently high through the July sampling. The highest Baywide average concentrations since the beginning of RMP were measured for total chromium (19.4 µg/L), copper (6.39 µg/L), and lead (2.67 µg/L) in April, and for total zinc (20.5 µg/L) in the July sampling. The average concentrations of nickel in April (11.2 µg/L) and July (8.8 µg/L) were the highest measured in RMP history for those particular seasons. These peak concentrations for the trace elements in April coincide with the highest Baywide TSS concentration (114 mg/L) ever measured by the RMP. Similar to their dissolved forms, increased concentrations of total trace elements in 1998 were influenced by high concentrations in the Estuary Interface and Southern Sloughs, and to a lesser extent, the Northern Estuary.

2.5.4 Organic Contaminants

Dissolved concentrations of the pesticides chlordane, chlorpyrifos, and dieldrin were highest in July at all stations in the Northern Estuary, Rivers, and Estuary Interface. The pesticide concentrations measured in these reaches displayed a seasonal variation of increasing concentrations from winter to summer. However, January concentrations were consistently higher at South Bay, Central Bay, and the Southern Sloughs compared to the two later RMP cruises.

Total (dissolved + particulate) chlordane and chlorpyrifos, among other organic contaminants in the 1998 RMP study, were significantly affected by laboratory contamination, as discussed in the following section. However, total chlordane concentrations in the Estuary Interface and Southern Sloughs were highest in April, with an average concentration of 4,400 pg/L measured in the Estuary Interface. Total concentrations of dieldrin in July were highest in the Northern Estuary, Rivers, and Estuary Interface. High concentrations of dissolved and particulate pesticides in the Northern Estuary and Estuary Interface suggest a steady contribution of contaminated sediment particles from the Central Valley during the extended periods of high flow conditions in 1998.

Total and dissolved PCBs followed similar patterns of contaminant distribution as the pesticides. Dissolved PCB concentrations in July were highest for all sites in the Northern Estuary, Rivers, and the Southern Sloughs, while January concentrations were generally higher in the South Bay and Central Bay. The highest average concentration (690 pg/L) was measured in the Southern Sloughs in July. Despite significant contamination of samples measured for total PCBs in January, unaffected data from April and July samplings still suggest that the highest concentrations of total PCBs in those months are found in the Estuary Interface, with an average concentration of 6,600 pg/L.

2.5.5 Effects of Laboratory Contamination and Interference on Organic Contaminants in the 1998 RMP

Water samples for organic compounds in 1998 suffered from more problems of blank contamination (which also appear as matrix interferences) than in previous years. This was in part due to a change in sourcing for sampling supplies made without notice by a vendor to the RMP contract lab. The lab attempted to correct for these interferences by post-extraction cleanup procedures and reanalysis of the samples, with limited success. These problems required additional evaluation and qualification of the data by SFEI.

The lab has assured RMP that in the future they will "trust no one" and will perform cleaning procedures on all sampling supplies and measure contaminants in these cleaned supplies prior to sampling. Generally RMP does not employ a quantitation limit in the reporting of data, thus for any compound with a signal above the background noise, a value is given. Blank contamination indicates a probability of sample contamination, and analytes in sample sets with measurable blank contamination have qualifiers to indicate the increased uncertainty resulting from this. In the past, sample measurements were simply designated as being less than (B) or greater than (b) this increased uncertainty. However, due to the extensive contamination in the 1998 data set, an additional category (B) was created for the PCB data to designate data for congeners that were measured below the uncertainty introduced by blank contamination but whose ratios to measured congeners (in 1998) were sufficiently similar to previous years' ratios as to appear unaffected by contamination. This was possible for PCBs and not for other organic contaminant types because stable and thus predictable ratios among congeners have been established for PCBs based on past RMP sampling, while ratios among analytes within other classes of organics are variable and not highly predictable.

The uncertainties from blank contamination and matrix interferences propagate into aggregate measures, like totals of dissolved and particulate fractions, and sums of compounds in contaminant groups (e.g. PCBs, PAHs). For totals, if either the dissolved or particulate fractions were unmeasurable due to contamination or interferences, no totals were provided because measurements in both fractions are usually of the same magnitude. Similarly, if a third of the contaminants (weighted by mass in previous years) for a sum were missing in the 1998 data, the sum was not provided (S). These qualifications are made to the data set to prevent the unmeasurable compounds from creating an apparent decrease in sums for contaminant groups where there is insufficient data. Suitability of the data for further interpretation is left for the user to determine given the field data and qualifiers presented. Preparation steps taken by the lab to minimize contamination and measure it before it might affect samples should prevent such extensive problems in the data for the future. Additionally, a process is underway to develop procedures for a whole method detection limit rather than the instrument measurement detection limit currently employed, which will give us a better indication of the uncertainties in the whole process of measuring blanks and samples.

2.5.6 Comparison to Water Quality Objectives

This section provides a brief overview of how 1998 data compare to relevant water quality guidelines (Table 2.1). Of the ten trace elements measured, concentrations of mercury, copper, nickel, chromium, lead, selenium, and zinc exceeded water quality guidelines on one or more occasions (Table 2.2). Nickel, mercury, and chromium were most frequently above guidelines. Although many of the results for trace organics were not available due to contamination, several of the reported organic concentrations, such as PCBs, DDTs, chlordanes, and dieldrin, were measured above water quality guidelines (Table 2.3). The sum of 40 PCB congeners were well above the congener-based ∑PCB criteria of 170 pg/L in all but eight of the samples analyzed.

2.5.7 Effects of Water Contamination

Previous RMP studies have assessed ambient water toxicity by determining the percent normal development and percent survival of aquatic organisms exposed to water samples from different reaches of the Bay. In 1998, the RMP modified its monitoring strategy in order to allocate more resources for studies on the effects of episodic storm events on water toxicity.

The baseline 1998 RMP study measured water toxicity at six sites located in the northern and southern reaches of the bay. Toxicity tests using Mysidopsis bahia indicated that none of the sites had significant water toxicity during the February and July samplings. The lowest percent survival (80%) was measured during the July cruise in the southern reaches of the bay at Dumbarton Bridge (BA30) and Sunnyvale (C-1-3).

The Episodic Toxicity study, described in the 1997 Annual Report, measured water toxicity at Guadalupe Slough, Pacheco Slough, and Mallard Island during the winter and spring of 1997-98. Statistically significant toxicity was consistently measured in water samples taken from all three of the stations. Because the samples were generally collected immediately following storm events, the study emphasized the influence of episodic events on water toxicity in the Bay.

2.5.8 References

Cloern, J.E., B.E. Cole, J.L. Edmunds, T.S. Schraga, and A. Arnsberg. 1999. Patterns of water-quality variability in San Francisco Bay during the first six years of the RMP, 1993-1998. Prepared for the San Francisco Estuary Institute, Richmond, CA.

Roos, M. 1998. Water year 1997-1998. Interagency Ecological Program Newsletter. 11(2):11-13.

CDWR. 1998a. Report to the California Water Commission on activities of the Department of Water Resources, April, 1998. California Department of Water Resources, Sacramento, CA.

CDWR. 1998b. Report to the California Water Commission on activities of the Department of Water Resources, May, 1998. California Department of Water Resources, Sacramento, CA.

2.6 References

Menconi, M. and C. Cox. 1994. Hazard assessment of the insecticide diazinon to aquatic organisms in the Sacramento-San Joaquin river system. Administrative Report 94-2, California Department of Fish and Game, Rancho Cordova, CA.

SFBRWQCB. 1995. 1995 Basin Plan. San Francisco Bay Regional Water Quality Control Board. Oakland, CA.

U.S. EPA. 1995. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance Final Rule. Federal Register Vol. 62, No. 150, Dec. 22, 1992.

U.S. EPA. 1997. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Proposed Rule. Federal Register Vol. 62, No. 150, August 5, 1997.

Table 2.1. Water quality guidelines (WQG) used for evaluation of 1998 RMP results. Dissolved trace element water quality criteria are from the Proposed California Toxics Rule (U.S. EPA, 1997). Total trace element water quality criteria are from the Basin Plan (SFBRWQCB, 1995). Organic compounds are listed on a total (dissolved + particulate) basis. Units are in µg/L. Bold and italicized values are hardness dependent criteria and were calculated using a hardness value of 100 mg/L.

	Aquatic Life				Human Health (10^{-6} risk for carcinogens)	
Parameter	**Freshwater**		**Saltwater**		**Freshwater**	**Salt- & Freshwater**
	1-hour	**4-day**	**1-hour**	**4-day**	**Water & Organisms**	**Organisms only**
Dissolved trace metals						
Ag	***3.4***	.	1.9	.	.	.
As	340	150	69	36	.	.
Cd	***4.3***	***2.2***	42	9.3	.	.
Cr VI	16	11	1100	50	.	.
Cu	***13***	***9***	5	3.1	1300	.
Ni	***468***	***52***	74	8.2	610	4600
Pb	***65***	***2.5***	210	8.1	.	.
Zn	***117***	***118***	90	81	.	.
Total trace metals						
Ag [A]	***4.1***		***2.3***		.	.
As	360	190	69.0	36.0	.	.
Cd	***3.9***	***1.1***	***43.0***	***9.3***	.	.
Cr VI	16	11	1100.0	50.0	.	.
Hg	2.4	0.025	2.1	0.025	.	.
Ni [B]	***1419***	***158***	.	7.1	.	.
Pb	***81.0***	***3.2***	***140.0***	***5.6***	.	.
Se [C]	5	.	.	.	.	.
Zn [D]	***21***	***23***	58.0	.	.	.
Trace organics						
alpha-HCH	.	.	.	.	0.0039	0.013
Acenaphthene	.	.	.	.	1200	2700
Anthracene	.	.	.	.	9600	110000
Benz(a)anthracene	.	.	.	.	0.0044	0.049
Benzo(a)pyrene	.	.	.	.	0.0044	0.049
Benzo(b)fluoranthene	.	.	.	.	0.0044	0.049
Benzo(k)fluoranthene	.	.	.	.	0.0044	0.049
beta-HCH	.	.	.	.	0.014	0.046
Chlordane	2.4	0.0043	0.09	0.004	0.00057	0.00059
Chlorpyrifos [E]	0.083	0.041	0.011	0.0056	.	.
Chrysene	.	.	.	.	0.0044	0.049
Diazinon [E]	0.08	0.04	0.08	0.04	.	.
Dibenz(a,h)anthracene	.	.	.	.	0.0044	0.049
Dieldrin	0.24	0.056	0.71	0.0019	0.00014	0.00014
Endosulfan I	0.22	0.056	0.034	0.0087	110	240
Endosulfan II	0.22	0.056	0.034	0.0087	110	240
Endosulfan Sulfate	.	.	.	.	110	240
Endrin	0.086	0.036	0.037	0.0023	0.76	0.81
Fluoranthene	.	.	.	.	300	370
Fluorene	.	.	.	.	1300	14000
gamma-HCH	0.095	0.08	0.16	.	0.019	0.063
Heptachlor	0.52	0.0038	0.053	0.0036	0.00021	0.00021
Heptachlor Epoxide	0.52	0.0038	0.053	0.0036	0.0001	0.00011
Hexachlorobenzene	.	.	.	.	0.00075	0.00077
Indeno(1,2,3-cd)pyrene	.	.	.	.	0.0044	0.049
p,p'-DDD	.	.	.	.	0.00083	0.00084
p,p'-DDE	.	.	.	.	0.00059	0.00059
p,p'-DDT	1.1	0.001	0.13	0.001	0.00059	0.00059
Pyrene	.	.	.	.	960	11000
Mirex [F]	.	0.001	.	0.001	.	.
Total PCBs	.	0.014	.	0.03	0.00017	0.00017
Total PAHs [G]	.	.	.	.	0.031	0.031

[A] Silver value is the instantaneous maximum
[B] Nickel saltwater value is 24-hour average
[C] Selenium values are region-specific criteria as outlined in the National Toxics Rule — 1992: values are for total recoverable selenium results and freshwater criteria apply to the whole Estuary.
[D] Zinc saltwater value is 24-hour average.
[E] Diazinon criteria are not included in the California Toxics Rule. Values are from the California Department of Fish and Game (Menconi and Cox, 1994).
[F] Chlorpyrifos and mirex are not listed in the proposed CTR but EPA criteria do exist for them.
[G] Total PAHs is not listed in the proposed CTR but an EPA criterion does exist for it.

Table 2.2.
Summary of trace elements that were above water quality guidelines (WQGs) for 1998 RMP water samples. Dissolved WQGs used in this comparison are from the proposed EPA-- California Toxics Rule (1997) 304(a) Criteria. Total WQGs used are from the San Francisco Basin Plan (1995). Of the ten RMP trace element compounds that have WQGs, only compounds that were above guidelines are listed. o = above guideline, - = data not available.

			Dissolved			Total																	
			Cu			Cr			Hg			Ni			Pb			Se			Zn		
	Code	Station	Jan	Apr	Jul	Jan	Apr	Jul	Jan	Apr	Jul	Jan	Apr	Jul	Jan	Apr	Jul	Jan	Apr	Jul	Jan	Apr	Jul
Southern Sloughs	C-1-3	Sunnyvale	〈			〈	〈	〈	〈	〈	〈	〈	〈	〈	〈	〈	〈				〈	〈	
	C-3-0	San Jose				〈	〈	〈	〈	〈	〈	〈	〈	〈	〈	〈	〈				〈	〈	〈
South Bay	BA10	Coyote Creek											〈	〈									
	BA20	South Bay			〈						〈			〈									
	BA30	Dumbarton Bridge								〈													
	BA40	Redwood Creek																					
	BB15	San Bruno Shoal																					
	BB30	Oyster Point					-																
	BB70	Alameda																					
Central Bay	BC10	Yerba Buena Island																					
	BC20	Golden Gate	-			-			-			-			-			-	-		-		
	BC30	Richardson Bay																					
	BC41	Point Isabel																					
	BC60	Red Rock																					
Northern Estuary	BD15	Petaluma River				〈	〈	〈	〈	〈	〈	〈	〈	〈	〈	〈	〈				〈	〈	〈
	BD20	San Pablo Bay				〈	〈			-			〈										
	BD30	Pinole Point					〈						〈										
	BD40	Davis Point					〈			〈			〈	〈		〈						〈	
	BD50	Napa River				〈	〈		〈	〈		〈	〈	〈	〈						〈		
	BF10	Pacheco Creek				〈		〈						〈									
	BF20	Grizzly Bay				〈		〈					〈	〈			〈						〈
	BF40	Honker Bay				〈		〈						〈									
Rivers	BG20	Sacramento River				〈						〈											
	BG30	San Joaquin River																					
Estuary Interface	BW10	Standish Dam				〈	〈		〈	〈					〈	〈	〈				〈	〈	〈
	BW15	Guadalupe River				〈	〈		〈	〈	〈				〈	〈	〈			〈	〈	〈	〈

Table 2.3.

Summary of organic contaminants that were above water quality guidelines (WQGs) for 1998 RMP water samples. WQGs used in this comparison are from the proposed EPA--California Toxics Rule (1997) 304(a) Criteria. Of the 28 RMP organic compounds that have WQCs, only those listed had concentrations that were above guidelines.
o = above guideline, - = data not available.

			p,p'-DDD			p,p'-DDE			p,p'-DDT			Total Chlordanes			Heptachlor Epoxide			Dieldrin			Total PCBs		
		WQG (ppb)	**0.00084**			**0.00059**			**0.00059**			**0.00059**			**0.00011**			**0.00014**			**0.00017**		
	Code	**Station**	**Jan**	**Apr**	**Jul**	**Jan**	**Apr**	**Jul**	**Jan**	**Apr**	**Jul**	**Jan**	**Apr**	**Jul**	**Jan**	**Apr**	**Jul**	**Jan**	**Apr**	**Jul**	**Jan**	**Apr**	**Jul**
Southern Sloughs	C-3-0	San Jose	-	-			〈	〈		-			〈	〈				〈			-	〈	〈
South Bay	BA10	Coyote Creek	-	-	-			-		-											-	-	〈
	BA30	Dumbarton Bridge		-	-			-		-		-		-	〈		-				-	〈	〈
	BA40	Redwood Creek	-	-	-			-					-	-			-				-	〈	〈
	BB70	Alameda	-		-			-		-		-		-		-					-		〈
Central Bay	BC10	Yerba Buena Island	-	-	-		〈			-				-		-	-				-	〈	〈
	BC20	Golden Gate	-	-	-	-		-	-			-	-	-	-			-			-		
	BC60	Red Rock	-	-	-					-		-		-			-				-	〈	〈
Northern Estuary	BD15	Petaluma River	-	-			〈	〈	-	-						-	-				-	〈	〈
	BD20	San Pablo Bay		-						-		-		-		-		-			〈	〈	〈
	BD30	Pinole Point	-	-	-	-				-		-		-		-					-	〈	〈
	BD40	Davis Point	-	-	-		〈					-		-			-					〈	〈
	BD50	Napa River	-	-		〈		〈	-	-				-		-					-	〈	〈
	BF20	Grizzly Bay	-	-	〈				-								-			〈	-		〈
Rivers	BG20	Sacramento River	-	-	-	〈			-	-				-				〈		〈			〈
	BG30	San Joaquin River	-	-					-	-		-		-						〈		-	〈
Estuary Interface	BW10	Standish Dam	-	-	〈	〈	〈	〈		〈	〈	〈	〈	〈		〈	〈			〈	〈	〈	〈
	BW15	Guadalupe River	-	-		〈	〈	〈	-	〈		〈	〈	〈		〈	〈			〈	〈	〈	〈

Figure 2.1

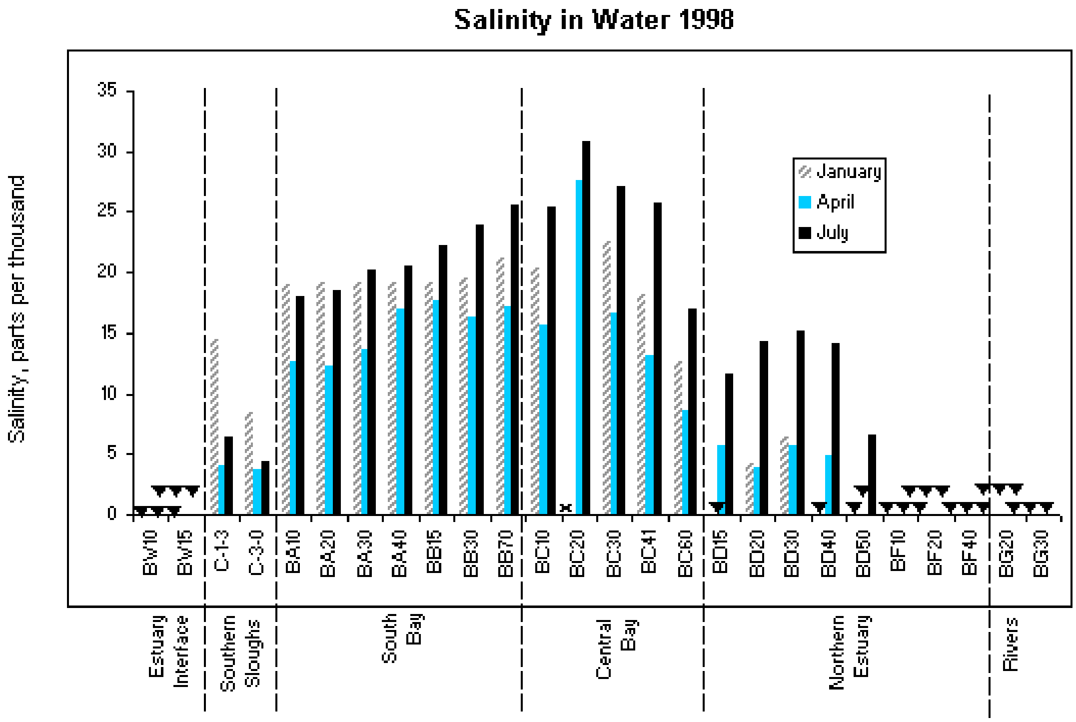

Figure 2.1. Salinity in parts per thousand (‰) at each RMP water station in January, April, and July 1998. × = not sampled. ▼ indicates salinity was < 1‰. Salinities ranged from below detection (1‰) to 31‰. The highest salinity was detected at Golden Gate (BC20) in July. Salinities were lowest in April. Salinities below 5‰ are considered freshwater for application of water quality standards. Golden Gate (BC20) was not sampled in January due to bad weather conditions.

Figure 2.2

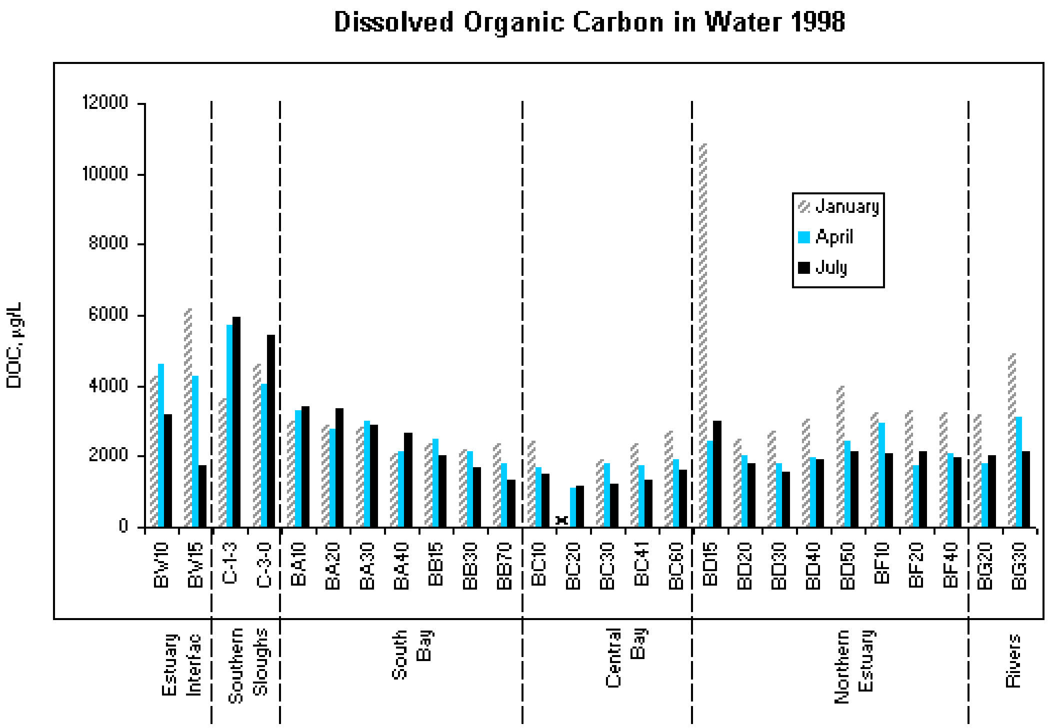

Figure 2.2. Dissolved organic carbon (DOC) in micrograms per liter (µg/L) at each water station in January, April, and July of 1998. ⨯ = not sampled. DOC ranged from 1105 µg/L to10840 µg/L. The highest concentration was sampled at Petaluma River (BD15) in January and the lowest concentration was sampled at Golden Gate (BC20) in April. Golden Gate (BC20) was not sampled in January due to bad weather conditions.

Figure 2.3

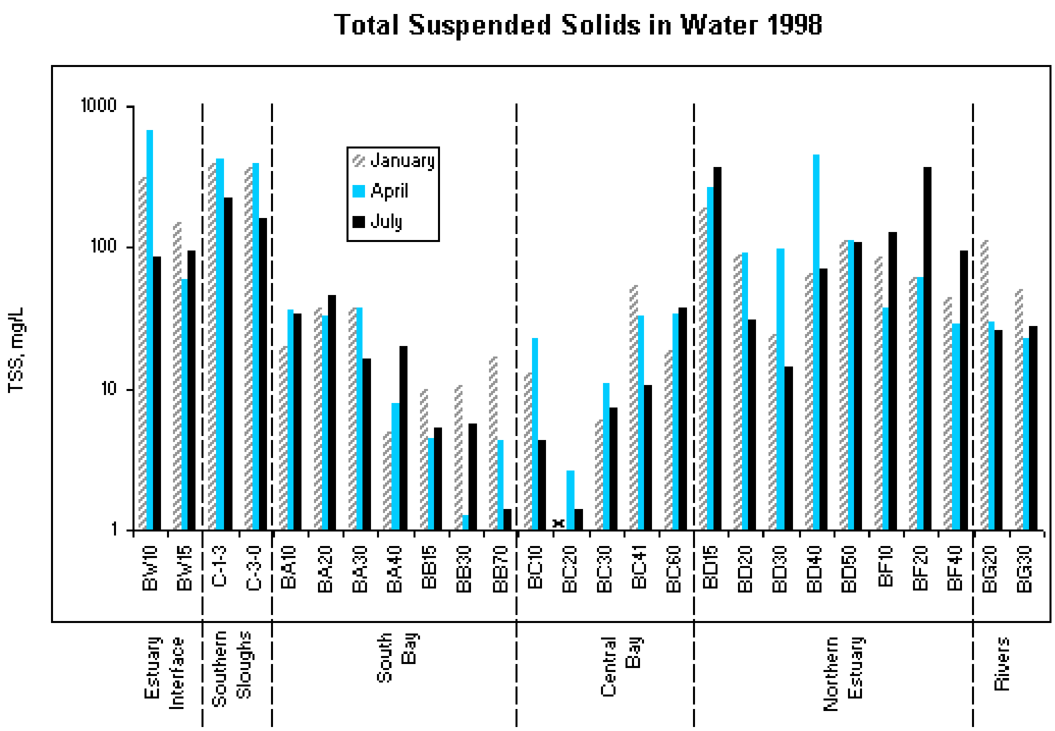

Figure 2.3. Total suspended solids (TSS) in milligrams per liter (mg/L) at each RMP water station in January, April, and July of 1998. × = not sampled. Note logarithmic scale. TSS concentrations ranged from 1.26 mg/L to 666.25 mg/L. The highest concentration was sampled at Standish Dam (BW10) in April and the lowest at Oyster Point (BB30) in April. Average TSS concentrations were higher in the Southern Sloughs stations than other Estuary reaches. Golden Gate (BC20) was not sampled in January due to bad weather conditions.

Figure 2.4a

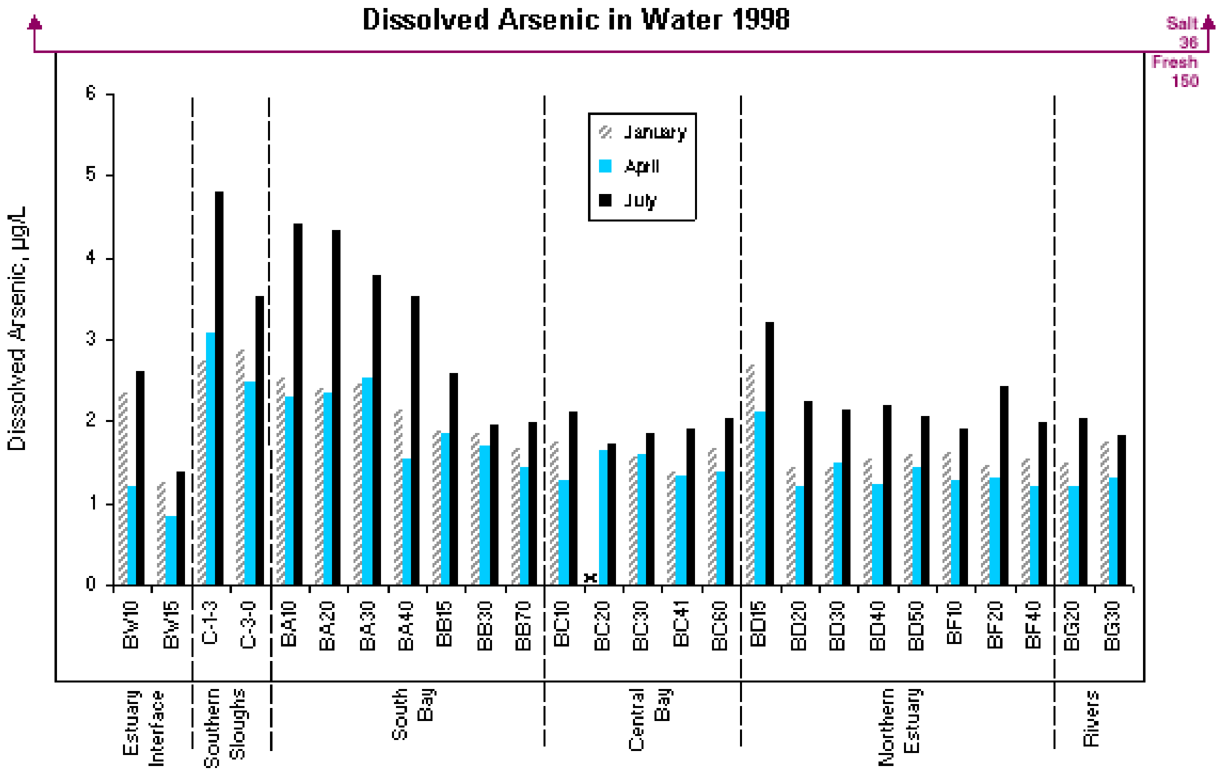

Figure 2.4a. Dissolved arsenic (As) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Concentrations ranged from 0.83 to 4.80 ppb. The highest concentration was sampled at Sunnyvale (C-1-3) in July. The lowest concentration was sampled at Guadalupe River (BW15) in April. Average concentrations were highest (4.16 ppb) in the Southern Sloughs in July and lowest (1.01 ppb) in the Estuary Interface in April. All samples were below the 4-day average WQC for dissolved arsenic (saltwater 36 ppb, freshwater 150 ppb).

Figure 2.4b

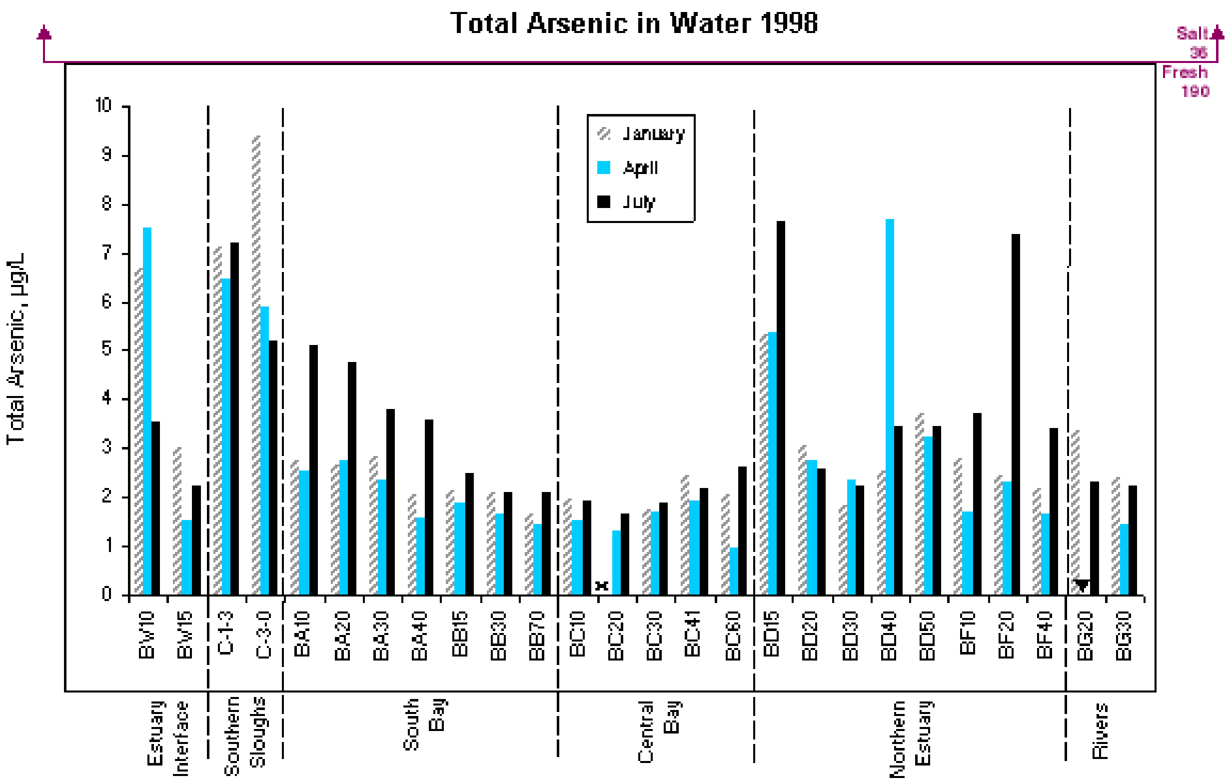

Figure 2.4b. Total arsenic (As) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. ▼= not detected. Concentrations ranged from not detected to 9.37 ppb. The highest concentration was sampled at San Jose (C-3-0) in January. Average concentrations were highest (8.24 ppb) in the Southern Sloughs in January and lowest (0.75 ppb) in the Rivers in April. All samples were below the 4-day average WQO for total arsenic (saltwater 36 ppb, freshwater 190 ppb).

Figure 2.5a

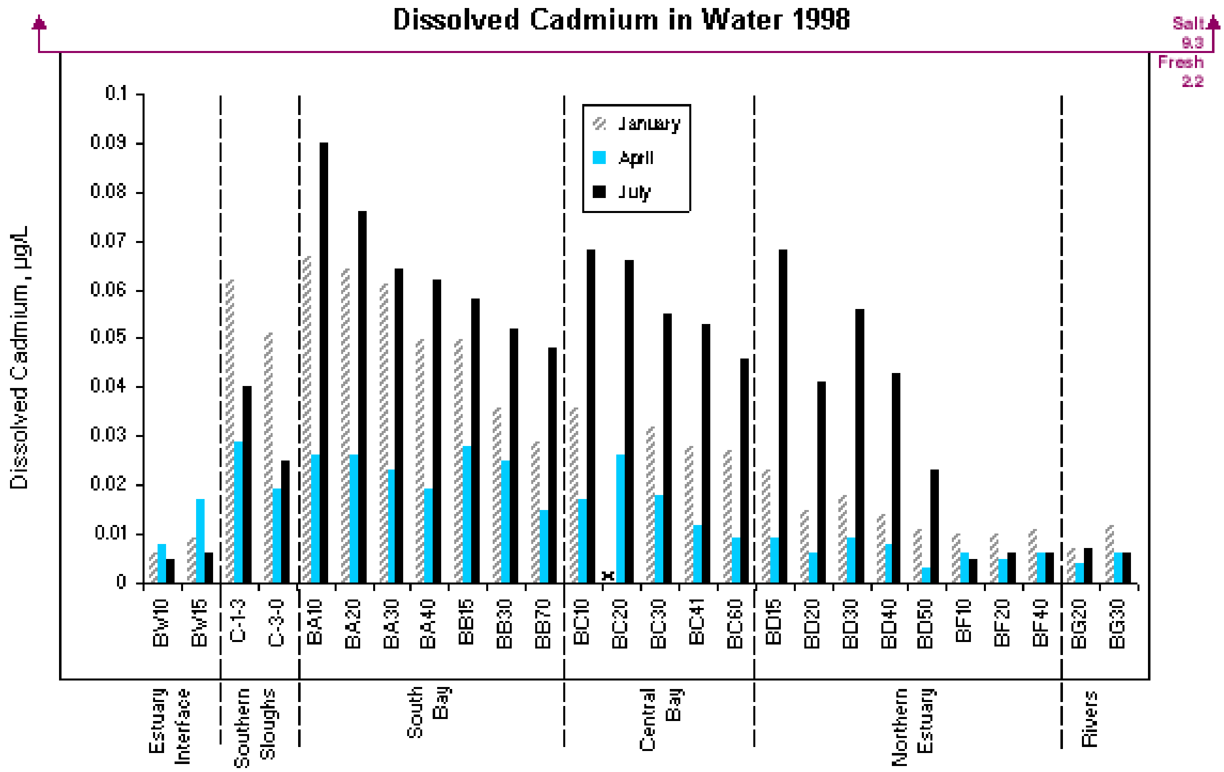

Figure 2.5a. Dissolved cadmium (Cd) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. ×= not sampled. Concentrations ranged from 0.003 to 0.09 ppb. The highest concentration was sampled at Coyote Creek (BA10) in July and the lowest at Napa River (BD50) in April. Average concentrations were highest (0.064) in the South Bay in July and lowest (0.005 ppb) in the Rivers in April. All samples were below the 4-day average WQC for dissolved cadmium (saltwater 9.3 ppb, freshwater--hardness dependent).

Figure 2.5b

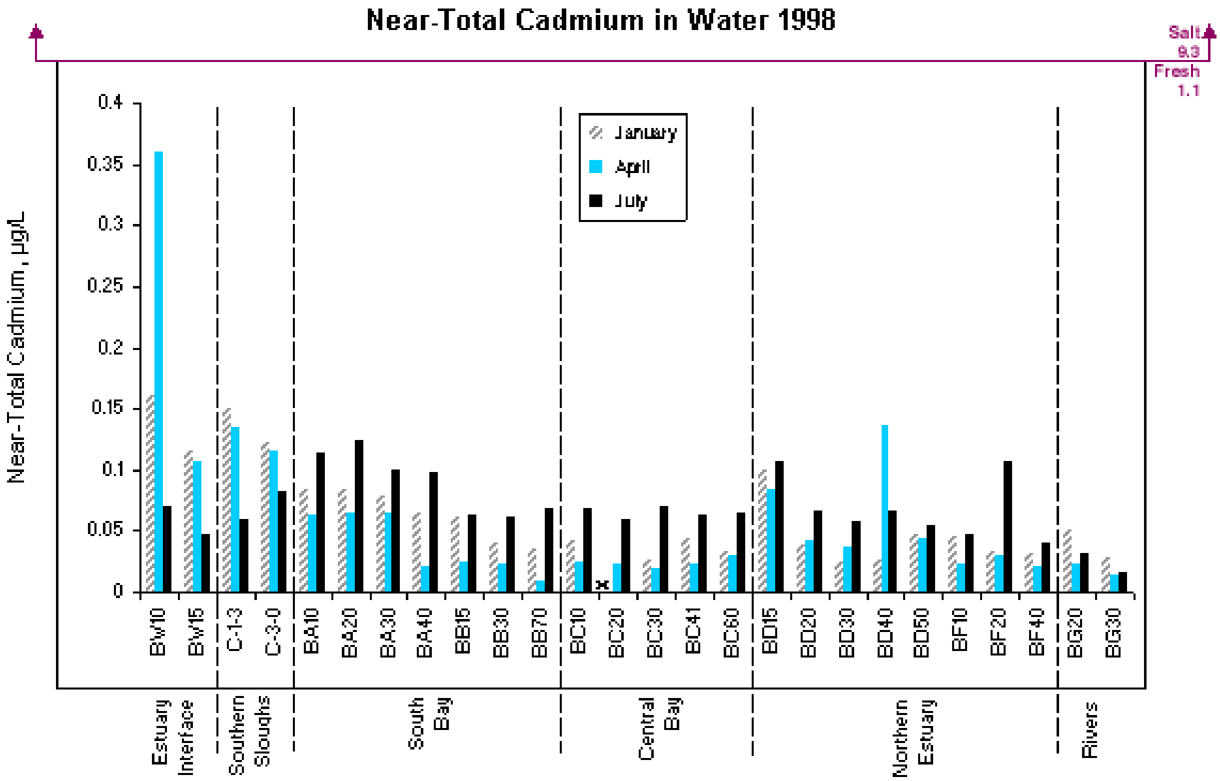

Figure 2.5b. Near-total cadmium (Cd) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Concentrations ranged from 0.009 to 0.36 ppb. The highest concentration was sampled at Standish Dam (BW10) in April and the lowest at Alameda (BB70) in April. Average concentrations were highest (0.23 ppb) in the Estuary Interface in April and lowest (0.19 ppb) in the Rivers in April. All samples were below the 4-day average WQO for total cadmium (saltwater 9.3 ppb, freshwater-hardness dependent).

Figure 2.6a

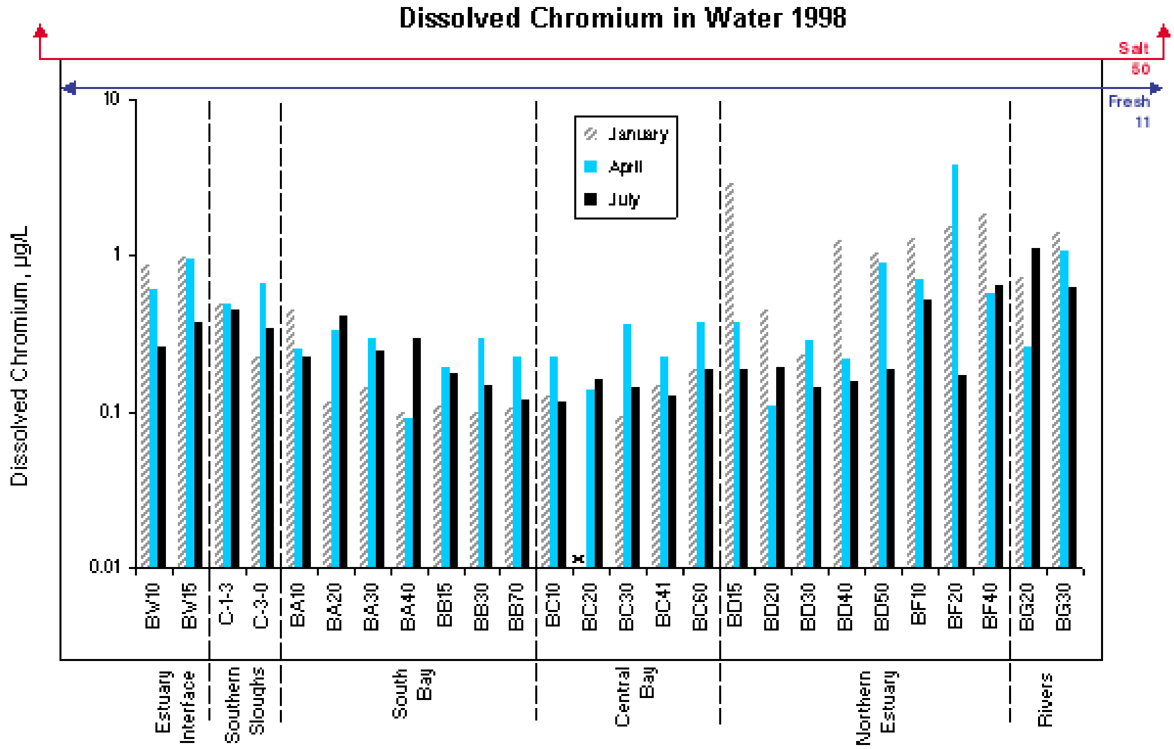

Figure 2.6a. Dissolved chromium (Cr) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Note logarithmic scale. Concentrations ranged from 0.09 to 3.84 ppb. The highest concentration was sampled at Grizzly Bay (BF20) in April and the lowest at Redwood Creek (BA40) in April. Average concentrations were highest (1.31 ppb) in the Northern Estuary in January and lowest (0.14 ppb) in the Central Bay in January. All samples were below the 4-day average WQC for dissolved chromium (saltwater 50 ppb, freshwater 11 ppb).

Figure 2.6b

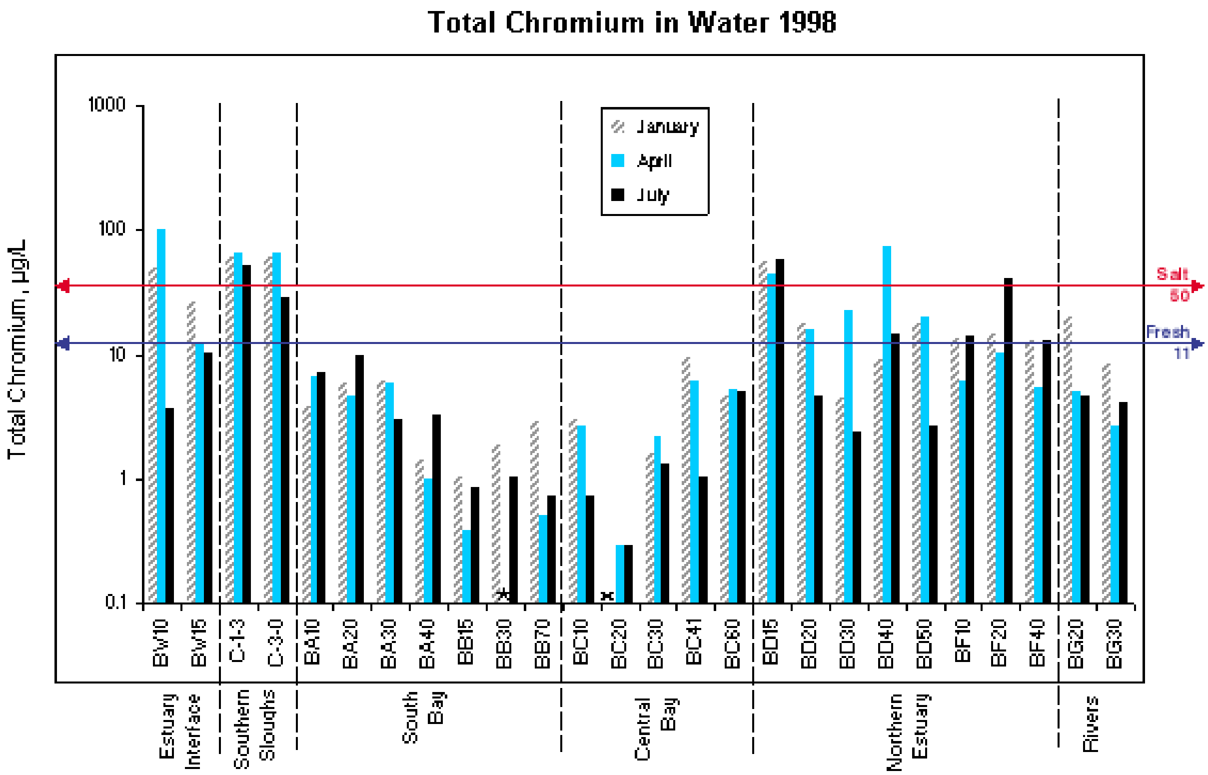

Figure 2.6b. Total chromium (Cr) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. ⨯ = not sampled. ★ = not analyzed. Note logarithmic scale. Concentrations ranged from 0.29 to 100.86 ppb. The highest concentration was sampled at Standish Dam (BW10) in April and the lowest at Golden Gate (BC20) in April. Average concentrations were highest (64.79 ppb) in the Southern Sloughs in April and lowest (1.67 ppb) in the Central Bay in July. Twenty-seven samples were above the 4-day average WQO for total chromium (saltwater 50 ppb, freshwater 11 ppb).

Figure 2.7a

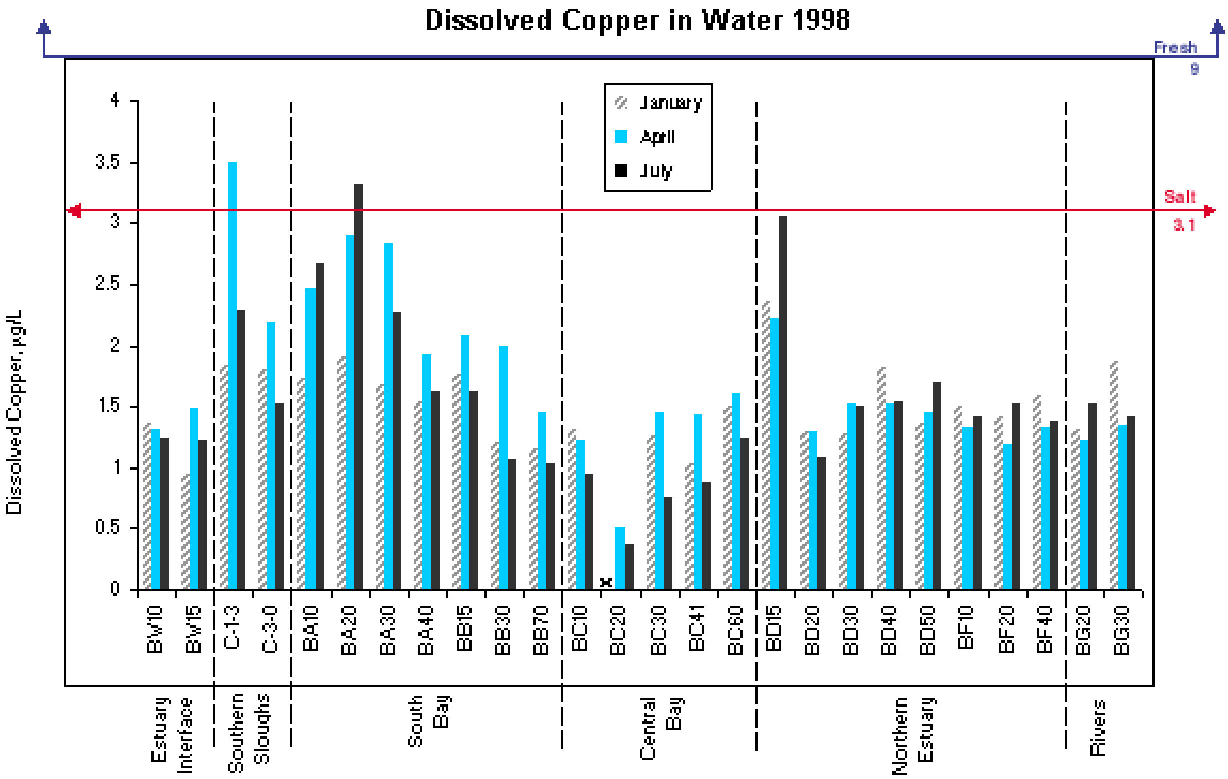

Figure 2.7a. Dissolved copper (Cu) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Concentrations ranged from 0.37 to 3.50 ppb. The highest concentration was sampled at Sunnyvale (C-1-3) in April and the lowest at Golden Gate (BC20) in July. Average concentrations were highest (2.84 ppb) in the Southern Sloughs in April and lowest (0.83 ppb) in the Central Bay in July. Two samples were above the WQC for dissolved copper (saltwater 3.1 ppb, freshwater--hardness dependent).

Figure 2.7b

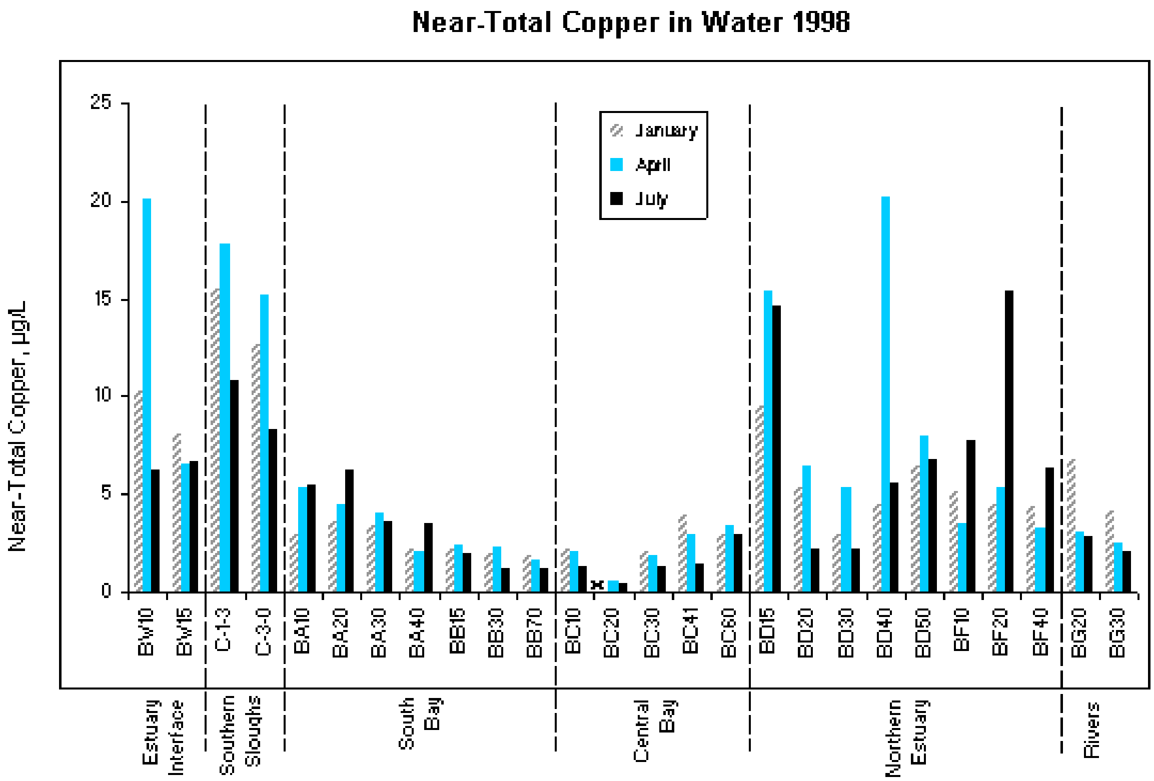

Figure 2.7b. Near-total copper (Cu) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Concentrations ranged from 0.42 to 20.19 ppb. The highest concentration was sampled at Davis Point (BD40) in April and the lowest at Golden Gate (BC20) in July. Average concentrations were highest (16.49 ppb) in the Southern Sloughs in April and lowest (1.47 ppb) in the Central Bay in July. Copper is compared to guidelines only on a dissolved basis.

Figure 2.8a

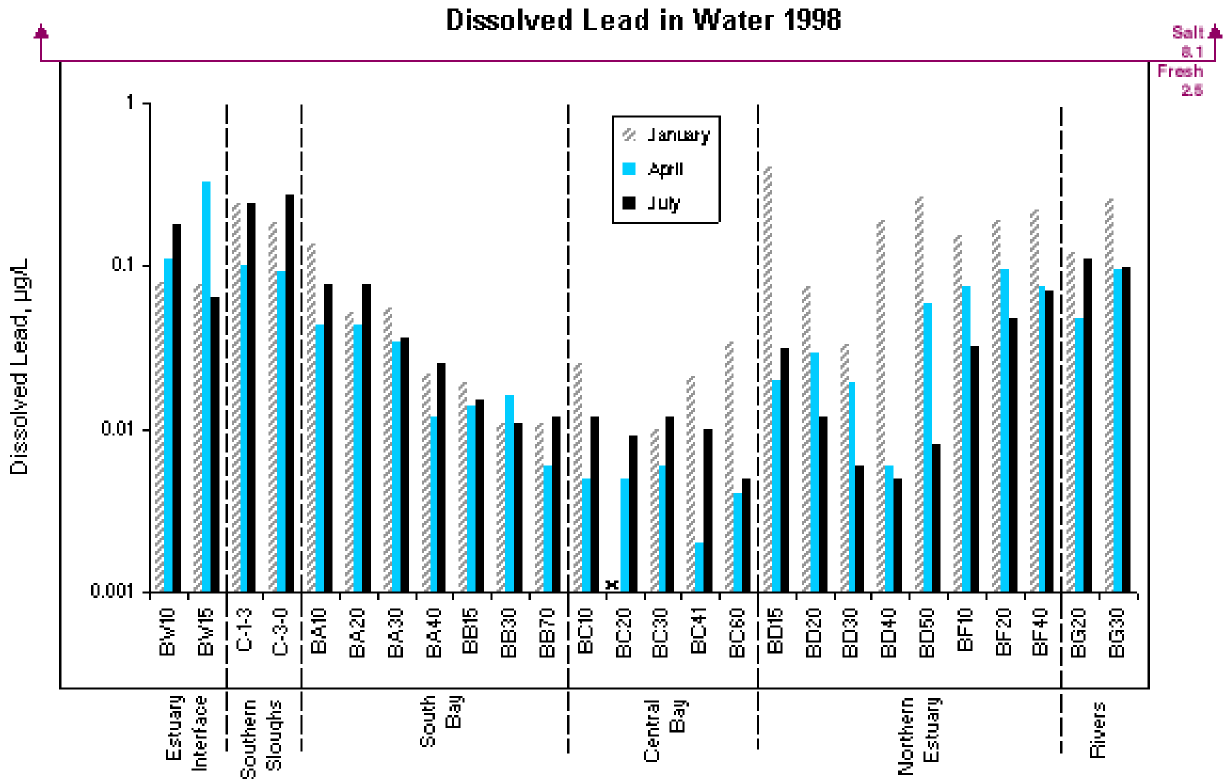

Figure 2.8a. Dissolved lead (Pb) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Note logarithmic scale. Concentrations ranged from 0.002 to 0.40 ppb. The highest concentration was sampled at Petaluma River (BD15) in January and the lowest at Point Isabel (BC41) in April. Average concentrations were highest (0.26 ppb) in the Southern Sloughs in July and lowest (0.004 ppb) in the Central Bay in April. All samples were below the 4-day average WQC for dissolved lead (saltwater 8.1 ppb, freshwater--hardness dependent).

Figure 2.8b

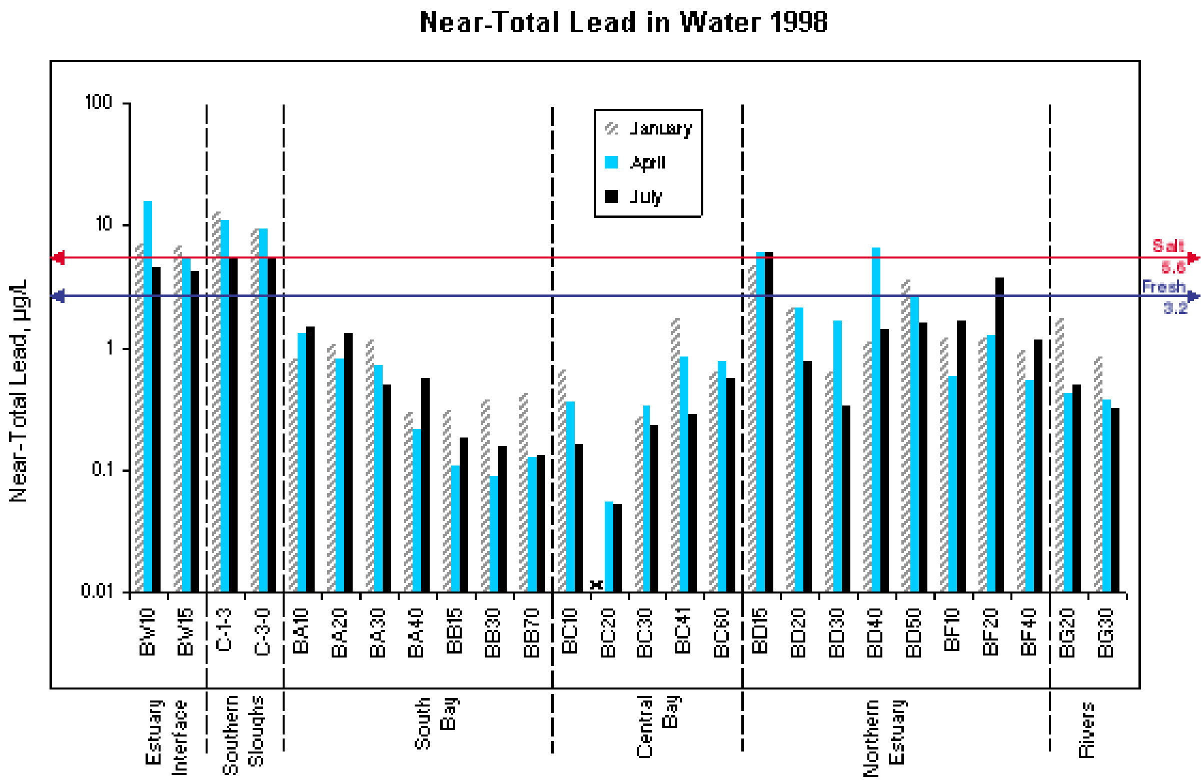

Figure 2.8b. Near-total lead (Pb) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Note logarithmic scale. Concentrations ranged from 0.05 to 15.85 ppb. The highest concentration was sampled at Standish Dam (BW10) in April and the lowest at Golden Gate (BC20) in July. Average concentrations were highest (11.12 ppb) in the Southern Sloughs in January and lowest (0.26 ppb) in the Central Bay in July. Eighteen samples were above the 4-day average WQO for total lead (saltwater 5.6 ppb, freshwater--hardness dependent).

Figure 2.9a

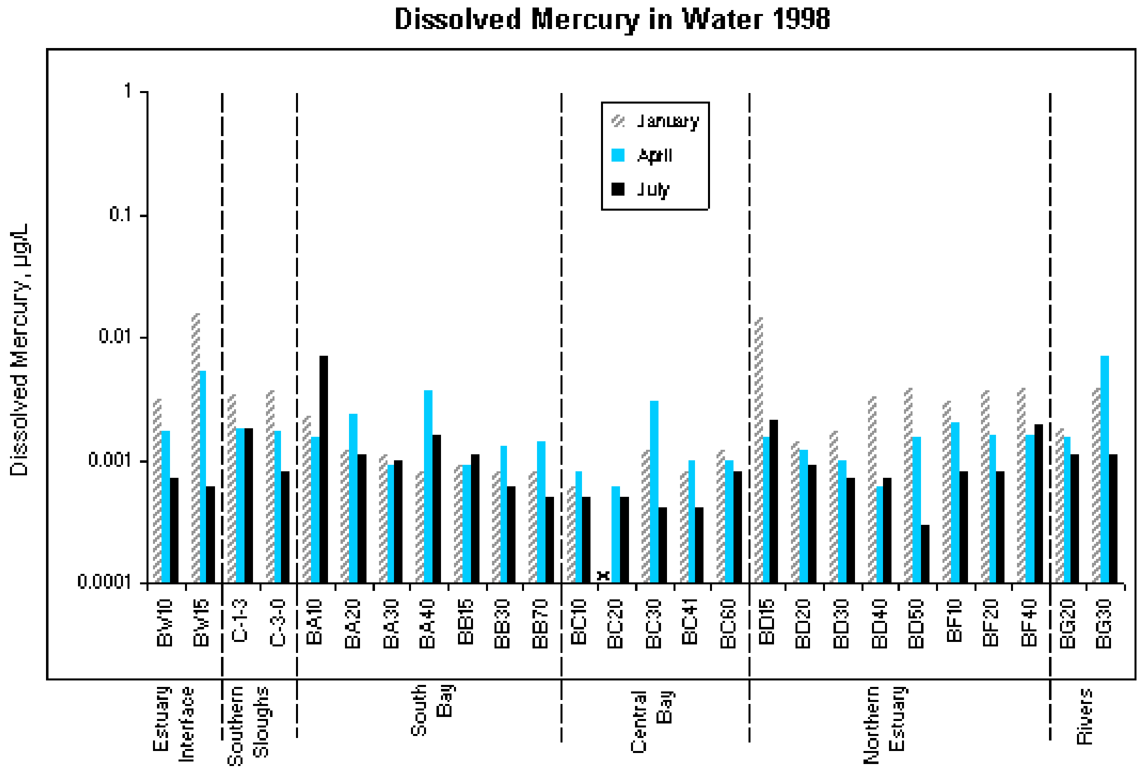

Figure 2.9a. Dissolved mercury (Hg) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Note logarithmic scale. Concentrations ranged from 0.0003 to 0.015 ppb. The highest concentration was sampled at Guadalupe River (BW15) in January and the lowest at Napa River (BD50) in July. Average concentrations were highest (0.0093 ppb) in the Estuary Interface in January and lowest (0.0005 ppb) in the Central Bay in July. Mercury is compared to guidelines only on a total basis.

Figure 2.9b

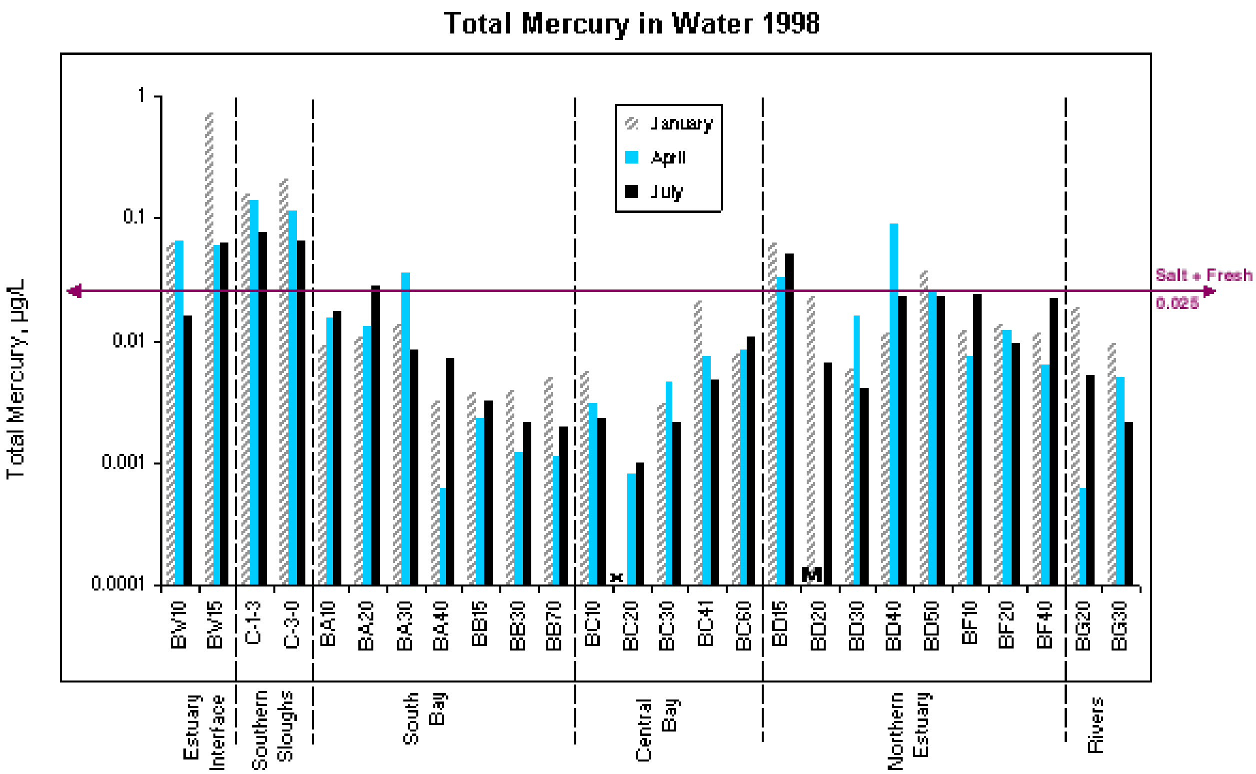

Figure 2.9b. Total mercury (Hg) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. M = matrix interference. Note logarithmic scale. Concentrations ranged from 0.0006 to 0.73 ppb. The highest concentration was at Guadalupe River (BW15) in January. The lowest concentration was at Sacramento River (BG20) and Redwood Creek (BA40) in April. Average concentrations were highest (0.40 ppb) in the Estuary Interface in January and lowest (0.0028 ppb) in the Rivers in April. Nineteen samples were above the 4-day average WQO for total mercury (saltwater 0.025 ppb, freshwater-0.025 ppb).

Figure 2.10a

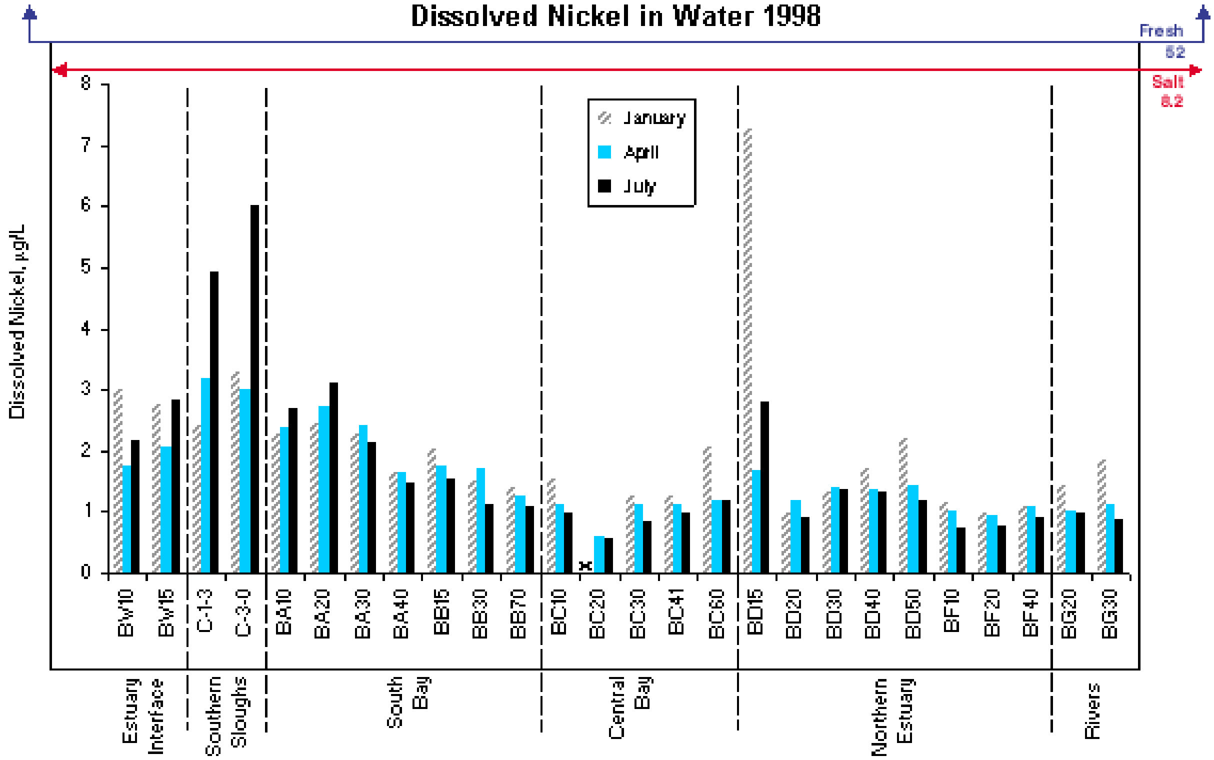

Figure 2.10a. Dissolved nickel (Ni) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Concentrations ranged from 0.56 to 7.25 ppb. The highest concentration was sampled at Petaluma River (BD15) in January and the lowest at Golden Gate (BC20) in July. Average concentrations were highest (5.46 ppb) in the Southern Sloughs in July and lowest (0.91 ppb) in the Central Bay in July. All samples were below the 4-day average WQC for dissolved nickel (saltwater 8.2 ppb, freshwater--hardness dependent).

Figure 2.10b

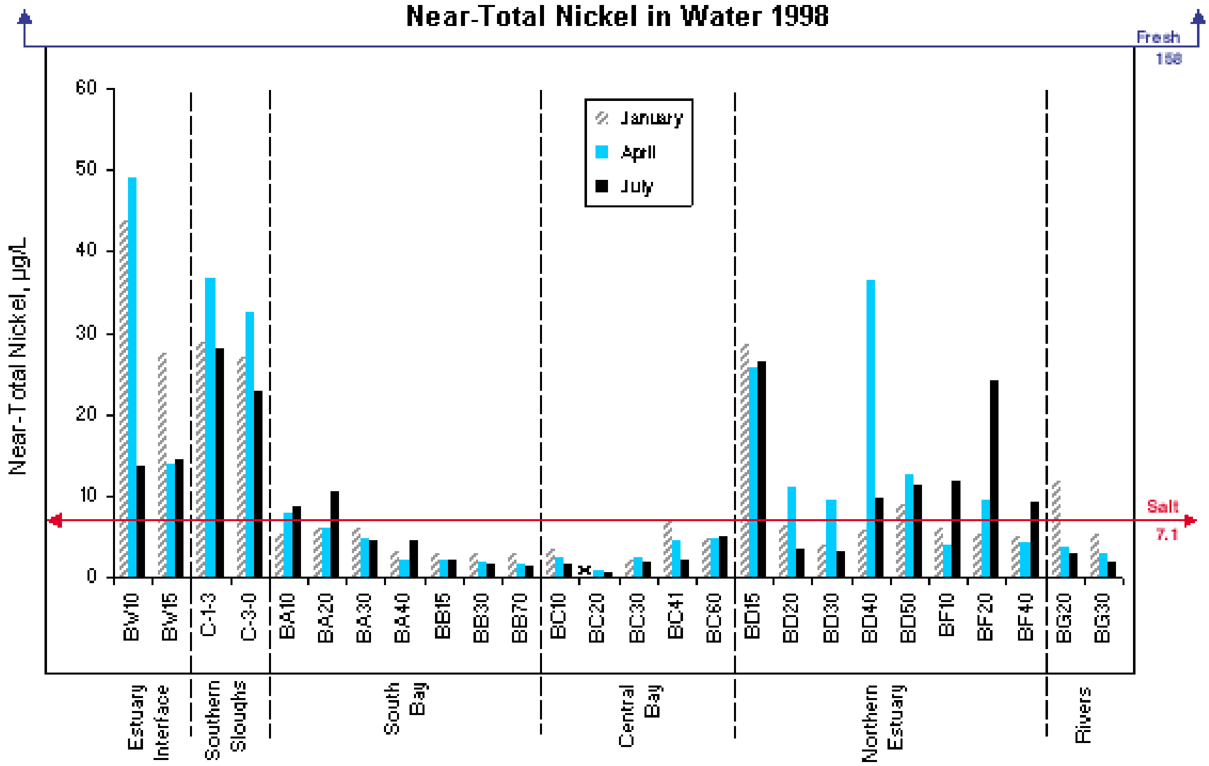

Figure 2.10b. Near-total nickel (Ni) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Concentrations ranged from 0.63 to 48.97 ppb. The highest concentration was sampled at Standish Dam (BW10) in April and the lowest at Golden Gate (BC20) in July. Average concentrations were highest (35.69 ppb) in the Estuary Interface in January and lowest (2.20 ppb) in the Central Bay in July. Thirty samples were above the 24-hour average WQO for total nickel (saltwater 7.1 ppb, freshwater--hardness dependent).

Figure 2.11a

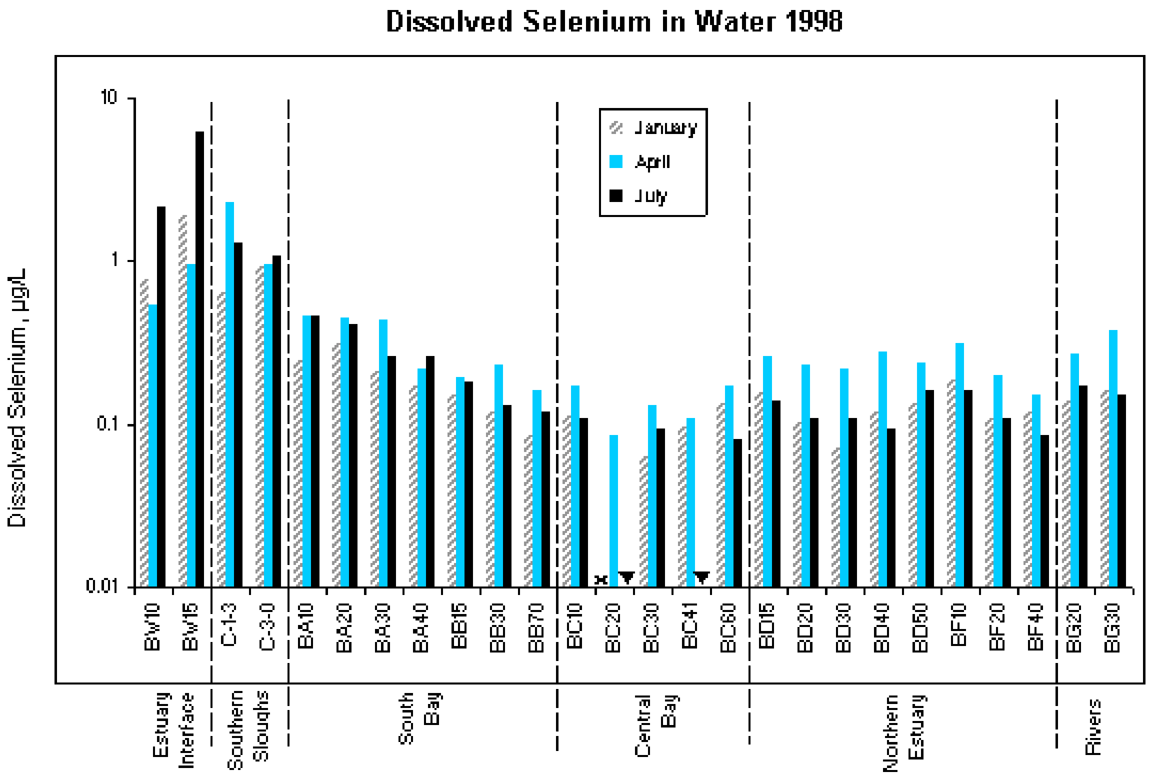

Figure 2.11a. Dissolved selenium (Se) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. ▼ = not detected. Note logarithmic scale. Concentrations ranged from not detected to 6.13 ppb. The highest concentration was sampled at Guadalupe River (BW15) in July. Average concentrations were highest (4.14 ppb) in the Estuary Interface in July and lowest (0.06 ppb) in the Central Bay in July. Selenium is compared to guidelines only on a total basis.

Figure 2.11b

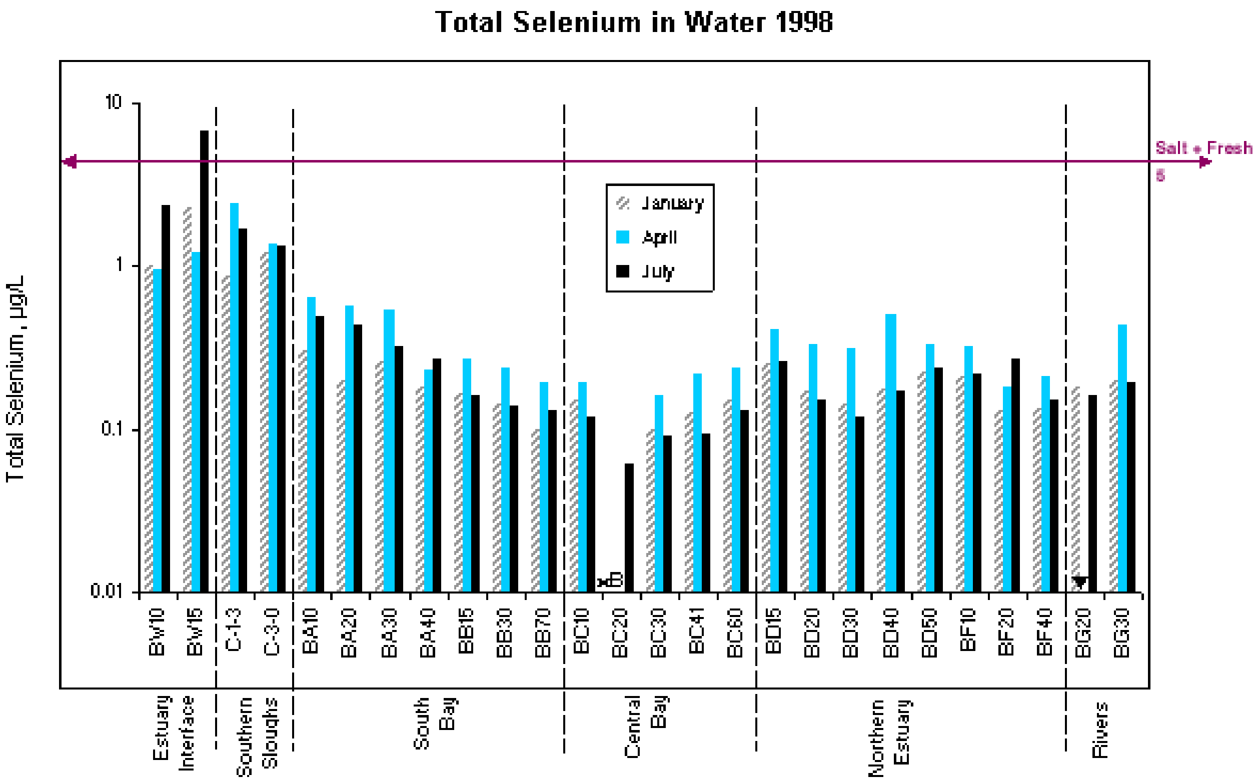

Figure 2.11b. Total selenium (Se) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. ▼ = not detected. B = blank contamination. Note logarithmic scale. Concentrations ranged from not detected to 6.79 ppb. The highest concentration was sampled at Guadalupe River (BW15) in July. Average concentrations were highest (4.56 ppb) in the Estuary Interface in July and lowest (0.10 ppb) in the Central Bay in July. There are no Basin Plan WQOs for selenium. One sample was above the National Toxics Rule WQC for total selenium (saltwater 5 ppb, freshwater 5 ppb).

Figure 2.12a

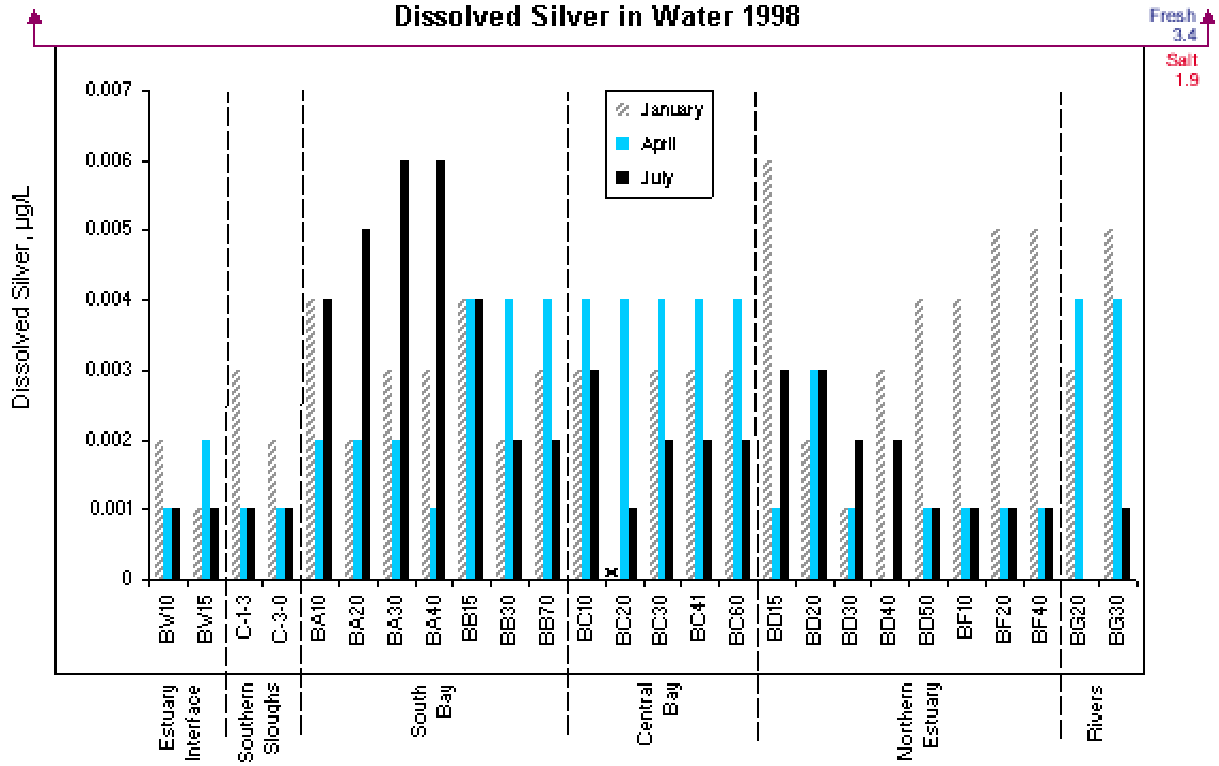

Figure 2.12a. Dissolved silver (Ag) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Concentrations ranged from 0.0002 to 0.006 ppb. The highest concentration was sampled at Petaluma River (BD15) in January, Dumbarton Bridge (BA30) in July, and Redwood Creek (BA40) in July. The lowest concentration was sampled at Sacramento River (BG20) in July. Average concentrations were highest (0.0041 ppb) in the South Bay in July and lowest (0.0006 ppb) in the Rivers in July. All samples were below the 1-hour maximum WQC for dissolved silver (saltwater 1.9 ppb, freshwater--hardness dependent).

Figure 2.12b

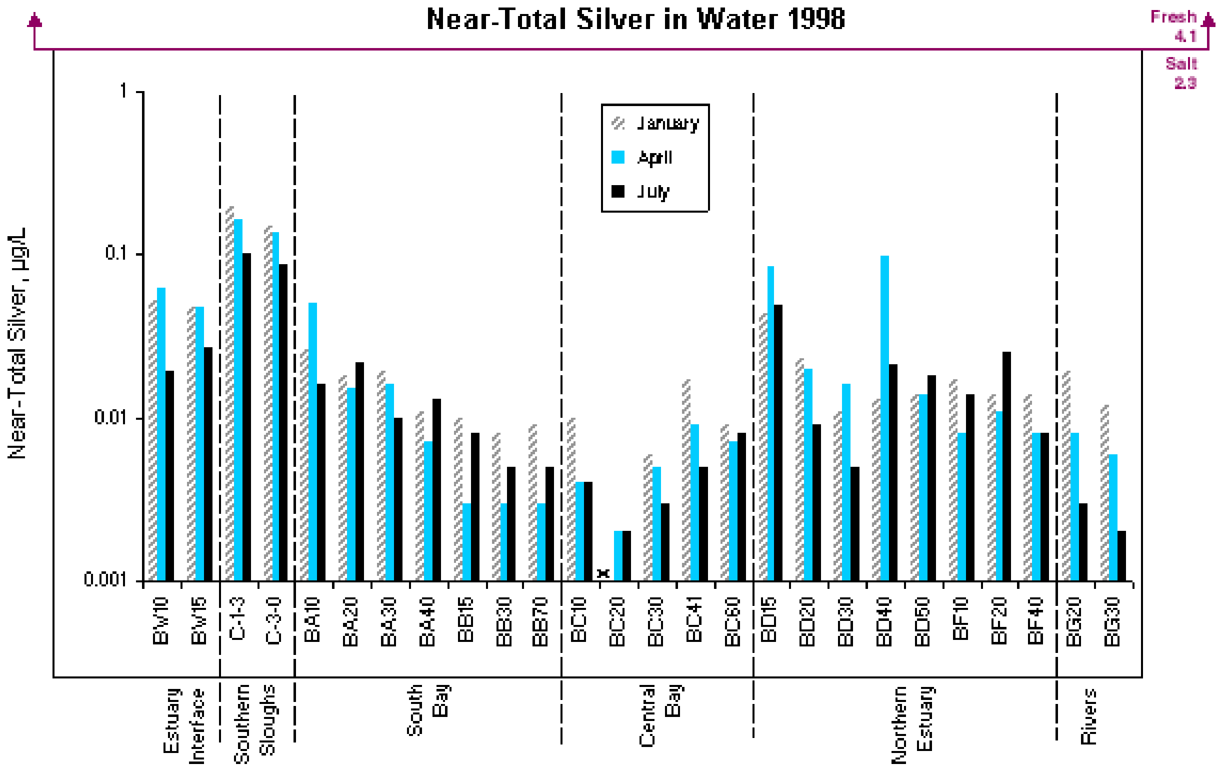

Figure 2.12b. Near-total silver (Ag) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Note logarithmic scale. Concentrations ranged from 0.002 to 0.20 ppb. The highest concentration was sampled at Sunnyvale (C-1-3) in January. The lowest concentration was sampled at Golden Gate (BC20) in April and July and at San Joaquin River (BG30) in July. Average concentrations were highest (0.17 ppb) in the Southern Sloughs in January and lowest (0.003 ppb) in the Rivers in July. All samples were below the 1-hour maximum WQC for total silver (saltwater 2.3 ppb, freshwater--hardness dependent).

Figure 2.13a

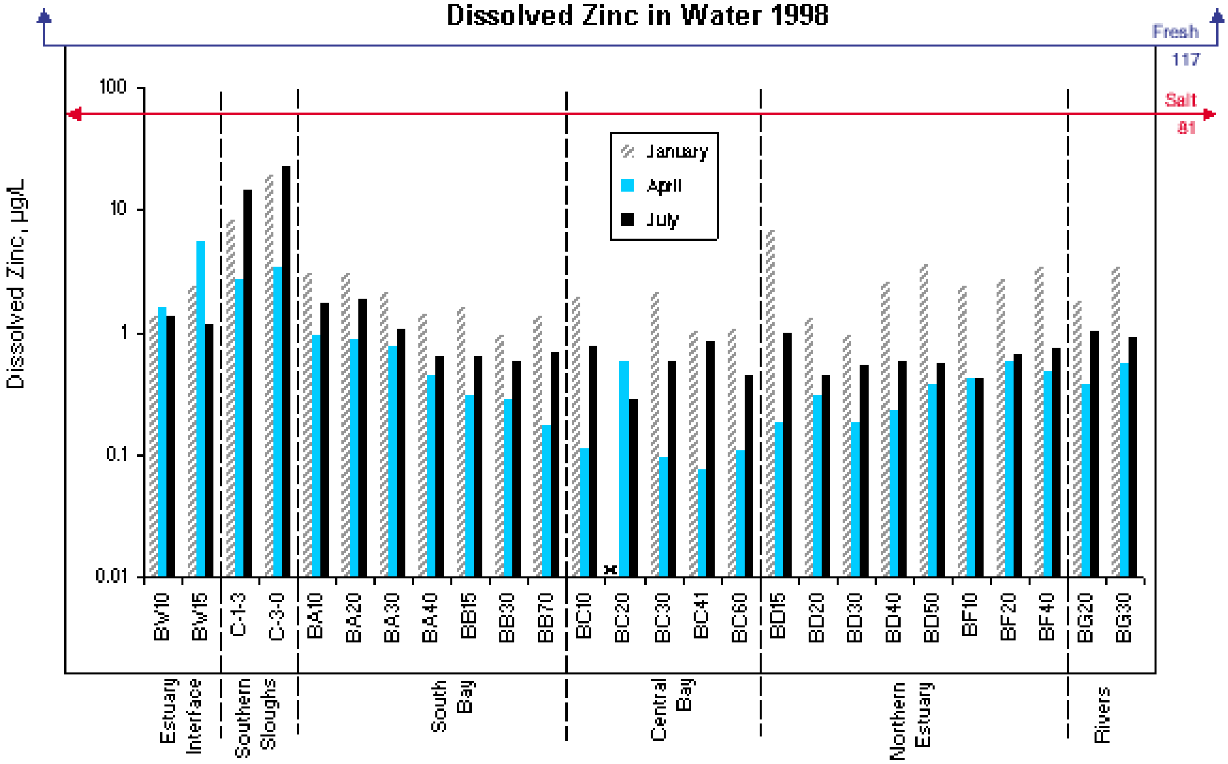

Figure 2.13a. Dissolved zinc (Zn) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. × = not sampled. Note logarithmic scale. Concentrations ranged from 0.07 to 22.54 ppb. The highest concentration was sampled at San Jose (C-3-0) in July and the lowest at Point Isabel (BC41) in April. Average concentrations were highest (18.39 ppb) in the Southern Sloughs in July and lowest (0.19 ppb) in the Central Bay in April. All samples were below the 4-day average WQC for dissolved zinc (saltwater 81 ppb, freshwater--hardness dependent).

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Figure 2.13b

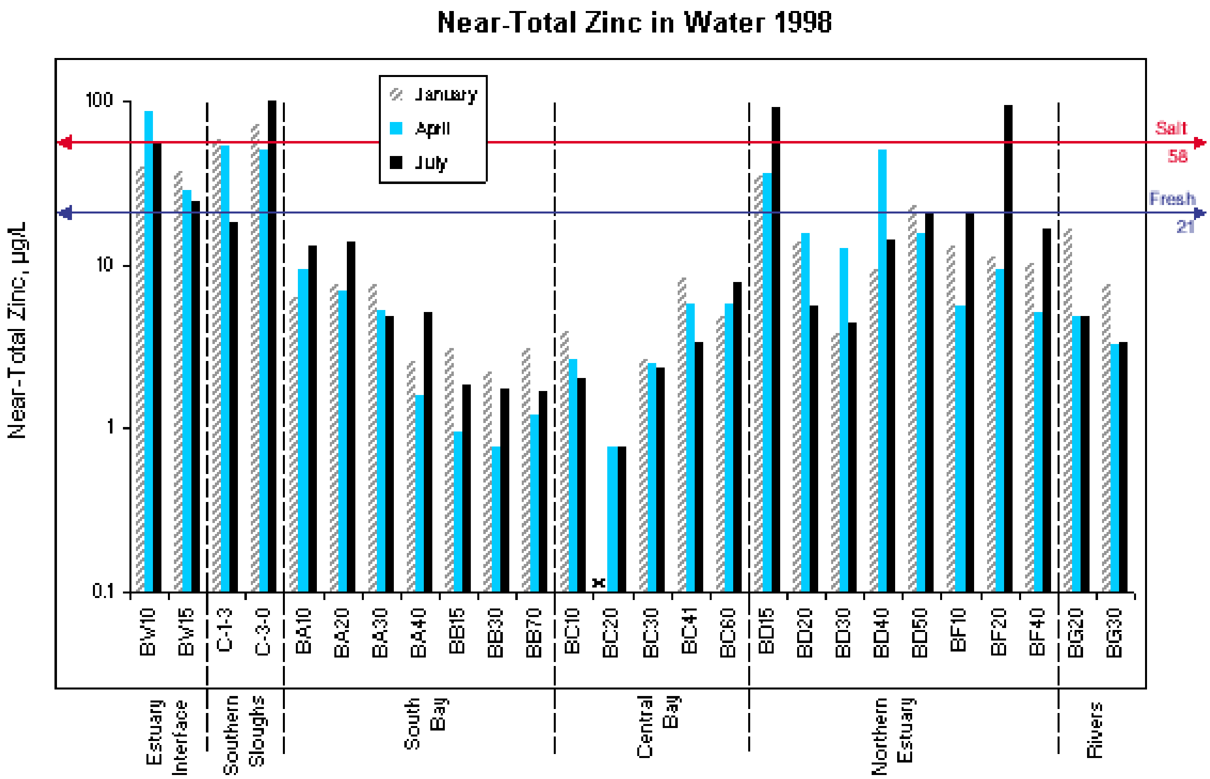


Figure 2.13b. Near-total zinc (Zn) concentrations in water in parts per billion (ppb) at 26 RMP stations sampled in January, April, and July 1998. ✖ = not sampled. Note logarithmic scale. Concentrations ranged from 0.77 to 98.56 ppb. The highest concentration was sampled at San Jose (C-3-0) in July and the lowest at Golden Gate (BC20) in July. Average concentrations were highest (65.09 ppb) in the Southern Sloughs in January and lowest (3.25 ppb) in the Central Bay in July. Seventeen samples were above the 24-hour average WQO for total zinc (saltwater 58 ppb, freshwater--hardness dependent).

Figure 2.14a

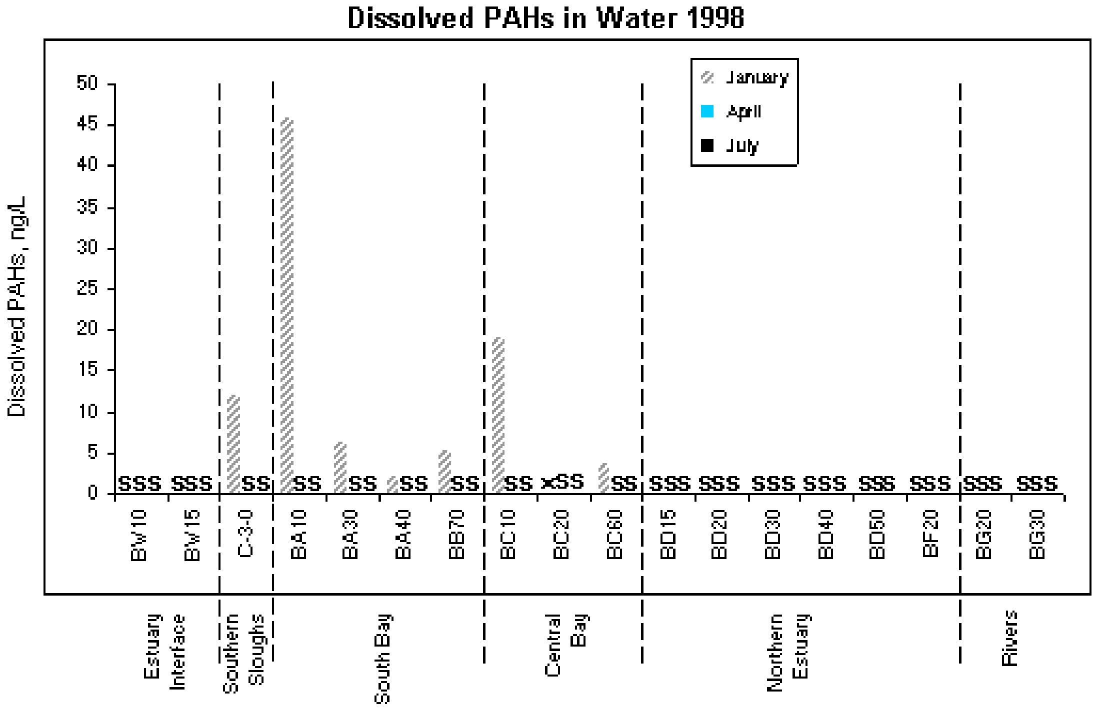


Figure 2.14a. Dissolved PAH concentrations in water (ppt) at 18 RMP stations sampled in January, April, and July 1998. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 2.1 ppt to 46 ppt (see QA Tables for MDLs).

Figure 2.14b

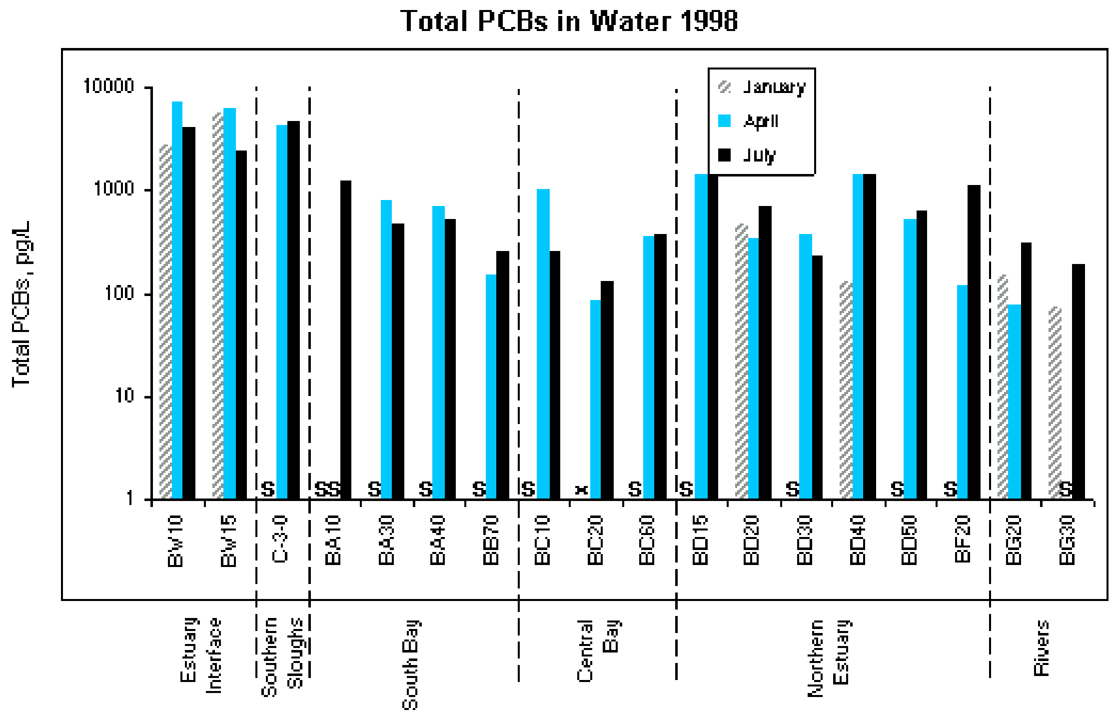


Figure 2.14b. Total PAH concentrations in water (ppt) at 18 RMP stations sampled in January, April, and July 1998. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 20 to 300 ppt (see QA Tables for MDLs).

Figure 2.15a

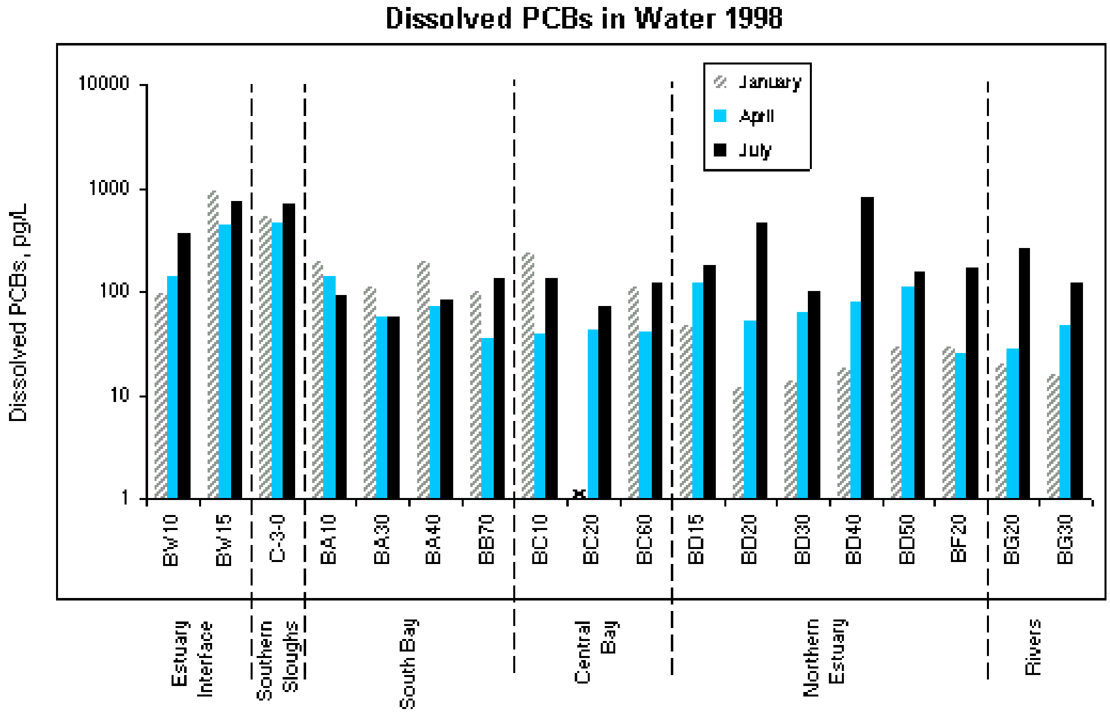


Figure 2.15a. Dissolved PCB concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. Concentrations ranged from 12 to 930 ppq (see QA Tables for MDLs). The highest concentration was sampled in the Guadalupe River (BW15) and the lowest in San Pablo Bay (BD20), both in January. Average concentrations were highest (690 ppq) in the Southern Sloughs in July and lowest (25 ppq) in the Northern Estuary in January.

Figure 2.15b

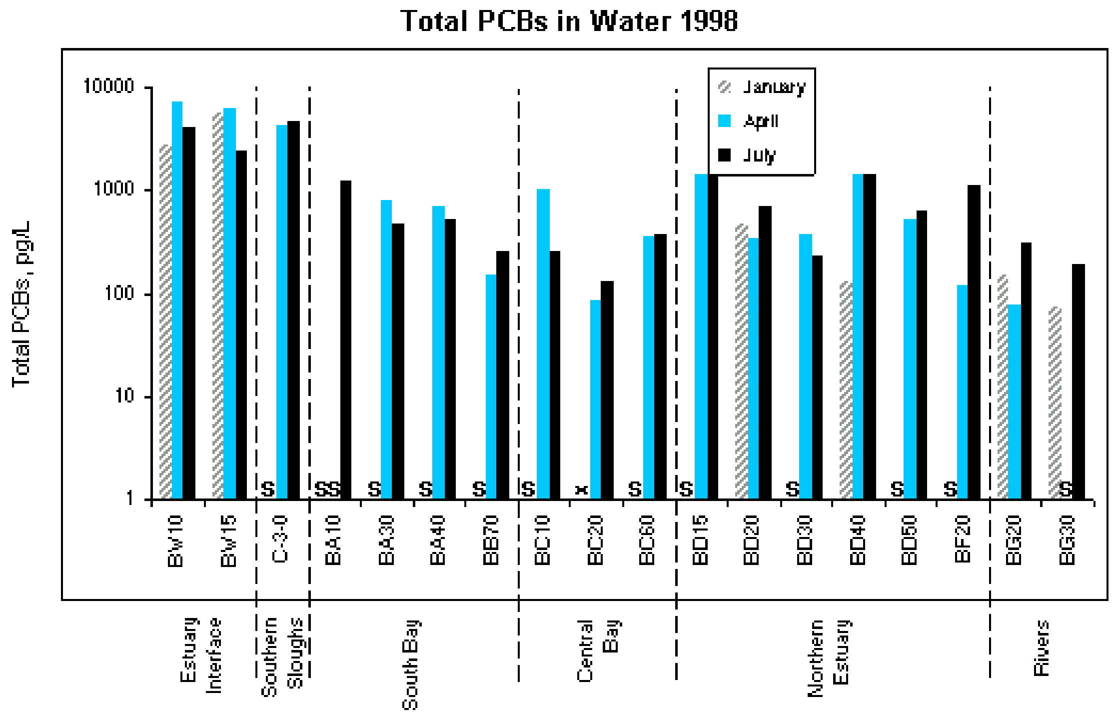


Figure 2.15b. Total PCB concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 75 to 7,000 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in April and the lowest at San Joaquin River (BG30) in January. Average concentrations were highest (6,600 ppq) in the Estuary Interface and lowest (75 ppq) in the Rivers, both in April.

Figure 2.16a

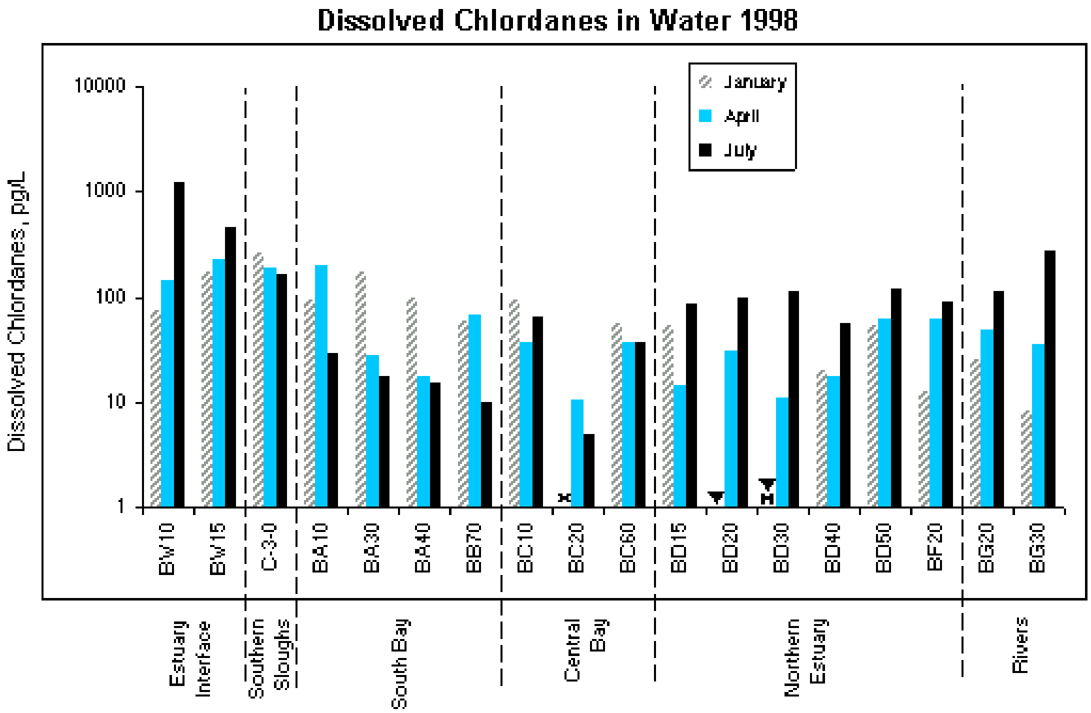


Figure 2.16a. Dissolved chlordane concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. ▼ = not detected. M = matrix interference. Concentrations ranged from not detected to 1,200 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in July. Average concentrations were highest (190 ppq) in the Southern Sloughs in April and in the Rivers in July. The lowest average concentrations (17 ppq) were found in the Rivers in January.

Figure 2.16b

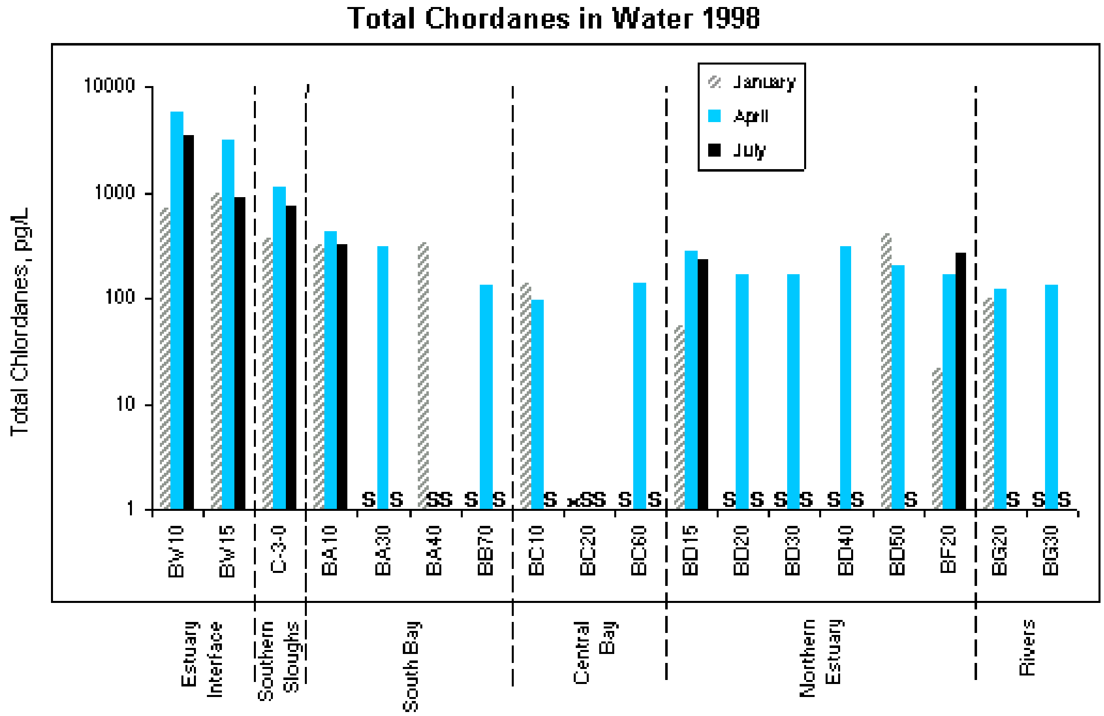


Figure 2.16b. Total chlordane concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 21 to 5,700 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in April and the lowest at Grizzly Bay in January**.**

Figure 2.17a

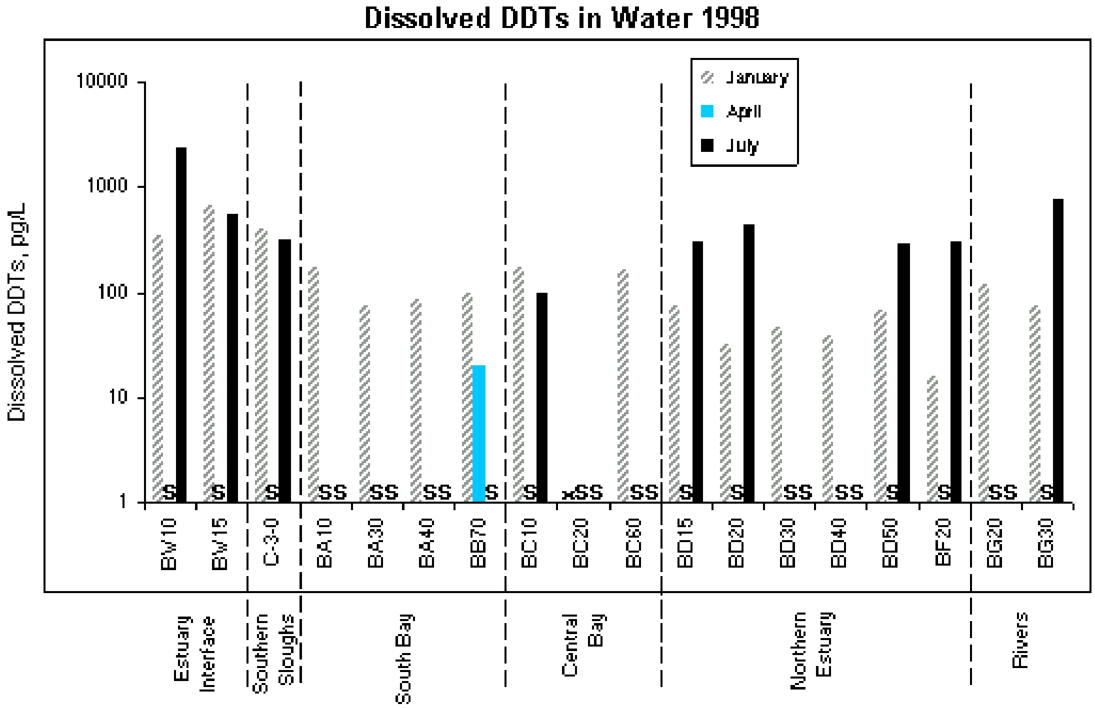


Figure 2.17a. Dissolved DDT concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 16 to 2,300 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in July and the lowest at Grizzly Bay (BF20) in January.

Figure 2.17b

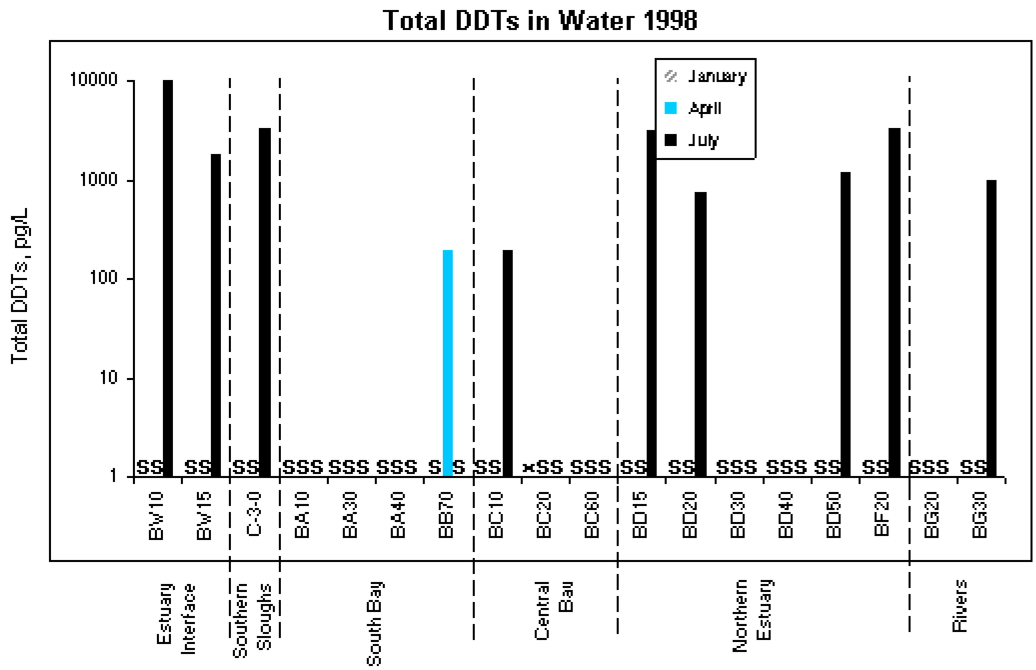


Figure 2.17b. Total DDT concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 190 to 9,900 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in July, and the lowest at Yerba Buena Island (BC10) in July and Alameda (BB70) in April.

Figure 2.18a

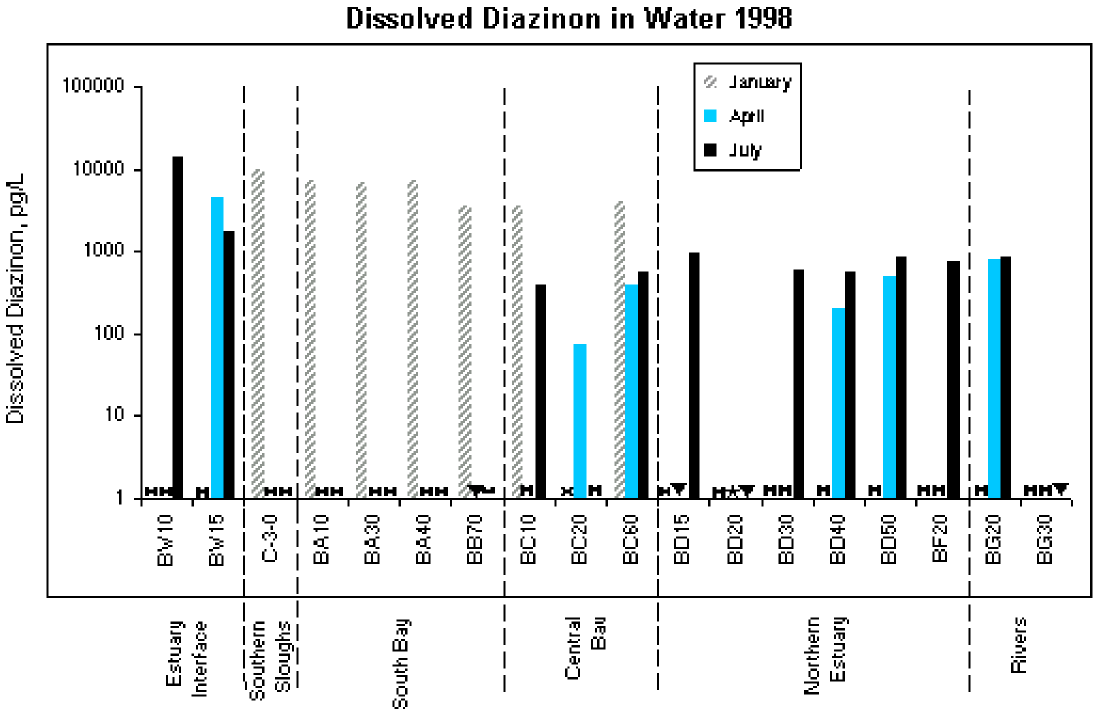


Figure 2.18a. Dissolved diazinon concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. H = not analyzed. ▼ = not detected. M = matrix interference. Concentrations ranged from not detected to 14,000 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in July.

Figure 2.18b

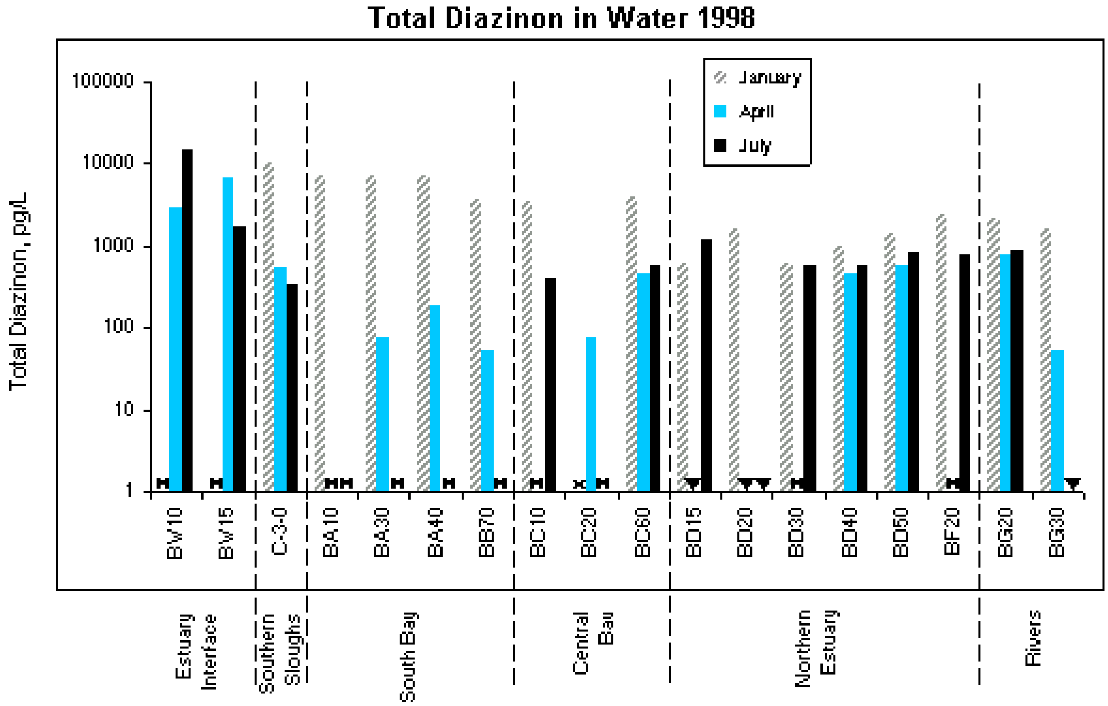


Figure 2.18b. Total diazinon concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. ▼ = not detected. M = matrix interference. Concentrations ranged from not detected to 15,000 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in July. Average concentrations were highest (10,000 ppq) in the Southern Sloughs in January and lowest (260 ppq) in the Central Bay in April.

Figure 2.19a

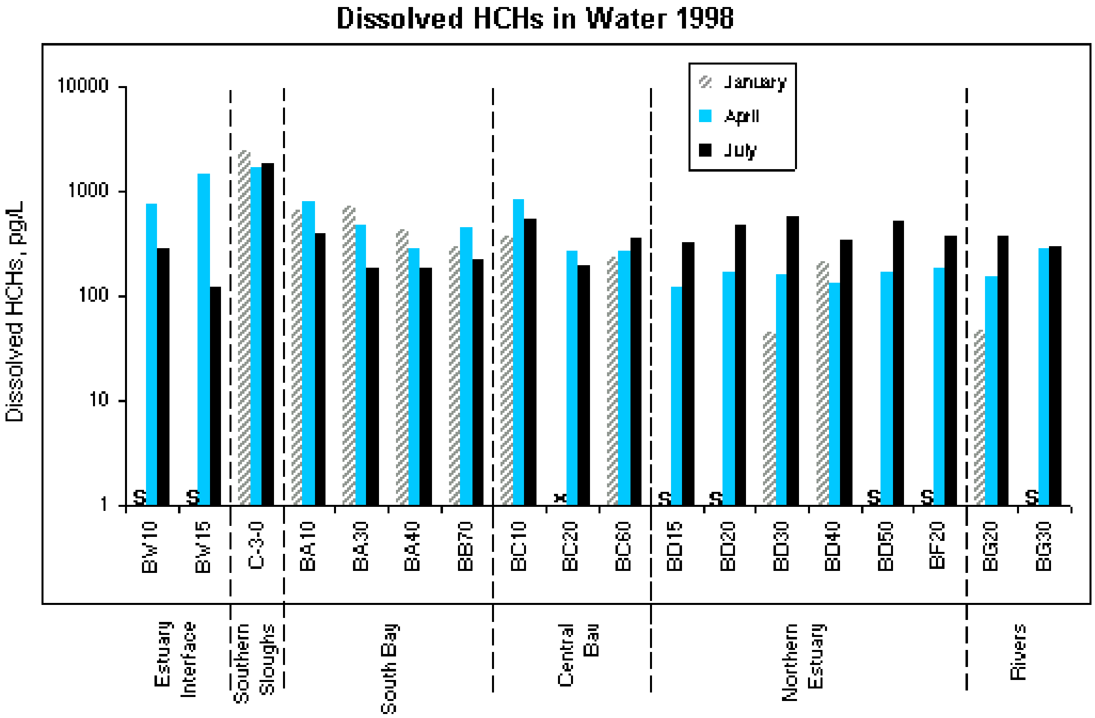


Figure 2.19a. Dissolved HCH concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 44 ppq to 2,400 ppq (see QA Tables for MDLs). The highest concentration was sampled at San Jose (C-3-0) and the lowest at Napa River in January. Average concentrations were highest (2,400 ppq) in the Southern Sloughs and lowest (47 ppq) in the Rivers, both in January.

Figure 2.19b

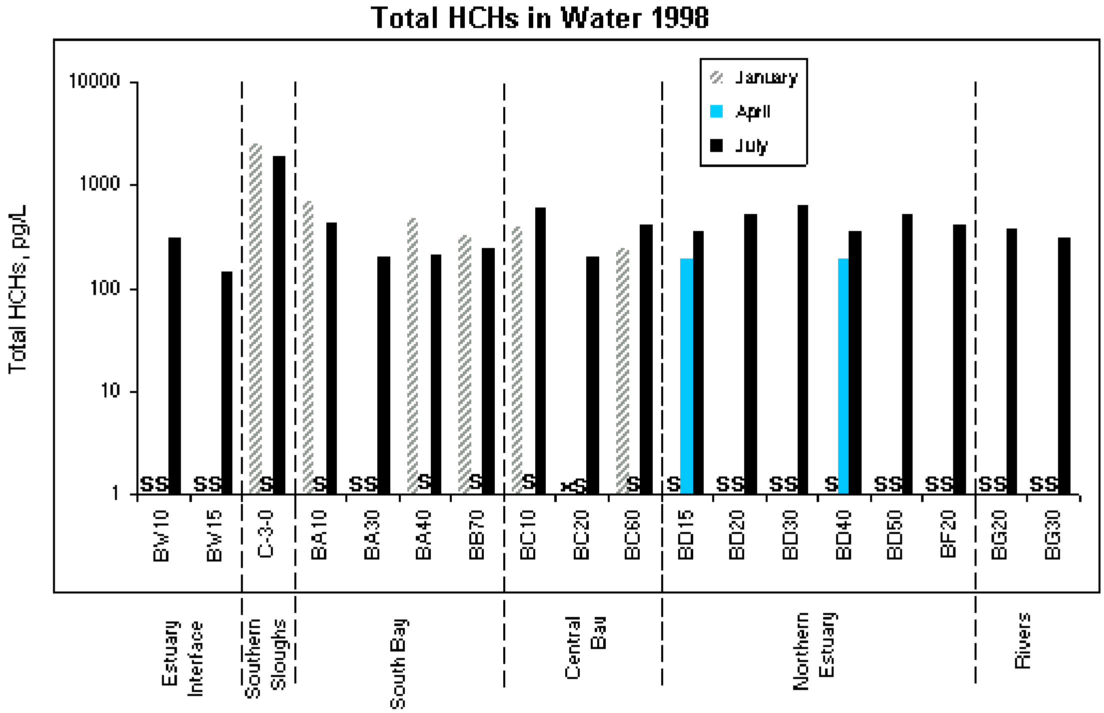


Figure 2.19b. Total HCH concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. Concentrations ranged from 140 to 2,500 ppq (see QA Tables for MDLs). The highest concentration was sampled at San Jose (C-3-0) in January and the lowest at Guadalupe River (BW15) in July. Average concentrations were highest (2,500 ppq) in the Southern Sloughs in January and lowest (190 ppq) in the Northern Estuary in April.

Figure 2.20a

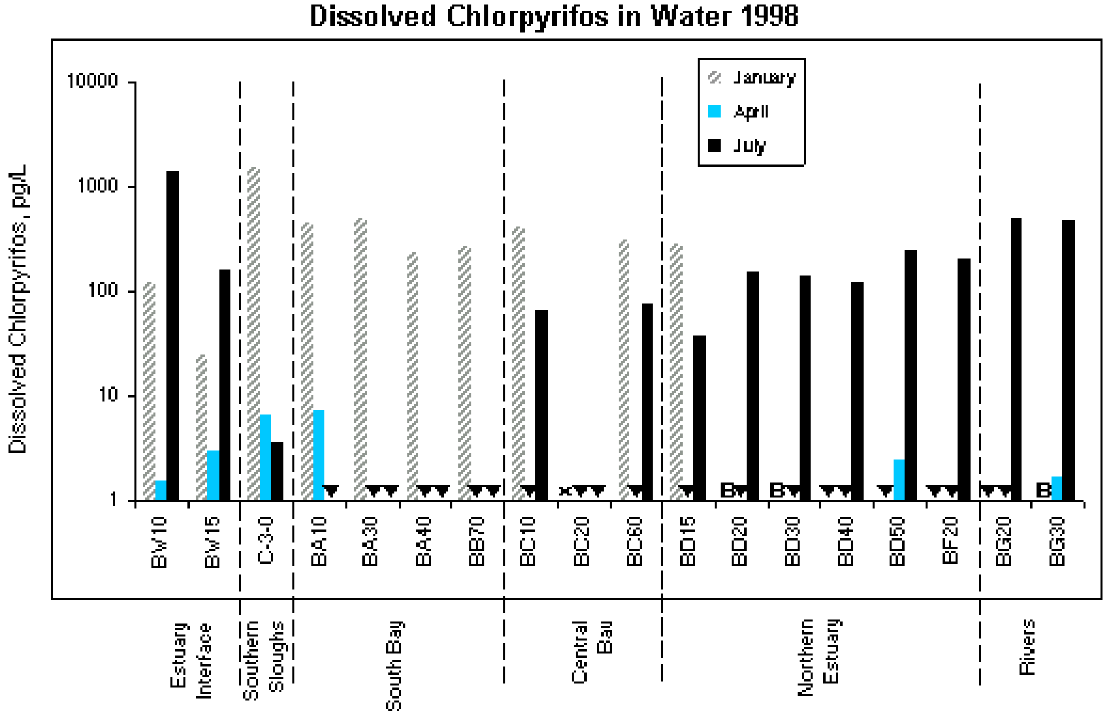


Figure 2.20a. Dissolved chlorpyrifos concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. ▼ = not detected. B = blank contamination. Concentrations ranged from not detected to 1,500 ppq (see QA Tables for MDLs). The highest concentration was sampled at San Jose (C-3-0) in January. Average concentrations were highest (1,500 ppq) in the Southern Sloughs in January.

Figure 2.20b

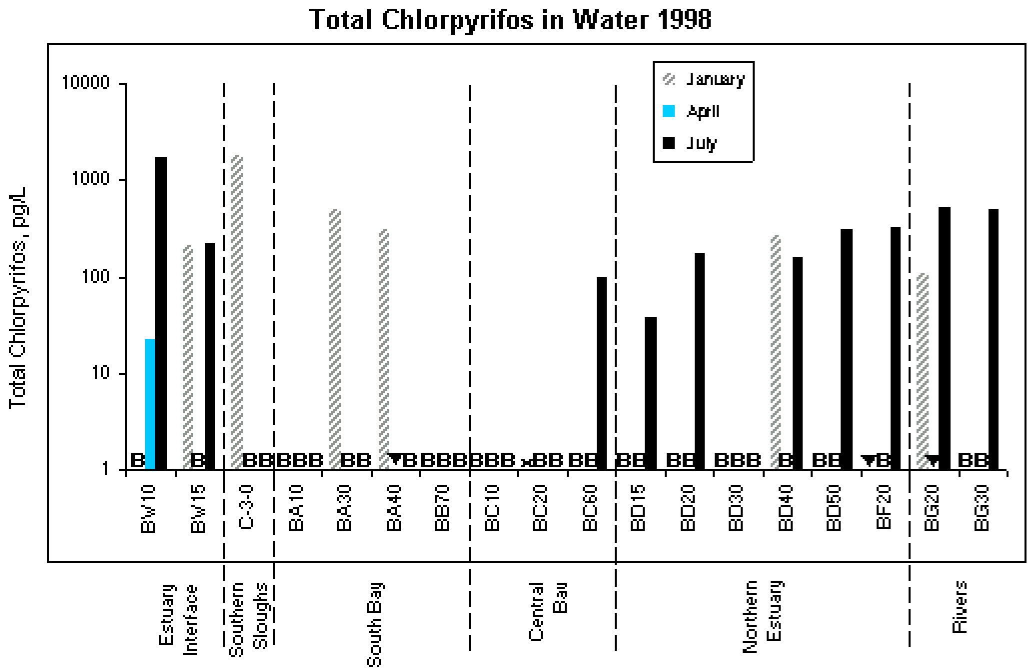


Figure 2.20b. Total chlorpyrifos concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. ▼ = not detected. B = blank contamination. Concentrations ranged from not detected to 1,800 ppq (see QA Tables for MDLs). The highest concentration was sampled at San Jose (C-3-0) in January.

Figure 2.21a

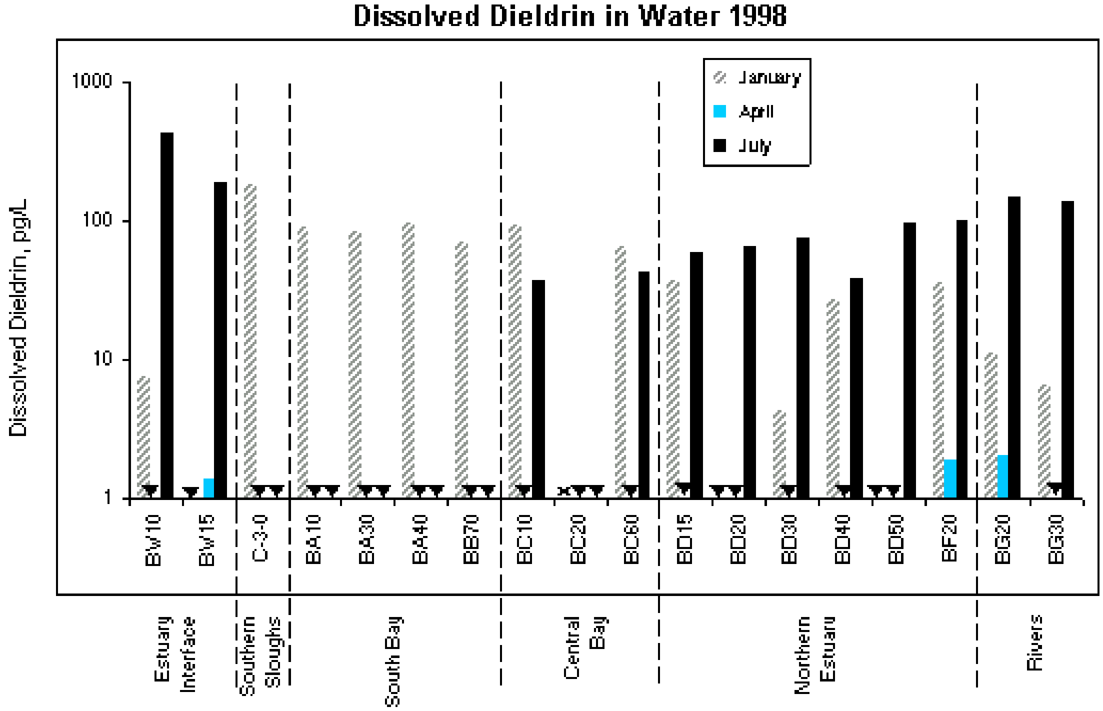


Figure 2.21a. Dissolved dieldrin concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. ▼ = not detected. Concentrations ranged from not detected to 420 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in July. Average concentrations were highest (145 ppq) in the Rivers in July.

Figure 2.21b

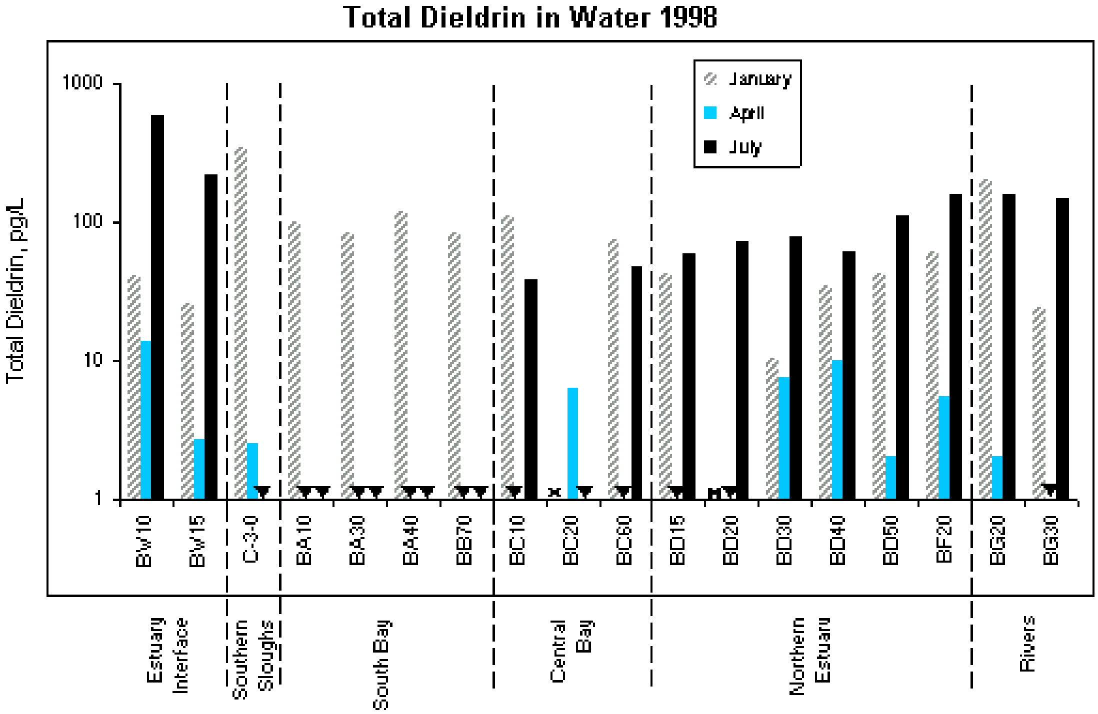


Figure 2.21b. Total dieldrin concentrations in water (ppq) at 18 RMP stations sampled in January, April, and July 1998. Note logarithmic scale. ✖ = not sampled. ▼ = not detected. M = matrix interference. Concentrations ranged from not detected to 580 ppq (see QA Tables for MDLs). The highest concentration was sampled at Standish Dam (BW10) in July. Average concentrations were highest (400 ppq) in the Estuary Interface in July.

Figure 2.22

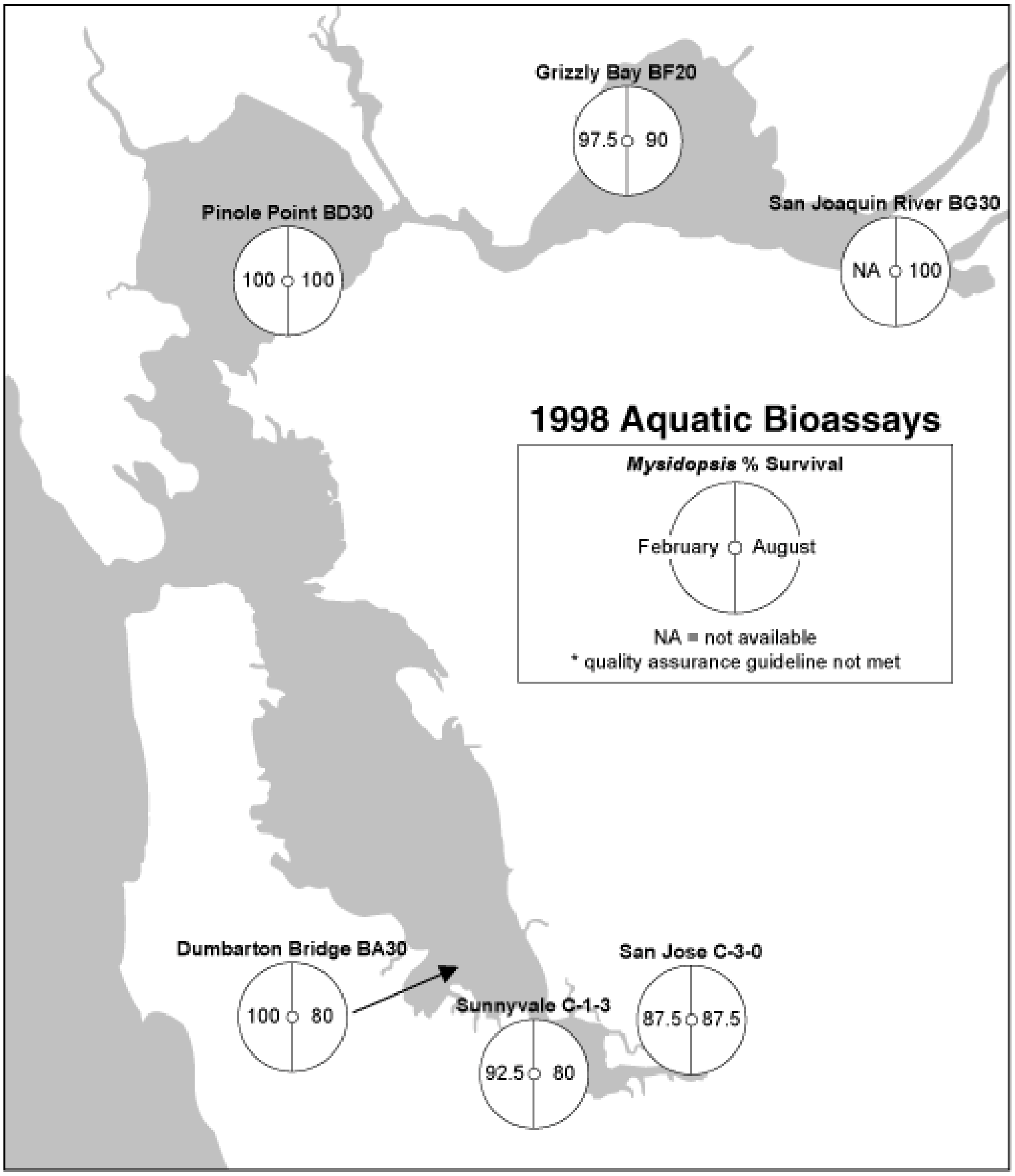


Figure 2.22. Aquatic bioassay results for 1998. Clean artificial seawater was used for control samples. See *Description of Methods* for more information on methods used. Toxicity was determined by statistical comparison to controls.

Figure 2.23

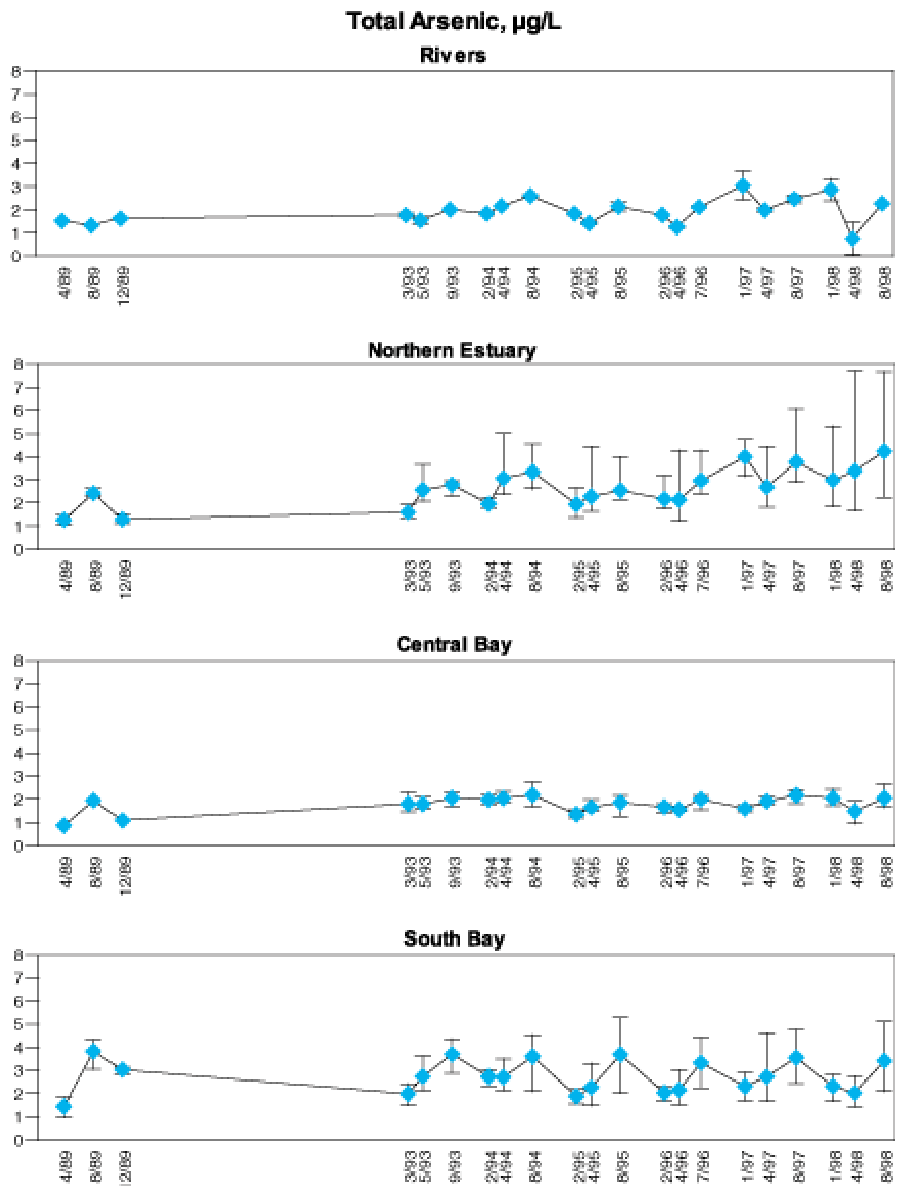


Figure 2.23. Average arsenic concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. The vertical bars represent the range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.24

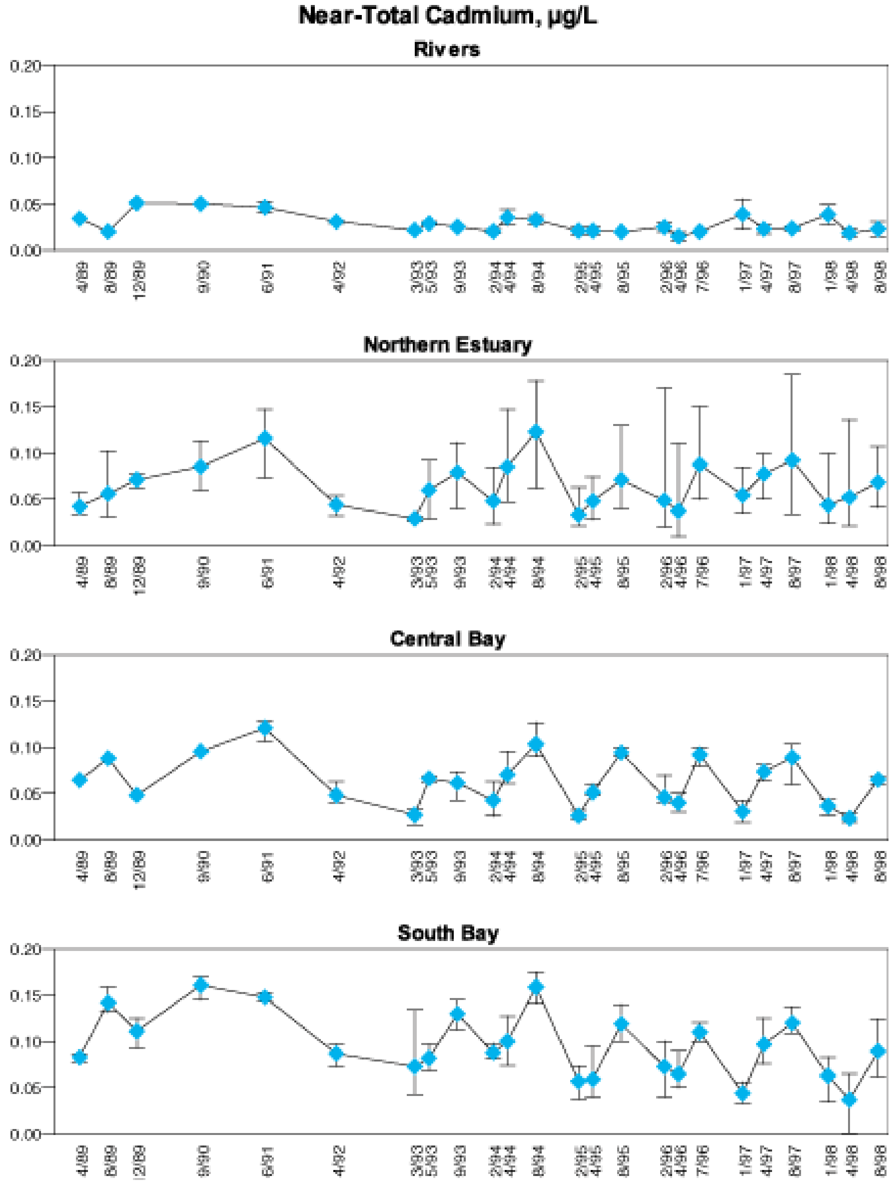


Figure 2.24. Average cadmium concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.25

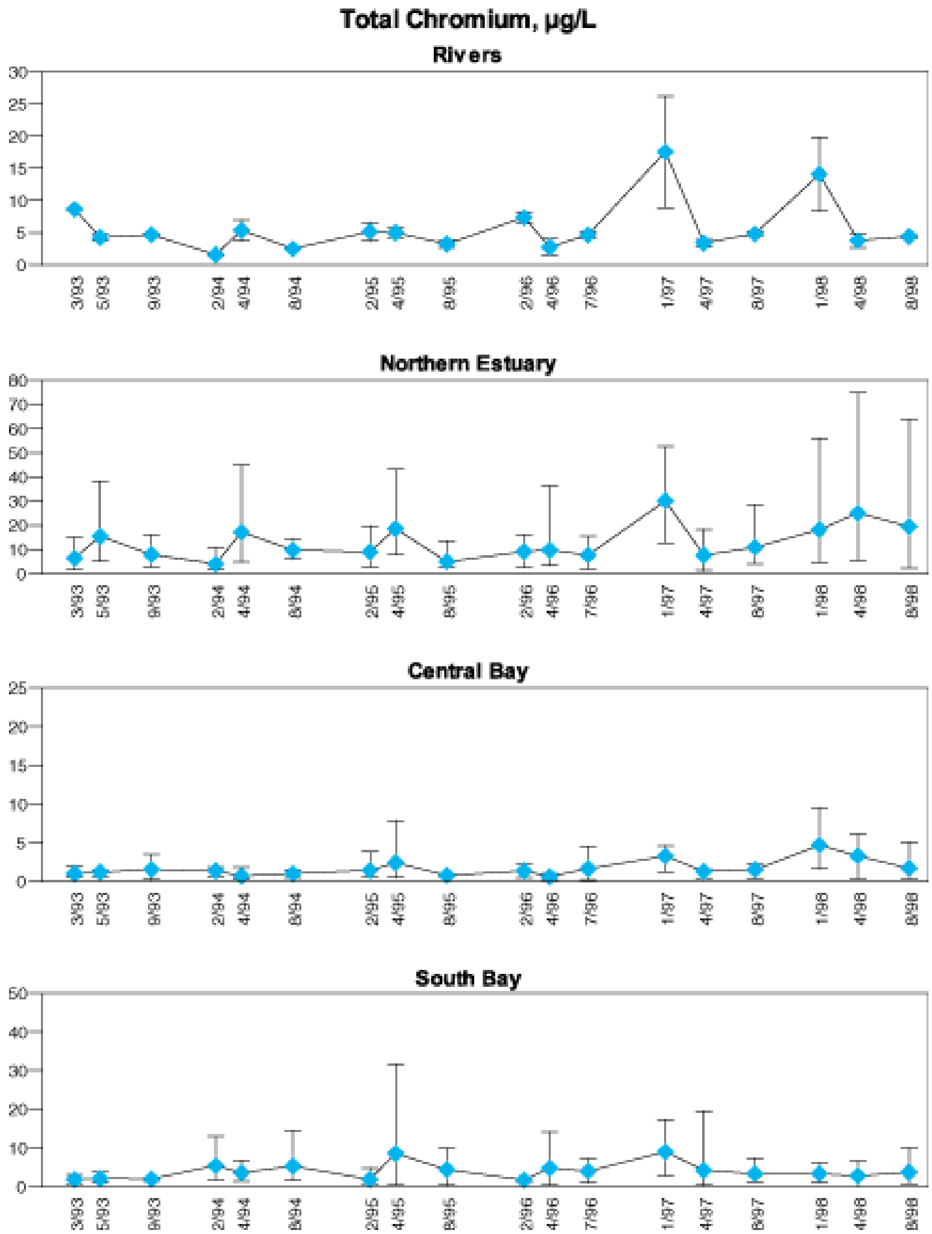


Figure 2.25. Average chromium concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. Note different y-axis scales. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.26

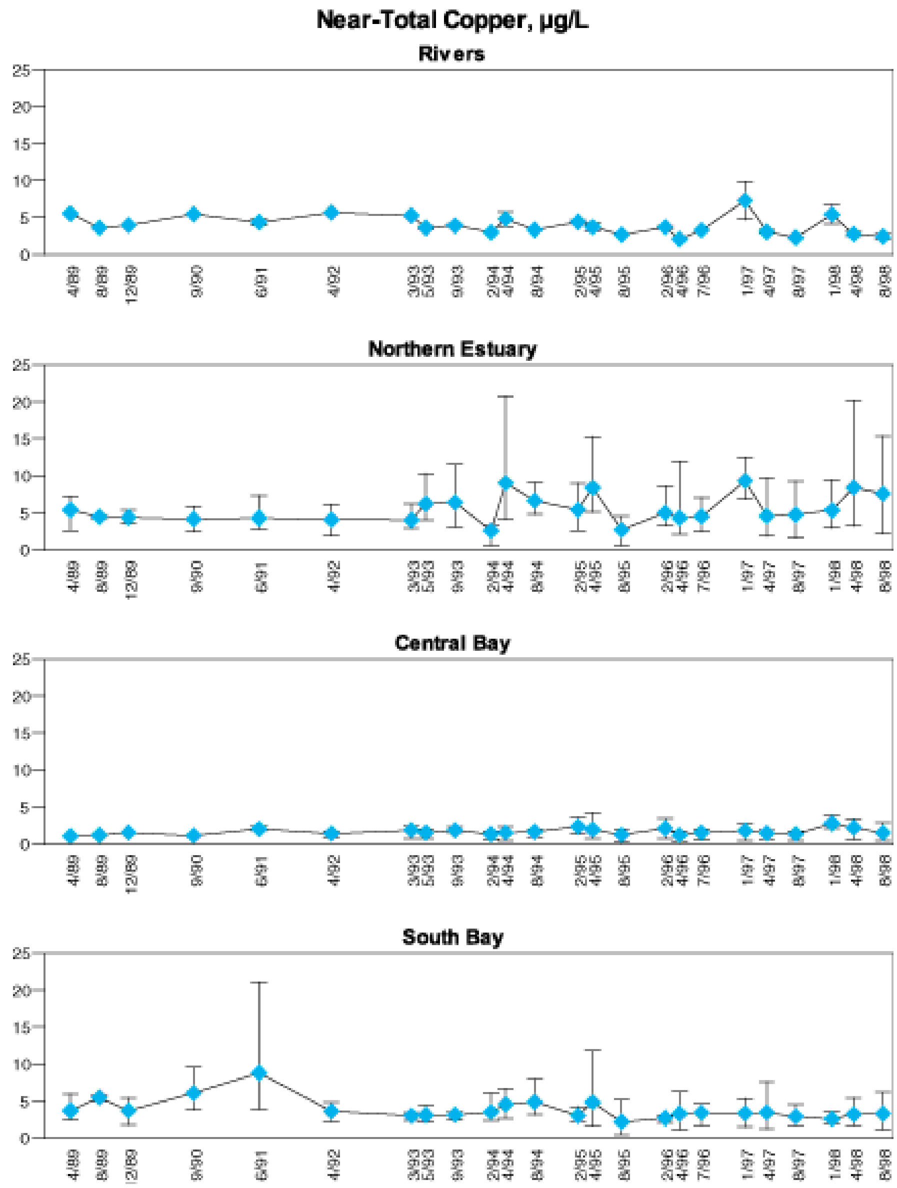


Figure 2.26. Average copper concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.27

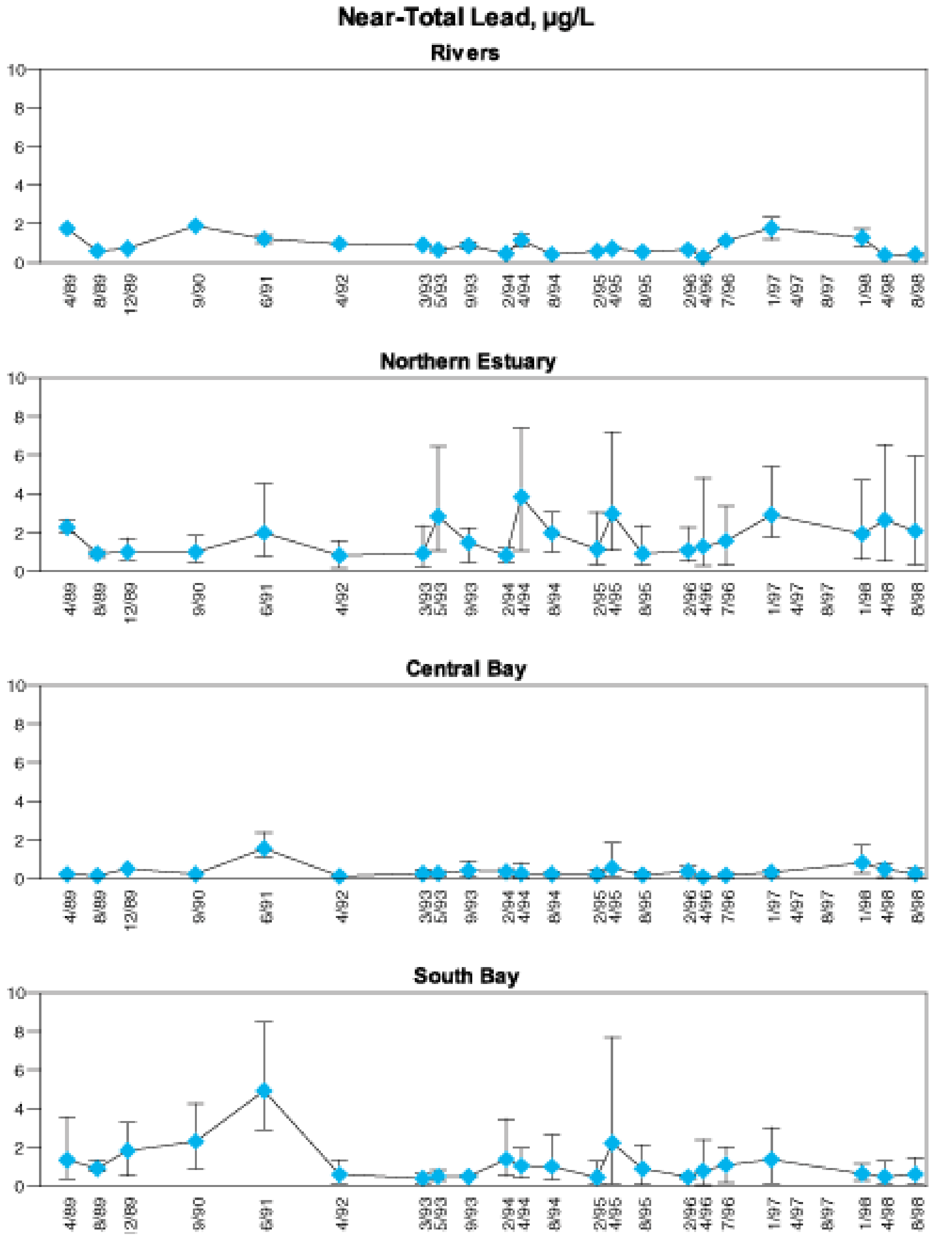


Figure 2.27. Average lead concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions. Note: Data for lead in 4/97 and 8/97 were not available at the time of report production.

Figure 2.28

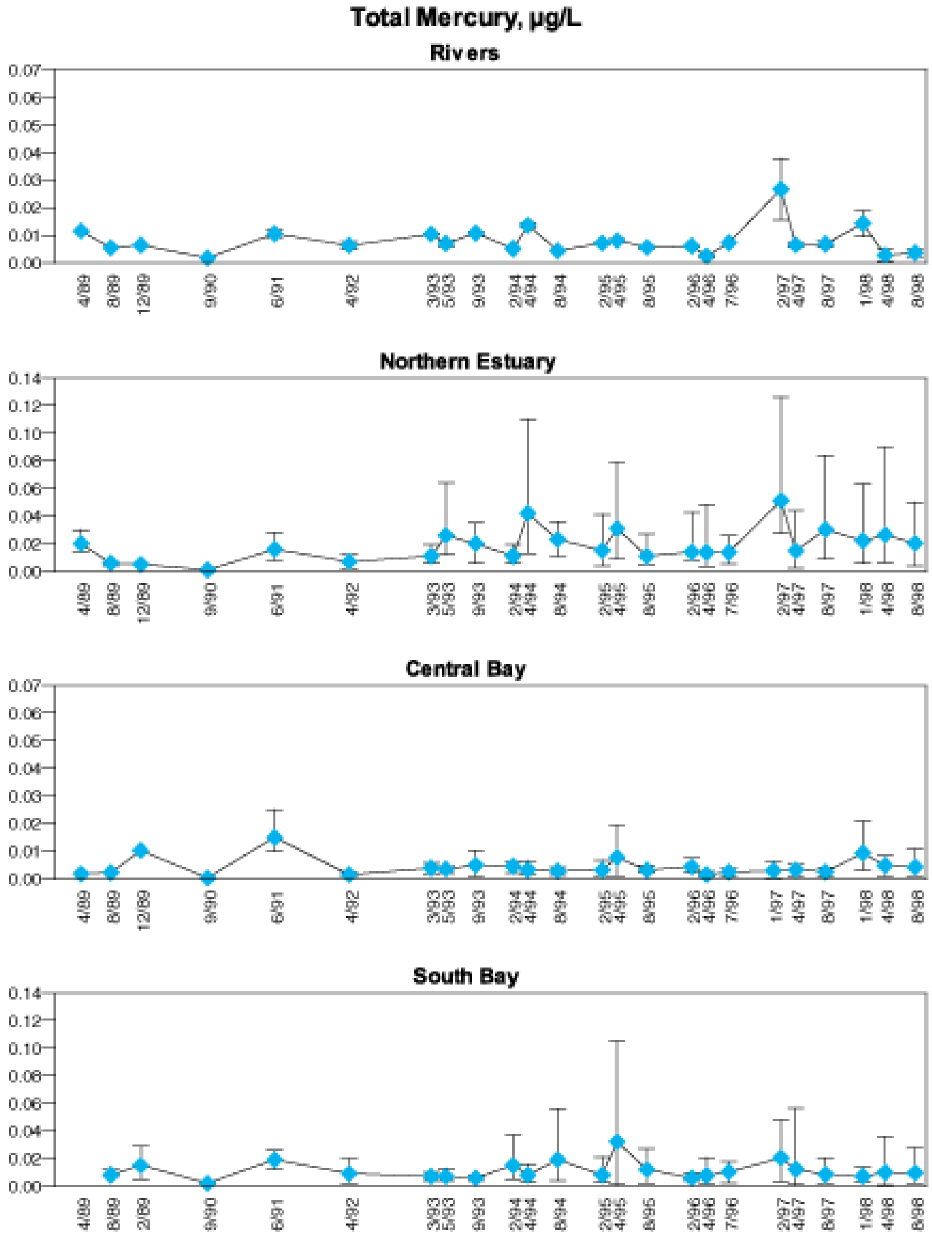


Figure 2.28. Average mercury concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. Note different y-axis scales. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.29

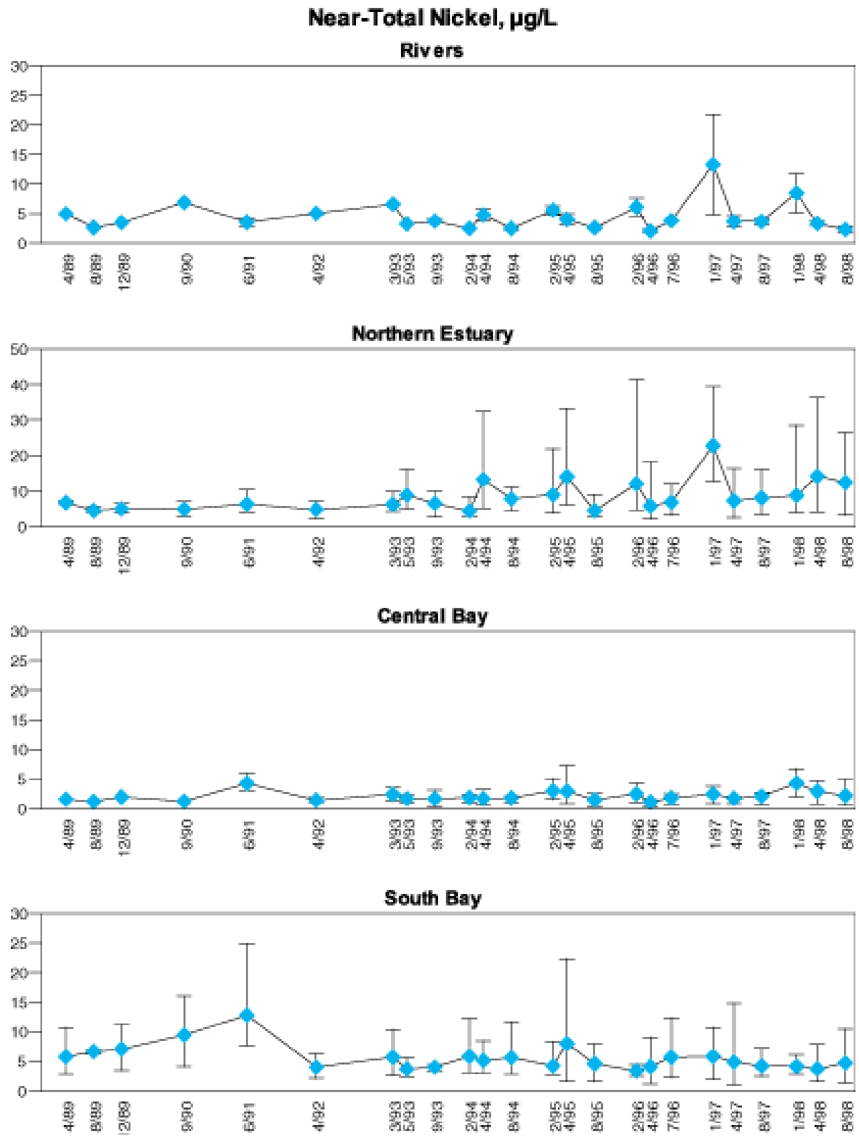


Figure 2.29. Average nickel concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. Note different y-axis scales. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.30

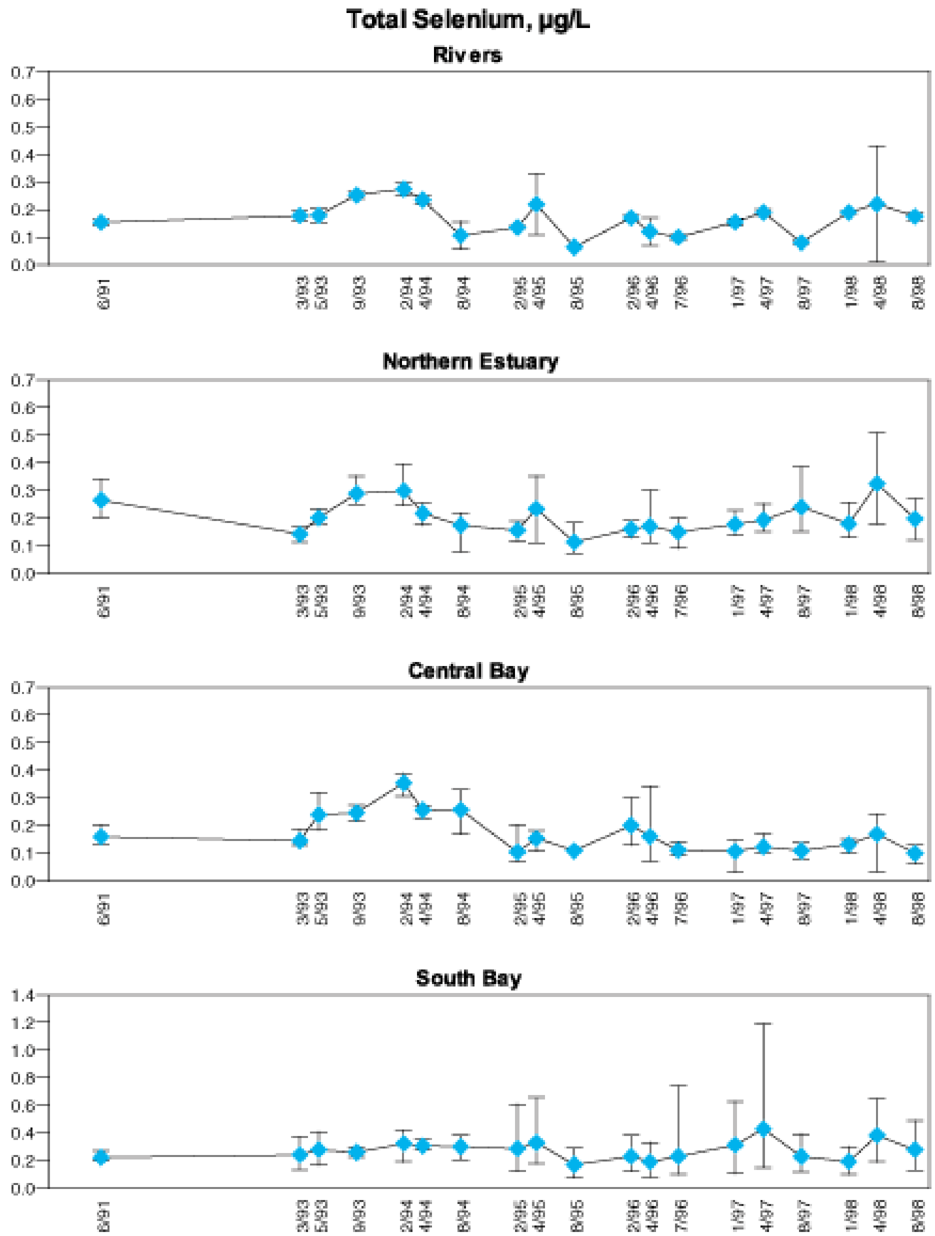


Figure 2.30. Average selenium concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.31

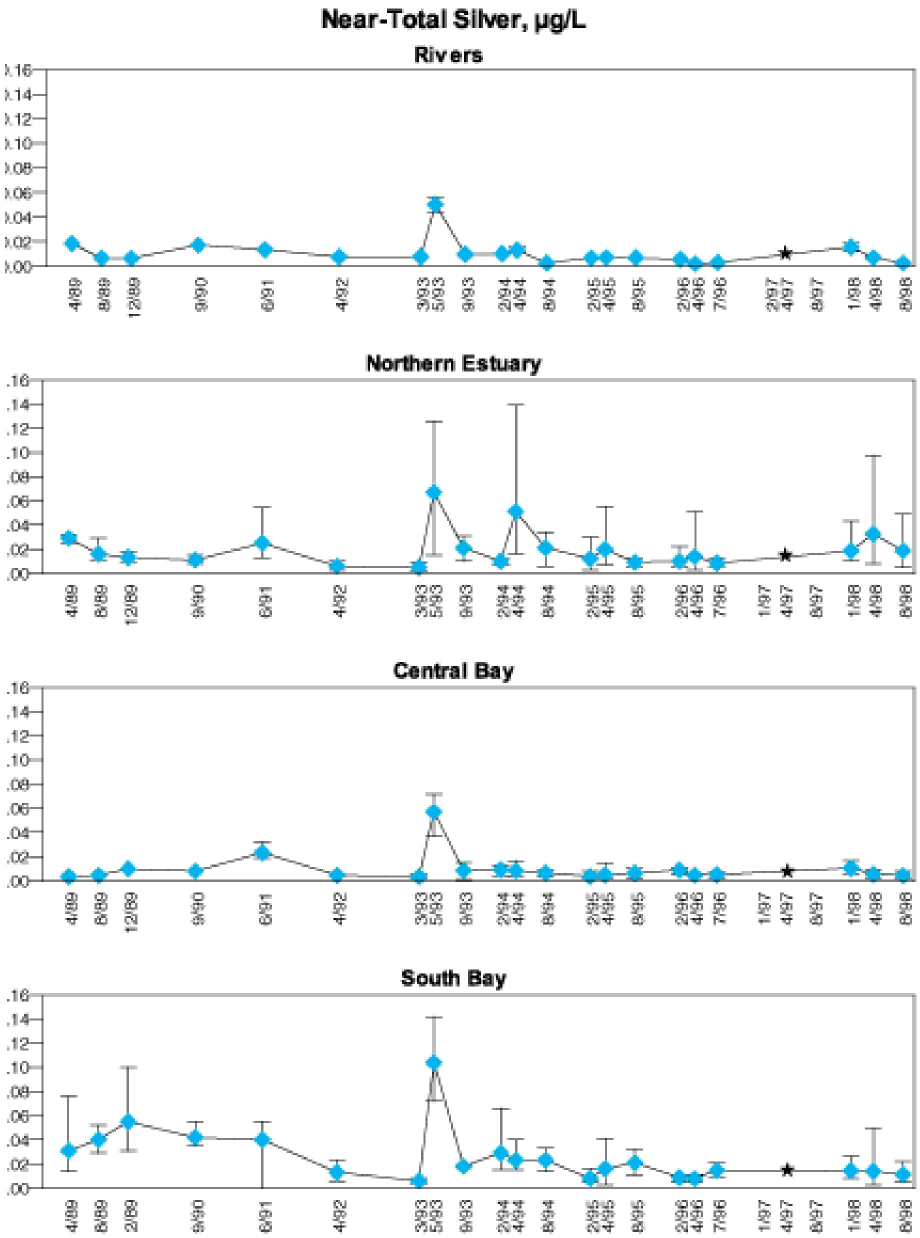


Figure 2.31. The vertical bars represent range of values. The sample size varies between sites and between seasons. ★ = All 1997 samples were lost due to methodological problems. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.32

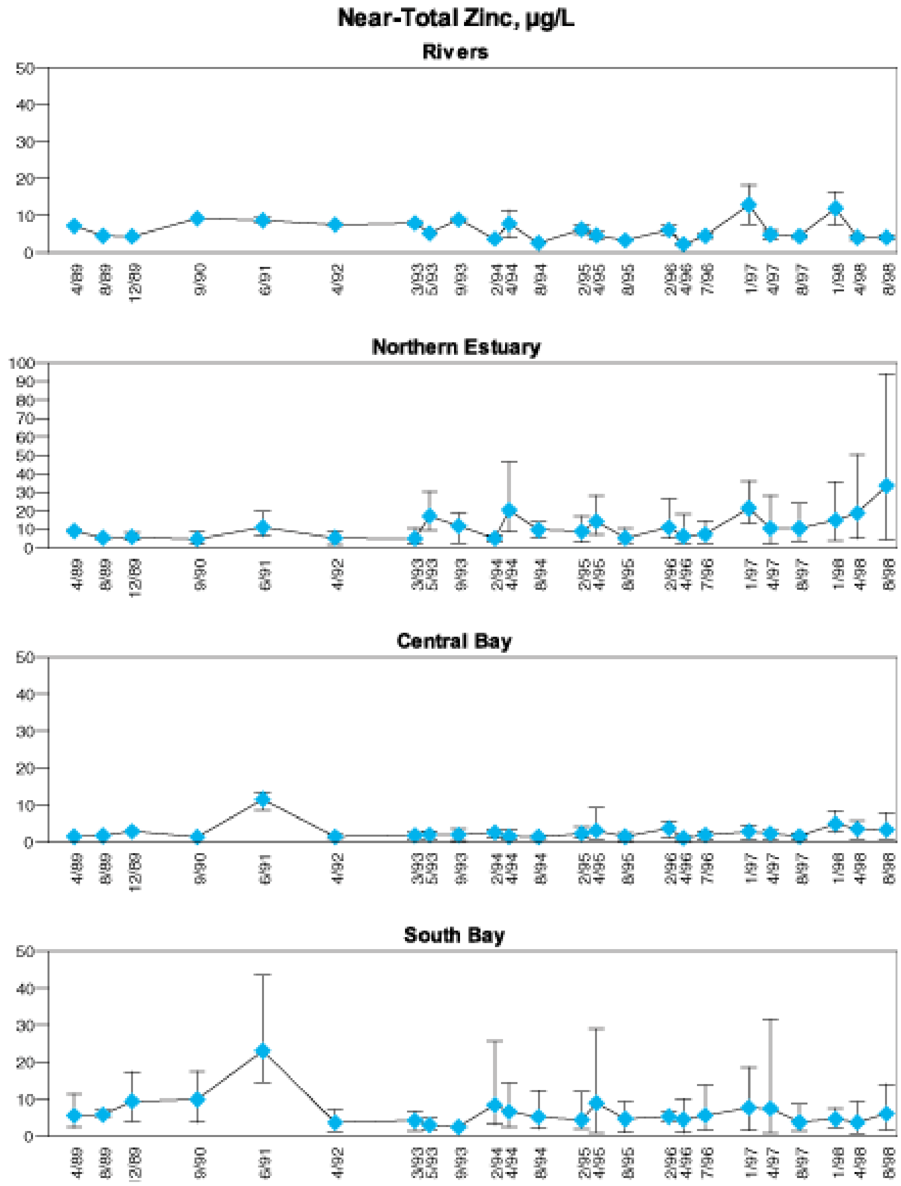


Figure 2.32. Average zinc concentrations (parts per billion, ppb) in water in each Estuary reach from 1989-1998. Note different y-axis scales. The vertical bars represent range of values. The sample size varies between sites and between seasons. Golden Gate (BC20) was not sampled in January 1998 due to bad weather conditions.

Figure 2.33

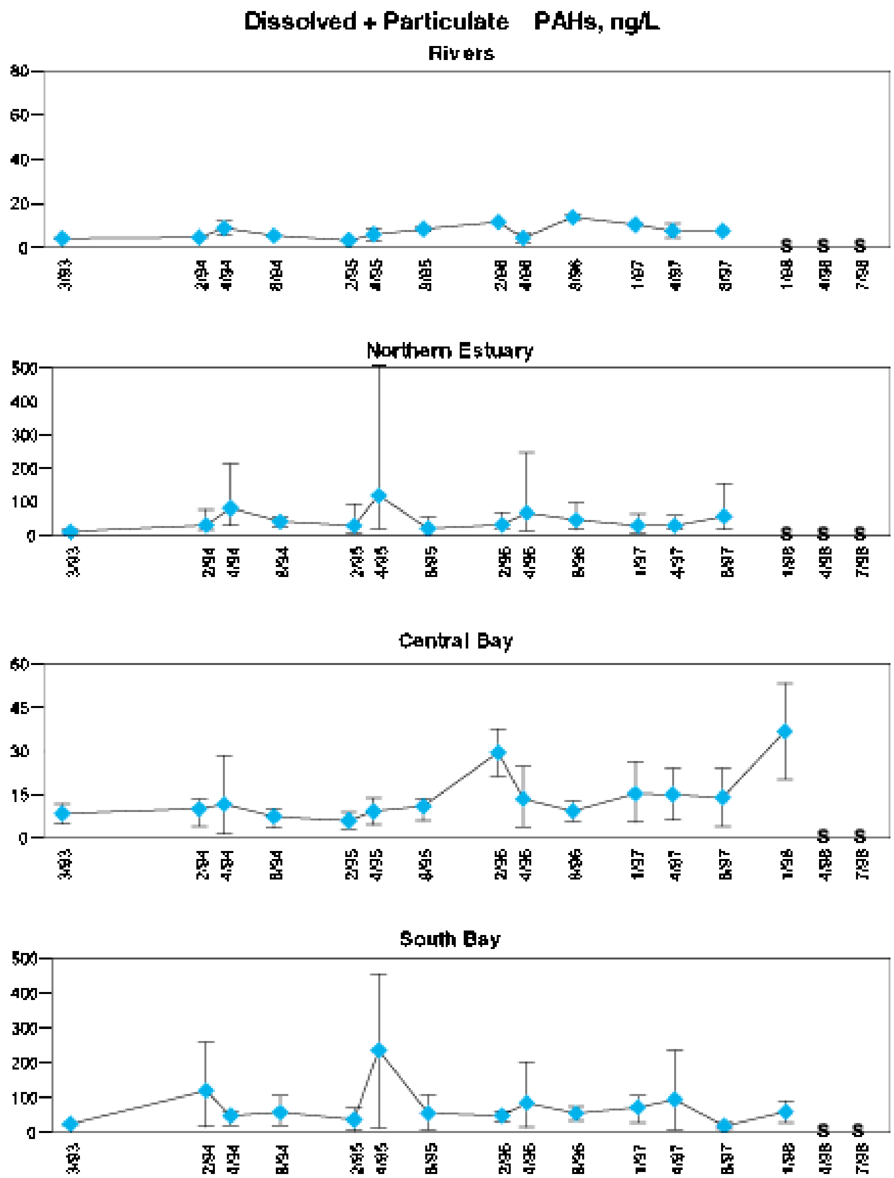


Figure 2.33. Plots of average dissolved + particulate PAH concentrations (parts per trillion, ppt) in water for each Estuary reach from 1993-1998. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

Figure 2.34

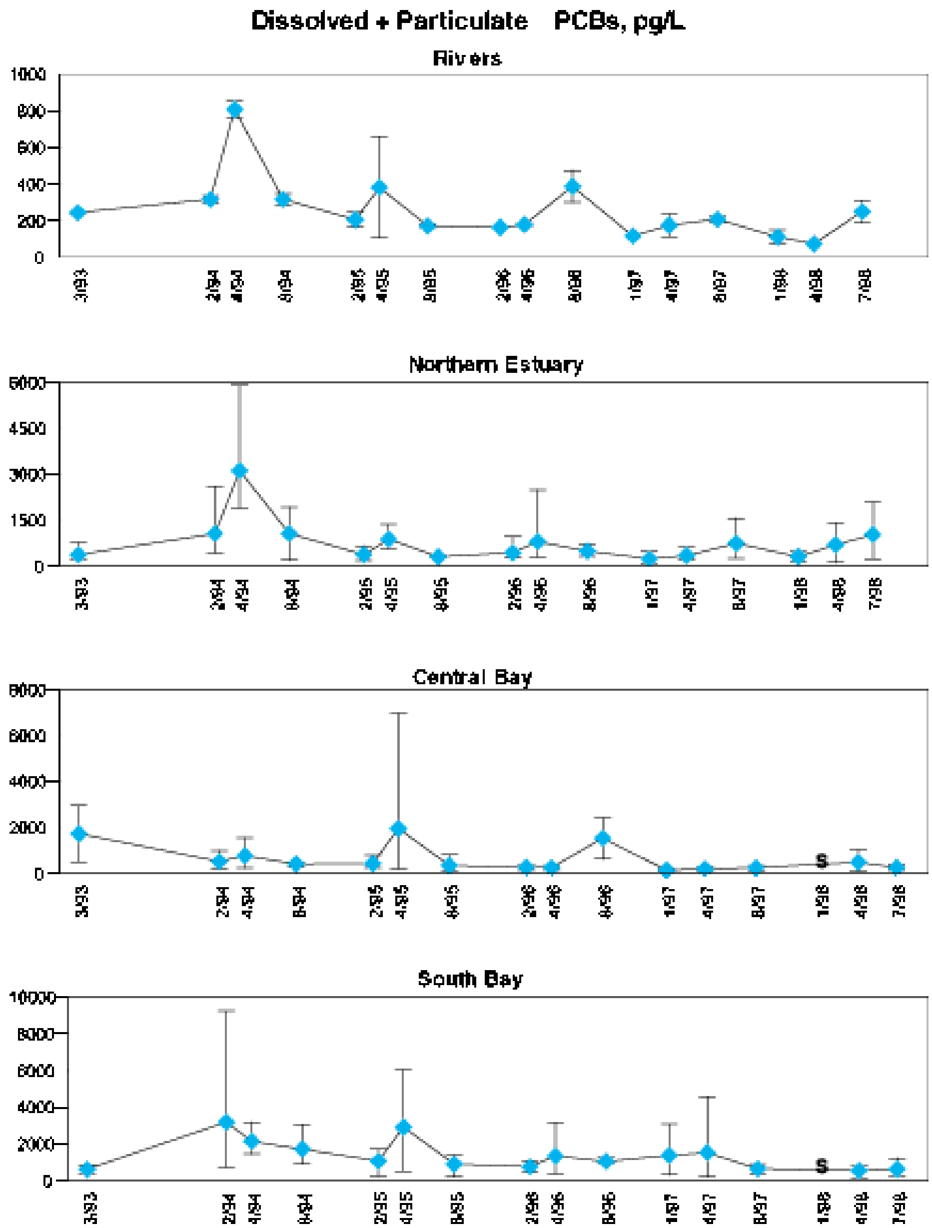


Figure 2.34. Plots of average dissolved + particulate PCB concentrations (parts per quadrillion, ppq) in water for each Estuary reach from 1993-1998. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

Figure 2.35

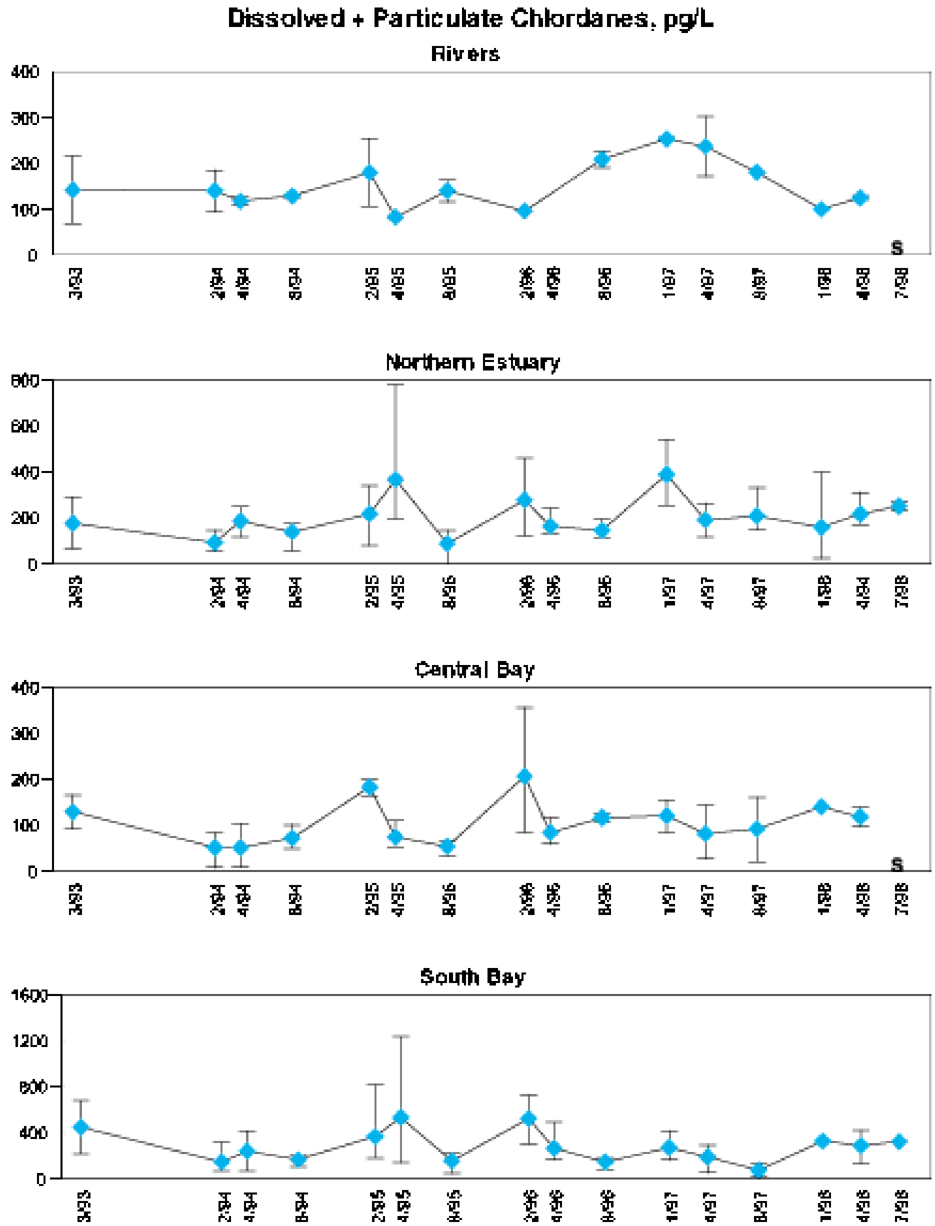


Figure 2.35. Plots of average dissolved + particulate chlordane concentrations (parts per quadrillion, ppq) in water for each Estuary reach from 1993-1998. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

Figure 2.36

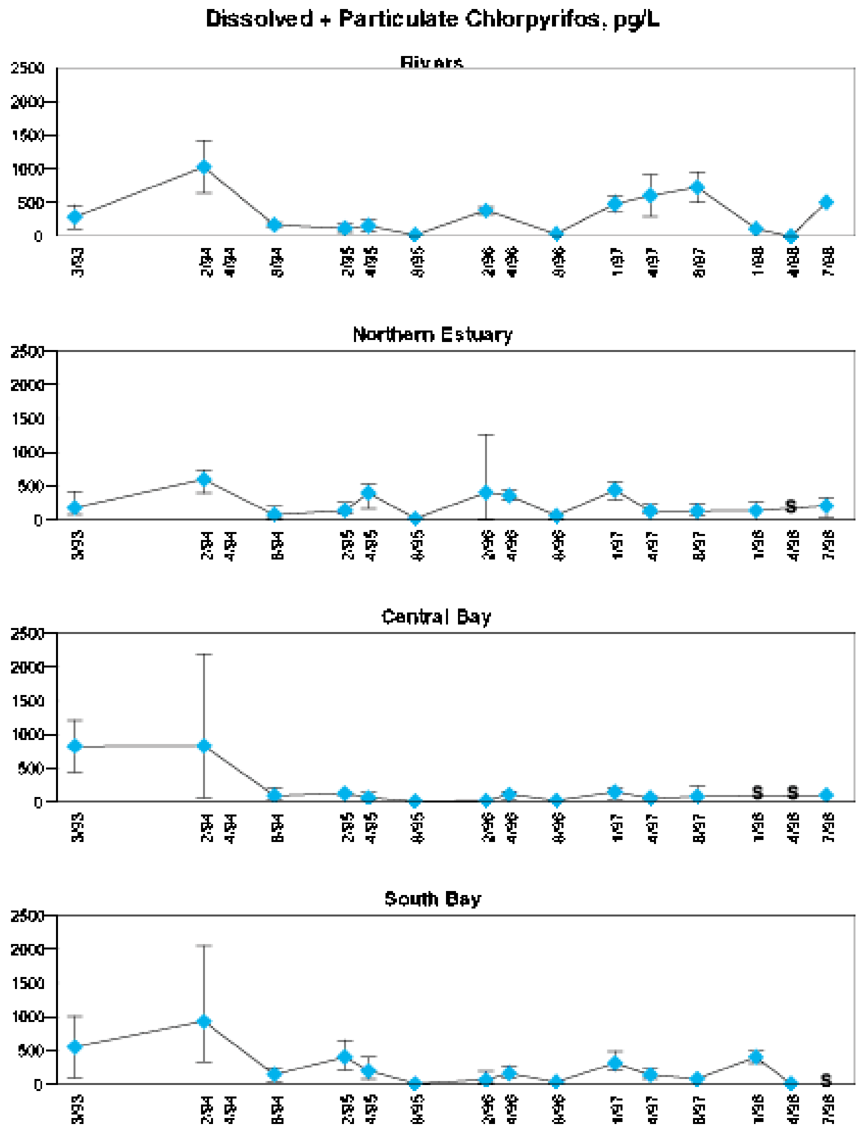


Figure 2.36. Plots of average dissolved + particulate chlorpyrifos concentrations (parts per quadrillion, ppq) in water for each Estuary reach from 1993-1998. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

Figure 2.37

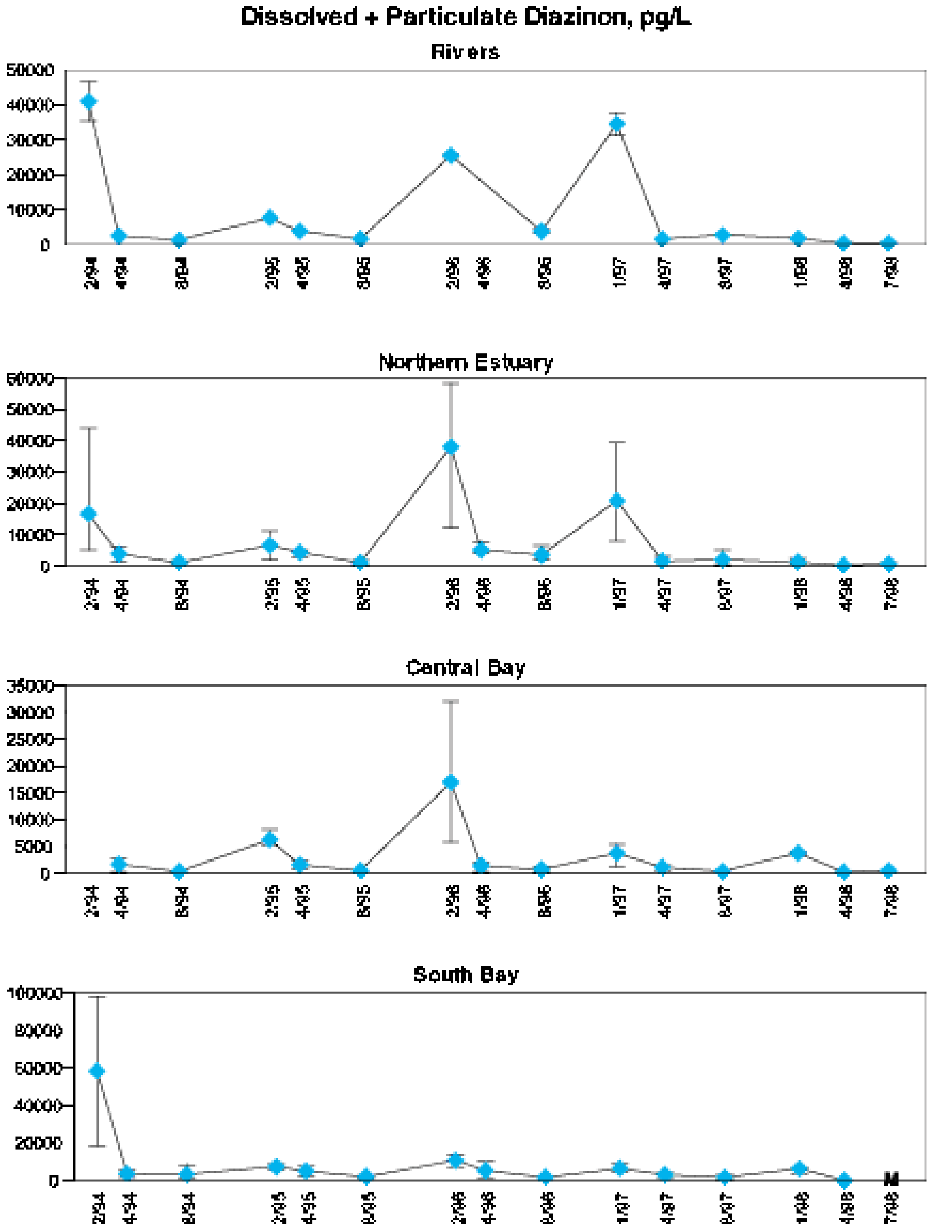


Figure 2.37. Plots of average dissolved + particulate diazinon concentrations (parts per quadrillion, ppq) in water for each Estuary reach from 1993-1998. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. M = matrix interference.

Figure 2.38

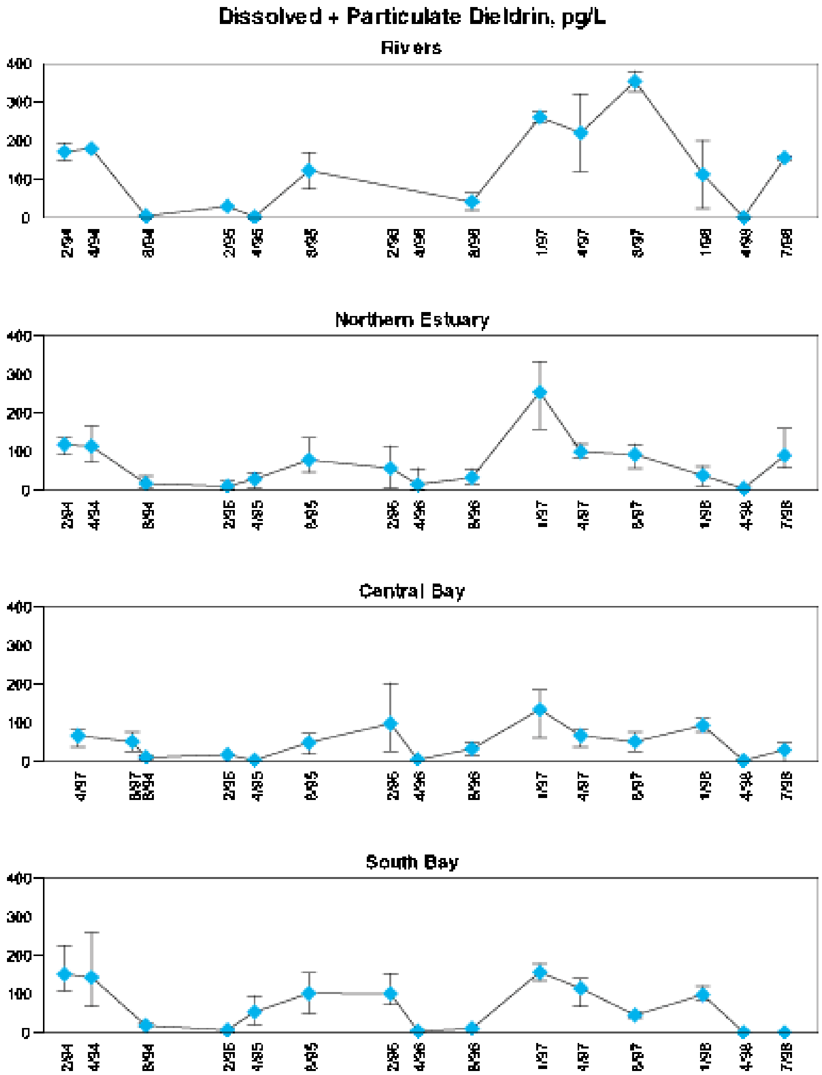


Figure 2.38. Plots of average dissolved + particulate dieldrin concentrations (parts per quadrillion, ppq) in water for each Estuary reach from 1993-1998. The vertical bars represent the range of values. Sample size varies between sites and between seasons.

Figure 2.39

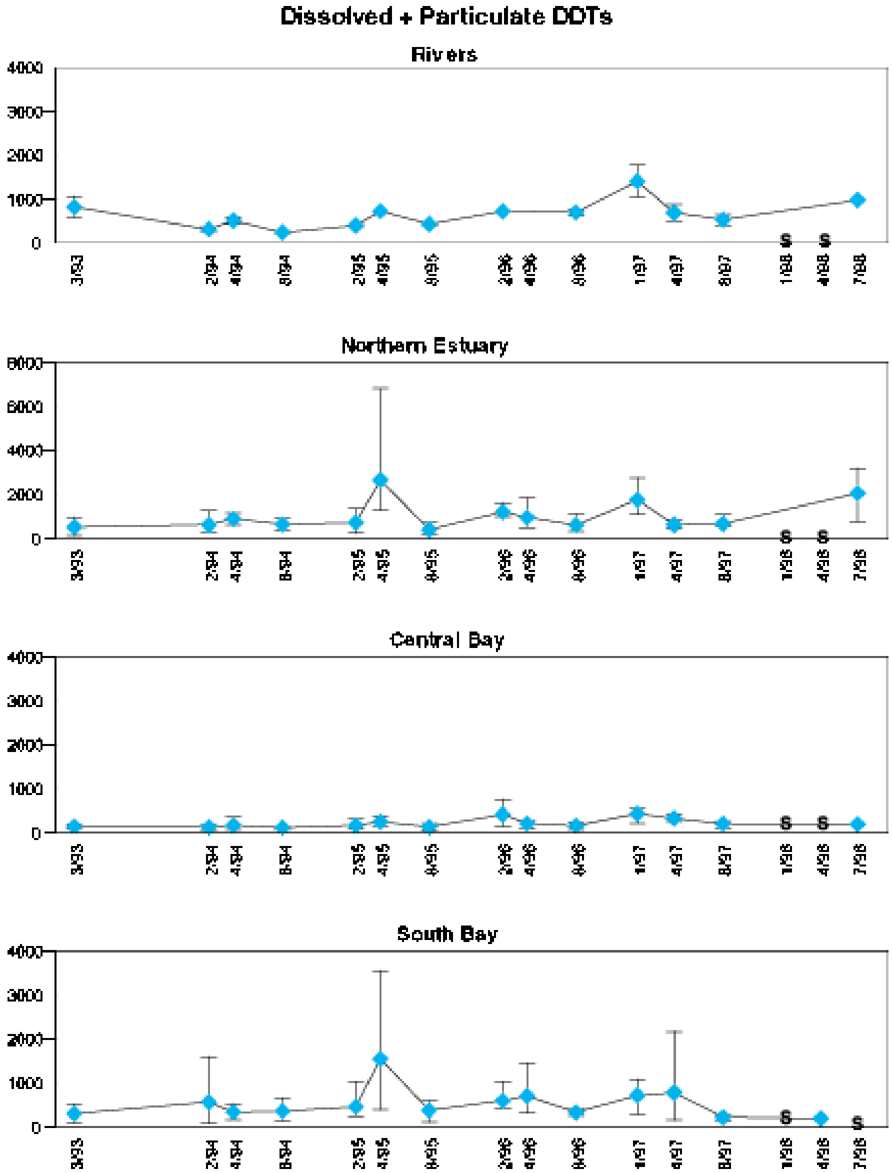


Figure 2.39. Plots of average dissolved + particulate DDT concentrations (parts per quadrillion, ppq) in water for each Estuary reach from 1993-1998. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

Figure 2.40

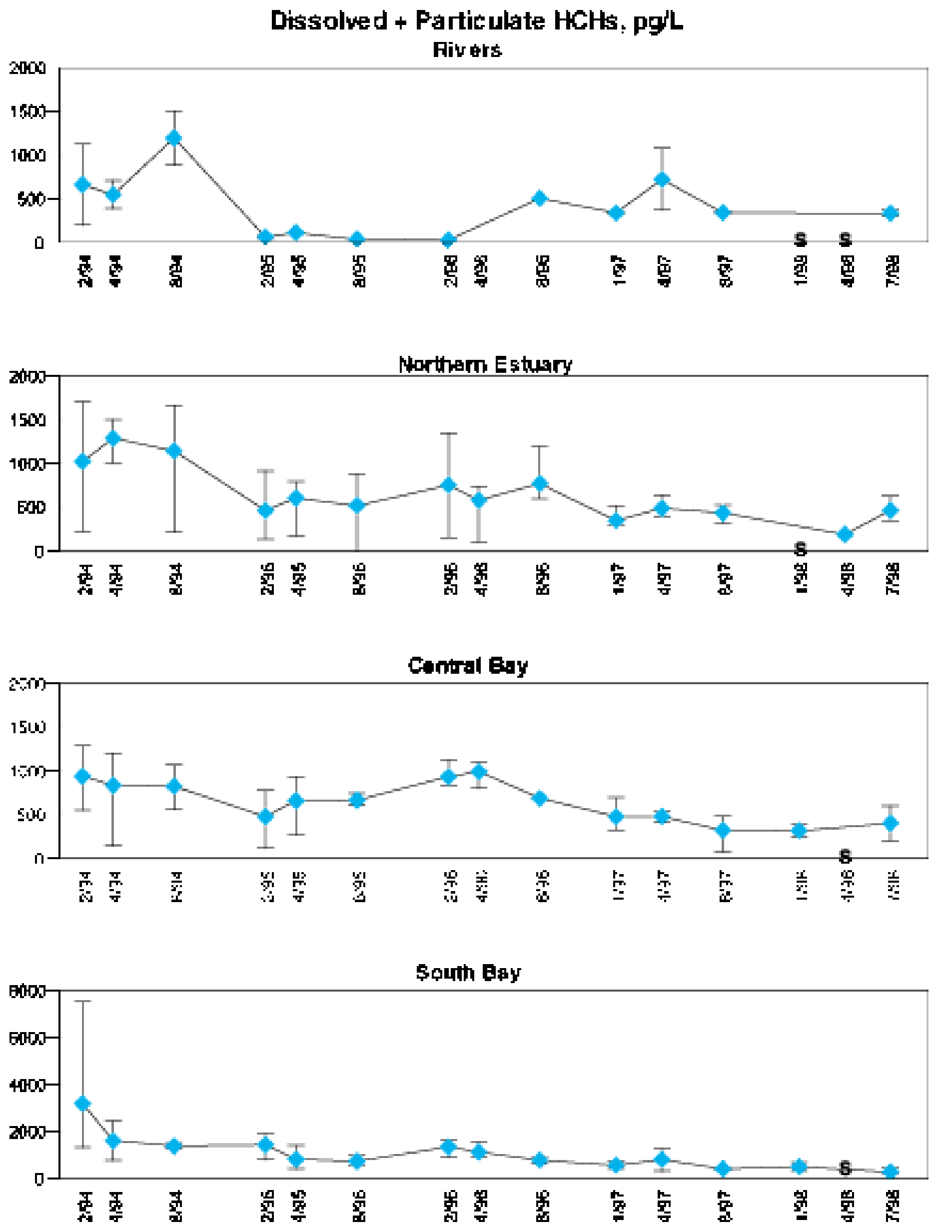


Figure 2.40. Plots of average dissolved + particulate HCH concentrations (parts per quadrillion, ppq) in water for each Estuary reach from 1993-1998. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

Sediment

3.1 Background

Sediments are monitored because they are a fundamental ecosystem component of the Bay, and they play a key role in the adsorption and transport of contaminants. Sediments serve as contaminant sources and sinks, and most contaminants are usually found in concentrations orders of magnitude higher in the upper few centimeters of sediments than in the water column. Information about sediments addresses aspects of all RMP Objectives (listed in the Introduction). In this section, patterns and trends in sediment contamination are described (Objective 1) and compared to several sets of sediment quality guidelines (Objective 4), while sediment bioassays address contaminant effects (Objective 3). Synthesis and interpretation of sediment information (Objective 5), and inferences about sources and loadings (Objective 2) will be addressed in a new RMP Technical Report, Atlas of Sediment Contamination, Toxicity, and Benthic Assemblages in San Francisco Bay.

Information about sediment contamination is used in making decisions related to many important management issues: the identification of sediment "toxic hot spots," currently a priority for the State and Regional Water Quality Control Boards; the clean-up of numerous military bases in the region which requires information about background contaminant levels; and the continuous dredging of the Estuary which requires testing and comparisons to some reference, or background, concentration. The RMP provides information that may be used by others to assess the condition of Estuary sediments. This information is also used in evaluation and redesign efforts for the RMP itself.

The geochemistry of sediments is complex, and in order to interpret contaminant concentrations measured in sediments it is necessary to understand how hydrology (flows) and other non-contaminant sediment properties may affect contaminant concentrations. An overview of Estuary hydrology and water quality was presented in the Introduction. CTD (conductivity, temperature, depth) profiles of the water column were collected at all RMP sediment stations. Those data are not presented in this report, but are available from the San Francisco Estuary Institute upon request. Several sediment quality parameters that may affect sediment contaminant concentrations (grain-size, organic carbon, ammonia, and sulfides) are also monitored, and are listed in the Data Tables.

Sediment contaminant monitoring includes trace elements and trace organic contaminants at 22 RMP Base Program stations. Sediments were also monitored at two stations at the southern end of the Estuary in cooperation with the Regional Board and the cities of San Jose (station C-3-0) and Sunnyvale (station C-1-3). As part of the Estuary Interface Pilot Study, sediments were monitored at two additional stations in the southern end of the Estuary: Standish Dam on Coyote Creek (station BW10) and Alviso Slough on the Guadalupe River (station BW15). For more information on this Pilot Study see RMP Technical Report #19 by Daum and Hoenicke, 1998.

Station locations are shown on Figure 1.1. Sediment samples were collected during the wet season (January-February) and dry season (August). Sampling dates are shown on Table 1.3 in the Introduction. Detailed methods of collection and analysis are included in the Description of Methods. Table 1.2 in the Introduction lists parameters measured in sediment. Sediment quality parameters including station depths, and all contaminant concentrations are tabulated in the Data Tables.

In order to compare sediment monitoring results among the major sub-regions of the Estuary, the RMP stations are separated into seven groups of stations (six base program plus Southern Sloughs) in five Estuary reaches based subjectively on geography, similarities in sediment types, and patterns of trace contaminant concentrations. The Estuary segments are: the Southern Sloughs (C-1-3 and C-3-0), South Bay (seven stations, BA10 through BB70), Central Bay (five stations, BC11 through BC60), Northern Estuary (eight stations, BD15 through BF40), and Rivers (BG20 and BG30). In addition, the Estuary Interface Pilot stations (BW10 and BW15) were included for comparative purposes. Stations with coarse sediments (>60% sand: three stations in the wet season and five in the dry season) generally have considerably lower contaminant concentrations and were identified on Figures 3.1-3.15.

Concentrations of total DDTs are not reported due to matrix interference. Total organic carbon (TOC) concentrations and the majority of % solids data for sediment cruise 16 in August have just been received and are currently being processed.

3.2 Sediment Quality Guidelines

There are currently no Basin Plan objectives or other regulatory criteria for sediment contaminant concentrations in the Estuary. However, several sets of sediment quality guidelines (Table 3.1) may be used as informal screening tools for sediment contaminant concentrations, but hold no regulatory status.

Sediment quality guidelines developed by Long et al. (1995) are based on data compiled from numerous studies in the United States that included sediment contaminant and biological effects information. The guidelines were developed to identify concentrations of contaminants that were associated with biological effects in laboratory, field, or modeling studies. The effects range-low (ERL) value is the concentration equivalent to the lower 10th percentile of the compiled study data, and the effects range-median (ERM) is the concentration equivalent to the 50th percentile of the compiled study data. Sediment concentrations below the ERL are interpreted as being "rarely" associated with adverse effects. Concentrations between the ERL and ERM are "occasionally" associated with adverse effects, and concentrations above the ERM are "frequently" associated with adverse effects. Effects range values for mercury, nickel, total PCBs, and total DDTs have low levels of confidence associated with them. The effects-range values used for chlordanes and dieldrin are from Long and Morgan (1990). There are no effects-range guidelines for selenium, but the Regional Board has suggested guidelines of 1.4 ppm (Wolfenden and Carlin, 1992), and 1.5 ppm (Taylor et al. 1992).

A set of sediment quality guidelines developed by the Regional Board and introduced in the 1997 RMP Annual Report were also used. Ambient Sediment Concentration (ASC) values are based on samples collected between 1991-1996 from the RMP and the Bay Protection and Toxic Cleanup Program (BPTCP). Samples collected from sites representative of the cleanest portions of the Estuary were used in deriving the "ambient" concentrations. This approach is thought to define contemporary ambient contaminant levels given the fact that virtually no San Francisco Bay sediments in the active layer are free of anthropogenic pollutants. Resulting ambient sediment concentrations are above pre-industrial "background" levels but below "toxic hot spot" levels. ASC values are different for sandy (< 40% fines) and muddy (> 40% fines) sediments. For more information on the ASC guidelines see Gandesbery and Hetzel. (1999) or Smith and Riege (1998). Both the Long et al (1995). and ASC guideline values are shown on the sediment contaminant concentration bar charts for comparative purposes.

3.3 Sediment Bioassays

Sediment bioassays are conducted to determine the potential for biological effects from exposure to sediment contamination. Two sediment bioassays were conducted at 14 of the RMP stations (Figure 3.16) in February and again in July-August of 1998. Sampling dates are listed in Table 1.3 in the Introduction. Amphipods (Eohaustorius estuarius) were exposed to whole sediment for ten days with percent survival as the endpoint. However, the elutriate test using Strongylocentrotus purpuratus was initiated during the February bioassays after Mytilus broodstock failed to spawn, and are included in the Data Tables. Larval mussels (Mytilus galloprovincialis) were exposed to sediment elutriates (water-soluble fraction) for 48 hours with percent normal development as the endpoint. The control sediment used in the Eohaustorius test was from the site near Newport, Oregon where the amphipods were collected. The control used for the Mytilus (mussel) test was clean seawater from Granite Canyon, California. The Description of Methods contains detailed methods of collection and testing and the QA Tables contains quality assurance information.

When a sample is found to be toxic, it is interpreted as an indication of the potential for biological effects. However, since sediments are mixtures of numerous contaminants, it is difficult to determine which contaminant(s) may have caused any toxicity observed (see 3.5 Discussion).

A sample was considered toxic if:

1. There was a significant difference between the laboratory control and test replicates using a t-test, and
2. The difference between the mean endpoint value in the control and the mean endpoint value in the test sample was greater than the 90th percentile minimum significant difference (MSD).

The MSD is a statistic that indicates the difference between the two means that will be considered statistically significant given the observed level of between-replicate variation and the alpha level chosen for the comparison. The 90th percentile MSD value is the difference that 90% of the t-tests will be able to detect as statistically significant. Use of the 90th percentile MSD is similar to establishing statistical power at a level of 0.90, and is a way to insure that statistical significance is determined based on large differences between means, rather than small variation among replicates. MSDs were established by analysis of numerous bioassay results for San Francisco Bay (Anderson and Hunt, unpubl.; Hunt et al. 1996). Based on those analyses, the 90th percentile MSD for Eohaustorius was 18.8% and for the bivalve larvae test 21%. For the 1998 sediment bioassays, an amphipod bioassay was toxic if it had below 78.2% survival in February and 79.2% July-August respectively. A larval bivalve bioassay was toxic it if had below 63% or 81% normal development in February or July-August, respectively.

3.4 Sediment Trends

Sediment contaminant concentrations have been measured at most of the RMP sites since 1991. Samples were collected by the State's Bay Protection and Toxic Clean-up Program (BPTCP) in 1991 and 1992, and by the RMP since 1993. Combining data from these two programs provides a time-series of 14 sampling periods over 8 years. Average and ranges of concentrations for several trace elements are shown for each major Estuary reach (Figures 3.18-3.27). Arsenic, cadmium, and mercury are not included for 1991 and 1992 due to quality control problems in the analyses.

Except for the Rivers, plots for the various Estuary segments represent only muddy sediments (<60% sand). At the River stations, one or both stations had coarse sediments in each sampling period. A separate plot is presented for stations with coarse (>60% sand) sediments that also includes the Rivers when sandy. Contaminant concentrations were generally lower in the coarse-grained than in the fine-grained samples.

In considering the trends in these plots, it is important to recognize that concentrations may be influenced by physical sediment factors as well as proximity to sources. In general, sediments with more silt and clay (percent fines) and higher TOC have higher concentrations than sediments with sandy sediments and low TOC. Therefore, some of the variation represented in the plots could be attributable to spatial and temporal variations in sediment type rather than in changes in concentrations per se. A draft RMP Technical Report to be released in the coming year examines sediment trends which take into account covarying factors of TOC and grain size.

3.5 Discussion

3.5.1 Discussion

Bay sediments are evaluated through comparisons to several sets of sediment quality guidelines described in Section 3.2. Although these guidelines hold no regulatory status, they provide concentration thresholds that may be used to assess the status of the Bay's sediments. They also provide one of three elements in a sediment quality assessment approach known as the Sediment Quality Triad (the other two being sediment toxicity and benthos (see Section 3.5.4).

High contaminant concentrations in sediments usually reflect a proximity to a source, anthropogenic or otherwise. This was illustrated by the RMP's Estuary Interface Pilot Study in Coyote Creek and Guadalupe River in South Bay (SFEI, 1999). However, concentrations can vary not only due to proximity to sources but also by the many and complex processes involved in sediment dynamics. For example, sediments with more silt and clay minerals contain higher concentrations of most contaminants than coarser, more sandy sediments because of their geochemical properties (Luoma, 1990; Horowitz, 1991). The strength and magnitude of freshwater inflows, through the transport of sediments and contaminants in both the dissolved and particulate fractions of the flows, may alter sediment type and contaminant distribution, particularly in estuarine regions such as San Francisco Bay (Krone, 1979). These kinds of relationships should be kept in mind in reviewing this summary.

3.5.2 Spatial Distributions

The southern sloughs and South Bay exhibit elevated contaminant concentrations when compared with the other reaches, as observed in previous years. The Estuary Interface Pilot Study stations located upstream from the southern sloughs also showed concentrations higher than those in the Central Bay, Northern Estuary, and river reaches, further emphasizing this pattern (SFEI, 1999; SFEI, 2000). Limited sampling points also hint at concentration gradients in some of the BPTCP sites (Mission Creek, Islais Creek, Peyton Slough), but more data are needed to confirm this. Concentration gradients of arsenic, cadmium, chromium, lead, selenium, zinc, PAHs, and PCBs were seen in channelized creeks draining to San Leandro Bay in an intensive, localized study (Daum et al., 2000).

Average concentrations of cadmium, lead, silver, zinc, PAHs, and PCBs were highest in sediments of the Southern Sloughs. The Estuary Interface sediment samples had the highest concentrations of chromium, copper, mercury, nickel, and selenium. Conversely, all contaminants except arsenic and dieldrin were lowest in the River and Central Bay reaches. As in previous years, arsenic was an exception to these trends with the highest average concentrations in the Northern Estuary and the lowest in the southern sloughs. Most of the high concentration values for individual stations were found at either southern slough or Estuary Interface stations.

Estuary Interface Study sites, and the southern slough sites near the outfalls San Jose and Sunnyvale usually had the most Effects Range exceedances (see Table 3.1). This is probably due to the fact that the watersheds which drain to this Bay reach cover a large area and consist of large percentages of urban land uses. The lowest sediment contaminant concentrations and number of guideline exceedances occurred at Richardson Bay, Red Rock, and Pacheco Creek stations, all of which are either Central Bay and/or coarse sediment stations. The 1998 El Niño produced observable changes in chlordanes in the Central Bay and PCBs at the Rivers (SFEI, 2000).

3.5.3 Trends

Two time scales are included in the current RMP sampling design: seasonal (wet and dry) and year to year. Trends in sediment contamination have been observed at both scales. Seasonal variation in some contaminants occurred at some sites, although only arsenic (Figure 3.1), mercury (Figure 3.6), and selenium (Figure 3.8) showed consistent variation throughout the Estuary based on seasonality (higher during dry weather sampling).

There were significant long term trends at a dozen RMP sites throughout most of the Estuary for one or more contaminants after normalizing for grain size and total organic carbon (TOC) (Thompson and Daum, 1999). Chromium and nickel showed significant increases at 9 and 7 of these stations respectively. Other contaminants showed increases or decreases at three or fewer stations. Coyote Creek, Pinole Point, and Petaluma River showed numerous significant changes in contaminant concentrations over time. Overall, significant long-term (five to eight years) trends have been observed in less than 10% of RMP samples collected through 1997. The coarse sediment stations generally had the lowest range of variation over time for metals, but not organics.

Interestingly, the Southern Sloughs and River Stations showed no significant trends. This may be due to the inherently dynamic hydrologic conditions in these areas. Time trends analyses require a large enough sample size i.e. enough measurements over time at a given location, to produce statistically significant results. The majority of RMP samples showed no significant changes in contaminant concentrations over time. This may be due to the fact that there were indeed no changes, or that there was not a large enough sample size to make a determination.

Sampling at a series of depths in the sediment can reveal trends in historical contamination levels. Such sampling indicates that most contaminants have dropped from peak levels seen in the 1960s and 1970s (Venkatesan et al. 1999) probably resulting from wastewater treatment improvements, product bans, and other regulatory actions.

Changes in sediment concentrations over time reflect a complex set of processes that include deposition, resuspension, mixing and transport, and biogeochemistry. The interplay of these processes determines the "active sediment layer" and any burial rates. The actual depth of the active layer was determined to be a key factor in the mass balance, and flux of chlorinated hydrocarbons in sediments (Davis et al. 1999). Active mixing and low deposition rates generally account for the long resident times of contaminants in surface sediments in the Bay.

Our understanding of sediment contamination trends in the Estuary were placed in a historic perspective by recently published USGS sediment coring studies (Van Geen and Luoma, 1999). The earliest evidence of contamination associated with human occupation and industrialization was found for mercury, in sediments deposited between 1850 and 1880 as a result of gold mining activities. Maximum concentrations were 20 times the baseline (i.e. pre-anthropogenic) concentrations. Silver, lead, copper, and zinc contamination first appeared after 1910 in the Bay sediment record. Most contaminant concentrations have decreased from the peaks seen in the 1960s and 1970s (Hornberger, et al. 1999).

3.5.4 Sediment Toxicty

Toxicity tests were conducted to indicate whether sediments were toxic to sensitive organisms, and are described in Section 3.3. Because these bioassays were conducted using non-resident organisms in laboratory exposures, the results may not necessarily indicate that actual ecological impacts occurred.

Bay sediments were toxic to either amphipods or bivalve embryos in 70% of the RMP samples tested between 1991 and 1998. The two tests showed different patterns of toxicity at the different RMP sites. Toxicity at sites near the confluence of tributaries showed higher incidence of bivalve embryo toxicity, and sites in the South Bay showed higher incidence of amphipod toxicity. Sediments were usually more toxic during the wet, than the dry sampling period. Other than an increasing trend in toxicity at Yerba Buena Is., there have been no significant increases or decreases in the incidence of toxicity at the RMP sites.

The exact causes of the toxicity to the amphipods and bivalve embryos are not known. However, analyses using several years of monitoring data suggested that the cumulative effects of mixtures of contaminants was associated with amphipod toxicity (Thompson et al. 1999c). A few individual contaminants were identified at some sites as probable determinants of toxicity. For example, toxicity at Grizzly Bay was related to covarying patterns of total chlordane, silver and cadmium between 1991-1996. At Alameda and San Bruno Shoal, seasonal variation in PAHs were related with percent survival. For the bivalve embryos, TIEs were conducted on the sediment elutriates from the Sacramento, and San Joaquin rivers and Grizzly Bay in 1997 and 1998, and indicated that dissolved metals (divalent cations) were probably responsible for the observed toxicity. Non-polar organic contaminants were also implicated at the Sacramento River site (Phillips et al., 1999). The above results have suggested that sediment toxicity may be related to different contaminants at the various RMP sites, and may change over time.

Another major study of sediment toxicity was conducted as part of the Bay Protection and Toxic Cleanup Program (BPTCP) in 1997 (Hunt et al. 1998). Toxicity tests of reference sites showed results in survival, growth, and larval development similar to those observed in laboratory controls.

During the past two years RMP investigators have conducted additional sampling and experiments focused on discovering the cause(s) of sediment toxicity. Those studies have demonstrated the complex nature of sediment toxicity owing to the numerous contaminant and non-contaminant factors in estuary sediments. Solid phase sediment toxicity to amphipods has been frequently observed at Redwood Creek and Grizzly Bay. Exposure to pore water from those sites did not produce toxicity, but exposure to bulk sediment did, suggesting that the toxicity is associated with ingestion of sediment particles. Amphipods accumulated PAHs, organochlorine pesticides, and PCBs from exposures to both bulk sediment and pore water, but not to levels known to cause mortality. Accumulation of PAHs accounted for most of the accumulation and may be a key causitive agent. However, mixtures of contaminants are also believed to be important agents (Anderson et al. 2000).

Sediment elutriates (water soluble fraction) have been toxic to bivalve larvae at the Sacramento, and San Joaquin River, and Grizzly Bay sites since 1993. TIEs have been conducted to evaluate which contaminants were responsible. Trace metals, particularly copper were shown to be, at least partially responsible for the toxicity, but organic contaminants were also identified as toxic components at the Sacramento River site (Phillips et al. 2000).

3.5.5 Effects of Sediment Contamination

The only RMP component that has addressed actual ecological effects of contamination in the Bay has been the Benthic Pilot Study. Preliminary screening of benthic samples (n=501) collected between 1994 and 1997 indicated that 16.6% percent of those samples had some evidence of contaminant impacts (Lowe et al. 1999). The remaining samples were considered to be reference, or unimpacted benthic samples and used in comparisons with samples collected by BADA near three large wastewater discharges and samples collected by the BPTCP. Only a few samples from near the BADA outfalls (1994-1997) were considered to be slightly impacted (Thompson et al., 1999a). BPTCP samples from several locations along the margins of the Bay were moderately to severely impacted (Hunt et al. 1998).

In another EPA funded study of the role of introduced species on benthos, sites with elevated sediment contamination and slightly to moderately impacted benthos had lower proportions of introduced species the reference sites (Lee et al. 1999).

The USGS has also been studying the effects of sediment contamination on benthic organisms. Bioaccumulation of metals by clams near the Palo Alto wastewater discharge (Hornberger, et al., 2000has shown that concentrations in their tissues has decreased as emissions of metals have decreased from those POTWs. The reproductive cycle and condition of the introduced Asian clam Potamocorbula amurensis, the dominant species in the estuarine portions of the Bay, were impaired by exposure to cadmium in sediments in the north Bay. The RMP Sediment Workgroup has recommended that the RMP undertake studies of resident, deposit feeding bivalves to improve our understanding contaminant uptake and effects on the benthos.

3.5.6 Assessment of Sediment Conditions using the Sediment Quality Triad

Assessments of sediment condition are often conducted using an approach that considers information about sediment contamination, sediment toxicity, and benthic community conditions; bioaccumulation or other biomarkers may also be used. That approach is known as the Sediment Quality Triad (Chapman et al., 1997). RMP results from 1998 marked the first year that a triad assessment could be accomplished for the RMP sites (Table 3.2).

Sediment contamination in each sample was evaluated by considering the number of contaminants that exceeded the San Francisco Estuary Ambient Sediment Concentration (ASC, Smith and Riege, 1998), Effects-Range guidelines (ERL and ERM, Long et al., 1995), and the ERM quotients (Long et al., 1998, see Sediment chapter of the 1998 RMP Annual Report for details). The number of sediment contaminants above the ERL or ERM guidelines has been used to predict potential sediment toxicity (Long et al., 1998). More than four ERM exceedances predicted toxicity in 68% of the tests, and when 10 to 14 ERLs were exceeded more than 89% of the samples were toxic. Therefore, to evaluate the 1998 RMP sediment results, sediment samples were considered possibly toxic if 4 or more ERMs or 10 or more ERLs were exceeded, or if half (22) of the ASC values were exceeded.

The mean ERM quotient (mERMq) may be considered to be a cumulative index of sediment contamination related to adverse ecological effects. Amphipod toxicity was significantly, and inversely correlated to mERMq (Thompson et al., 1999). Analysis of RMP data collected between 1991 and 1997 showed that mERMq values below 0.178 were never toxic toxic to amphipods, while mERMq values above 0.288 were toxic in 64% of the tests. Those values were used to evaluate potential for toxicity in the 1998 RMP samples.

Benthic assessments were made for nine sediment samples each season by comparing key benthic attributes at test sites to "ambient" reference conditions resulting in a qualitative comparison of each benthic community to "ambient" reference communities. The preliminary benthic assessment method used was developed under the RMP Benthic Pilot Study (Lowe et al., 1999). The sediment assessment showed that 29 of 52 samples had mERMq values above 0.288, suggesting a potential for toxicity. Of those, thirteen were shown to be toxic by the RMP toxicity tests, three were not; thirteen were not tested. Eight of the 29 samples had more than ten ERL exceedances (one of these had more than four ERM exceedances), which added to the weight-of-evidence for potential toxicity or impairment at those sites.

Three samples from the benthic assessments indicated slight ecological impacts even though toxicity tests were not toxic, mERMq values for two of the samples predicted toxicity (were above 0.288). Six benthic samples showed no impact but the sediments were toxic. Only two samples had mERMq values that predicted toxicity. Redwood Creek (BA41) and San Bruno Shoal (BB15) had no discernable benthic impact although samples had elevated mERMqs and were toxic to amphipods in three of the four samples. Only one sample, Davis Point (BD41), showed no evidence of in pacts in sediment chemistry, toxicity, or benthos.

Sediment assessments are useful tools that integrate sediment contamination, toxicity and ambient ecological condition into a weight-of-evidence evaluation of condition of the sediments in the Estuary. Each component of the triad is analyzed independently and should be related, but as shown, they not always provide similar answers. This kind of ecological complexity demonstrates the need to consider as much data as possible in sediment assessments and to undertake studies to try to reconcile and understand apparent contradictions.

3.5.7 References

Anderson, B., Hunt, J., Phillips, B., Sericano, J., 2000. Investigations of chemicals associated with amphipod mortality at two Regional Monitoring Program stations. Draft RMP Technical Report. SFEI, 16 pp.

Chapman, P. M., Anderson, B, Carr, S., et al.,1997. General Guidelines for using the Sediment Quality Triad. Marine Pollution Bulletin. 34:368-372.

Daum, T., and G. Bartow. 2000. Sediment Contamination in San Leandro Bay, CA: a Watershed-based Investigation. Draft Report to SFBRWQBC, San Francisco Estuary Institute. Richmond, CA.

Davis, J.A. 1999. Technical Report of the Chlorinated Hydrocarbon Workgroup. San Francisco Estuary Institute, Richmond, CA.

Gandesbery, T. and F. Hetzel. 1999. Ambient concentrations of toxic chemicals in San Francisco Bay sediments: Summary. In: 1997 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. San Francisco Estuary Institute, Richmond, CA. pp. 140–147.

Hornberger, M., S. Luoma, A. van Geen, C. Fuller, and R. Anima. 1999. Historical Trends of Metals in the Sediments of San Francisco Bay, California. Mar. Chem. 64: 39-55.

Hornberger, M., S. Luoma, D. Cain, F. Parchaso, C. Brown, R. Bouse, C. Wellise, J. Thompson. 2000. Linkage of Bioaccumulation and Biological Effects to Changes in Pollutant Loads in South San Francisco Bay. Environmental Science and Technology. 60.

Horowitz, A. 1991. A Primer on Sediment-Trace Element Chemistry, 2nd rev. ed. Lewis Publishers/CRC Press, Inc. Boca Raton, FL. 136 pp.

Hunt, J.W., B.S. Anderson, S. Tudor, M.D. Stephenson, H.M. Puckett, F.H. Palmer, and M. Reeve. 1996. Marine Bioassay Project, Eighth Report: Refinement and implementation of four effluent toxicity testing methods using indigenous marine species. Report #94-4. State Water Resources Control Board, Sacramento, CA. pp. 85-104.

Hunt, J., B. Anderson, B. Phillips, J. Newman, R. Tjeerdema, K. Taberski, C. Wilson, M. Stephenson, H. Puckett, R. Fairey, and J. Oakden. 1998. Bay Protection and Toxic cleanup Program Final Technical Report. California State Water Resources Control Board, Sacramento, CA.

Krone, R. 1979. Sedimentation in the San Francisco Bay system, In: San Francisco Bay, the Urbanized Estuary. T. Conomos, ed. Pacific Div. of the Amer. Assoc. for the Advancement of Science, San Francisco. pp. 85-96.

Long, E.R. and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Tech. Memo NOS OMA 52. National Oceanic and Atmospheric Administration, Seattle, WA. 175p.

Long, E.R., D.D. MacDonald, S.L. Smith and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Env. Mgmt. 19:18–97.

Long, E. R., L. J. Field, and D. D. MacDonald. 1998. Predicting toxicity in marine sediments with numerical sediment quality guidelines. Environmental Toxicology and Chemistry. 17:714-727

LTMS. 1996. Draft Environmental Impact Statement/Programmatic Environmental Impact Report, Vol. 1. Long Term Management of Sediments, Oakland, CA.

Luoma, S.N. 1990. Processes affecting metal concentrations in estuarine and coastal marine sediments. In: Heavy metals in the marine environment. R.W. Furness and P.S. Rainbow, (eds.). CRC Press, Inc., Boca Raton, FL.

Lowe, S., B. Thompson. 2000. A Preliminary Assessment of Benthic Responses to Sediment Contamination in San Francisco Bay. Regional Monitoring Program Technical Report. San Francisco Estuary Institute, Richmond, CA.

Phillips, B., Anderson, B., Hunt, J. 2000. Investigations of sediment elutriate toxicity at three estuarine stations in San Francisco Bay, California. Draft RMP Technical Report. SFEI, 16 pp.

SFEI. 1999. 1997 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. San Francisco Estuary Institute, Richmond, CA.

SFEI. 2000. In Preparation. 1998 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. San Francisco Estuary Institute, Richmond, CA.

Smith, R.W. and L. Riege, 1998. San Francisco Bay Sediment Criteria Project Ambient Analysis Report. Report prepared for the CRWQCB by EcoAnalysis, Inc. Ojai, CA.

Taylor, K., W. Pease, J. Lacy, and M. Carlin. 1992. Mass Emissions Reduction Strategy for Selenium. San Francisco Regional Water Quality Control Board, Oakland, CA. 61p.

Thompson, B., Anderson, B., Hunt J., Taberski K., Phillips B. 1999. Relationships Between Sediment Contamination and Toxicity in San Francisco Bay. Marine Environ. Research.

Thompson, B. and T. Daum. 1999. Atlas of Sediment Contamination, Toxicity, and Benthic Assemblages in San Francisco Bay. Draft Regional Monitoring Program Report. San Francisco Estuary Institute. Richmond, CA.

U.S. EPA. 1991. Proposed sediment quality criteria for the protection of benthic organisms: 5 draft reports: Acenaphthene; Dieldrin; Endrin; Fluoranthene; Phenanthrene.

van Geen, A., and S. Luoma. 1999. The Impact of Human Activities on Sediments of San Francisco Bay, California: an Overview. Mar. Chem. 64: 1-6.

Wolfenden, J.D. and M.P. Carlin. 1992. Sediment screening criteria and testing requirements for wetland creation and upland beneficial reuse. California Environmental Protection Agency and California Regional Water Quality Control Board.

References

Barrick, R., S. Becker, R. Pastorok, L. Brown, and H. Beller. 1988. Sediment quality values refinement: 1988 update and evaluation of Puget Sound AET. Vol. I. Prepared for Tetra Tech Inc. and U.S. EPA Region 10. PTI Environmental Services, Bellevue, WA.

Gandesbery, T. 1998. Ambient concentrations of toxic chemicals in sediments. MEMO: Regional Boards Staff, from Tom Gandesbery, March 1998, File No: 1150.00.

Gandesbery, T. and F. Hetzel. 1999. Ambient concentrations of toxic chemicals in San Francisco Bay sediments: Summary. In 1997 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. San Francisco Estuary Institute, Richmond, CA. pp. 140<ETH>147.

Hornberger, M.I., S.N. Luoma, A. van Geen, C. Fuller, and R. Anima. 1999. Historical trends of metals in the sediments of San Francisco Bay, California. Marine Chemistry, 64:39<ETH>55.

Hunt, J.W., B.S. Anderson, S. Tudor, M.D. Stephenson, H.M. Puckett, F.H. Palmer, and M. Reeve. 1996. Marine Bioassay Project, Eighth Report: Refinement and implementation of four effluent toxicity testing methods using indigenous marine species. Report #94-4. State Water Resources Control Board, Sacramento, CA. pp. 85<ETH>104.

Long, E.R. and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Tech. Memo NOS OMA 52. National Oceanic and Atmospheric Administration, Seattle, WA. 175p.

Long, E.R., D.D. MacDonald, S.L. Smith and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Env. Mgmt. 19(1):81<ETH>97.

Pereira, W.E., F.D. Hostettler, S.N. Luoma, A. van Geen, C.C. Fuller, and R.J. Anima. 1999. Sedimentary record of anthropogenic polycyclic aromatic hydrocarbons in San Francisco Bay, California. Marine Chemistry 64:99-113.

Smith, R.W. and L. Riege, 1998. San Francisco Bay Sediment Criteria Project Ambient Analysis Report. Report prepared for the CRWQCB by EcoAnalysis, Inc. Ojai, CA.

Taylor, L., W. Pease, J. Lacy, and M. Carlin. 1992. Mass Emissions Reduction Strategy for Selenium. San Francisco Regional Water Quality Control Board, Oakland, CA. 61p.

Wolfenden, J.D. and M.P. Carlin. 1992. Sediment screening criteria and testing requirements for wetland creation and upland beneficial reuse. California Environmental Protection Agency and California Regional Water Quality Control Board.

Table 3.1. Sediment quality guidelines for evaluation of chemical concentrations in sediment.
. = no value available

Parameter	unit (dry wt)	ERL[1]	ERM[1]	ASC[2]-sandy <40% fines	ASC[2]-muddy >40% fines	Amphipod AET[3]	Bivalve AET[3]	Background Concentrations (Baywide ranges)[4, 5] Total	Near Total
Arsenic	mg/kg	8.2	70	13.5	15.3	.	.	.	.
Cadmium	mg/kg	1.2	9.6	0.25	0.33	6.7	9.6	.	.
Chromium	mg/kg	81	370	91.4	112	270	.	110 - 170	70 - 120
Copper	mg/kg	34	270	31.7	68.1	1300	390	20 - 55	20 - 41
Mercury	mg/kg	0.15	0.71	0.25	0.43	2.1	0.59	.	0.05 - 0.05
Nickel	mg/kg	20.9	51.6	92.9	112	.	.	70 - 100	50 - 100
Lead	mg/kg	46.7	218	20.3	43.2	660	660	20 - 40	10 - 20
Selenium	mg/kg	.	.	0.59	0.64	.	.	.	.
Silver	mg/kg	1	3.7	0.31	0.58	5.9	0.56	0.1 - 0.1	0.1 - 0.1
Zinc	mg/kg	150	410	97.8	158	960	1600	60 - 70	50 - 100
Total HPAHs	µg/kg	1700	9600	256	3060	69000	17000	.	.
Fluoranthene	µg/kg	600	5100	78.7	514	30000	2500	.	.
Perylene	µg/kg	.	.	24	145	.	.	.	.
Pyrene	µg/kg	665	2600	64.6	665	16000	3300	.	.
Benz(a)anthracene	µg/kg	261	1600	15.9	244	5100	1600	.	.
Chrysene	µg/kg	384	2800	19.4	289	9200	2800	.	.
Benzo(b)fluoranthene	µg/kg	.	.	32.1	371	.	.	.	.
Benzo(k)fluoranthene	µg/kg	.	.	29.2	258	.	.	.	.
Benzo(b,k)fluoranthene	µg/kg	.	.	.	.	7800	3600	.	.
Benzo(a)pyrene	µg/kg	430	1600	18.1	412	3000	1600	.	.
Benzo(e)pyrene	µg/kg	.	.	17.3	294	.	.	.	.
Dibenz(a,h)anthracene	µg/kg	63.4	260	3	32.7	540	230	.	.
Benzo(g,h,i)perylene	µg/kg	.	.	22.9	310	1400	720	.	.
Indeno(1,2,3-c,d)pyrene	µg/kg	.	.	19	382	1800	690	.	.
Total LPAHs	µg/kg	552	3160	37.9	434	24000	5200	.	.
1-Methylnaphthalene	µg/kg	.	.	6.8	12.1	.	.	.	.
1-Methylphenanthrene	µg/kg	.	.	4.5	31.7	.	.	.	.
2,3,5-Trimethylnaphthalene	µg/kg	.	.	3.3	9.8	.	.	.	.
2,6,-Dimethylnaphthalene	µg/kg	.	.	5	12.1	.	.	.	.
2-Methylnaphthalene	µg/kg	70	670	9.4	19.4	.	.	.	.
Naphthalene	µg/kg	160	2100	8.8	55.8	2400	2100		
Acenaphthylene	µg/kg	44	640	2.2	31.7	1300	.	.	.
Acenaphthene	µg/kg	16	500	11.3	26.6	2000	500	.	.
Fluorene	µg/kg	19	540	4	25.3	3600	540	.	.
Phenanthrene	µg/kg	240	1500	17.8	237	6900	1500	.	.
Anthracene	µg/kg	85.3	1100	9.3	88	13000	960	.	.
Total PAHs	µg/kg	4022	44792	211	3390	.	.	36 - 931	
p,p'-DDE	µg/kg	2.2	27	.	.	15	.	.	.
DDD	µg/kg	.	.	.	.	43	.	.	.
DDT	µg/kg	.	.	.	.	.	.	.	.
Total DDTs	µg/kg	1.58	46.1	2.8	7	.	.	.	.
Total Chlordanes	µg/kg	0.5	6	0.42	1.1	.	.	.	.
Dieldrin	µg/kg	0.02	8	0.18	0.44	.	.	.	.
Endrin	µg/kg	.	.	.	.	.	.	.	.
TOTAL PCBs (NIST 18)	µg/kg	.	.	5.9	14.8	3000	1100	.	.
Total PCBs	µg/kg	22.7	180	8.6	21.6	3000	1100	.	.

[1] Long *et al*., 1995.
[2] Gandesbery, 1998; Smith and Riege, 1998.
[3] Barrick *et al*., 1988.
[4] Hornberger *et al*., 1999.
[5] Pereira *et al*., 1999.

Table 3.2. Triad summary of sediment quality guideline evaluation, sediment toxicity, and benthic evaluation for the RMP in 1998. **.** = not evaluated

CODE	SITE NAME	DATE	mERMq	No. of ASC above Guidelines	No. of ERL above Guidelines	No. of ERM above Guidelines	Toxic to Amphipods?	Toxic to Bivalves?	Benthic Evaluation
BA10	Coyote Creek	02/11/98	0.5538	9	10	2	yes	yes	.
BA21	South Bay	02/10/98	0.4506	6	8	1	yes	no	slight impact
BA30	Dumbarton Bridge	02/10/98	0.2934	2	6	1	.	.	.
BA41	Redwood Creek	02/10/98	0.3459	3	6	1	yes	no	No impact
BB15	San Bruno Shoal	02/10/98	0.2969	2	4	1	yes	no	No impact
BB30	Oyster Point	02/10/98	0.2435	1	6	1	.	.	.
BB70	Alameda	02/10/98	0.2872	1	7	1	yes	no	No impact
BC11	Yerba Buena Island	02/09/98	0.2319	0	5	1	yes	no	No impact
BC21	Horseshoe Bay	02/09/98	0.2277	5	7	1	no	no	slight impact
BC32	Richardson Bay	02/09/98	0.2687	1	4	1	.	.	.
BC41	Point Isabel	02/09/98	0.3258	2	6	1	.	.	.
BC60	Red Rock	02/09/98	0.2584	2	3	1	no	no	.
BD15	Petaluma River	02/06/98	0.3534	3	7	1	.	.	No impact
BD22	San Pablo Bay	02/06/98	0.3031	7	7	1	.	.	.
BD31	Pinole Point	02/06/98	0.2751	1	6	1	.	.	slight impact
BD41	Davis Point	02/06/98	0.2227	5	4	1	no	yes	No impact
BD50	Napa River	02/06/98	0.3363	7	11	1	yes	yes	.
BF10	Pacheco Creek	02/05/98	0.1584	4	3	1	.	.	.
BF21	Grizzly Bay	02/05/98	0.3231	3	5	1	yes	yes	.
BF40	Honker Bay	02/05/98	0.3771	5	6	1	.	.	.
BG20	Sacramento River	02/05/98	0.2213	8	2	1	no	yes	.
BG30	San Joaquin River	02/05/98	0.1934	0	4	1	no	yes	.
BW10	Standish Dam	02/04/98	0.3297	5	8	2	.	.	.
BW15	Guadalupe River	02/04/98	0.4827	8	10	2	.	.	.
C-1-3	Sunnyvale	02/11/98	0.3013	5	7	2	.	.	.
C-3-0	San Jose	02/11/98	0.4094	7	8	1	yes	yes	.
BA10	Coyote Creek	08/04/98	0.3842	4	9	1	yes	yes	.
BA21	South Bay	08/04/98	0.3361	3	6	1	yes	yes	No impact
BA30	Dumbarton Bridge	08/04/98	0.3394	2	9	1	.	.	.
BA41	Redwood Creek	08/04/98	0.2803	0	8	1	yes	no	No impact
BB15	San Bruno Shoal	08/04/98	0.3257	3	5	1	no	no	No impact
BB30	Oyster Point	08/04/98	0.2355	0	4	1	.	.	.
BB70	Alameda	08/03/98	0.3267	7	9	1	no	no	No impact
BC11	Yerba Buena Island	08/03/98	0.2988	17	14	1	yes	yes	slight impact
BC21	Horseshoe Bay	08/03/98	0.2110	27	3	1	no	no	No impact
BC32	Richardson Bay	08/03/98	0.2680	0	7	1	.	.	.
BC41	Point Isabel	08/03/98	0.2880	1	7	1	.	.	.
BC60	Red Rock	07/31/98	0.1619	0	2	1	no	no	.
BD15	Petaluma River	07/31/98	0.3381	2	5	1	.	.	slight impact
BD22	San Pablo Bay	07/31/98	0.3378	18	12	1	.	.	.
BD31	Pinole Point	07/31/98	0.2626	0	6	1	.	.	No impact
BD41	Davis Point	07/31/98	0.1946	1	2	1	no	no	No impact
BD50	Napa River	07/31/98	0.3743	4	7	1	yes	yes	.
BF10	Pacheco Creek	07/30/98	0.2040	14	2	1	.	.	.
BF21	Grizzly Bay	07/30/98	0.3551	3	8	1	no	yes	.
BF40	Honker Bay	07/30/98	0.3654	3	8	1	.	.	.
BG20	Sacramento River	07/30/98	0.1889	0	3	1	no	yes	.
BG30	San Joaquin River	07/30/98	0.2441	0	4	1	no	yes	.
BW10	Standish Dam	08/06/98	0.4214	6	10	2	.	.	.
BW15	Guadalupe River	08/06/98	0.4815	10	11	2	.	.	.
C-1-3	Sunnyvale	08/05/98	0.2801	1	7	1	no	yes	.
C-3-0	San Jose	08/05/98	0.6896	18	16	4	no	yes	.

Figure 3.1

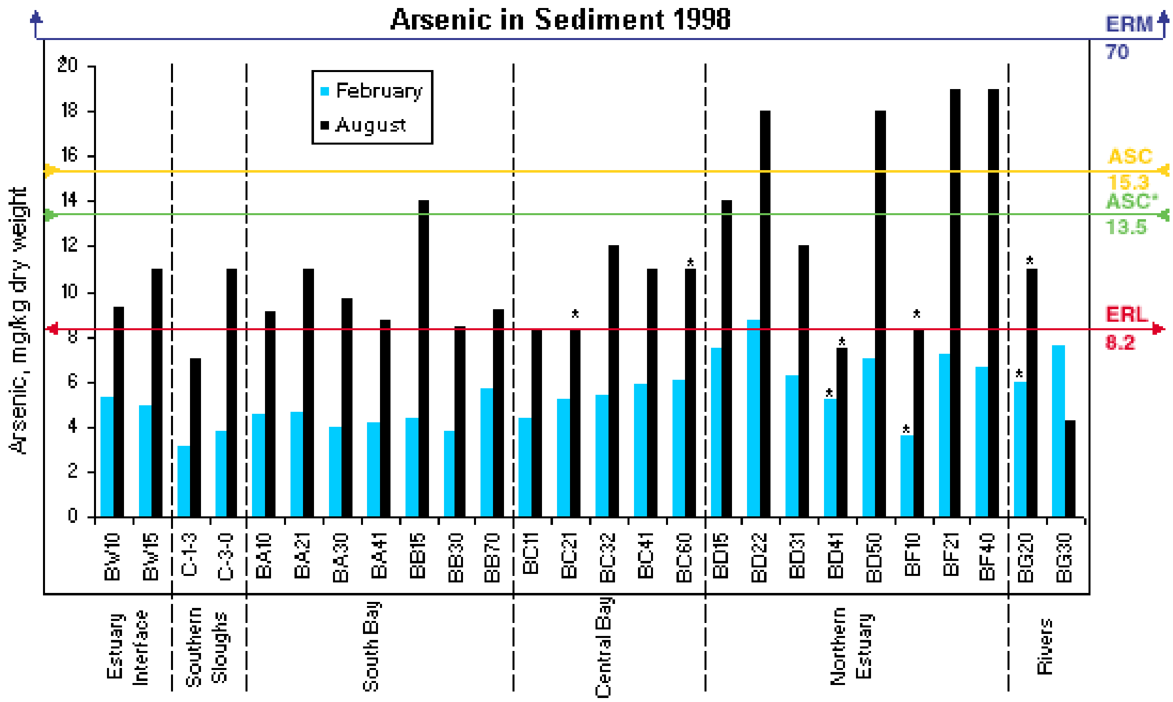


Figure 3.1. Arsenic (As) concentrations in sediment in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Arsenic concentrations ranged from 3.1 to 19 ppm. The highest concentration was sampled at Honker Bay (BF40) and Grizzly Bay (BF21) in August and the lowest at Sunnyvale (C-1-3) in February. Average concentrations were highest (14.5 ppm) in the Northern Estuary in August and lowest (3.5 ppm) in the Southern Sloughs in February.

Figure 3.2

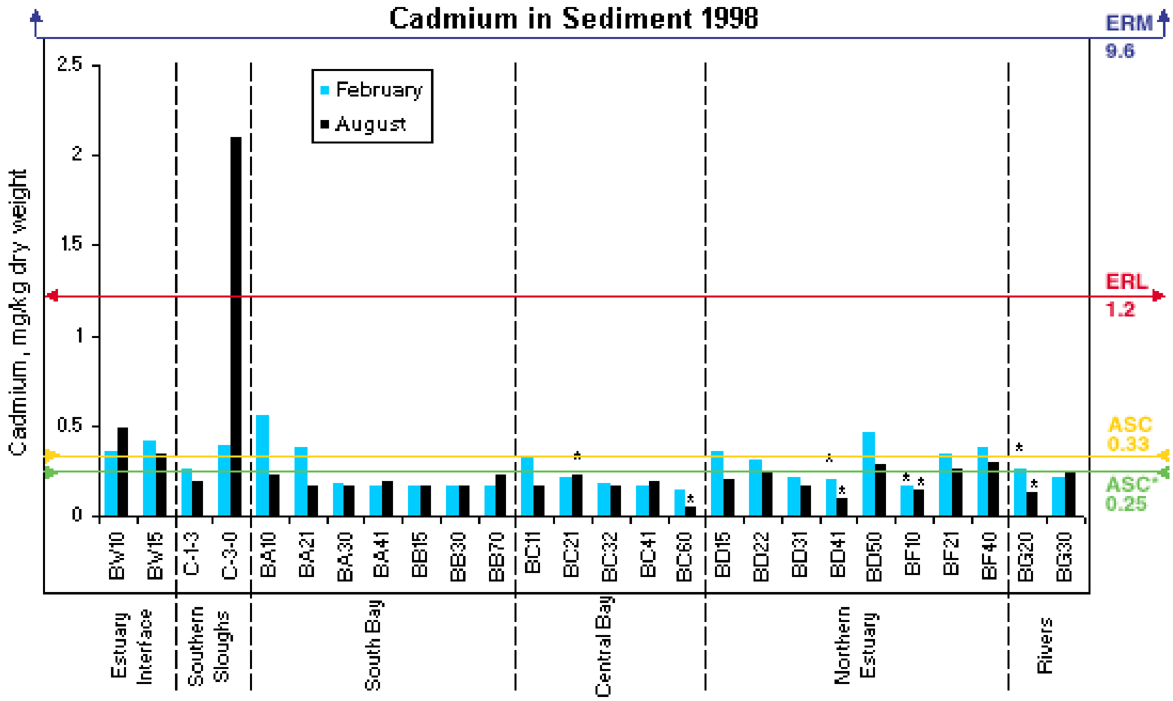


Figure 3.2. Cadmium (Cd) concentrations in sediment in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Cadmium concentrations ranged from 0.1 to 2.1 ppm. The highest concentration was sampled at San Jose (C-3-0) and lowest at Red Rock (BC60), both in August. Average concentrations were highest (1.1 ppm) in the Southern Sloughs and lowest (0.2 ppm) in the Central Bay, both in August.

Figure 3.3

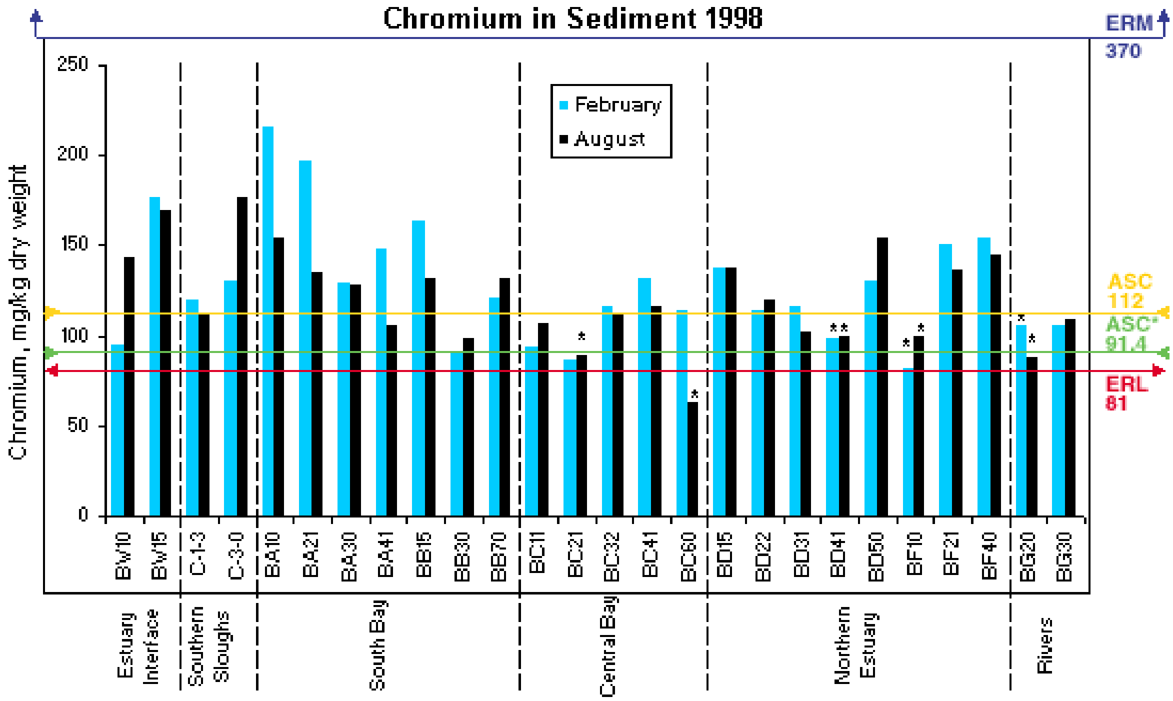


Figure 3.3. Chromium (Cr) concentrations in sediment in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Chromium concentrations ranged from 62.9 to 216 ppm. The highest concentration was sampled at Coyote Creek (BA10) in February and the lowest at Red Rock (BC60) in August. Average concentrations were highest (157 ppm) in the Estuary Interface and lowest (97.4 ppm) in the Central Bay, both in August.

Figure 3.4

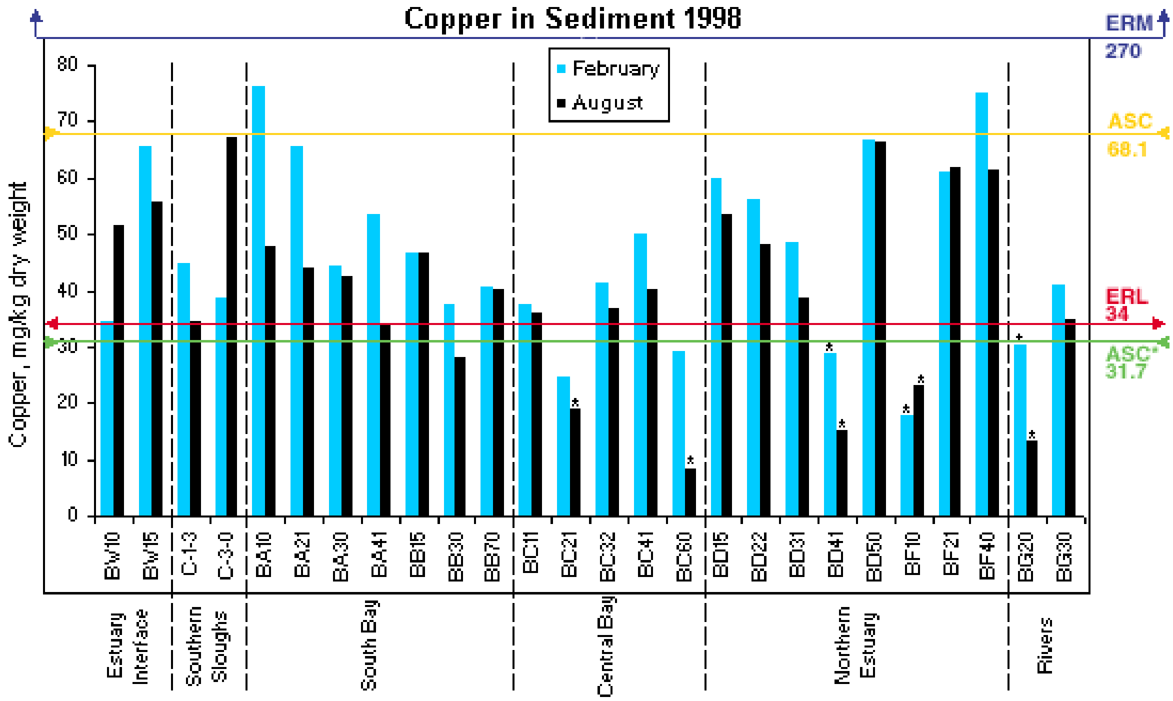


Figure 3.4. Copper (Cu) concentrations in sediment in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Copper concentrations ranged from 8.5 to 76.1 ppm. The highest concentration was sampled at Coyote Creek (BA10) in February and the lowest at Red Rock (BC60) in August. Average concentrations were highest (53.7 ppm) in the Estuary Interface and lowest (24.1 ppm) in the Rivers, both in August.

Figure 3.5

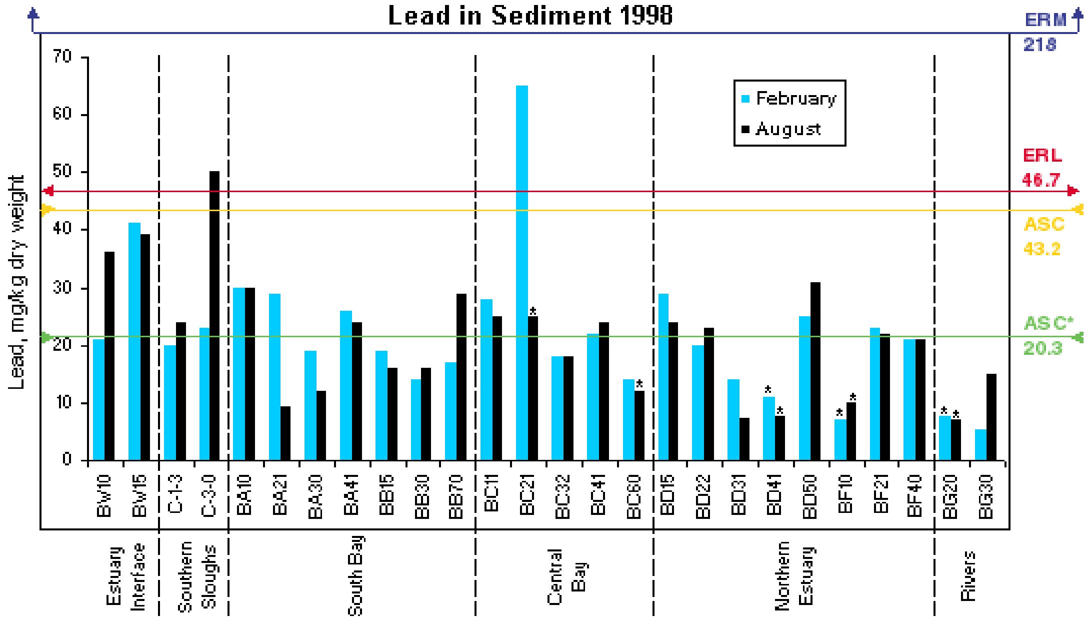


Figure 3.5. Lead (Pb) concentrations in sediment in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Lead concentrations ranged from 5.4 to 65 ppm. The highest concentration was sampled at Horseshoe Bay (BC21) and the lowest at San Joaquin River (BG30), both in February. Average concentrations were highest (38 ppm) in the Estuary Interface in August and lowest (6.6 ppm) in the Rivers in February.

Figure 3.6

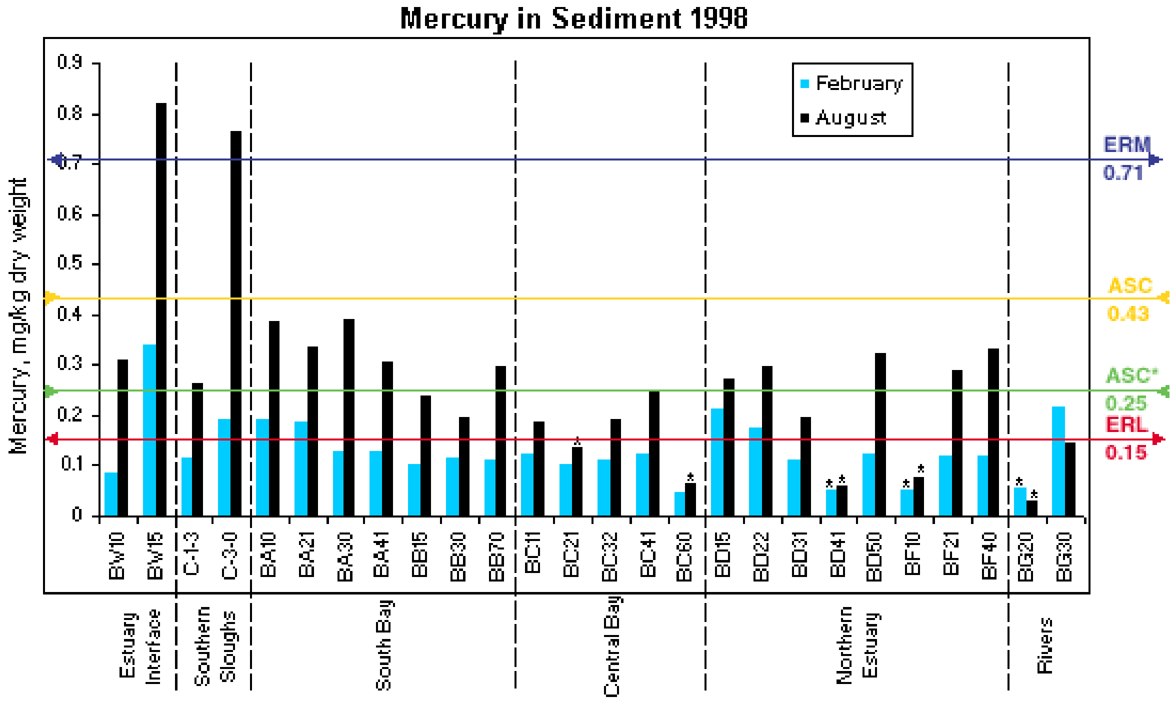


Figure 3.6. Mercury (Hg) concentrations in sediments in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Mercury concentrations ranged from 0.03 to 0.82 ppm. The highest concentration was sampled at Guadalupe River (BW15) and the lowest at Sacramento River (BG20), both in August. Average concentrations were highest (0.57 ppm) in the Estuary Interface and lowest (0.09 ppm) in the Rivers, both in August.

Figure 3.7

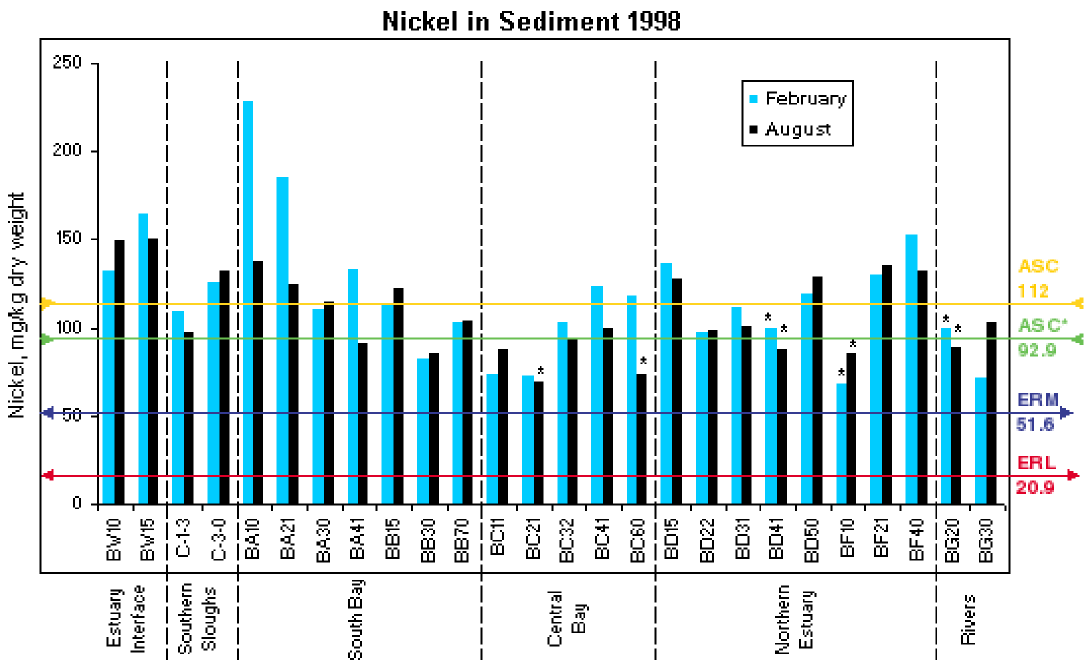


Figure 3.7. Nickel (Ni) concentrations in sediments in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Nickel concentrations ranged from 68.2 to 228 ppm. The highest concentration was sampled at Coyote Creek (BA10) and the lowest at Pacheco Creek (BF10), both in February. Average concentrations were highest (150 ppm) in the Estuary Interface and lowest (84.7 ppm) in the Central Bay, both in August.

Figure 3.8

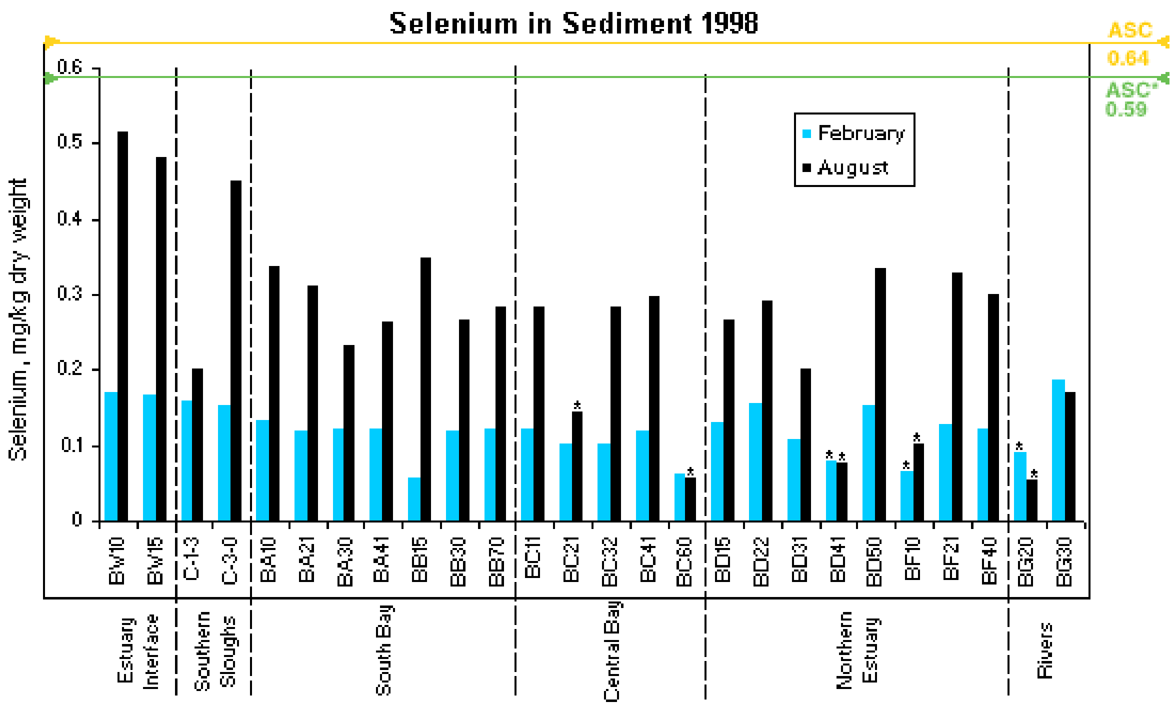


Figure 3.8. Selenium (Se) concentrations in sediments in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Selenium concentrations ranged from 0.06 to 0.52 ppm. The highest concentration was sampled at Standish Dam (BW10) and the lowest at Sacramento River (BG20), both in August. Average concentrations were highest (0.50 ppm) in the Estuary Interface in August and lowest (0.10 ppm) in the Central Bay in February. There are no ERM and ERL values for selenium.

Figure 3.9

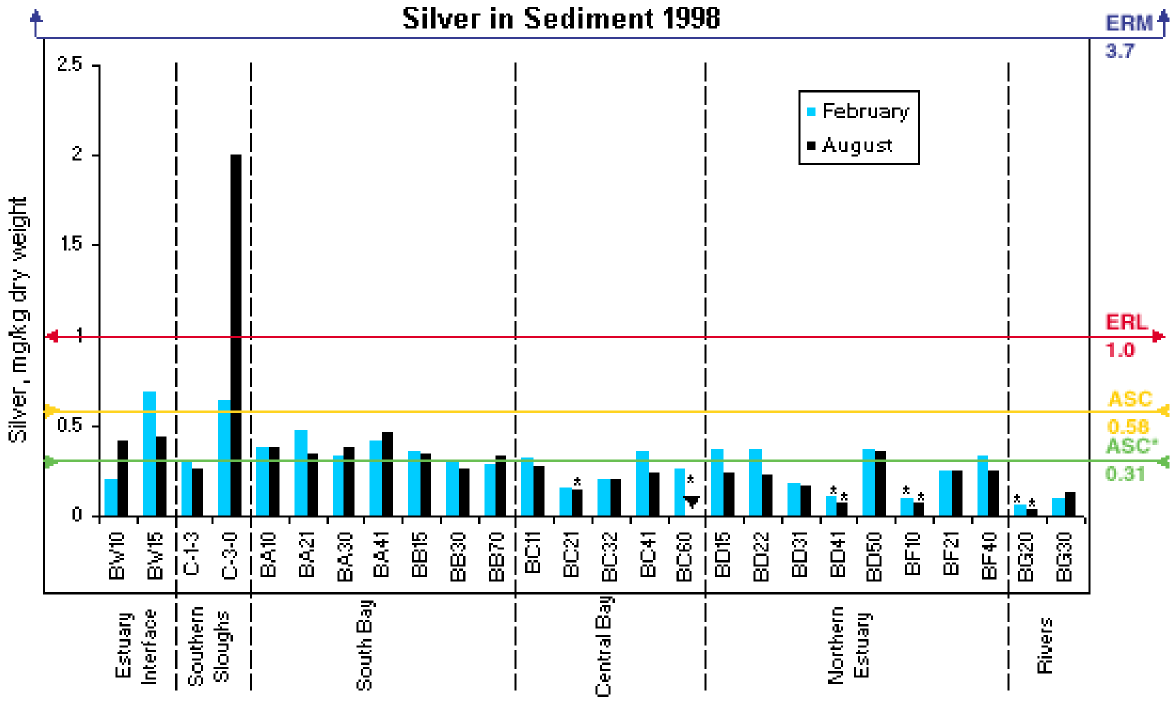


Figure 3.9. Silver (Ag) concentrations in sediments in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. ▼= not detected. Silver concentrations ranged from not detected (▼) to 2.0 ppm. The highest concentration was sampled at San Jose (C-3-0) in August. Average concentrations were highest (1.1 ppm) in the Southern Sloughs in August, and lowest (0.1 ppm) in the Rivers in February.

Figure 3.10

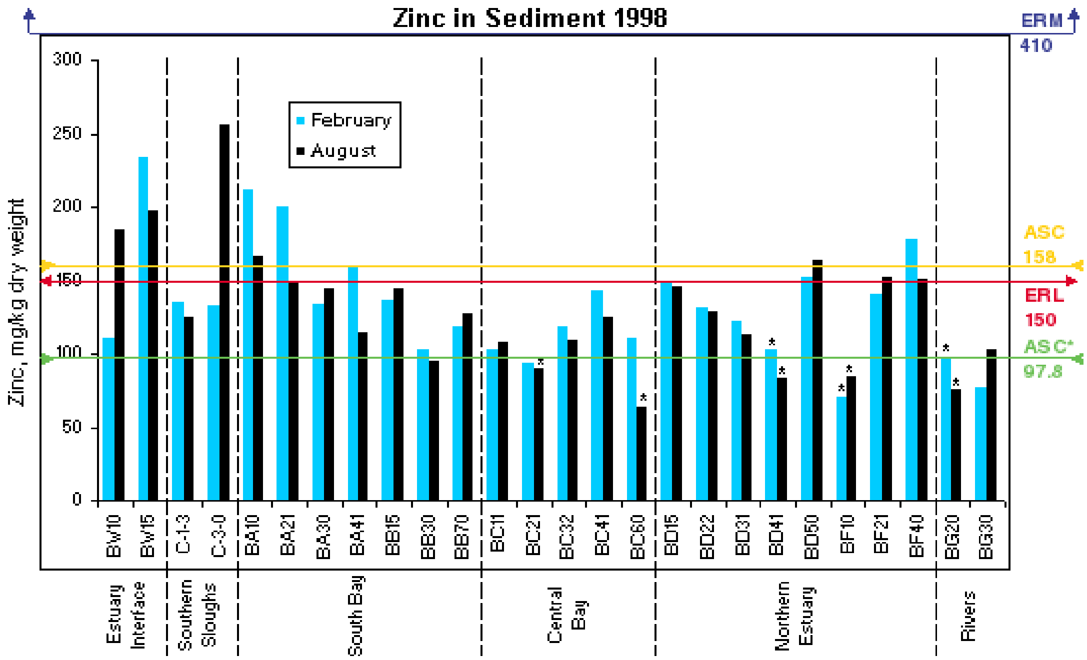


Figure 3.10. Zinc (Zn) concentrations in sediments in parts per million, dry weight (ppm) at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Zinc concentrations ranged from 64.0 to 256 ppm. The highest concentration was sampled at San Jose (C-3-0) and the lowest at Red Rock (BC60), both in August. Average concentrations were highest (191 ppm) in the Southern Sloughs in August and lowest (86.9 ppm) in the Rivers in February.

Figure 3.11

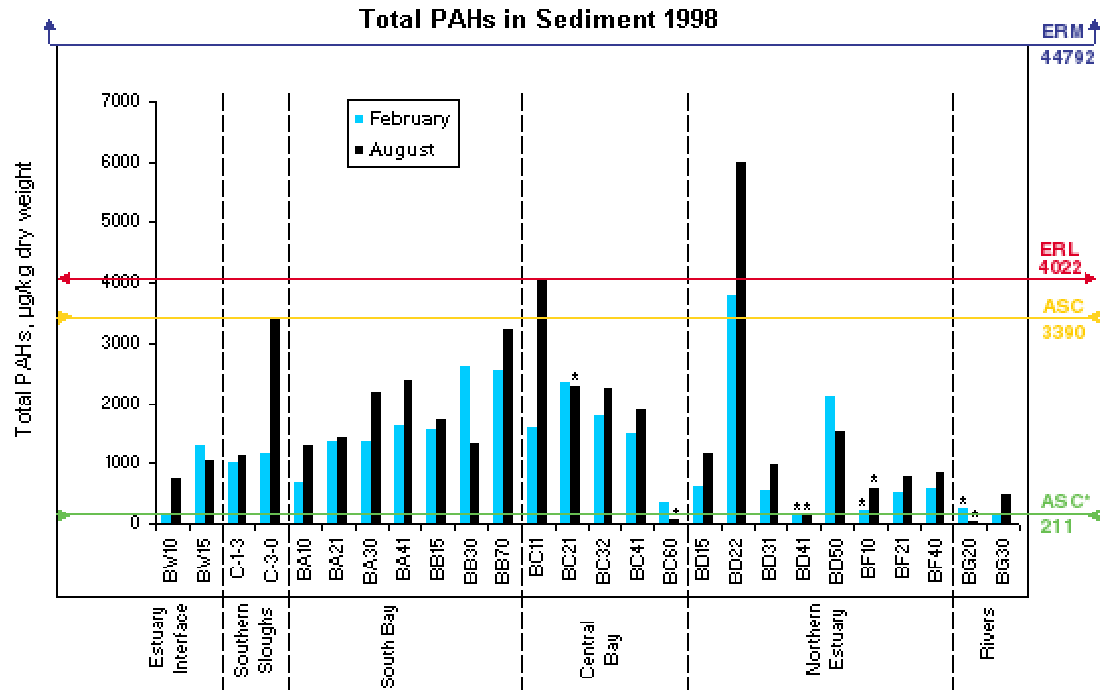


Figure 3.11.Total PAH concentrations in sediment in µg/kg, dry weight at 26 stations sampled in February and August of 1998. * indicates coarse sediment stations. Total PAH concentrations ranged between 33.10 and 6259.91 µg/kg. The highest concentration was sampled at San Pablo Bay (BD22) in August and the lowest at Sacramento River (BG20) in August. Average concentrations were highest (3023.0 µg/kg) in the Central Bay in August and lowest (193.37 µg/kg) in the Rivers in February.

Figure 3.12

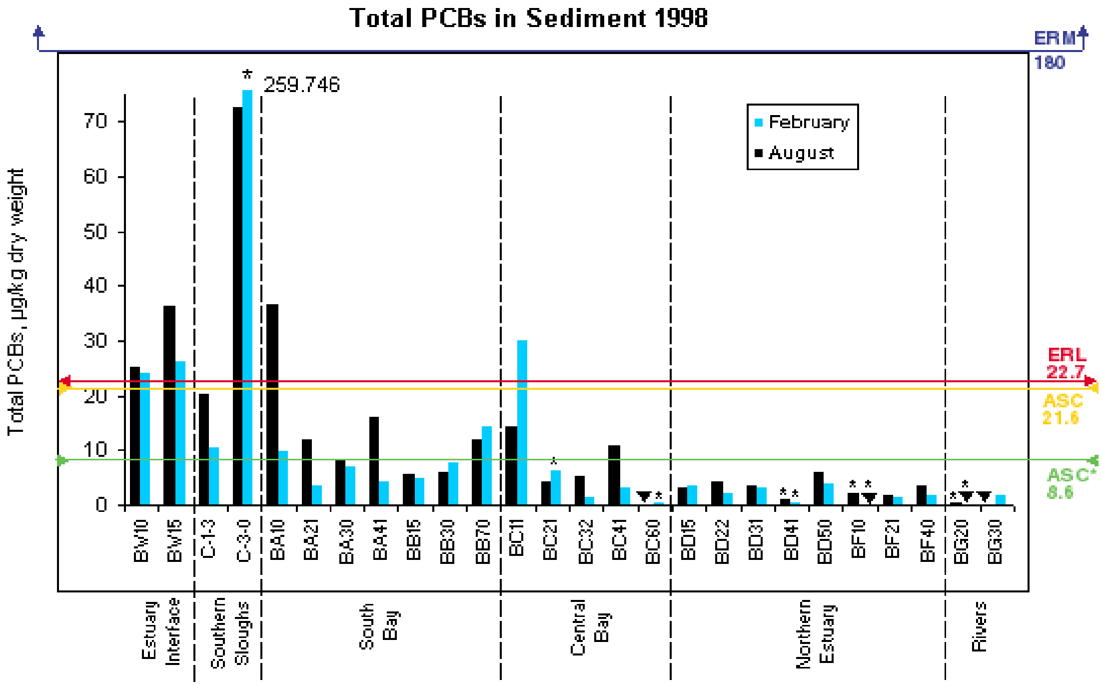


Figure 3.12. Total PCB concentrations in sediment in µg/kg, dry weight at 26 stations sampled in February and August 1998. *indicates coarse sediment stations. ▼indicates that analyte was not detected. Total PCB concentrations ranged between not detected (▼) and 259.746µg/kg. The highest concentration was sampled at San Jose (C-3-0) in August. Average concentrations were highest (135.131 µg/kg) in the Southern Sloughs in August, and lowest (0.238 µg/kg) in the Rivers in February.

Figure 3.13

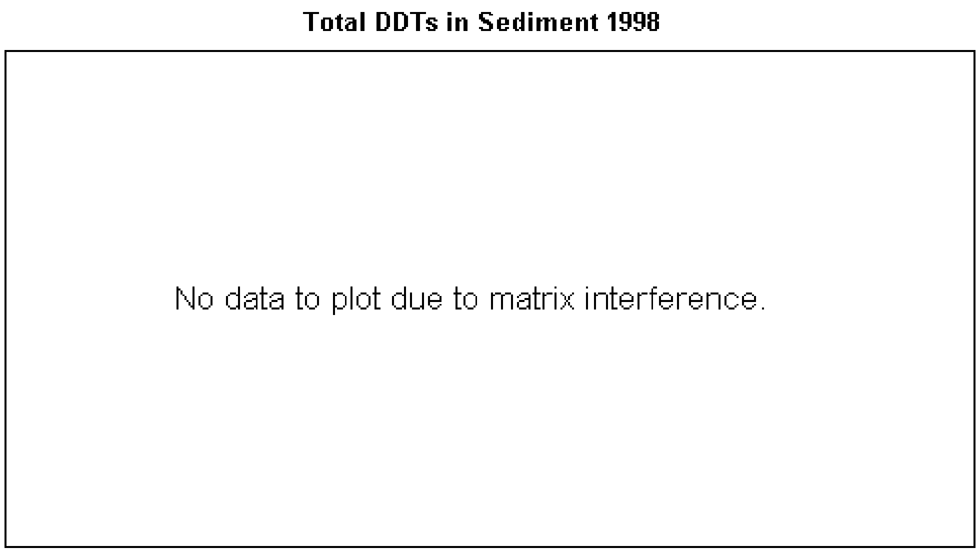


Figure 3.13. Total DDT concentrations in sediment. No data were plotted due to matrix interference.

Figure 3.14

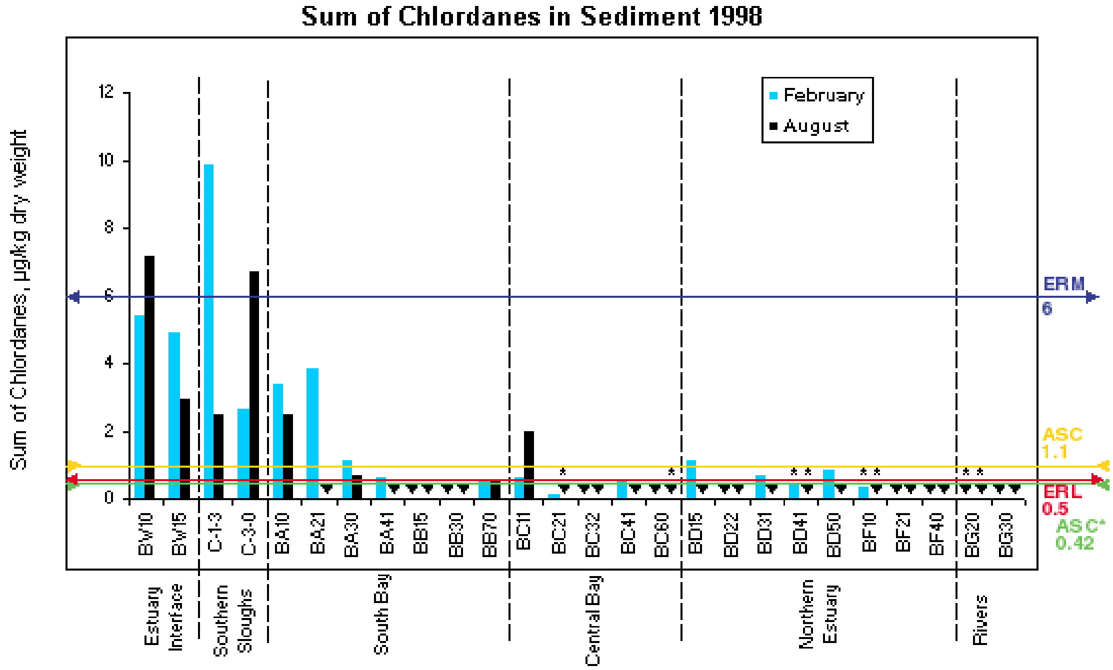


Figure 3.14. Sum of chlordane concentrations in sediment in µg/kg, dry weight at 26 stations sampled in February and August 1998. *indicates coarse sediment stations. ▼indicates that analyte was not detected. Chlordane concentrations ranged between not detected (▼) and 9.879*µ*g/kg. The highest concentration was sampled at Sunnyvale (C-1-3) in February. Average concentrations were highest (6.2645 *µ*g/kg) in the Southern Sloughs, and lowest (0.4353 *µ*g/kg) in the Central Bay, both in February.

Figure 3.15

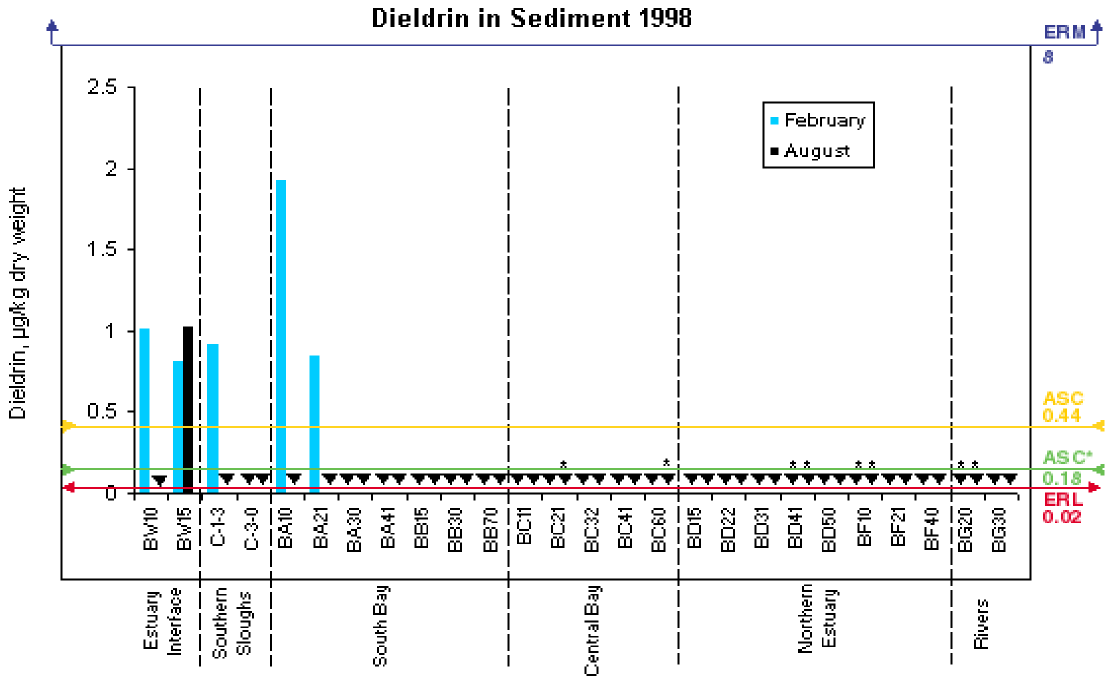


Figure 3.15. Dieldrin concentrations in sediment in µg/kg, dry weight at 26 stations sampled in February and August 1998. *indicates coarse sediment stations. ▼indicates that the analyte was not detected. Dieldrin concentrations ranged between not detected (▼) and 1.91 µg/kg. The highest concentration was sampled at Coyote Creek (BA10) in February. Averages were not calculated because concentrations were below the detection limit for all but six samples.

Figure 3.16

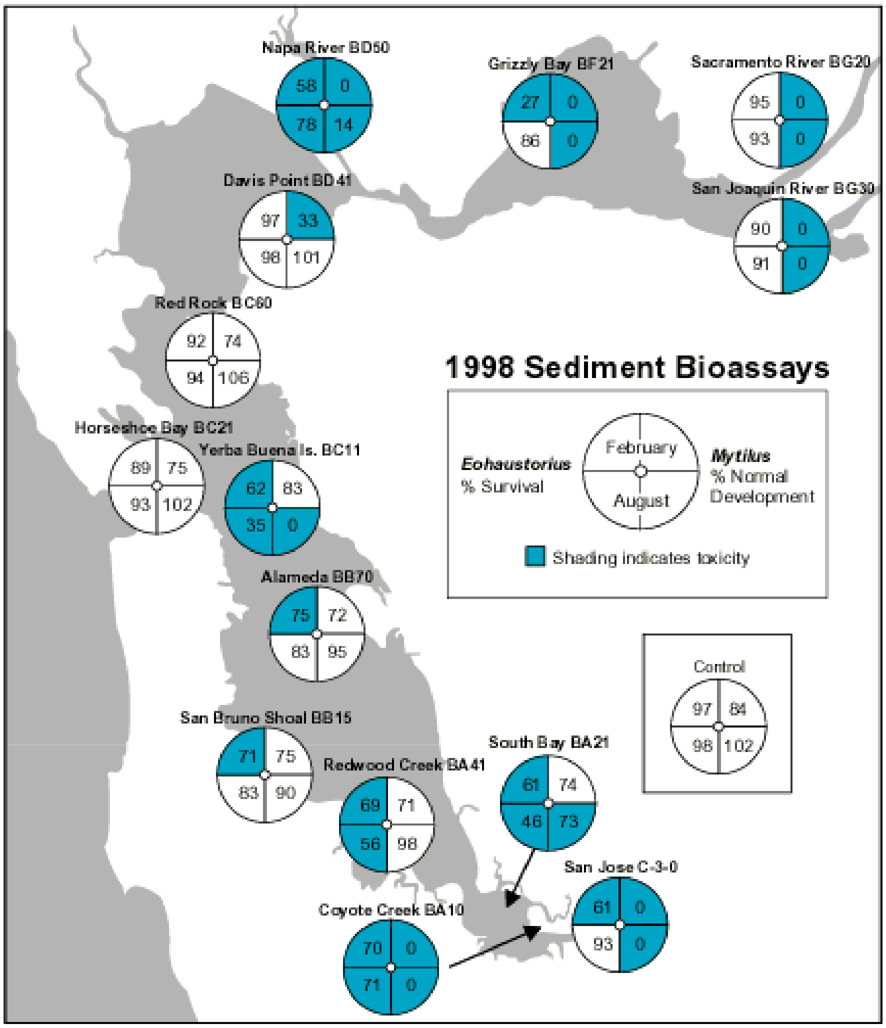


Figure 3.16. Sediment bioassay results for 1998. Sediments were not toxic (see text definition) to either amphipods or bivalve larvae at Horseshoe Bay (BC21) and Red Rock (BC60). Amphipod toxicity was observed in both sampling periods at Napa River (BD50), Yerba Buena Island (BC11), South Bay (BA21), Redwood Creek (BA41), and Coyote Creek (BA10), and only in the wet-sampling period (February) at Alameda (BB70), Grizzly Bay (BF21), San Bruno Shoal (BB15), and San Jose (C-3-0). Sediment elutriates were toxic to larval bivalve during both sampling periods at Sacramento River (BG20), San Joaquin River (BG30), Grizzly Bay (BF21), Napa River (BD50), Coyote Creek (BA10), and San Jose (C-3-0). Bivalve toxicity was observed in the wet-sampling period at Davis Point (BD41), and in the dry-sampling period at Yerba Buena Island (BC11) and South Bay (BA21). Sediment conditions that could have influenced toxicity are considered in the *Discussion*.

Figure 3.17

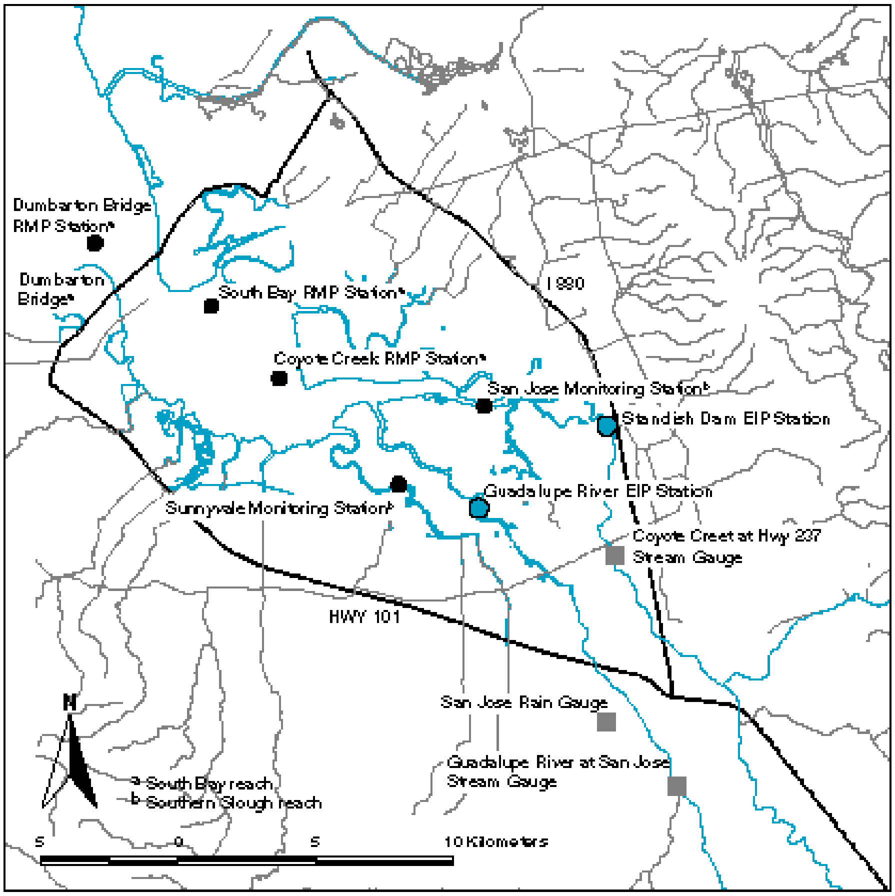


Figure 3.17. Map of Estuary Interface Pilot Study stations.

Figure 3.18

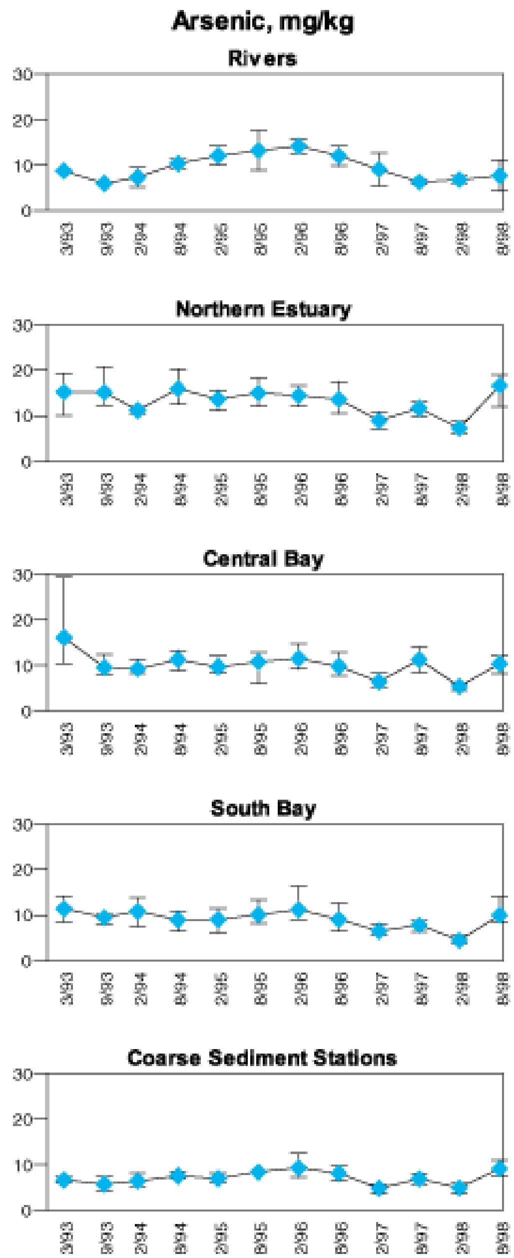


Figure 3.18. Average arsenic concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between seasons. The South Bay reach does not include Southern Slough stations.

Figure 3.19

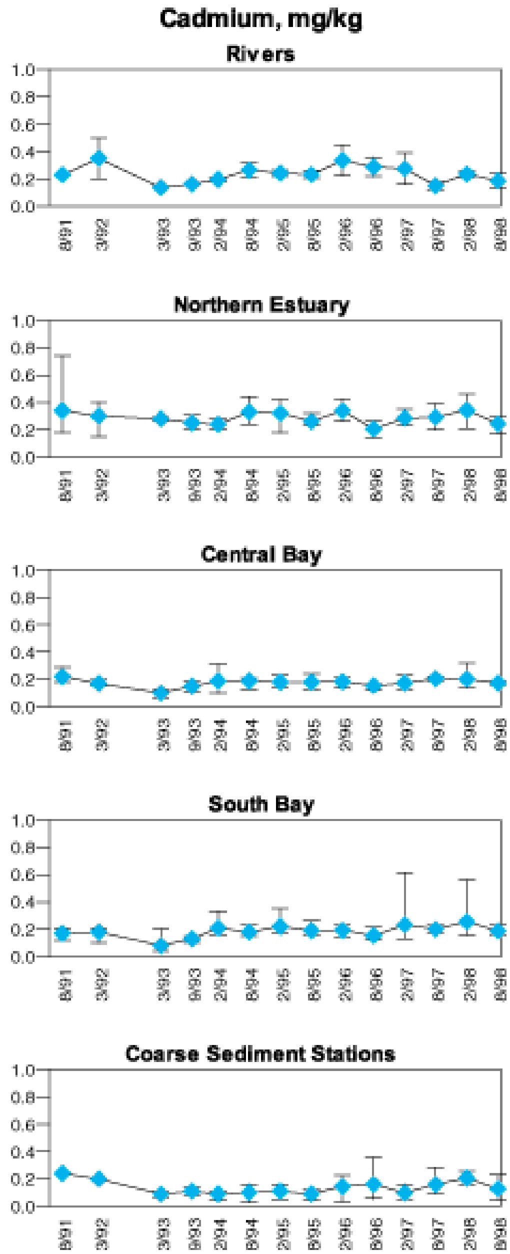


Figure 3.19. Average cadmium concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between seasons. The South Bay reach does not include Southern Slough stations.

Figure 3.20

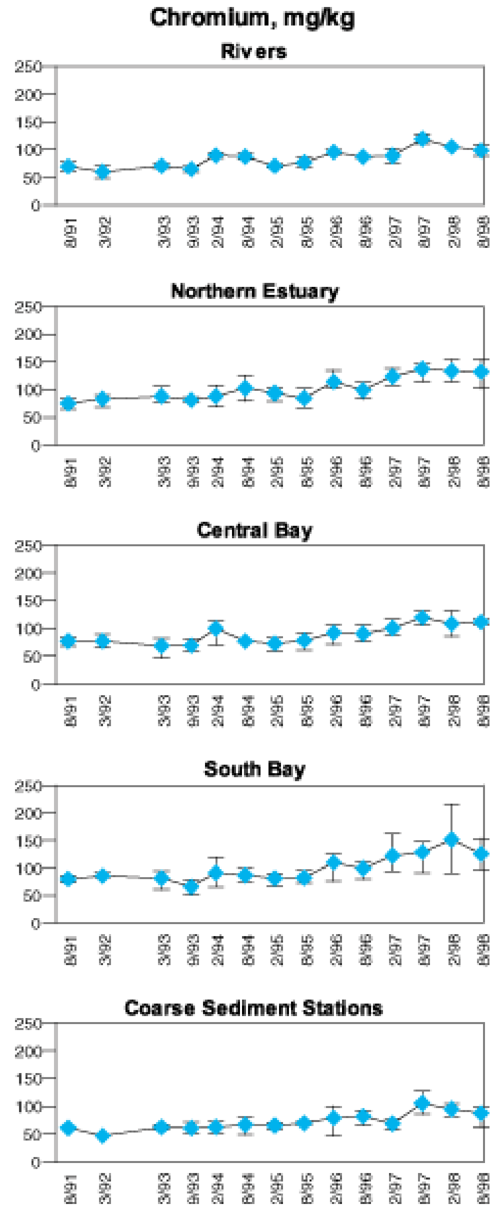


Figure 3.20. Average chromium concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between seasons. The South Bay reach does not include Southern Slough stations.

Figure 3.21

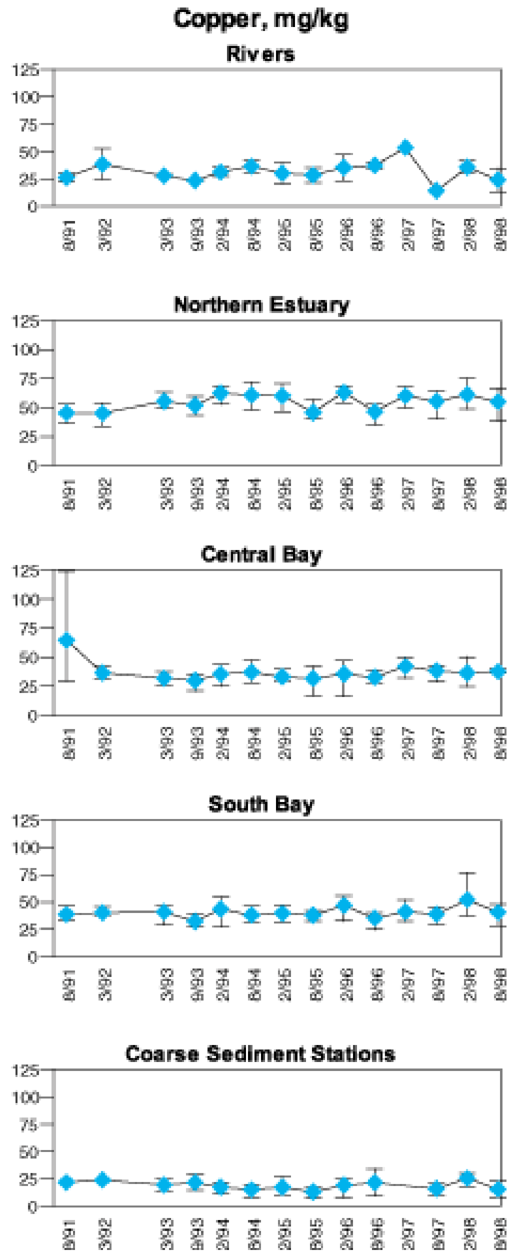


Figure 3.21. Average copper concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between times. The South Bay reach does not include Southern Slough stations. Due to contaminated blanks, copper data for 1997 are incomplete as follows: February data in the Rivers and Northern Estuary are missing; February Central Bay copper average consists of only one sample; February and August South Bay data are incomplete; and February Coarse Sediment Station average consists of two samples.

Figure 3.22

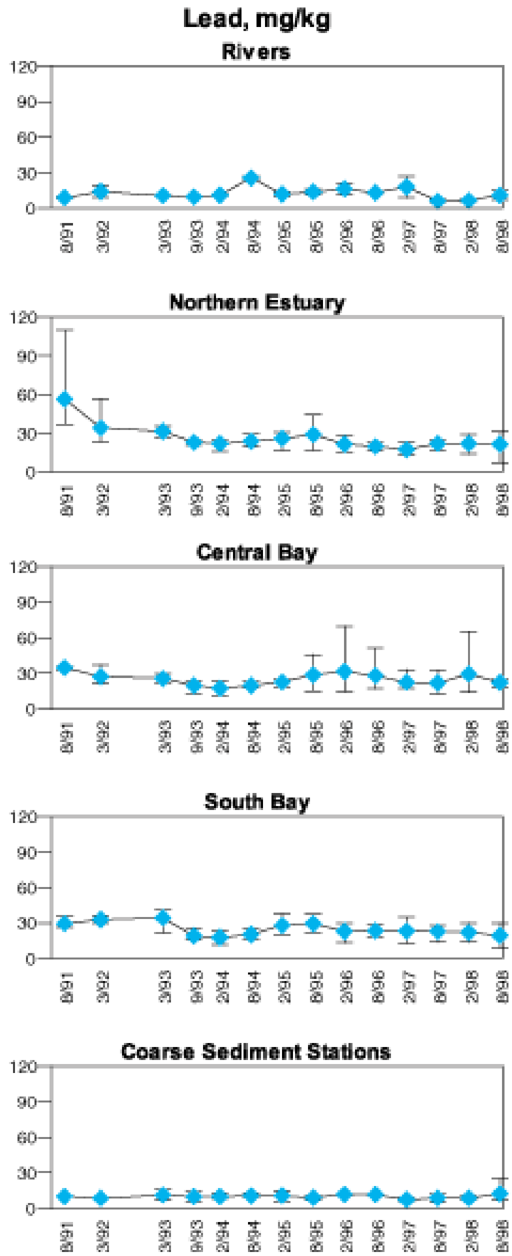


Figure 3.22. Average lead concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between seasons. The South Bay reach does not include Southern Slough stations.

Figure 3.23

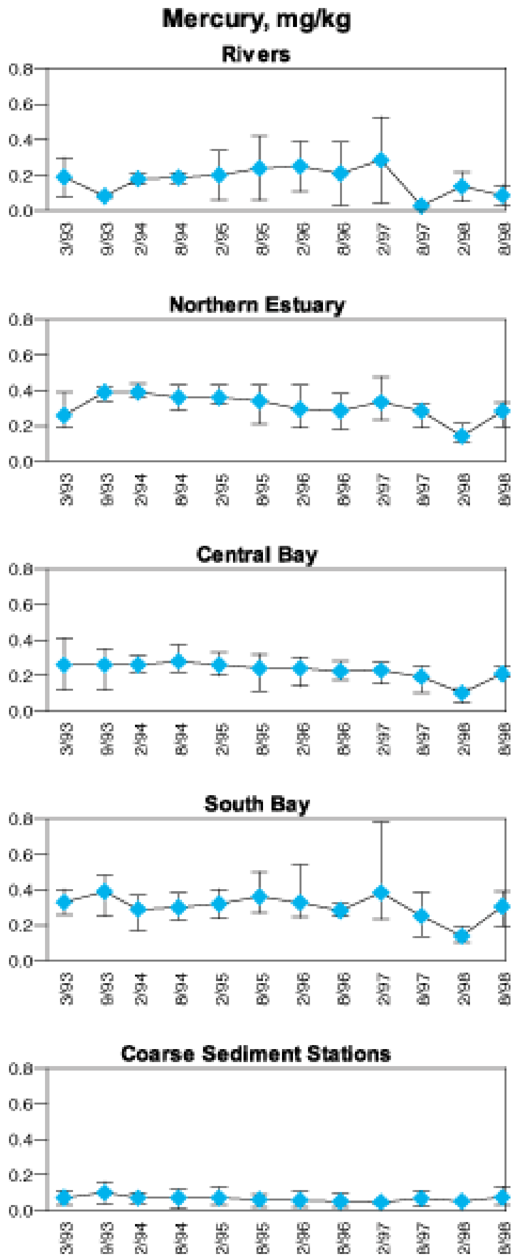


Figure 3.23. Average mercury concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between times. The South Bay reach does not include Southern Slough stations.

Figure 3.24

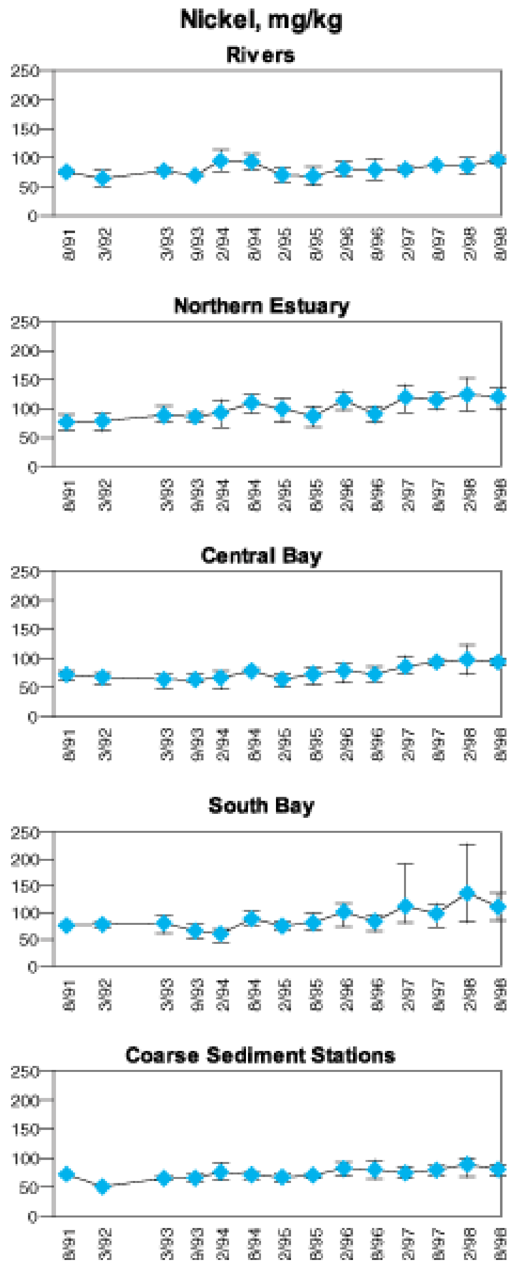


Figure 3.24. Average nickel concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between seasons. The South Bay reach does not include Southern Slough stations.

Figure 3.25

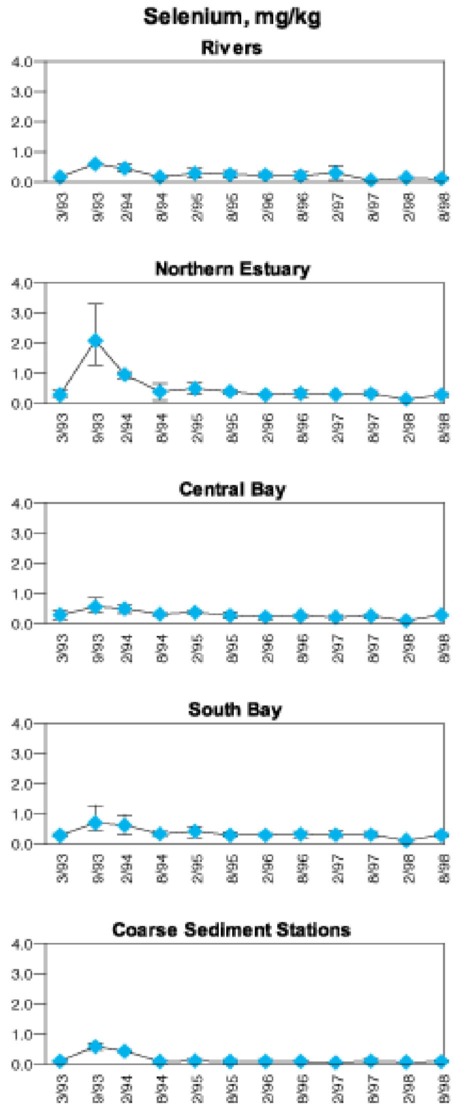


Figure 3.25. Average selenium concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between seasons. The South Bay reach does not include Southern Slough stations.

Figure 3.26

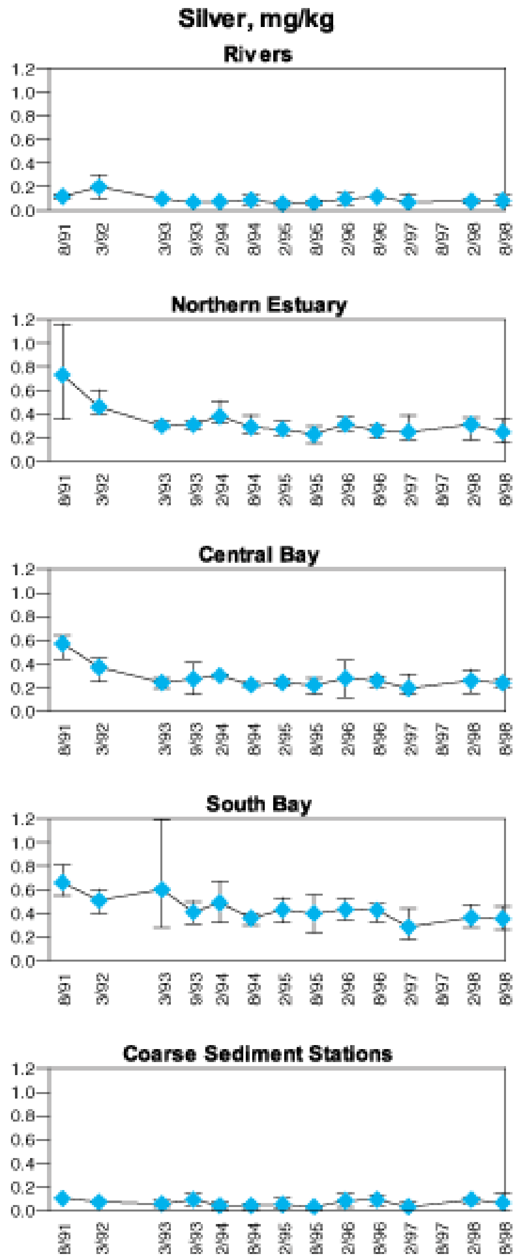


Figure 3.26. Average silver concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between times. The South Bay reach does not include Southern Slough stations. There are no data for silver in August 1997 because the blanks were contaminated.

Figure 3.27

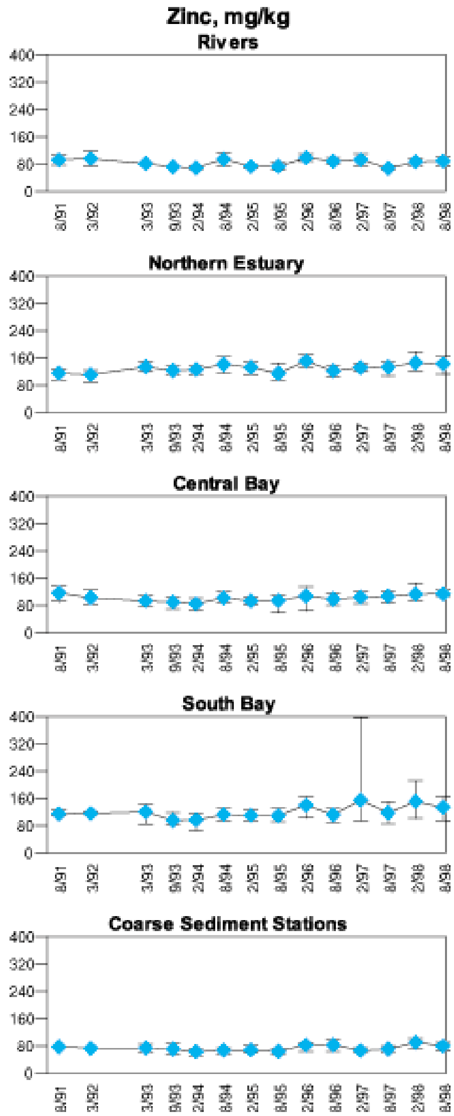


Figure 3.27. Average zinc concentrations in sediments for each Estuary reach from 1991-1998. The vertical bars represent the range of all values within a reach. The sample size varies between reach and between seasons. The South Bay reach does not include Southern Slough stations.

Figure 3.28

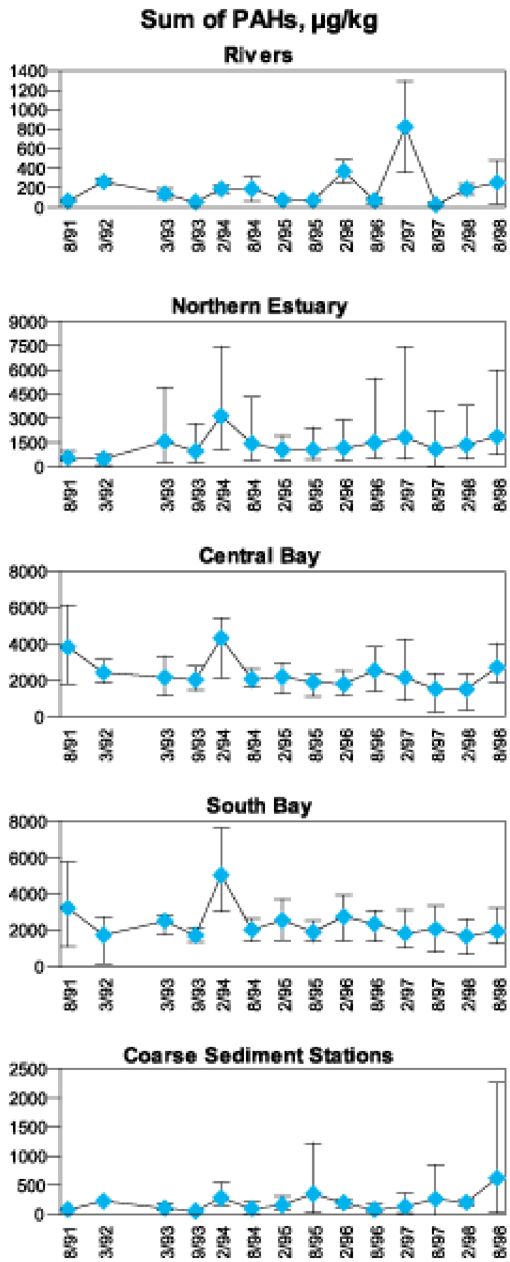


Figure 3.28. Plots of average PAH concentrations in sediments for each Estuary reach from 1991-1998. Units are in parts per billion, ppb. Note scale changes. The vertical bars represent the range of all values within a reach. The sample size varies between sites and between seasons.

Figure 3.29

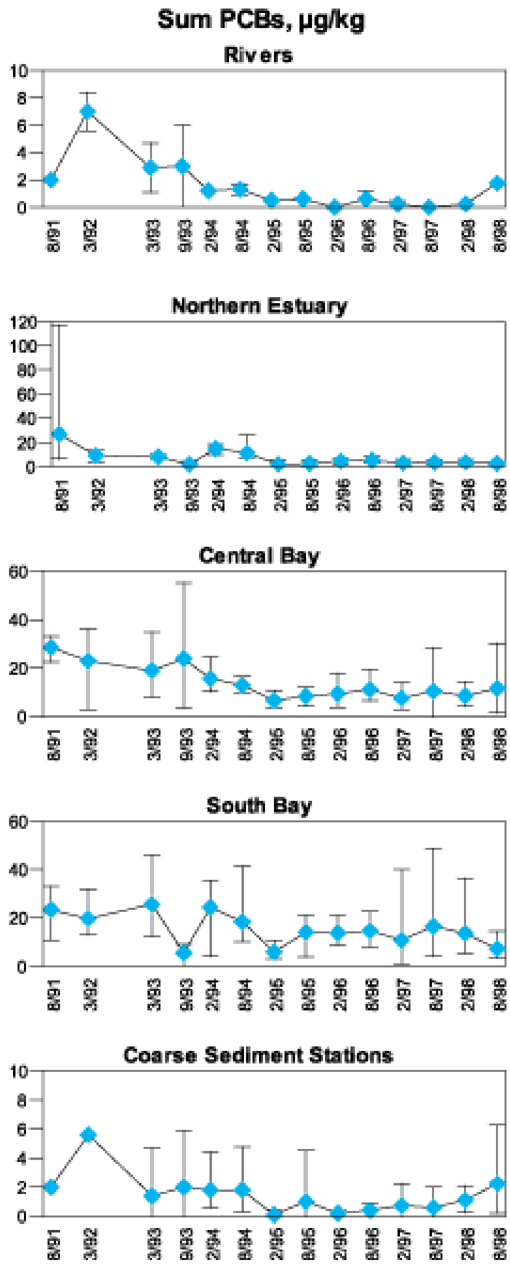


Figure 3.29. Plots of average PCB concentrations in sediments for each Estuary reach from 1991-1998. Units are in parts per billion, ppb. Note scale changes. The vertical bars represent the range of all values within a reach. The sample size varies between sites and between seasons.

Figure 3.30

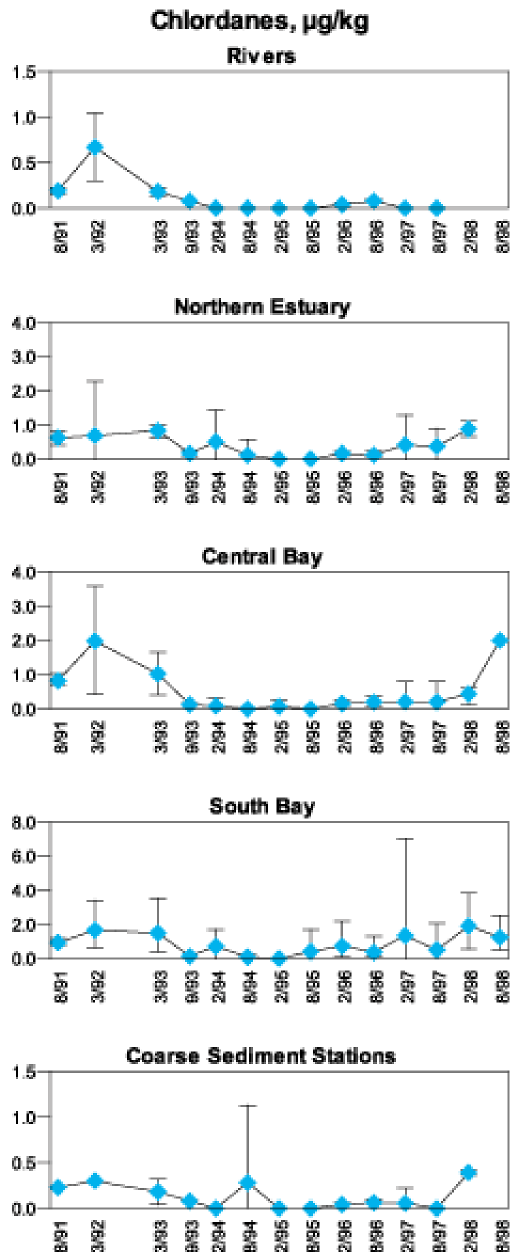


Figure 3.30. Plots of average chlordane concentrations in sediments for each Estuary reach from 1991-1998. Units are in parts per billion, ppb. Note scale changes. The vertical bars represent the range of all values within a reach. The sample size varies between sites and between seasons. Chlordanes were not detected for the following reaches and seasons: Rivers: February and August 1998; Northern Estuary: August 1998; and Coarse Sediment Stations: August 1998.

Figure 3.31

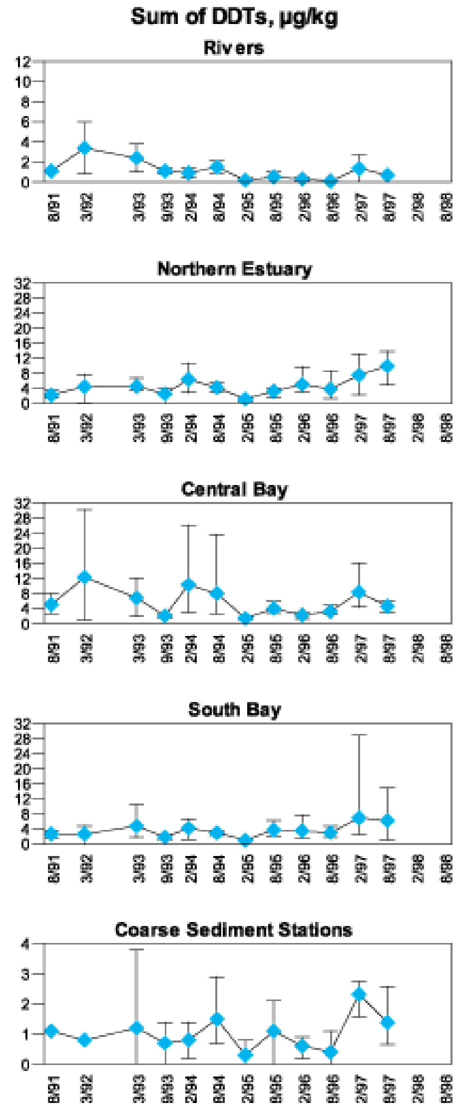


Figure 3.31. Plots of average DDT concentrations in sediments for each Estuary reach from 1991-1998. Units are in parts per billion, ppb. Note scale changes. The vertical bars represent the range of all values within a reach. The sample size varies between sites and between seasons. There was no 1998 DDT data to plot due to matrix interference.

Figure 3.32

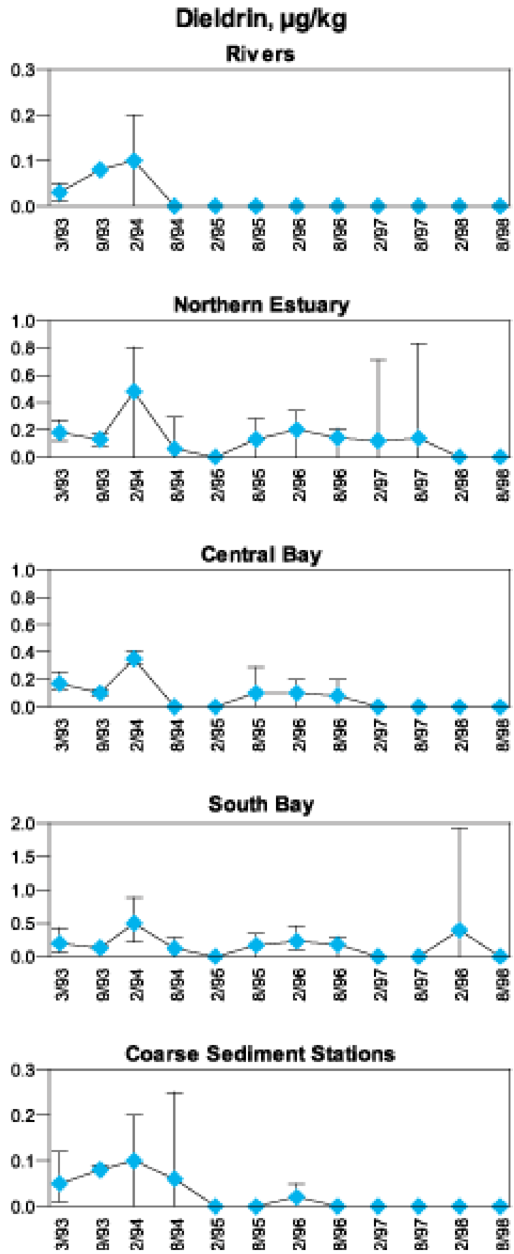


Figure 3.32. Plots of average dieldrin concentrations in sediments for each Estuary reach from 1991-1998. Units are in parts per billion, ppb. Note scale changes. The vertical bars represent the range of values. Sample size varies between sites and between seasons. Dieldrin was not detected for the following reaches and seasons: Rivers, Central Bay, and Coarse Sediment Stations in February and August 1997 and 1998; South Bay in February and August 1997; and Northern Estuary in February and August 1998.

Bivalve Monitoring

4.1 Background

The purpose of monitoring contaminant concentrations in bivalve tissue for the RMP is two-fold. First, bivalves integrate the bioavailable portion of contaminants in the water column over time, and second, for many contaminants, bivalves are good indicators of contaminant transfer from water into the food web. Bivalves will accumulate certain contaminants in concentrations much greater than those found in ambient water (Vinogradov, 1959). This phenomenon is a result of the limited ability of bivalves to regulate the concentrations of most contaminants in their tissues. This method of active biomonitoring has been widely applied by the California State Mussel Watch Program (Phillips, 1988; Rasmussen, 1994) and others (Young et al., 1976; Wu and Levings, 1980; Hummel et al., 1990; Martincic et al., 1992). For reviews of bioaccumulation monitoring, see Luoma and Linville (1996) and Gunther and Davis (1997).

Bivalves were collected from sites thought to be uncontaminated and transplanted to 15 stations in the Estuary during the wet season (April) and the dry season (September). Contaminant concentrations in tissues, survival, and biological condition were measured before deployment (referred to as time zero (T-0) or background) and at the end of the 90-100 day deployment period. Because of the variability between each individual bivalve organism, composite samples of tissue were made from T-0 organisms and from surviving organisms from each deployment site (up to 45 individuals) for analyses of trace contaminants. The Corbicula reference site for the wet season was not optimal, since initial concentrations were found to be high after changing the site from Lake Isabella and Putah Creek to Lake Chabot. For the dry season clams could no longer be found at "clean" sites and consequently additional specimen were collected from a native population in the Sacramento and the San Joaquin rivers.

The effects of high short-term flows of freshwater on the transplanted bivalves west of Carquinez Strait were minimized by deploying the bivalves near the bottom where density gradients tend to maintain higher salinities. All bivalves were kept on ice after collection and deployed within 72 hours. Multiple species were deployed at several stations due to uncertain salinity regimes and tolerances. Detailed sampling and analysis methods are included in the Description of Methods. Data are tabulated in the Data Tables.

Overall, the bivalve bioaccumulation and condition study objectives for 1998 were met, although the unusual wet season with extremely high freshwater inputs from January until March caused high mortality rates in Mytilus spp. during the winter/spring deployment.

4.2 Accumulation Factors

In addition to using the absolute tissue concentrations at the end of each deployment period and comparing them to initial tissue concentrations prior to transplanting the bivalves to the Estuary (T-0), this report uses accumulation factors (AFs) to indicate accumulation or depuration (loss of constituents from bivalve tissue) during the 90-100 day deployment period. The accumulation factor is calculated by dividing the contaminant concentration in transplants by the initial bivalve concentration at T-0. For example, an accumulation factor of 1.0 indicates that the concentration of a specific contaminant remained the same during the deployment period compared to the initial contaminant level prior to transplanting the bivalve sample to the Estuary. An AF less than 1 indicates that the bivalves decreased in contaminant concentration during the deployment period, while an AF above 1 indicates accumulation.

4.3 Guidelines

Fish and shellfish consumption advisories for the public are issued by the California EPAÕs Office of Environmental Health Hazard Assessment (OEHHA) to protect residents from the health risks of consuming contaminated non-commercially caught fish and wildlife. These advisories inform the public that high concentrations of chemical contaminants have been found in local fish and wildlife and include recommendations to limit or avoid consumption of certain fish and wildlife species from specific waterbodies or waterbody types. The U.S. EPA has developed guidance documents for estimating risks to human health from the consumption of chemically contaminated, non-commercial fish and wildlife. Figures 4.1-4.16 used the recommended tissue screening values (SVs) for use in State fish/shellfish consumption advisory programs for the general adult population* from table 5-2 of EPA document #823-R-95-007 (Methods for Sampling and Analyzing Contaminants in Fish and Shellfish Tissue). Tissue guidelines are generally expressed in wet weight, while the RMP tissue data are reported in dry weight. A wet-to-dry weight conversion factor of 7 was applied to the guideline values for comparative purposes. This value is based on an average moisture content in bivalves of 85%. Listed in Table 4.1 are converted dry weight SVs for those parameters reported by the RMP. It should be noted that the U.S. EPA screening values only apply to human health risks associated with consuming contaminated fish and wildlife. There are published guidelines protective of wildlife (NAS, 1973). However, they are only for total DDT and total PCB, although evidence exists of adverse effects on wildlife above certain contaminant thresholds for a variety of contaminants (e.g., Young et al., 1998).

* general adult population: Risk level = 10-5 for carcinogens given an average consumption rate of 6.5 g/day for a body weight of 70 kg.

4.4 Biological Condition and Survival

The biological condition (expressed as the ratio of dry tissue weight to shell cavity volume) and survival rates of transplanted bivalves following exposure to Estuary water are evidence that the animals were healthy and capable of bioaccumulation at most sites (Figures 4.17 and 4.18). However, the data on survival and condition of the transplants indicate that certain sites are generating physiological stress in the animals at certain times, which confounds the interpretation of bioaccumulation data and interferes with the bivalves' usefulness as biomonitors.

4.5 Bivalve Trends

Transplanted bivalves are valuable in assessment of long-term trends because they provide an integrated measure of contamination over a three month period. This interval is more appropriate for assessment of interannual trends than the one-hour interval represented by RMP water samples or the approximate 20 year interval represented by RMP sediment samples.

This section presents plots of RMP bivalve bioaccumulation data for trace elements and trace organics from 1993 to 1998 (Figures 4.19-4.31). Concentrations in these plots are expressed as net bioaccumulation or depuration during the deployment period (initial concentrations prior to deployment have been subtracted from final concentrations measured after deployment). Presented in this manner, the plots are capable of showing the presence or absence of both trends and accumulation during deployment. In many cases (e.g., arsenic) there was either little accumulation or even net depuration during deployment. Cadmium in mussels has exhibited a consistent seasonal pattern, with higher concentrations in summer samples in all six years. The trace metals database accumulated so far is fairly noisy, and clear trends are not expected to be discernible for the near future.

4.6 Discussion

Bivalve monitoring is a valuable tool to assess to what degree contaminants in the water column of the Estuary are bioavailable and bioaccumulate. Bivalves are also a good indicator of long-term contaminant trends. As currently designed, this program component is unable to evaluate contaminant bioavailability and accumulation in different segments of the Estuary due to the different bioaccumulation characteristics of the three species deployed in segments with different salinities (see Method Section and RMP Regional Monitoring News Vol. 4, Issue 2 "RMP Bivalve Study Field Methods (or how we do what we do)", by Jordan Gold and David Bell). http://www.sfei.org/rmp/rmp_news/vol_4_issue_2_html/Volume_4_Issue_2.html

Oysters showed higher PAH concentrations and greater accumulation during the 1998 dry season compared to previous years. Consistent with previous years, the concentrations measured were higher than any measured values in mussels or clams. The highest concentration was measured in oysters at Coyote Creek - about 48 times above the pre-deployment concentration. Oysters seem to either accumulate PAHs at a higher rate or have a lower capacity for metabolism and excretion of this compound.

The lipid-normalized data indicated higher PAH concentrations in all species for the1998 wet season compared to the previous year, and above the running mean concentration. In contrast, the 1998 dry season concentrations in mussels were below the running mean from all years combined and showed a clear decrease from 1997 data.

In 1998 mussels had the highest mean accumulation factor for PCBs for the dry season, although the absolute concentrations were within the range of previous years. Consistent with the previous years' data, the 1998 PCB tissue concentrations were strongly correlated with the lipid content of the bivalves. 1998 was the first year that oysters discontinued their decline in DDT concentrations. Although the absolute concentrations were lower during the wet season than in previous years, the lipid-normalized values were higher for all stations but Grizzly Bay and Sacramento River. Given that during high rainfall years pollutants stored in the watershed may be mobilized, a reversal in the existing trend is not too surprising.

Another significant difference occurred in mussels at Pinole Point. At this station, bivalves accumulated twice the amount of DDT than the year before during the dry season. Oysters appeared to have a much higher lipid-normalized dieldrin concentration than in previous years where the tissue concentration had decreased continuously. For all chlorinated hydrocarbons, the lipid normalized data showed an increase in concentrations for the bivalves deployed during the wet season. There is a consistent pattern of higher CHC concentrations after the wet season that could be explained by increased mobilization of deposits of these compounds due to the unusually heavy rainfall during the El Nino year of 1998.

Dry-season concentrations showed a distinct decrease in dieldrin and chlordane and a slight decrease for PCBs and DDTs compared to 1997. The DDT concentrations were lower in 1995 and 1996 so that a clear trend over the years is nor yet apparent for DDTs. Yerba Buena Island (BC10) discontinued the decline for PCBs from the previous year; concentrations were slightly higher in 1998 compared to the 1997 dry season. Due to the loss of mooring during the winter deployment period, no comparable data for April are available for this station. A higher level in this contaminant concentration could be caused by intense mixing of the sediment due to strong tidal currents or winds. Paralleling the bivalve concentrations, a much higher level of PCBs was indicated in the sediment data for this station as well.

Lipid-normalization for HCHs and PAHs revealed patterns that were not always apparent otherwise. For example, the absolute concentrations in DDTs seemed to decrease for almost all stations in 1998's wet season, but related to the lipid content of the bivalves, the values increased compared to 1997. Higher concentrations of total PAHs, PCBs, Chlordanes, and DDTs in the water column, especially at the Estuary Interface, Southern Sloughs, and South Bay were reflected in the tissue bioaccumulation.

Regarding trace metals, oysters seem to accumulate cadmium to a higher degree consistently, while the other species do not exhibit substantial bioaccumulation over the years. As in previous years all bivalve species used in the program have not been good indicators for bioaccumulation of mercury. For the 2000 monitoring year, mercury measurements in bivalves were discontinued and replaced with triennial fish tissue measurements as a better indicator for mercury bioaccumulation.

The nickel concentration in mussels and oysters went slightly lower compared to previous years. For the first time clams accumulated nickel much more than *Mytilus* and *Crasosstrea*. The measured concentration at the end of the deployment period during wet season was about nine times higher than the initial concentration prior to deployment.

The silver accumulation in mussels was considerably lower in 1998 compared to the previous year, only twice the initial concentration compared to 3-10 times in 1997. For the first time, mussels showed a lower accumulation than oysters, which maintained their accumulation range for silver.

Mussels continued to exhibit the highest accumulation factor of the three bivalve species, but compared to previous years, absolute concentrations were considerably lower. During the dry season, sampling high trace element concentrations occurred over the running mean, especially noticeable in *Corbicula fluminea* for lead, nickel, and zinc.

These metals were consistently higher through the July water sampling as well, due to high stream flow and the highest Baywide TSS concentration ever measured in the RMP. These few metals seem to be heavily influenced by extreme hydrologic conditions. They are mobilized throughout the watershed and reflected in above-average bivalve tissue concentrations. On the other hand, concentrations for arsenic, copper, and tributyltin decreased significantly compared to the mean values of the previous years. Generally, bioaccumulation factors were consistent and comparable to previous years of RMP sampling. Almost every metal's accumulation varied within a range of plus or minus two times the contaminant accumulation.

Only accumulation of nickel and lead during the wet season was three and five times higher in *Corbicula fluminea* in 1998 compared to 1997. This change may have been caused by a higher transport rate of these metals into the Estuary because of El Niño's exceptionally heavy precipitation. 1998's mean bioaccumulation factors showed no appreciable differences in pre- and post-deployment periods for most metals. *Corbicula fluminea* in the wet season showed the highest accumulation rates for lead (10.4 times), and nickel (9.3 times the initial concentration). Arsenic, selenium, and mercury did not show significant bioaccumulation above background concentrations in any of the three species. Cadmium, chromium, silver, and copper showed mean accumulation factors between 1.1 and 4.2, although a slight but consistent increase in copper over the last four years of RMP sampling is evident. Condition, % lipid, and % moisture measurements were made prior to deployment and after the transplants were collected to show natural variables affecting condition, such as weight loss due to reproduction, which can also account for a decrease in contaminant accumulation.

Some water quality parameters in the Estuary were outside optimum levels for the bivalve species and therefore may have affected bioaccumulation at certain times. In mussels, for example, survival, condition, and percent lipid are significantly positively related to dissolved oxygen and salinity (Hardin & Hoenicke, 1999). The unusual wet season with extremely high freshwater inputs caused an impact and higher mortality rates in *Mytilus californianus*. They are deployed at sites with highest expected salinities because the tolerance of the organism to freshwater exposure is low. Their natural habitat is the ocean's intertidal and they only survive short-term exposure to salinities as low as 5%.

Other potential effects that dissolved oxygen, salinity, temperature, total suspended solids, and chlorophyll could have on the bioaccumulation of contaminants also confound the ability to describe spatial concentration patterns throughout the Bay.

The San Francisco Estuary exhibits very high spatial and temporal variations in water quality parameters. That is why trends can be compared among sites with the same species only. *Corbicula fluminea* are no longer transplanted from clean reference locations, but resident clams from the Sacramento and San Joaquin Rivers have been analyzed since the 1998 dry season. Due to the missing T-0 value, the bioaccumulation factor for the dry season could not be analyzed here. Trend monitoring is much more responsive in bivalves than it is in water or sediment, because accumulation or even depuration is shown over a three months deployment period and not only for a one-hour sampling interval.

Most of the metals show either little net accumulation or even net depuration (e.g. arsenic and selenium) over the deployment period. Mercury, copper, and zinc in oysters continued to show a consistent seasonal pattern with higher concentrations during the summer sampling period. Trace organics trends indicate a much higher net bioaccumulation than trace metals. Slight seasonal patterns were exhibited in mussels for PAHs and PCBs with higher concentrations during the summer.

4.7 References

Gunther, A.J. and J.A. Davis. 1997. An evaluation of bioaccumulation monitoring with transplanted bivalves in the RMP. In 1996 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. San Francisco Estuary, Richmond, CA, pp. 187-200.

Hummel, H., R.H. Bogaards, J. Nieuwenhiuze, L. DeWolf, and J.M. VanLiere. 1990. Spatial and seasonal differences in the PCB content of the mussel Mytilus edulis. Science of the Total Environment 92:155-163.

Luoma, S.N. and R. Linville. 1996. A comparison of selenium and mercury concentrations in transplanted and resident bivalves from north San Francisco Bay. In 1995 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. San Francisco Estuary, Richmond, CA, pp. 160-170.

Martincic, D., Z. Kwokal, Z. Peharec, D. Margus, and M. Branica. 1992. Distribution of Zn, Pb, Cd, and Cu between seawater and transplanted mussels (Mytilus galloprovinciatis). Science of the Total Environment 119:211-230.

NAS. 1973. National Academy of Sciences and National Academy of Engineering. NAS Guidelines and FDA Action Levels for Toxic Chemicals in Shellfish.

Phillips, P.T. 1988. California State Mussel Watch ten year data summary, 1977-1987. Water Quality Monitoring Report No. 87-3, Division of Water Quality, State Water Resources Control Board.

Rasmussen, D. 1994. State Mussel Watch Program, 1987<ETH>1993 Data Report. State Water Resources Control Board 94-1WQ.

U.S. EPA. Methods for Sampling and Analyzing Contaminants in Fish and Shellfish Tissue. U.S. EPA document #823-R-95-007. http://www.epa.gov/OST/fishadvice/vol1/doc2ndx.html.

Vinogradov, A.P. 1959. The geochemistry of rare and dispersed chemical elements in soils. Chapman and Hall, London.

Wu, R.S.S. and C.D. Levings. 1980. Mortality, growth and fecundity of transplanted mussel and barnacle populations near a pulp mill outfall. Marine Pollution Bulletin 11:11-15.

Young, D.R., T.C. Heesen, and D.J. McDermott. 1976. An offshore biomonitoring system for chlorinated hydrocarbons. Marine Pollution Bulletin 7:156-159.

Table 4.1

Table 4.1. Tissue quality guidelines used for evaluation of 1998 RMP results (U.S. EPA #823-R-95-007). These guidelines are screening values recommended for use in state fish/shellfish consumption advisory programs for the general adult population. Screening values have been converted to dry weight using a conversion factor of 7 which is based on an 85% average moisture content in bivalves.

Parameter	Screening Value dry weight	Unit
As	21	ppm
Cd	70	ppm
Cr	4.2	ppm
Se	350	ppm
TBT	2.1	ppm
Dieldrin	49	ppb
Endrin	21000	ppb
Gamma-HCH	560	ppb
Heptachlor Epoxide	70	ppb
Hexachlorobenzene	490	ppb
Mirex	14000	ppb
Total Chlordanes (SFEI)	560	ppb
Total DDTs (SFEI)	2100	ppb
Total PAHs (SFEI)	70	ppb
Total PCBs (SFEI)	70	ppb

Figure 4.1

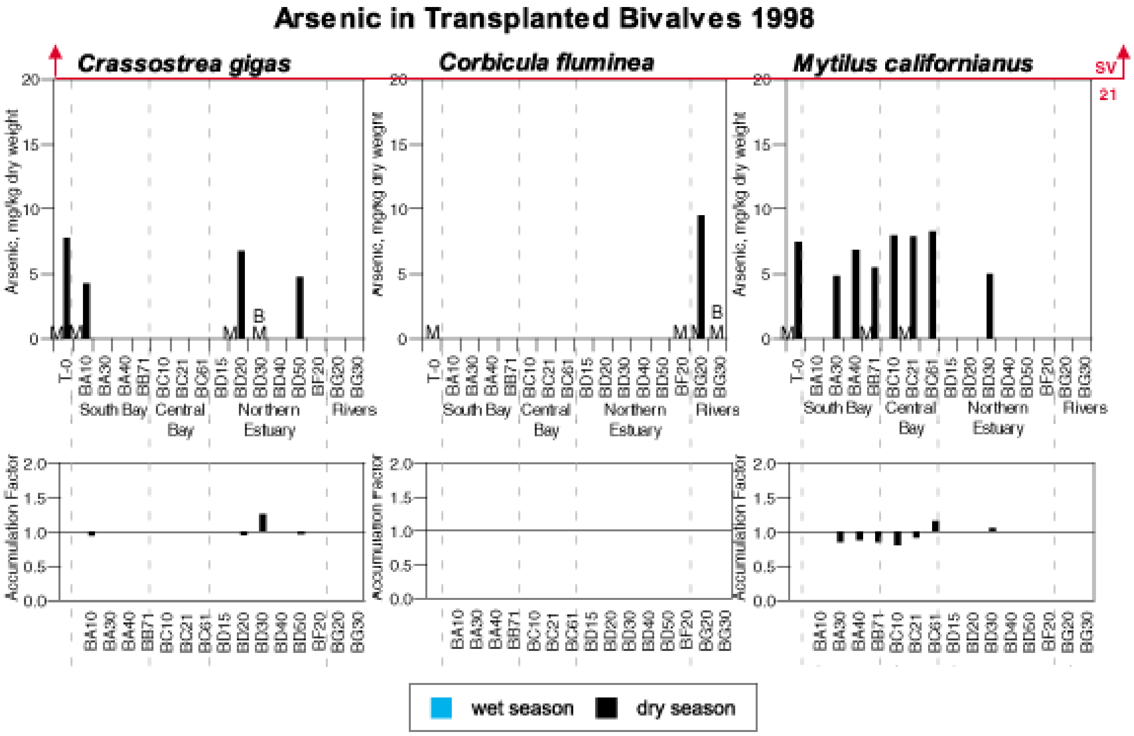


Figure 4.1. Arsenic concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. M indicates matrix interference, and B indicates blank contamination. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 0.55 (depuration) to 1.22. Median concentrations were highest in *M. californianus*, intermediate in *C. gigas*, and lowest in *C. fluminea*. The highest measured concentration was in *C. gigas*, at Sacramento River (BG20) in the dry season.

Figure 4.2

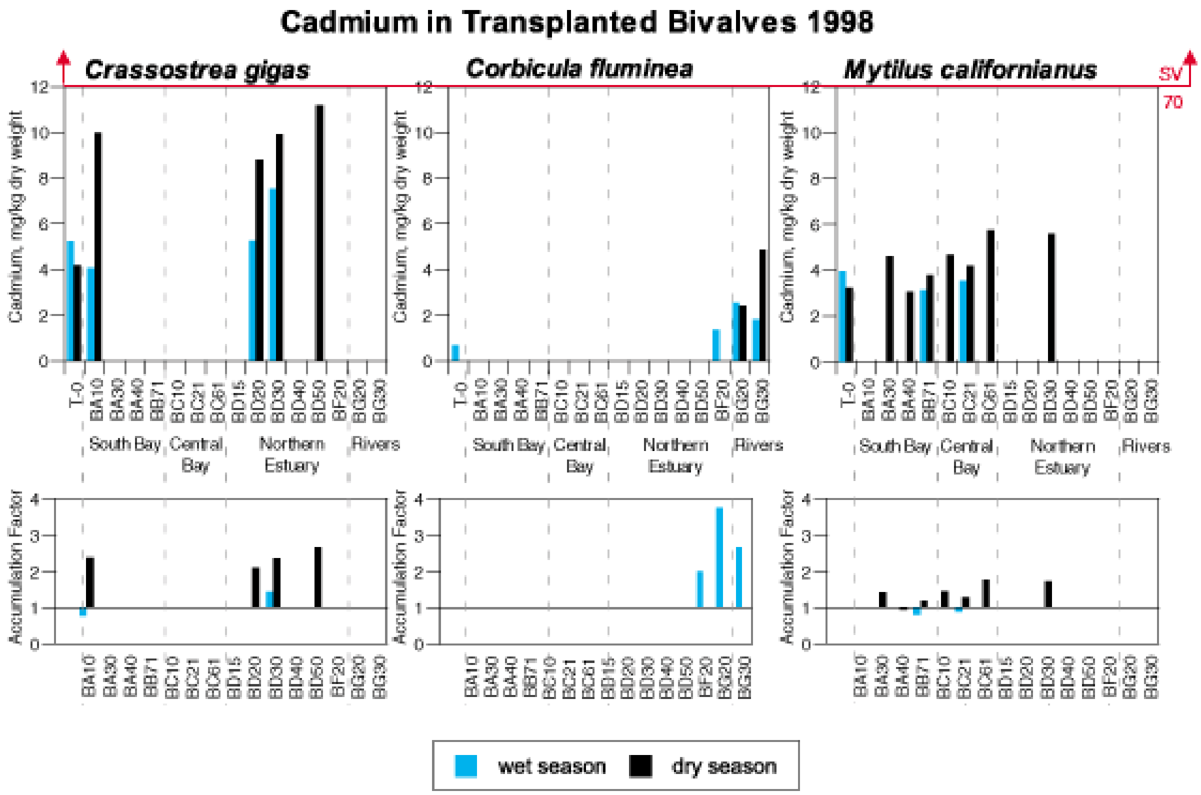


Figure 4.2. Cadmium concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 0.77 (depuration) to 3.76. Median concentrations were highest in *C. gigas*, intermediate in *M. californianus*, and lowest in *C. fluminea*. The highest measured concentration was in *C. gigas*, at Napa River (BD50) in the dry season.

Figure 4.3

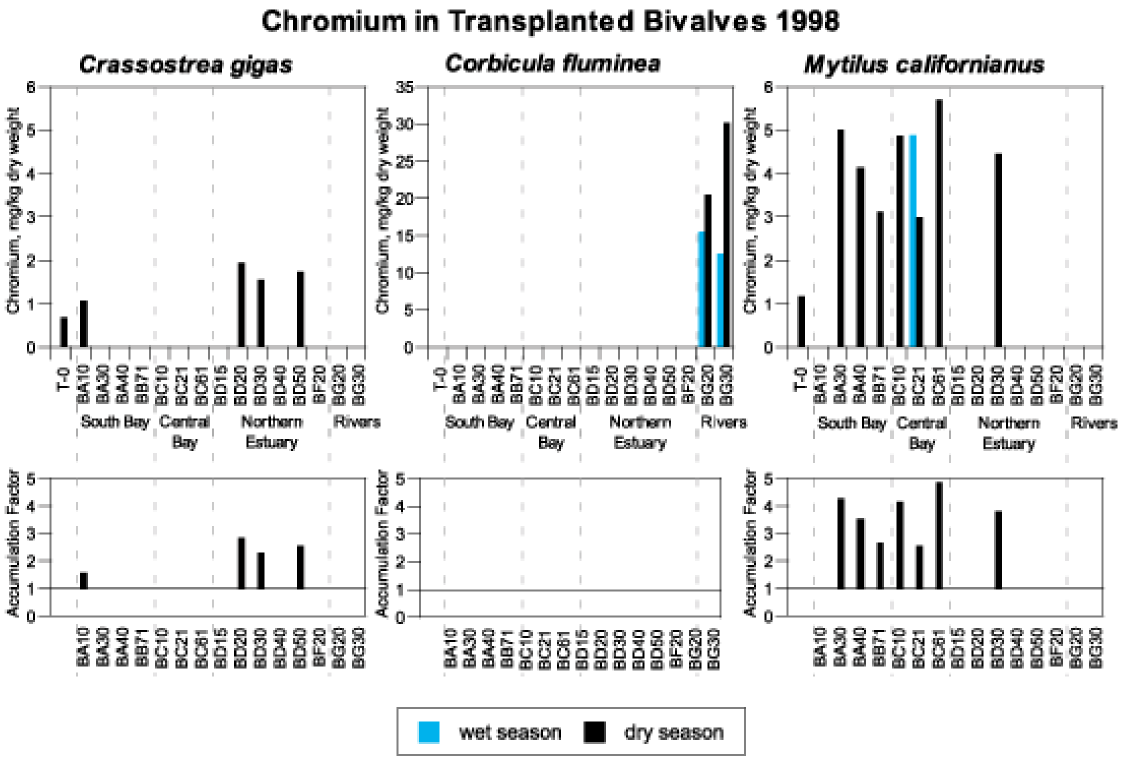


Figure 4.3. Chromium concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. Note different y-axis scales. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 1.58 to 4.86. Median concentrations were highest in *C. fluminea*, intermediate in *M. californianus*, and lowest in *C. gigas*. The highest measured concentration was in *C. fluminea*, at San Joaquin River (BG30) in the dry season.

Figure 4.4

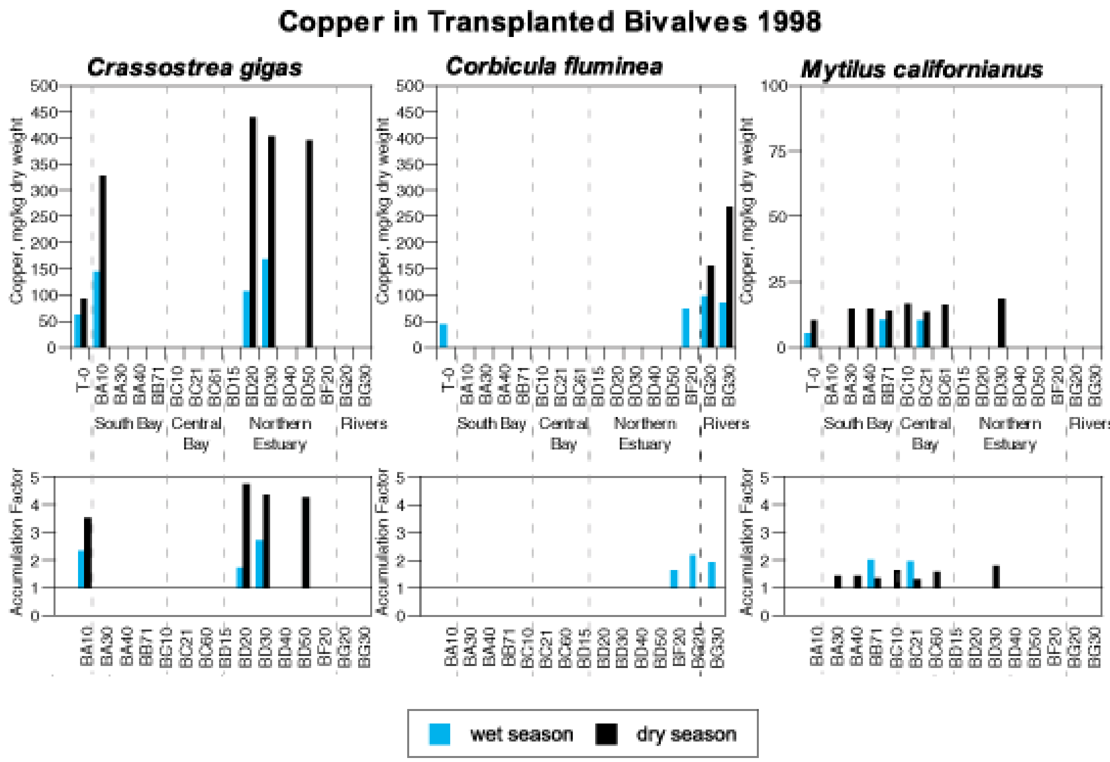


Figure 4.4. Copper concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. Note different y-axis scales. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 1.31 to 4.76. Median concentrations were highest in *C. gigas*, intermediate in *C. fluminea*, and lowest in *M. californianus*. The highest measured concentration was in *C. gigas*, at San Pablo Bay (BD20) in the dry season.

Figure 4.5

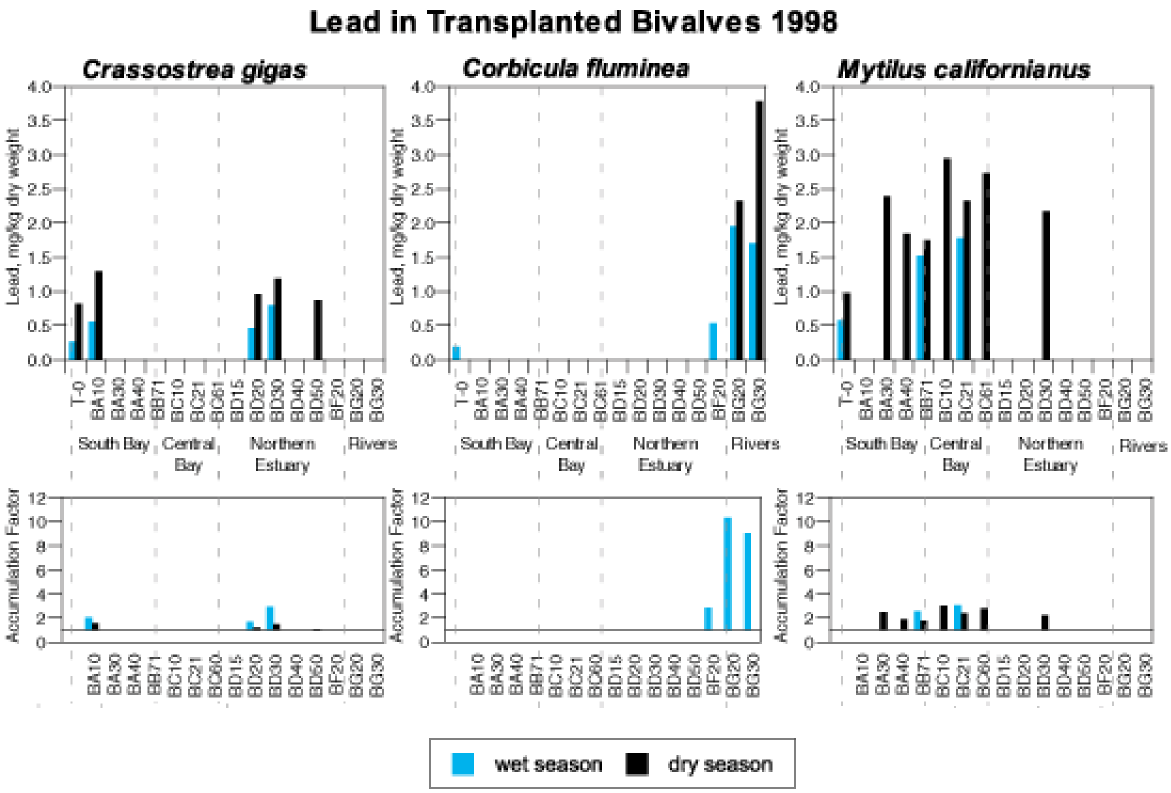


Figure 4.5. Lead concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 1.06 to 10.36. Median concentrations were highest in *M. californianus*, intermediate in *C. fluminea*, and lowest in *C. gigas*. The highest measured concentration was in C. fluminea, at San Joaquin River (BG30) in the dry season.

Figure 4.6

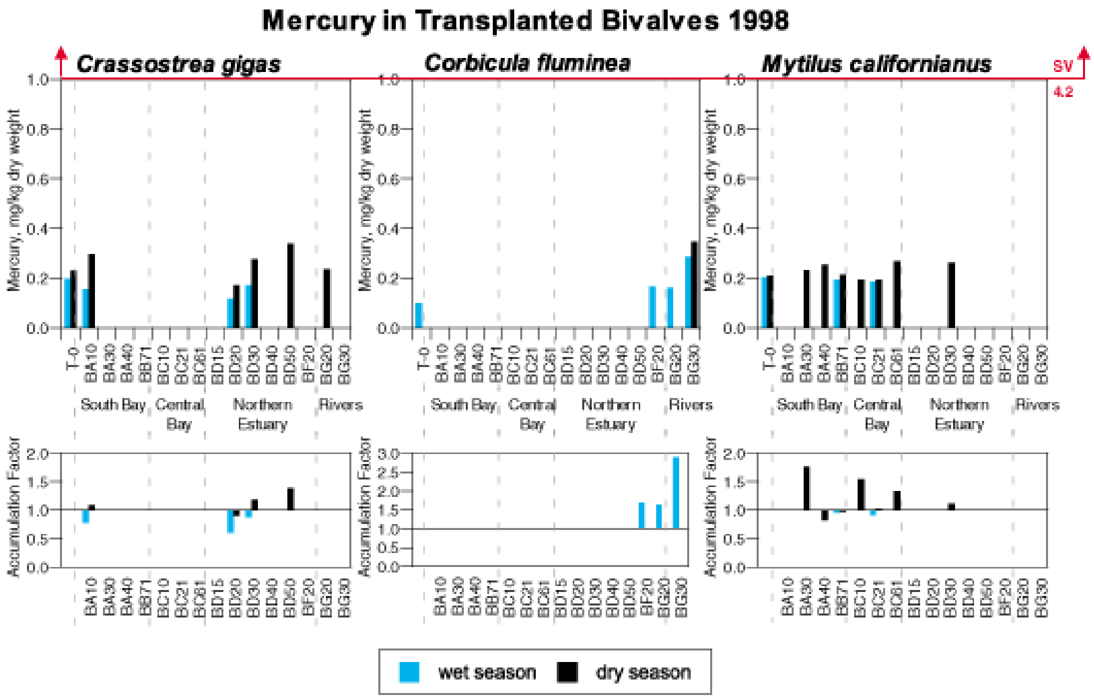


Figure 4.6. Mercury concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 0.75 (depuration) to 2.89. Note different y-axis scales. Median concentrations were highest in *C. fluminea*, intermediate in *M. californianus*, and lowest in *C. gigas*. The highest measured concentration was in *C. fluminea*, at San Joaquin River (BG30) in the dry season.

Figure 4.7

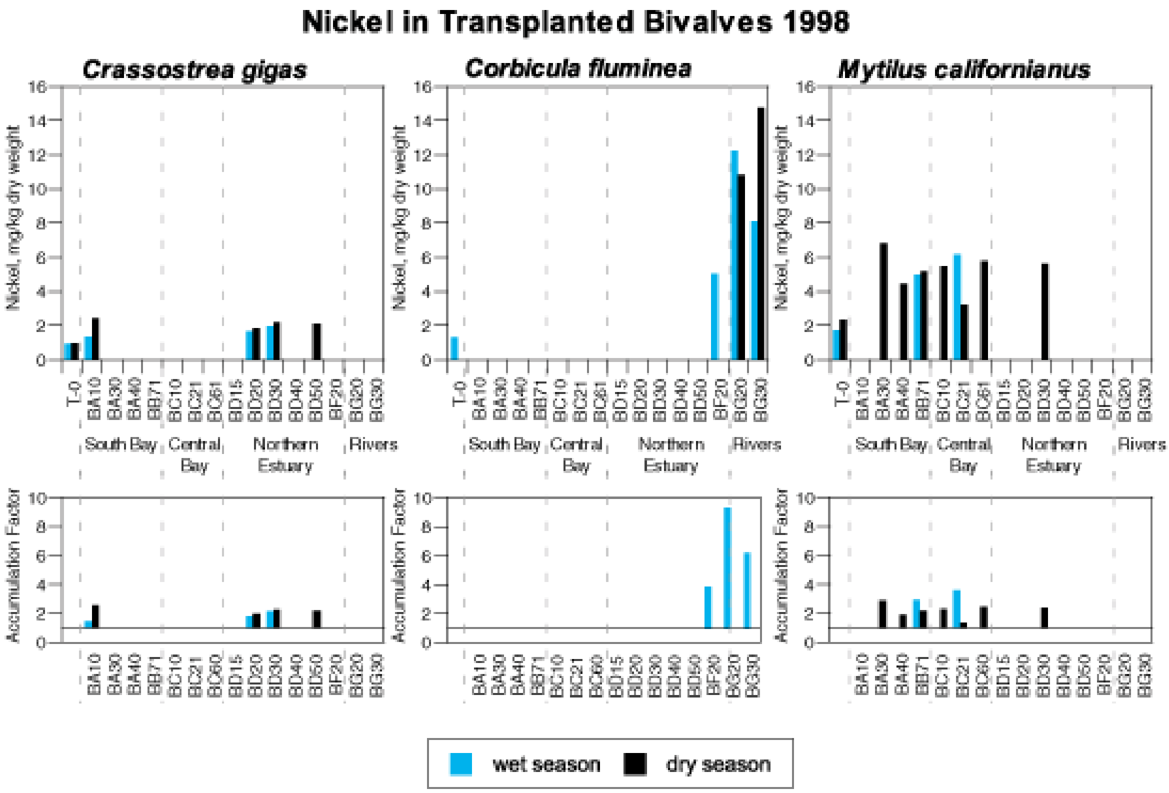


Figure 4.7. Nickel concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 1.36 to 9.33. Median concentrations were highest in *C. fluminea*, intermediate in *M. californianus*, and lowest in *C. gigas*. The highest measured concentration was in *C. fluminea*, at San Joaquin River (BG30) in the dry season

Figure 4.8

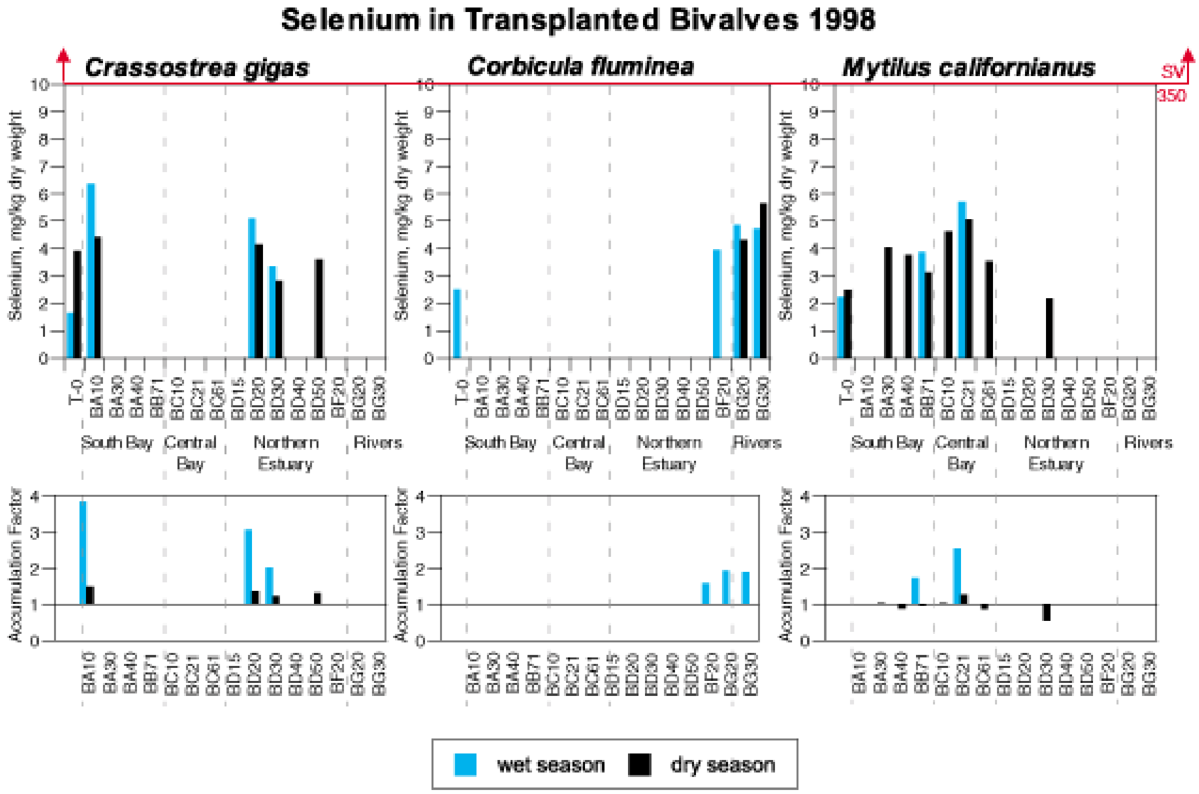


Figure 4.8. Selenium concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 0.72 (depuration) to 3.85. Median concentrations were highest in *C. fluminea*, intermediate in *C. gigas*, and lowest in *M. californianus*. The highest measured concentration was in *C. gigas*, at Coyote Creek (BA10) in the wet season.

Figure 4.9

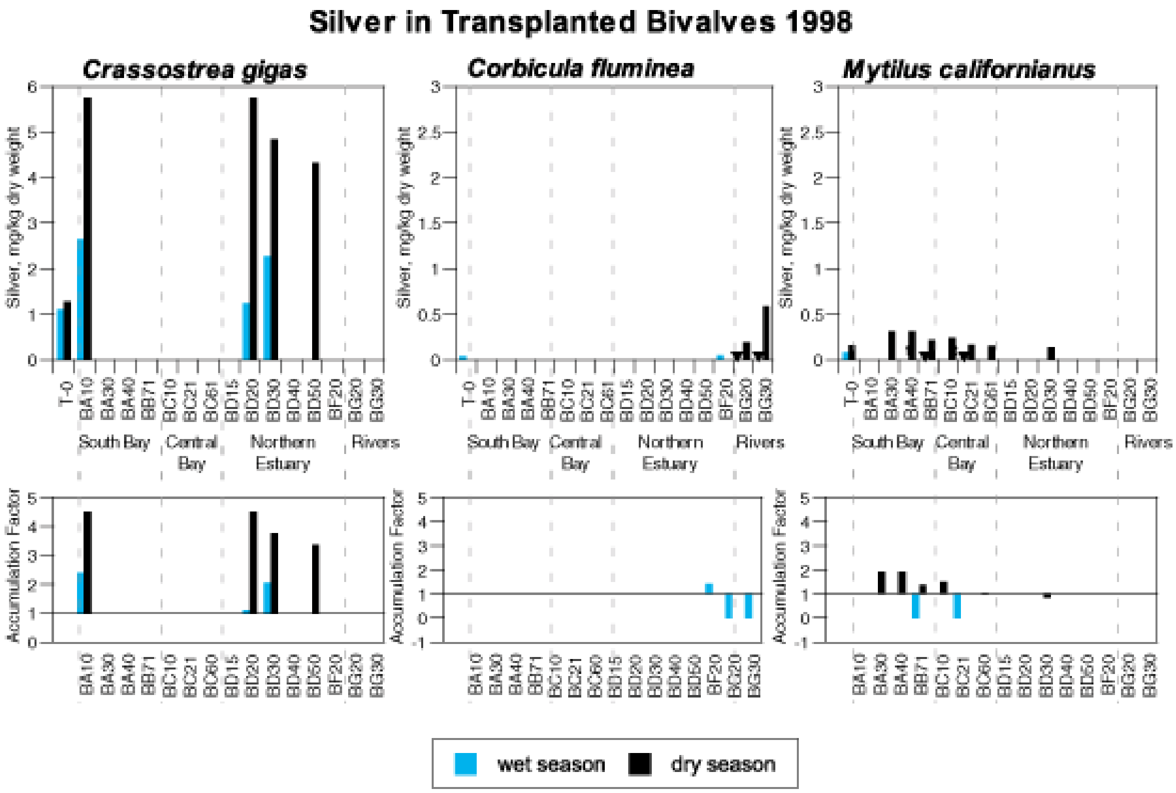


Figure 4.9. Silver concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. ▼= not detected. Note different y-axis scales. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 0.01 (depuration) to 4.5. Median concentrations were highest in *C. gigas*, intermediate in *M. californianus*, and lowest in *C. fluminea*. The highest measured concentration was in *C. gigas*, at San Pablo Bay (BD20) in the dry season.

Figure 4.10

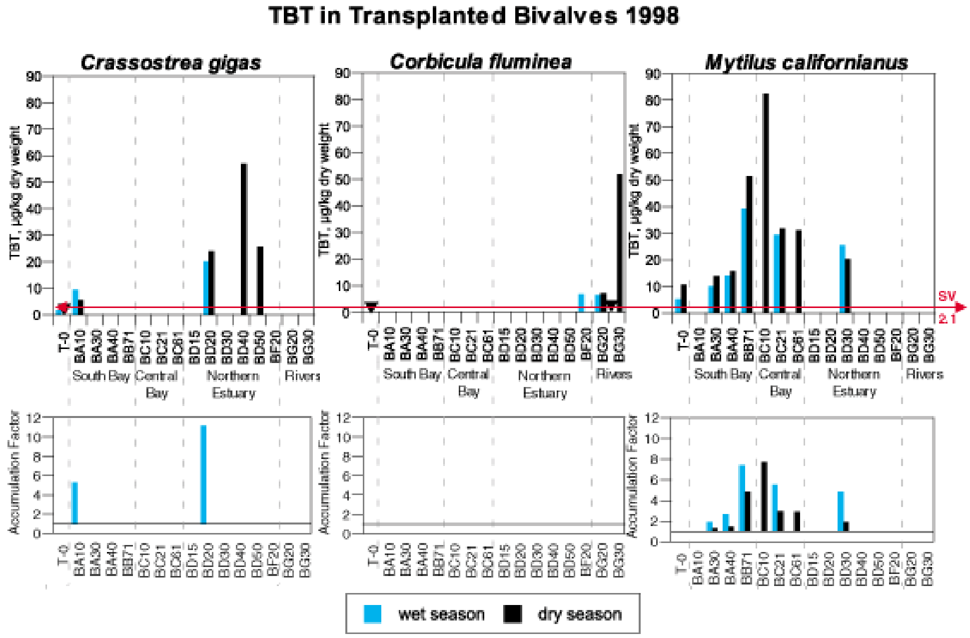


Figure 4.10. Tributyltin concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. ▼= not detected. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 0.5 to 11.20. Accumulation factors were not calculated for *C. gigas* in the dry season and *C. fluminea* for both the wet and dry seasons because T-0 concentrations were not detected. Median concentrations were highest in *M. californianus,* intermediate in *C. gigas,* and lowest in *C. fluminea.* The highest measured concentration was in *M. californianus,* at Yerba Buena Island (BC10) in the dry season.

Figure 4.11

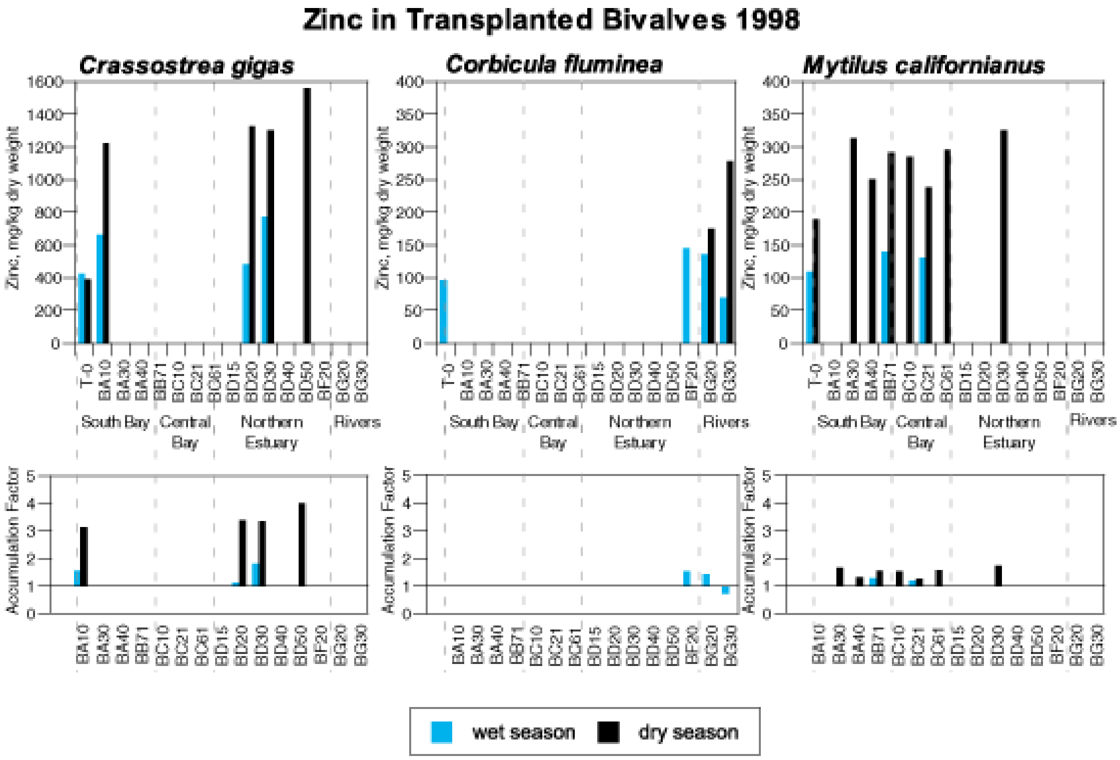


Figure 4.11. Zinc concentrations in parts per million dry weight (ppm) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. Note different y-axis scales. There were no samples for Dumbarton Bridge (BA30), Redwood Creek (BA40), and Red Rock (BC61) in the wet season due to zero percent species survival. Bivalves were not deployed at Davis Point (BD40) in the wet season. T-0 (time zero) is the initial concentration before deployment in the Estuary. Accumulation factors ranged from 0.04 (depuration) to 4.3. Median concentrations were highest in *C. gigas*, intermediate in *M. californianus*, and lowest in *C. fluminea*. The highest measured concentration was in *C. gigas*, at Napa River (BD50) in the dry season.

Figure 4.12

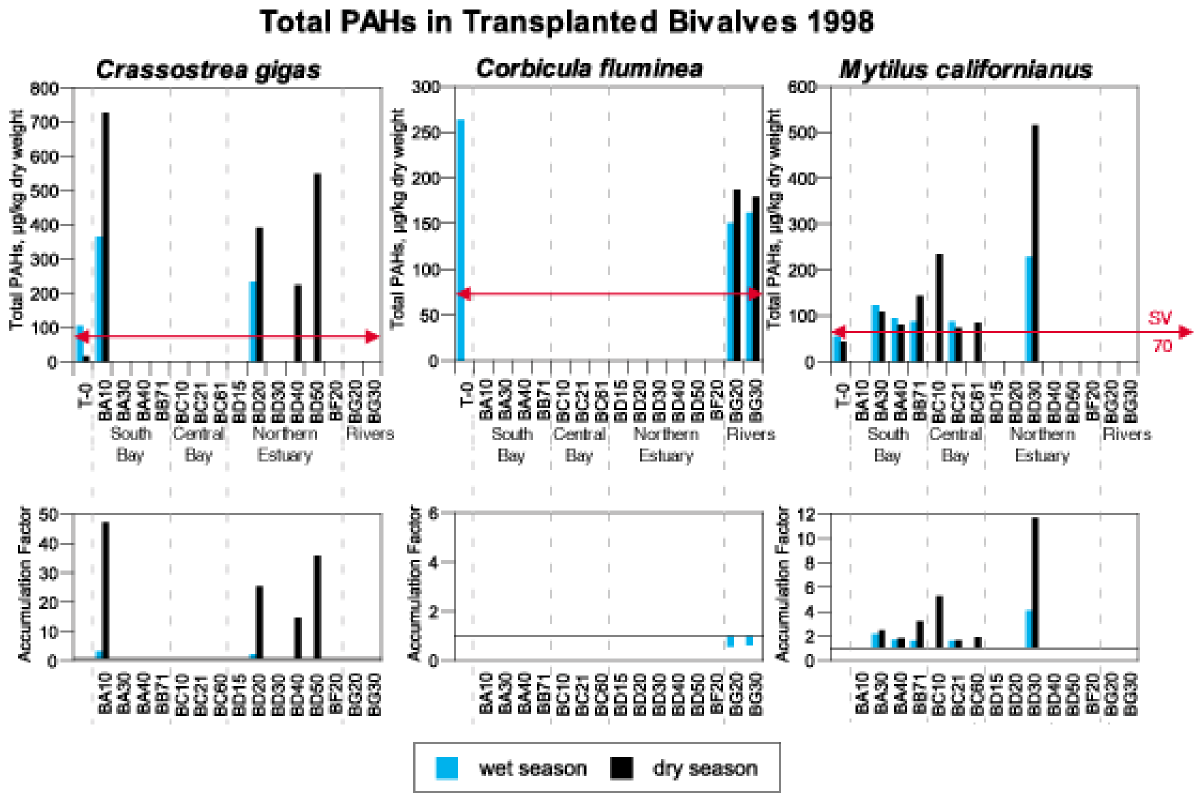


Figure 4.12. Total PAH concentrations in parts per billion dry weight (ppb) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. Note different y-axis scales. There were no samples for Yerba Buena Island (BC10), Red Rock (BC60), Petaluma River (BD15), Davis Point (BD40), and Napa River (BD50) in the wet season due to zero percent species survival. Petaluma River (BD15) also had zero percent survival in the dry season. In the dry season, the Grizzly Bay data could not be used due to a high contamination at the "clean" site. Bivalves were not deployed at Grizzly Bay (BF20) in the dry season due to a lack of species from a "clean" source.T-0 (time zero) is the initial concentration before deployment in the Estuary. T-0 values are missing for *C. fluminea* for the dry season because the population at Lake Chabot crashed before sampling. Accumulation factors ranged from 0.57 (depuration) to 47.42. Median concentrations were highest in *C. gigas* during the dry season, intermediate in *C. fluminea*, and lowest in *M. californianus* during the wet season. The highest measured concentration was in *C. gigas*, at Coyote Creek (BA10) in the dry season.

Bivalve Monitoring: Figure 4.13

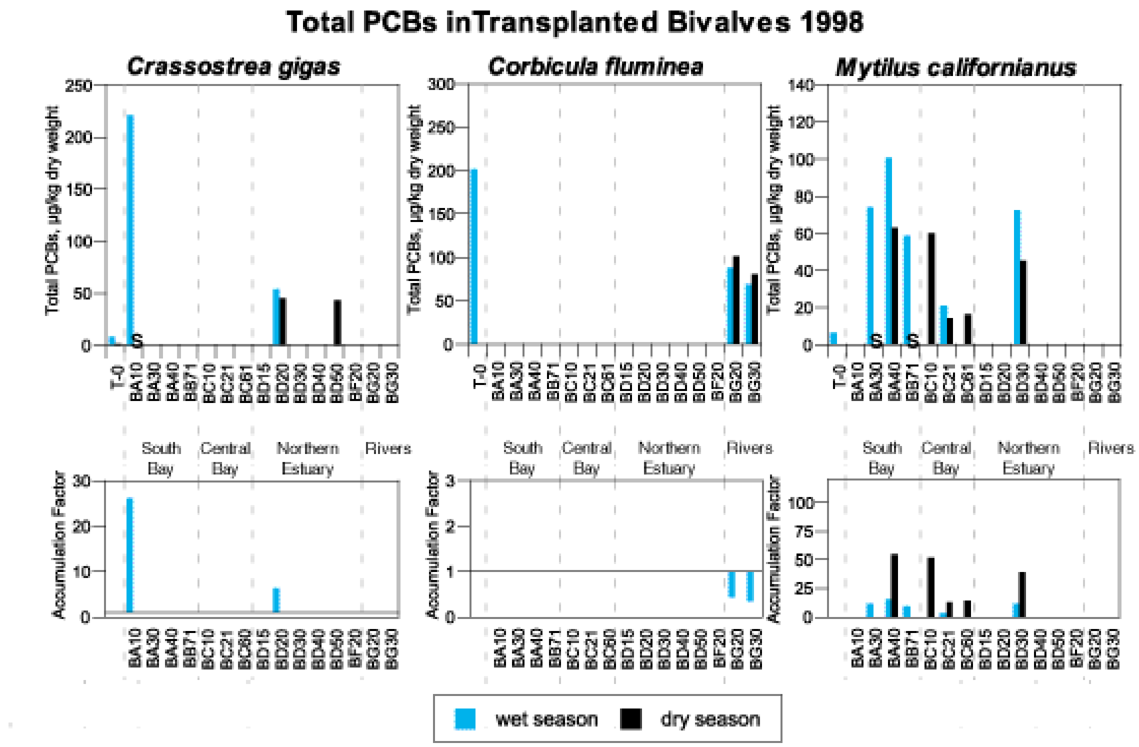


Figure 4.13. Total PCB concentrations in parts per billion dry weight (ppb) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. S = Compounds generally comprising a significant portion of sum not quantifiable, sum not calculated. There were no samples for Yerba Buena Island (BC10), Red Rock (BC60), Petaluma River (BD15), Davis Point (BD40), and Napa River (BD50) in the wet season due to zero percent species survival. Petaluma River (BD15) also had zero percent survival in the dry season. Bivalves were not deployed at Grizzly Bay (BF20) in the dry season due to a lack of species from a "clean" source. The Grizzly Bay (BF20) data for the wet season cannot be used due to contamination at the reference site Lake Chabot. T-0 (time zero) is the initial concentration before deployment in the Estuary. T-0 values are missing for *C. fluminea* for the dry season because the population at Lake Chabot crashed before sampling. Accumulation factors ranged from 0.39 (depuration) to 54.47. Median concentrations were highest in C. fluminea in the wet season, intermediate in *C. gigas*, and lowest in *M. californianus* in the dry season. The highest measured concentration was in *C. gigas*, at Coyote Creek (BA10) in the wet season**.**

Figure 4.14

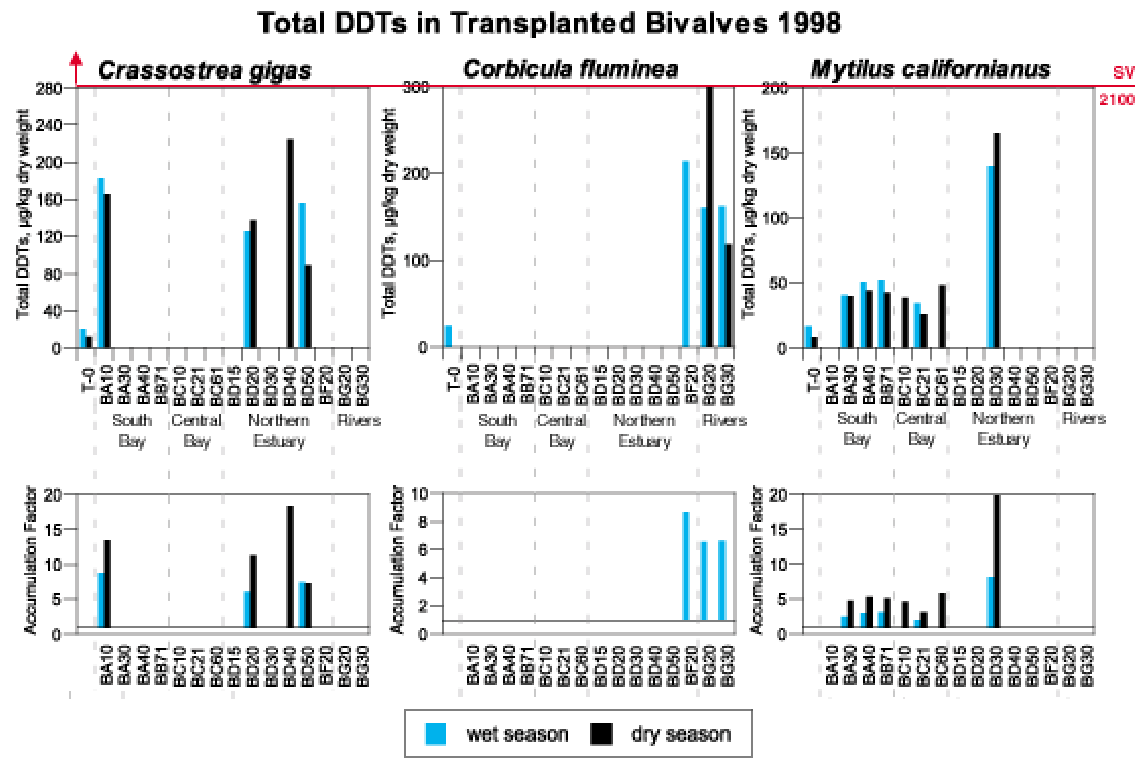


Figure 4.14. Total DDT concentrations in parts per billion dry weight (ppb) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. There were no samples for Yerba Buena Island (BC10), Red Rock (BC60), Petaluma River (BD15), and Davis Point (BD40) in the wet season due to zero percent species survival. Petaluma River (BD15) also had zero percent survival in the dry season. Bivalves were not deployed at Grizzly Bay (BF20) in the dry season due to a lack of species from a "clean" source. T-0 (time zero) is the initial concentration before deployment in the Estuary. T-0 values are missing for *C. fluminea* for the dry season because the population at Lake Chabot crashed before sampling. Accumulation factors ranged from 2.0 in the wet season to 19.9 in the dry season. Median concentrations were highest in *C. fluminea*, intermediate in *C. gigas*, and lowest in *M. californianus*. The highest measured concentration was in *C. fluminea*, at Sacramento River (BG20) in the dry season.

Figure 4.15

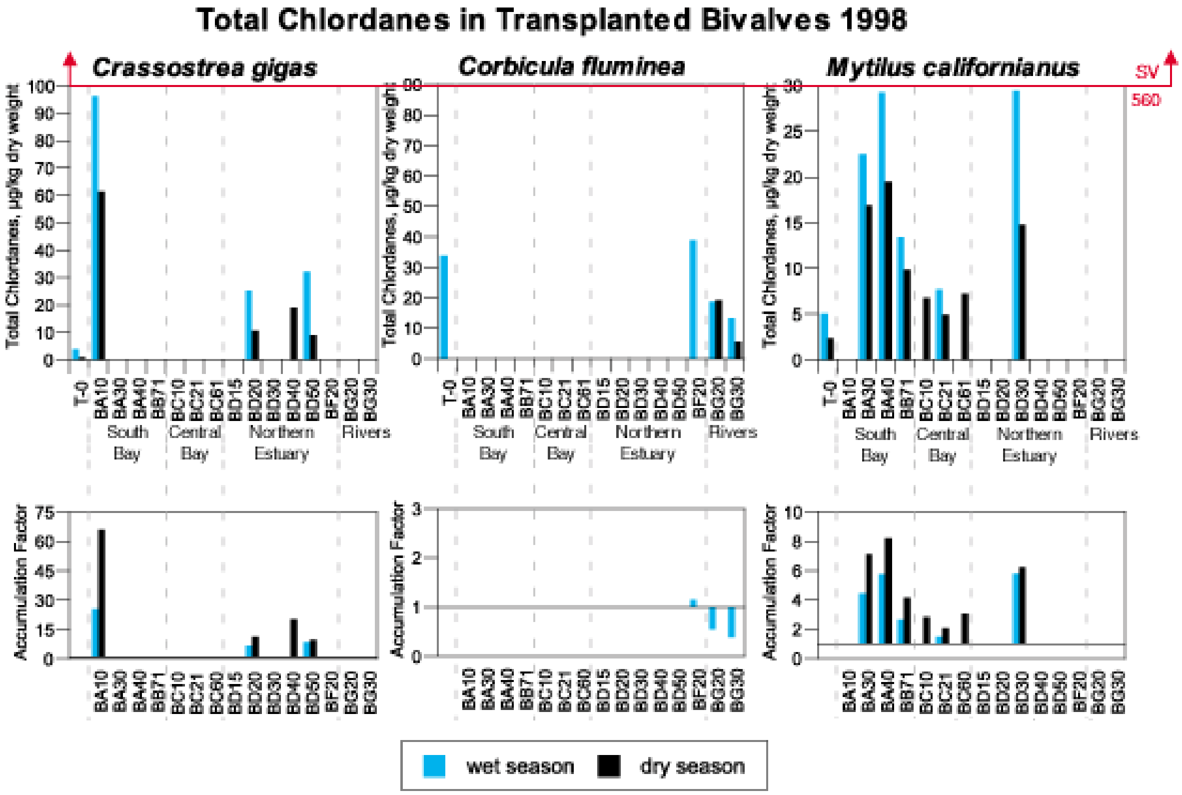


Figure 4.15. Total chlordane concentrations in parts per billion dry weight (ppb) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. Note different y-axis scales. There were no samples for Yerba Buena Island (BC10), Red Rock (BC60), Petaluma River (BD15), and Davis Point (BD40) in the wet season due to zero percent species survival. Petaluma River (BD15) also had zero percent survival in the dry season. Bivalves were not deployed at Grizzly Bay (BF20) in the dry season due to a lack of species from a "clean" source. T-0 (time zero) is the initial concentration before deployment in the Estuary. T-0 values are missing for *C. fluminea* for the dry season because the population at Lake Chabot crashed before sampling. Accumulation factors ranged from 0.39 (depuration) in the wet season to 66.01 in the dry season. Median concentrations were highest in *C. gigas*, intermediate in *C. fluminea*, and lowest in *M. californianus*. The highest measured concentration was in *C. gigas* at Coyote Creek (BA10) in the wet season.

Figure 4.16

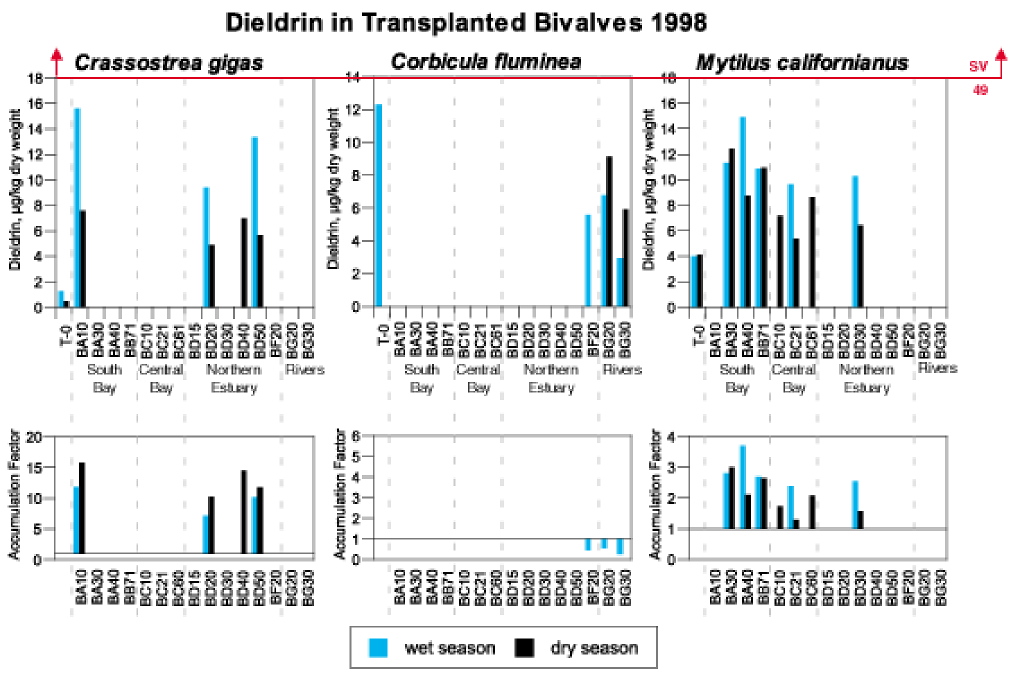


Figure 4.16. Total dieldrin concentrations in parts per billion dry weight (ppb) in three transplanted bivalve species at 15 RMP stations during the wet- and dry-season sampling periods. Note different y-axis scales. There were no samples for Yerba Buena Island (BC10), Red Rock (BC60), Petaluma River (BD15), and Davis Point (BD40) in the wet season due to zero percent species survival. Petaluma River (BD15) also had zero percent survival in the dry season. Bivalves were not deployed at Grizzly Bay (BF20) in the dry season due to a lack of species from a "clean" source. T-0 (time zero) is the initial concentration before deployment in the Estuary. T-0 values are missing for *C. fluminea* for the dry season because the population at Lake Chabot crashed before sampling. Accumulation factors ranged from 0.24 (depuration) in the wet season to 15.81 in the dry season. Median concentrations were highest in *M. californianus* in the wet season, intermediate in *C. fluminea*, and lowest in *C. gigas* in the dry season. The highest measured concentration was in *C. gigas* at Coyote Creek (BA10) in the wet season.

Figure 4.17

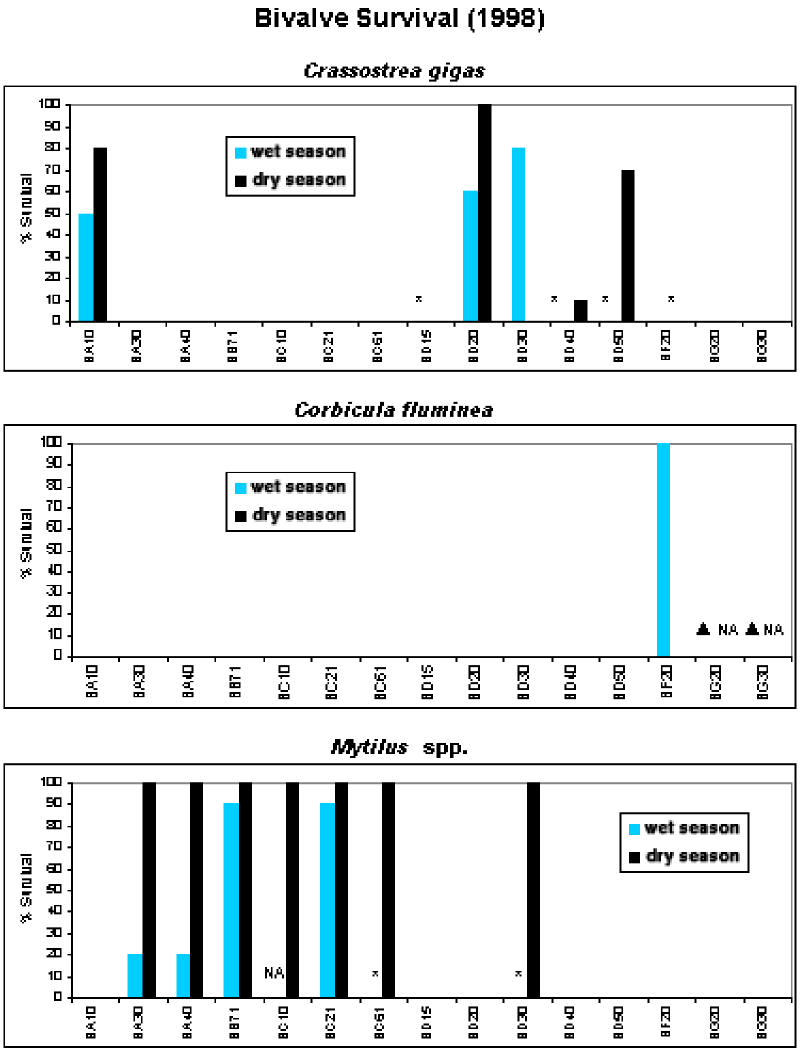


Figure 4.17. Percent survival of transplanted bivalves following exposure to Estuary conditions during the wet (April) and dry season (September) of 1998. * indicates 0% survival, ▲ indicates insufficient clams for deployment, and NA = not analyzed.

Figure 4.18

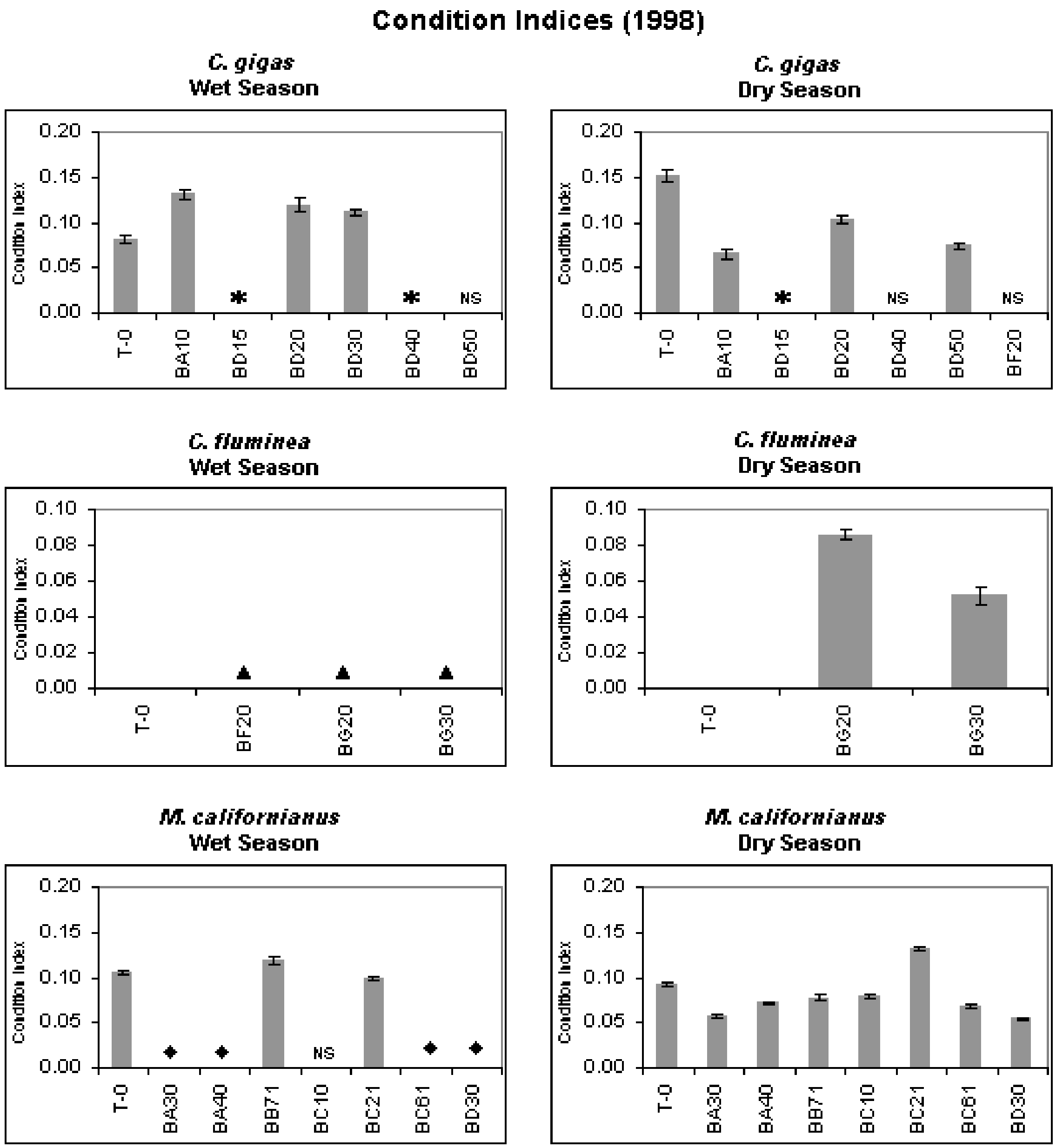
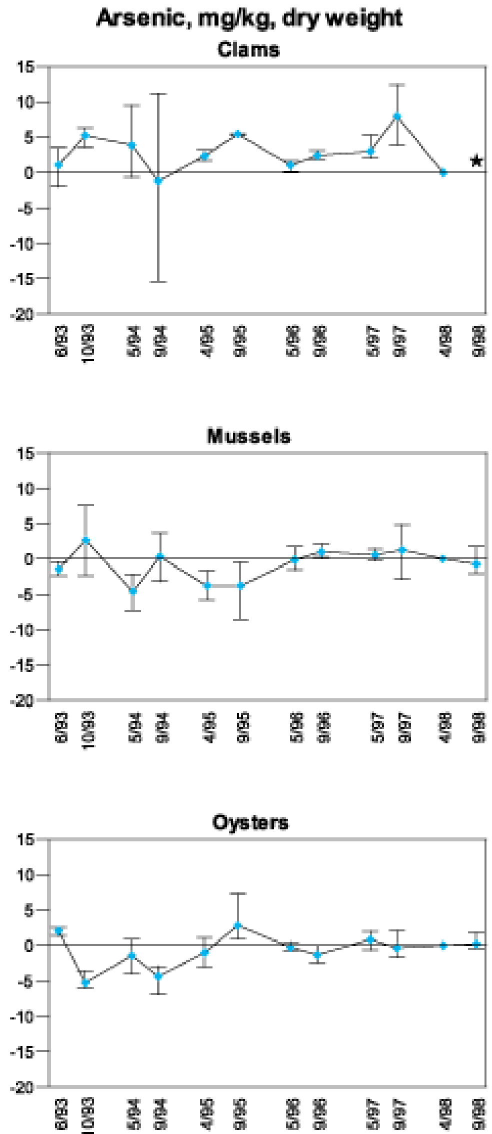


Figure 4.18. Condition indices of three species of bivalve at their original "reference" locations, prior to deployment (T-0), and at the end of their exposure to San Francisco Estuary waters (various locations) during the wet and dry seasons of 1998. NS = not sampled, ◆ = all bivalves allotted to chemistry, ∗ = 0 % survival, and ▲ = insufficient clams for deployment. Data for *C. fluminea* at station T-0 were not available. Bars indicate range of values.

Figure 4.19



San Francisco Estuary Institute

Figure 4.19. Arsenic accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. ★ means no analyzed data available.

Figure 4.20

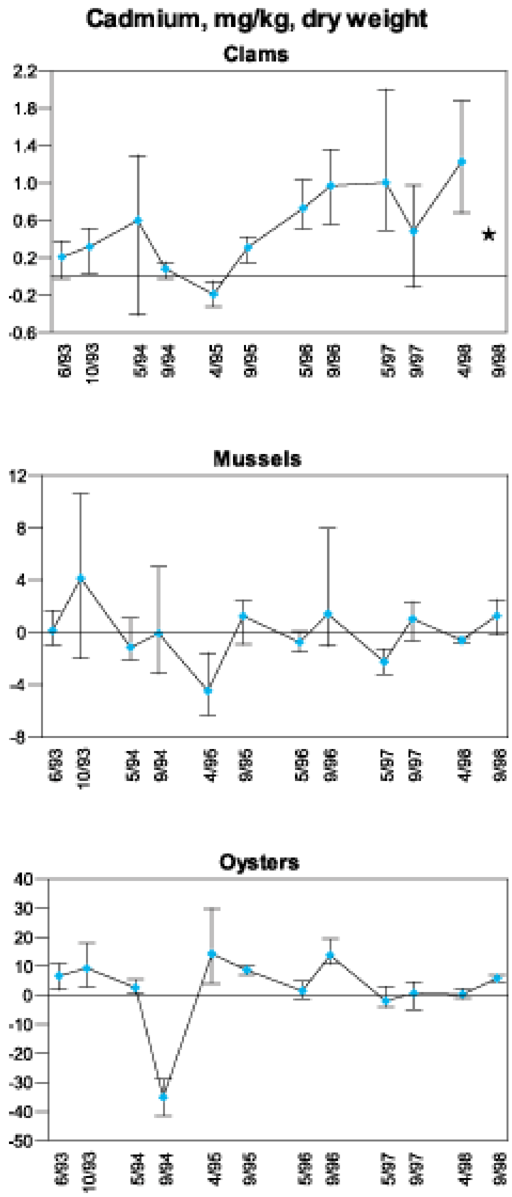


Figure 4.20. Cadmium accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ★ means no analyzed data available.

Figure 4.21

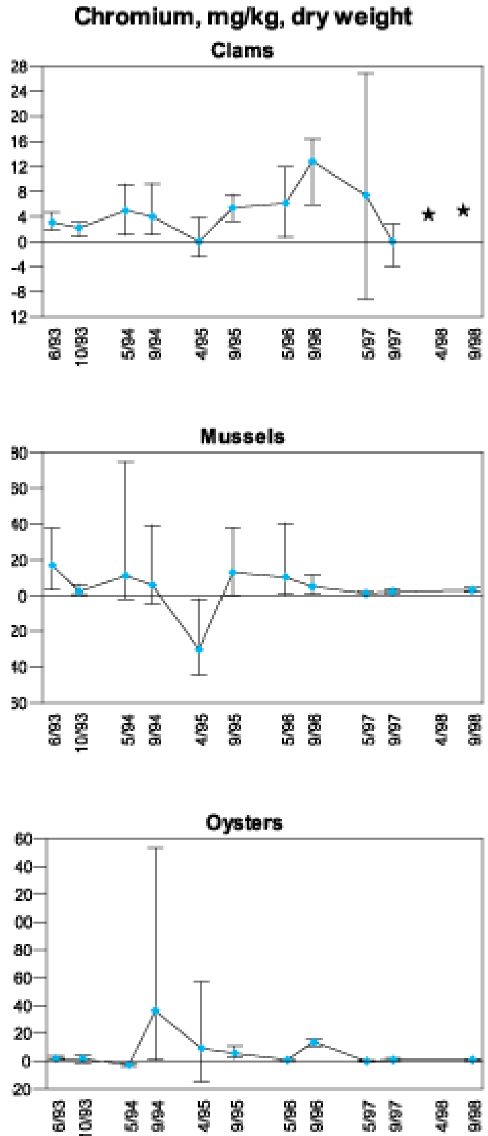


Figure 4.21. Chromium accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ⋆ means no analyzed data available.

Figure 4.22

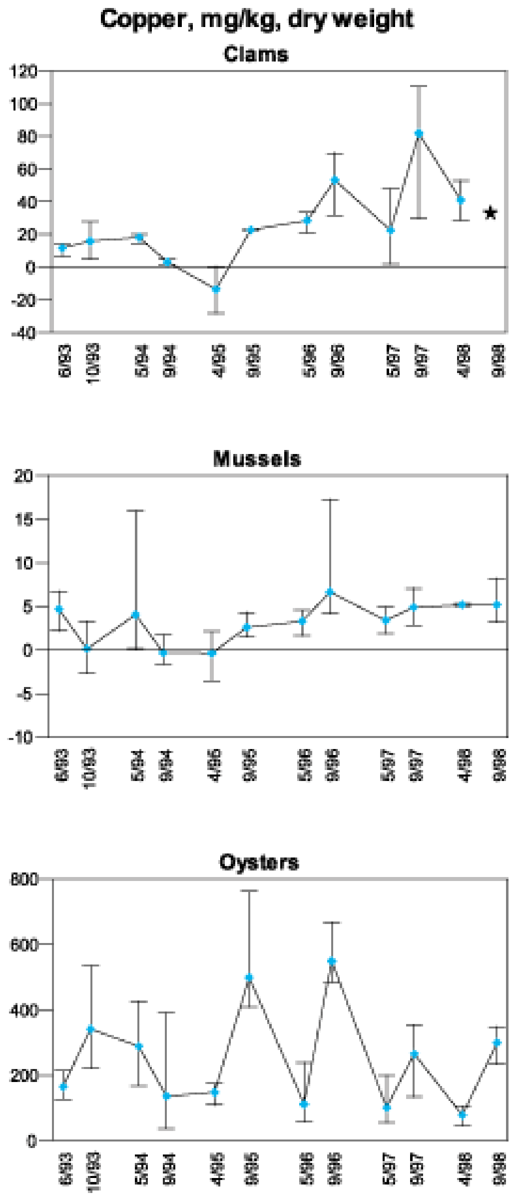


Figure 4.22. Copper accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ★ means no analyzed data available.

Figure 4.23

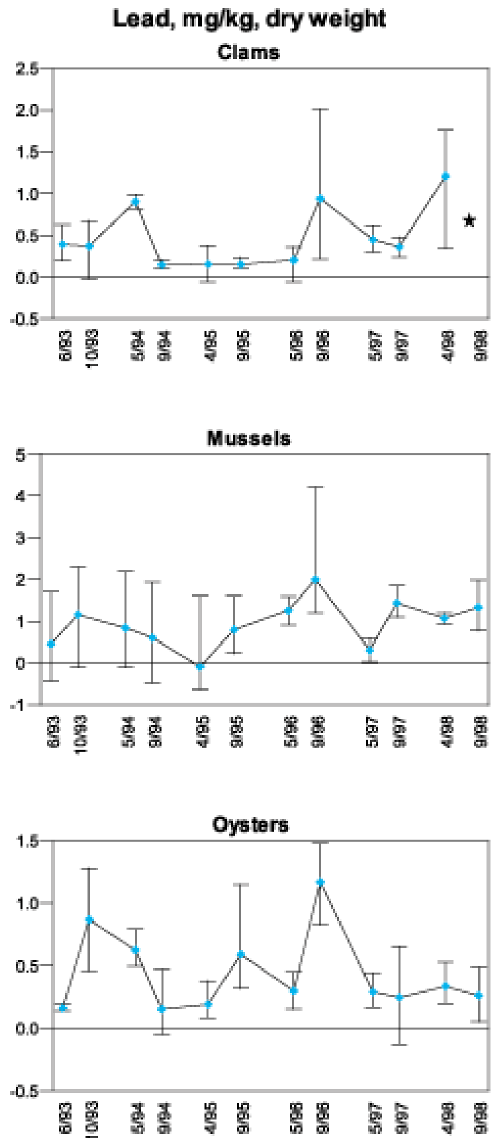


Figure 4.23. Lead accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ★ means no analyzed data available.

Figure 4.24

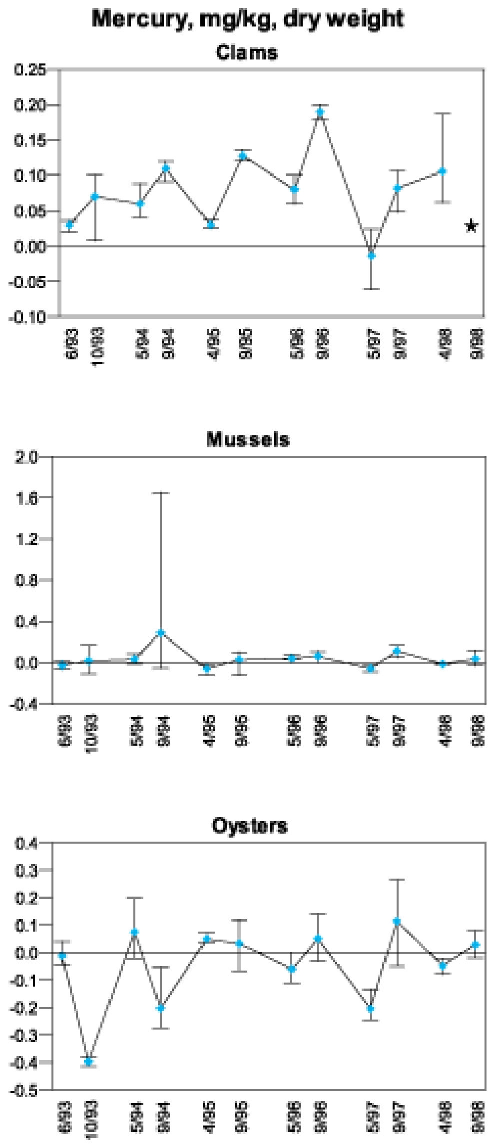


Figure 4.24. Mercury accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ⋆ means no analyzed data available.

Figure 4.25

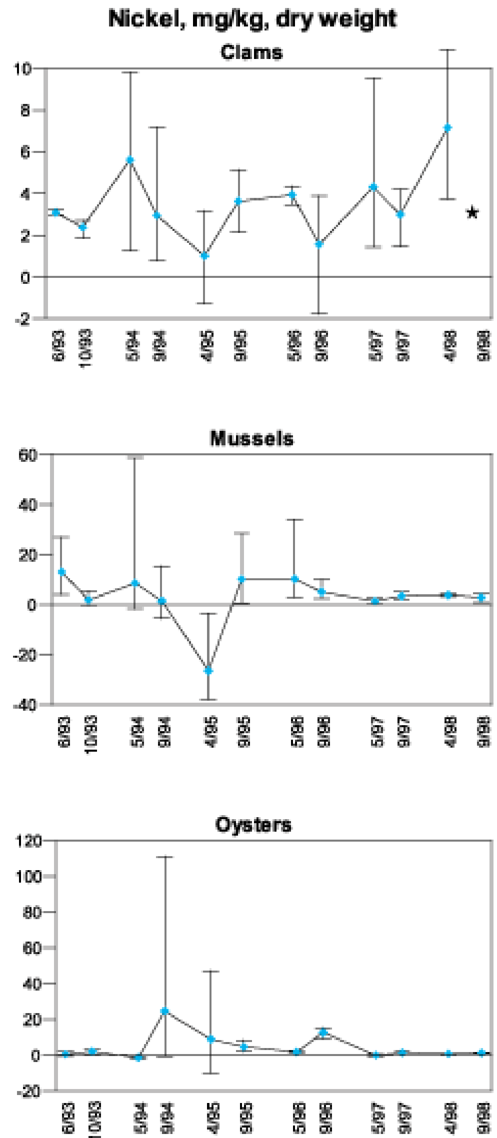


Figure 4.25. Nickel accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ⋆ means no analyzed data available.

Figure 4.26

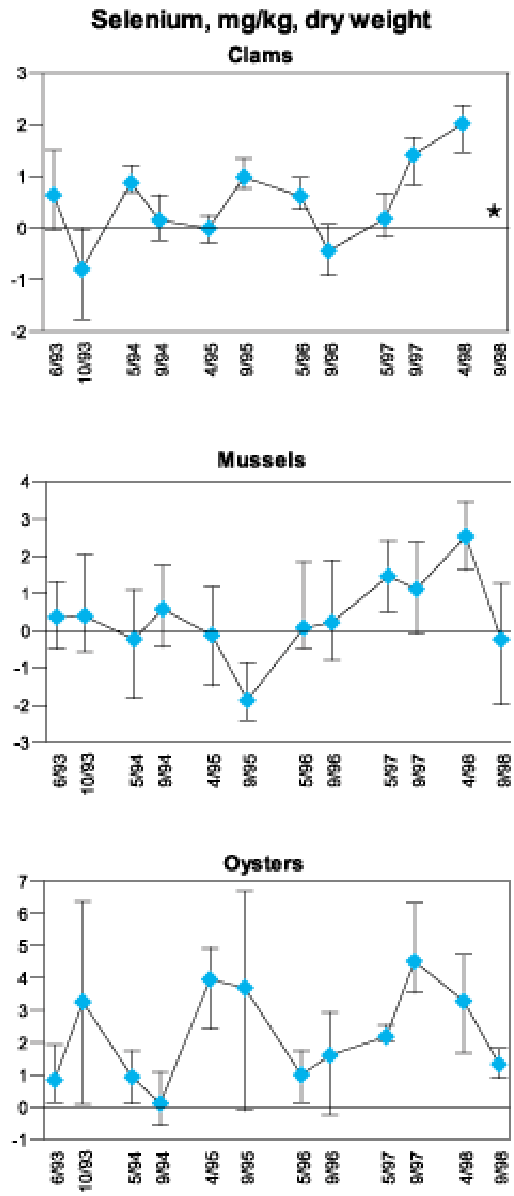


Figure 4.26. Selenium accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ★ means no analyzed data available.

Figure 4.27

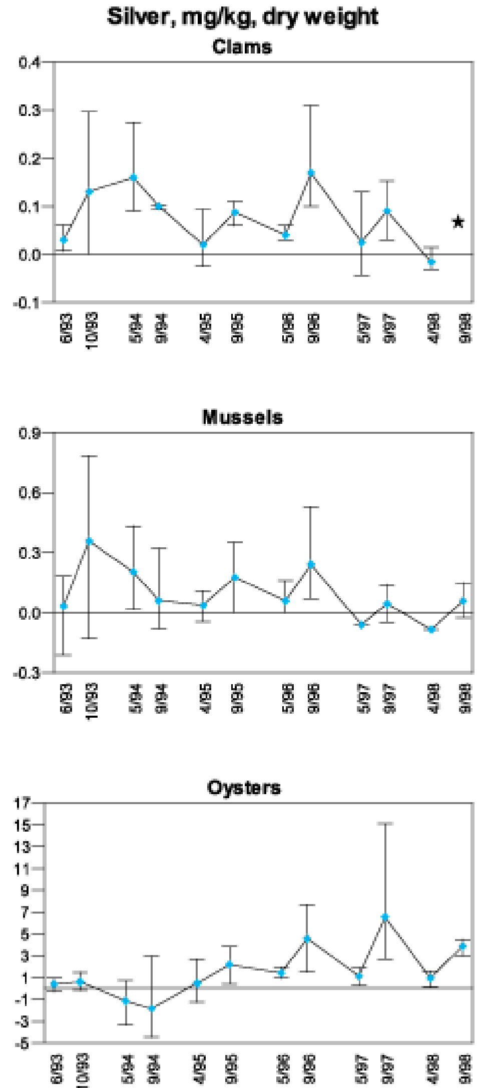


Figure 4.27. Silver accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ★ means no analyzed data available. For calculations, non-detects were substituted with 1/2 the target method detection (MDL) listed in the 1999 QAPP.

Figure 4.28

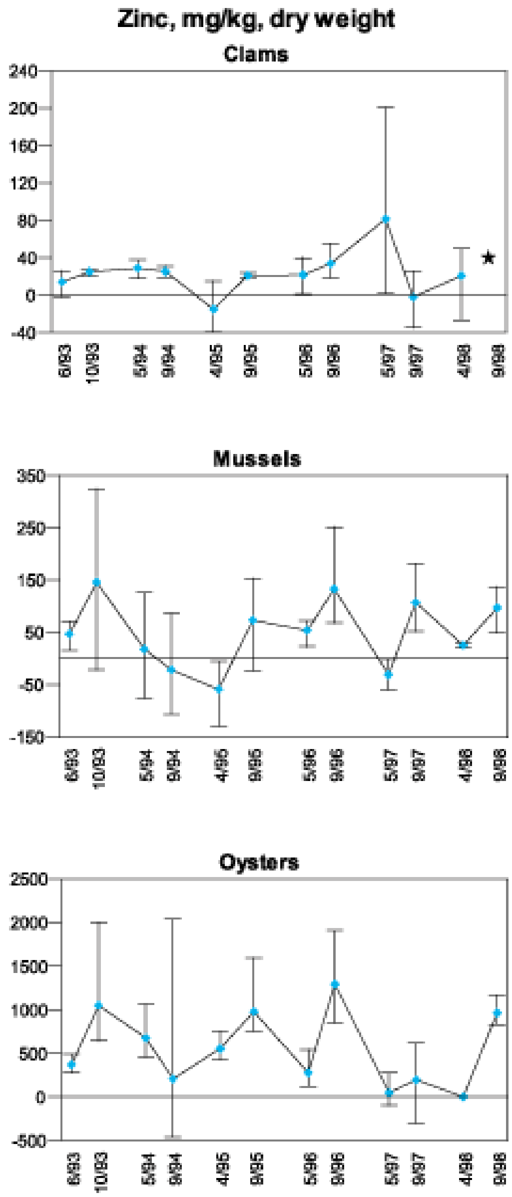


Figure 4.28. Zinc accumulation or depuration in parts per million dry weight (ppm) in three transplanted bivalve species for twelve sampling periods from 1993-1998. Initial (T-0) concentrations are subtracted from tissue concentrations after retrieval to give concentrations accumulated or depurated (negative value) during deployment in the Estuary. Bars indicate the range of values of all stations where species were deployed. Note different y-axis scales. ★ means no analyzed data available. For calculations, non-detects were substituted with 1/2 the target method detection (MDL) listed in the 1999 QAPP.

Figure 4.29

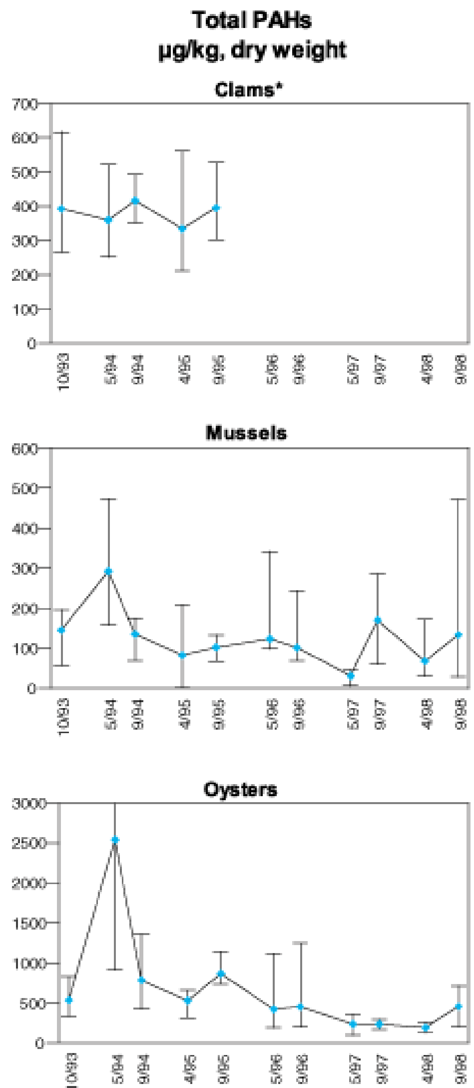


Figure 4.29. Total PAH accumulation or depuration in parts per billion dry weight (ppb) in three species of transplanted bivalves for eleven sampling periods from 1993-1998 (mean of all stations). Accumulation or depuration was calculated by subtracting initial tissue (T-0) concentrations from concentrations after deployment. Bars indicate range of values within a sampling period. Note different y-axis scales. * In 1996, the reference population of "clean" *Corbicula fluminea* at Lake Isabella crashed and disappeared. Despite exploring several other potential reference sites, field staff was unable to find sufficiently large populations suitable for transplantation into the Estuary. Beginning with the 1996 data, *C. fluminea* bioaccumulation could no longer be compared with previous years due to the initial high concentrations of some contaminants, particularly trace organics, which biases bioaccumulation estimates toward the low end.

Figure 4.30

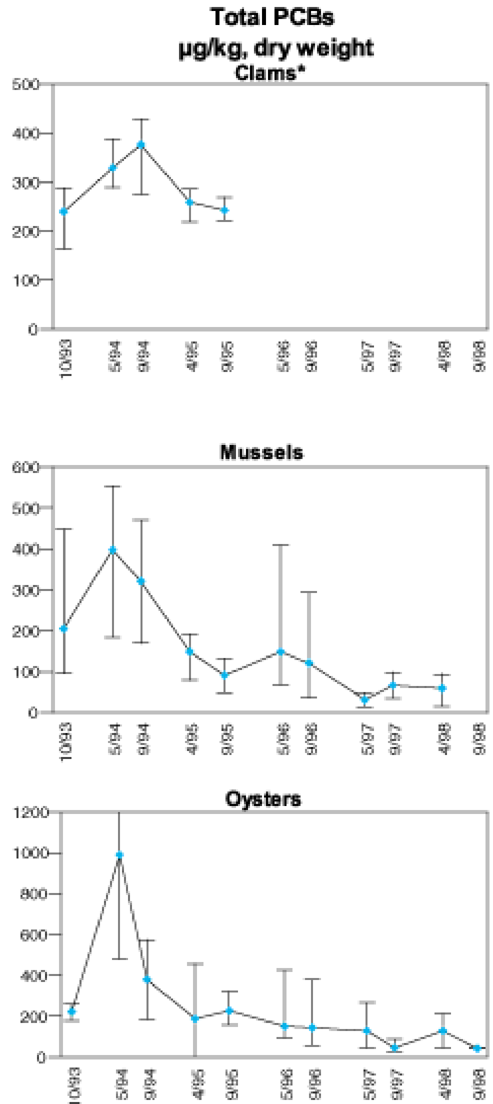


Figure 4.30. Total PCB accumulation or depuration in parts per billion dry weight (ppb) in three species of transplanted bivalves for eleven sampling periods from 1993-1998 (mean of all stations). The vertical bars represent the range of values of all stations where species were deployed. Note different y-axis scales. * In 1996, the reference population of "clean" *Corbicula fluminea* at Lake Isabella crashed and disappeared. Despite exploring several other potential reference sites, field staff was unable to find sufficiently large populations suitable for transplantation into the Estuary. Beginning with the 1996 data, *C. fluminea* bioaccumulation could no longer be compared with previous years due to the initial high concentrations of some contaminants, particularly trace organics, which biases bioaccumulation estimates toward the low end. Trends could not be calculated for the 1998 dry season since *M. californianus* had no T-0 value.

Figure 4.31

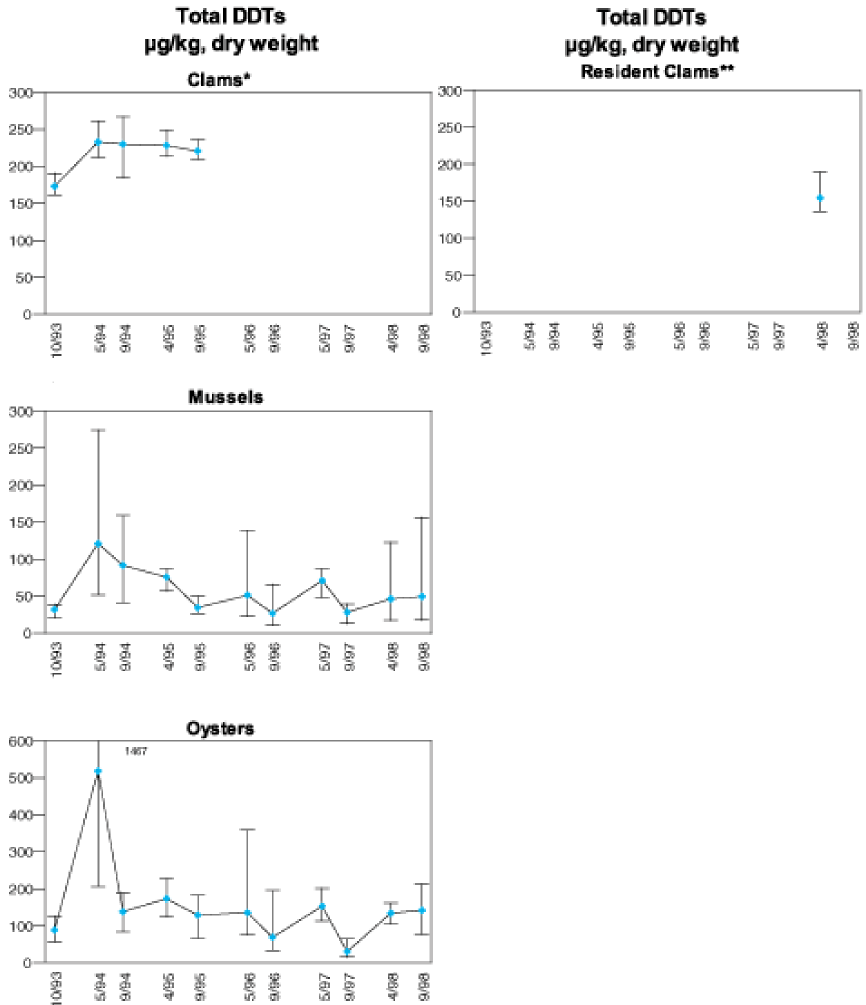


Figure 4.31. Total DDT accumulation or depuration in parts per billion dry weight (ppb) in three species of transplanted bivalves for eleven sampling periods from 1993-1998 (mean of all stations). Note different y-axis scales. * In 1996, the reference population of "clean" *Corbicula fluminea* at Lake Isabella crashed and disappeared. Despite exploring several other potential reference sites, field staff was unable to find sufficiently large populations suitable for transplantation into the Estuary. Beginning with the 1996 data, *C. fluminea* bioaccumulation could no longer be compared with previous years due to the initial high concentrations of some contaminants, particularly trace organics, which biases bioaccumulation estimates toward the low end. ** Specimen were collected for analysis from the native population in the Sacramento and the San Joaquin Rivers. This resident clam is not comparable with the ones from Lake Isabella and therefore not included in the same chart.

Summary of Overall Condition

Some Estuary contaminants are clearly reduced from peak levels seen in earlier decades. Nevertheless, there are several indications that the level of contamination today is high enough to impair the health of the Estuary ecosystem. These indications include the toxicity of water and sediment samples; the frequent presence of contaminant concentrations exceeding water, sediment and fish guidelines; and altered communities of sediment dwelling organisms. As a whole, the Estuary can be described as moderately contaminated. The remedy for this contamination involves both action by Estuary managers to decrease the continuing input of contaminants and undertake sediment clean up actions where appropriate, and the passing of time, to allow the large reservoir of contaminants in the sediment to decrease naturally through permanent burial by new sediment, degradation, and transport to the ocean.

Sites of greatest concern, sites of least concern

Overall, sites in the lower South Bay, the Petaluma River mouth, and San Pablo Bay are the more contaminated than other sites. Contamination in the Central Bay is lower primarily due to mixing with relatively clean ocean water. The site west of the Golden Gate is least contaminated.

Contaminants of greatest concern

Of the contaminants measured by the RMP, results suggest that levels of mercury, PCBs, diazinon, and chlorpyrifos are of highest concern. Also of concern are copper, nickel, zinc, DDT, chlordane, dieldrin, dioxins and PAHs. Work outside the RMP suggests that selenium is also of high concern. Of unknown concern are each of the many synthetic organic contaminants that may be in the Estuary but that the RMP does not currently measure.

Description of Methods

6.1 Water Sampling

One of the objectives of the RMP is to evaluate if water quality objectives are met at sampled stations. Therefore, the sampling and analysis methods must be able to detect, and wherever possible quantify, substances below these levels. In order to attain the low detection levels used in the RMP, ultra-clean sampling methods are used in all sampling procedures (Flegal and Stukas, 1987; EPA Method 1669, 1995).

Water samples are collected approximately one meter below the water surface using peristaltic and gear-driven pumps. The sampling ports for both the organic chemistry and trace element samplers are attached to aluminum poles that are oriented up-current from the vessel and upwind from equipment and personnel. The vessel is anchored and the engines turned off. Total (or near-total) and dissolved fractions of Estuary water are measured for trace elements. Particulate and dissolved fractions are measured for trace organics, and totals are calculated.

The RMP used the polyurethane foam plug sampler to collect water for trace organics analyses during the first four years of the Program (Risebrough et al., 1976; de Lappe et al., 1980; 1983) and began to phase in a new, modified, commercially available resin extraction sampler in 1996, beginning with side-by-side comparisons of both sampling systems. XAD (cross-linked amberlite dininyl benzene) resins have been used throughout the world to measure synthetic organic contaminants in both water and air (Infante et al., 1993). The sampler comparisons were continued in 1997, and results from both years are presented in 1997 Annual Report (SFEI, 1999). Beginning with the 1997 monitoring year, the custom-manufactured Axys system (Axys Environmental Systems, Ltd., Sidney, B.C.) has been used to collect all RMP water samples for analysis of trace organic pollutants. It consists of a constant-flow, gear-driven positive displacement pump, 1/2 inch Teflon® tubing, 1 µm glass fiber cartridge particulate filter, and two parallel Teflon® columns filled with XAD-2 resin with a particle size range of 300-900 µm. Amberlite XAD-2 resin is a macroreticular, styrene-divinyl benzene copolymer, nonionic bead. Each bead is an agglomeration of microspheres. This sponge-like structure offers excellent physical and chemical stability. The discrete pores allow rapid mass transfer of analytes, and the mesh size ensures very little, if any, back pressure during use. The hydrophobic chemical nature of the resin leads to excellent capability of concentrating hydrophobic contaminants.

The sample water is first passed through a coarse screen as it moves into the Teflon® intake line to remove large particles that may interfere with sample collection; particles greater than 140 µm are removed as the sample water passes through the inline pre-filter. The water then passes through the pump head and through a pressure gauge, before it goes through one of two parallel four-inch diameter wound glass fiber filters (1 µm). Using two filters allows a quick change to the second filter if the first filter becomes clogged, without interrupting sample collection. Material retained on the glass fiber filter (or filters) becomes the particulate fraction. After passing through the filter, the water is split and routed through two Teflon® columns, packed with 85 mL of XAD-2 resin. Two filters are used simultaneously to increase the flow to approximately 1.3 L/min. The compounds which are adsorbed to the XAD resin are classified as the dissolved fraction. Lastly, the water passes through a flow meter and out the exit tube where the extracted water volume is verified with 20 L carbouys.

Equipment blanks are taken for both the resin columns and the glass fiber filters. The two column blanks are collected by leaving both ends of a column open while the filled sample columns are being loaded into the sampler. Similarly, the two glass fiber filter blanks are collected by exposing a filter to the air while loading the sample filters into the cartridges. The blanks receive the same analytical treatment in the laboratory as the field samples.

For trace metals, water samples are collected using a peristaltic pump system equipped with C-Flex tubing in the pump head. Sample aliquoting is conducted on deck on the windward side of the ship to minimize contamination from shipboard sources (Flegal and Stukas, 1987). Filtered water samples are obtained by placing an acid-cleaned polypropylene filter cartridge (Micron Separations, Inc., 0.45 µm pore size) on the outlet of the pumping system. Unfiltered water samples are pumped directly into acid-cleaned containers. Prior to collecting water, several liters of water are pumped through the system, and sample bottles are rinsed five times before filling. The bottles are always handled with polyethylene-gloved "clean hands". The sample tubing and fittings are acid-cleaned polyethylene or Teflon®, and the inlets and outlets are kept covered except during actual sampling. Samples are acidified within two weeks in a class 100 trace metal laboratory, except for chromium samples, which are acidified and extracted within a hour of collection.

Samples for conventional water quality parameters are collected using the same apparatus as for trace metals; however, containers are only rinsed three times, and the "clean hands" procedure is unnecessary.

Water samples are collected for toxicity tests using the same pumping apparatus as for the collection of the trace organic samples, but are not filtered. Five gallons of water are collected and placed in ice chests for transfer at the end of each cruise day to the testing laboratory. Two field blanks are collected each cruise by filtering (0.45 µm) water known to be non-toxic from the Bodega Marine Laboratory.

6.2 Sediment Sampling

Sediment sampling is conducted using a Young-modified van Veen grab with a surface area of 0.1 m2. The grab is made of stainless steel, and the jaws and doors are coated with Dykon® (formerly known as Kynar®) to achieve chemical inertness. All scoops, buckets, and stirrers used to collect and homogenize sediments are also constructed of Teflon® or stainless steel coated with Dykon®. Sediment sampling equipment is thoroughly cleaned prior to each sampling event. In order to further minimize sample contamination, personnel handling the sample wear gloves.

A sub-core of sediment is removed for measurement of porewater ammonia. Then, the top 5 cm of sediment is scooped from each of two replicate grabs and mixed in a Dykon®-coated bucket to provide a single composite sample for each station. Between sample grabs, the compositing bucket is covered with aluminum foil to prevent airborne contamination. After two sediment samples have been placed into the compositing bucket, the bucket is taken into the ship's cabin and thoroughly mixed to obtain a uniform, homogeneous mixture. Aliquots are subsequently split for each analytical laboratory, for archive samples, and for sediment toxicity tests. The quality of grab samples is ensured by requiring each sample to satisfy criteria concerning depth of penetration and disturbance of the sediment within the grab.

6.3 Benthic Infauna

Benthic infauna samples are comprised of primarily sedentary invertebrate organisms that burrow in or live on the surface of sediments. One sample is taken at each of the nine RMP sediment stations with a Ponar grab sampler. Lead weights are added to or removed from the outside of the grab as appropriate to the sediment type in order to control depth of penetration. Incomplete closure of the grab results in rejection of the sample. The retrieved grab is placed on a stand designed with a stainless steel funnel directed to a sample bucket. Once the grab has passed acceptance criteria (complete closure, no evidence of sediment washout through the doors, even distribution of sediment in the grab, minimum disturbance of the sediment surface, and minimum overall sediment depth appropriate for the sediment type), the grab jaws are opened, and the sediment is dumped into a five-gallon plastic bucket. The sample is then moved to a wash table for sieving through two screens stacked on top of each other. The top screen has a 1 mm mesh size, and the smaller screen retains animals in its 0.5 mm mesh. The material retained in each screen is gently washed into separate, labeled sample jars. A wash bottle with seawater is used to rinse any material on the inside screen frame and canning funnel into the sample jar. Any organisms remaining on the screens are carefully picked off with forceps and placed in the appropriate sample jars. Jars are taken to the formalin station where seawater is decanted from the sample jars with 0.25 mm Nitex mesh. Relcant (isotonic MgCl2) is added to the sample through the mesh to a level approximately one third higher than the sample level. The sample is allowed to sit in the relaxant for 15 to 30 minutes, the relaxant is decanted, and 10%

buffered formalin is added to the sample through the screen lid. As a final step, two to three drops of stain (rose bengal solution) are added to the sample for ease of organism identification.

6.4 Bivalve Bioaccumulation Sampling

Generally, bivalves are collected from uncontaminated sites and transplanted to fifteen stations in the Estuary during the wet season (February through May) and the dry season (June through September). Contaminant concentrations in the animals' tissues and the animals' biological condition (expressed as the ratio of dry weight and shell cavity volume) are measured before deployment (referred to as time zero or background samples) and at the end of the 90-100 day deployment period. Since the RMP sites encompass a range of salinities, three species of bivalves are used, according to the expected salinities in each area and the known tolerances of the organisms. The mussel (Mytilus californianus) is collected from Bodega Head and stored in running seawater at the Bodega Marine Laboratory until deployment at the stations west of Carquinez Strait, which are expected to have the highest salinities. Mytilus californianus will survive short-term exposure to salinities as low as 5 ppt (Bayne, 1976). Oysters (Crassostrea gigas) are obtained from Tomales Bay Oyster Company (Marshall, California) and deployed at moderate-salinity sites closest to Carquinez Strait and in the extreme South Bay. Crassostrea gigas tolerates salinities as low as 2 ppt.

In 1998, the freshwater clam Corbicula fluminea was collected from Lake Chabot in Alameda County and held in the lake four weeks prior to deployment to sites with the lowest salinities. The limited quantity of C. fluminea obtained from Lake Chabot was transplanted to Grizzly Bay during Bivalve Deployment Cruise #16. Consequently, additional specimens were collected for analysis on this cruise from the native population in the Sacramento and the San Joaquin rivers. The native population is scarce and requires a lot of time to collect. Resident clams were also collected from the native populations in the Sacramento and the San Joaquin rivers for dry-season deployment. The transplantation approach with the freshwater clam Corbicula fluminea has been discontinued on an interim basis, since reference population from "clean" locations could no longer be found in sufficient numbers. Corbicula fluminea tolerates salinities from 0 ppt to perhaps 10 ppt (Foe and Knight, 1986). The effects of high, short-term flows of freshwater on the transplanted bivalves west of Carquinez Strait are minimized by deploying the bivalves near the bottom where density gradients tend to maintain higher salinities. All bivalves are kept on ice after collection and deployed within 24-48 hours.

The condition of animals from the control sites at Lake Chabot (Corbicula fluminea), Bodega Head (Mytilus californianus), and Tomales Bay (Crassostrea gigas) was determined at the end of each deployment period in order to sort out Estuary effects from natural factors affecting bivalve condition. Survival during deployment was also measured. Composites of tissue were made from 40-60 individual bivalves from each site before and after deployment for analyses of trace contaminants.

Within each species, animals of approximately the same size are used. Mussels are between 49-81 mm shell length, oysters are between 71-149 mm, and clams are 25-36 mm. One-hundred-fifty oysters and 160 mussels and clams are randomly allocated for deployment at the appropriate sites, with the same number being used as travel blank (time zero) samples for analysis of tissue and condition before deployment. At each site, oysters are divided among five nylon mesh bags, and mussels and clams are divided among four nylon mesh bags.

Moorings are associated with pilings or other permanent structures. Mooring installation, bivalve deployment, maintenance, and retrieval are all accomplished by SCUBA divers.

At each site, a line runs from the bottom of the fixed structure out to the bivalve mooring, which consists of a large screw (earth anchor) that is threaded into the bottom. A large subsurface buoy is attached to the earth anchor by a 1-2 meter-long line. The bivalves (in mesh bags) are attached to the buoy line, which keeps the bivalves off the bottom so they are not smothered. In one hundred and fifty individual deployments, loss of a mooring has occurred on only two occasions, probably due to being ripped out by a vessel anchor.

The deployed samples are checked approximately half-way through the 90-day deployment period to ensure consistent exposure. Moorings and nylon bags are checked for damage and repaired, and fouling organisms are removed.

Upon retrieval, the bags of bivalves are placed into polyethylene bags and taken to the surface. On the vessel, the number of dead organisms are noted. Twenty percent of the live organisms are allocated for condition measurement, and the remainder are equally split for analyses of trace metal and organic compounds. Bivalves used for trace organic analyses are rinsed with reagent grade water to remove extraneous material, shucked using a stainless steel knife (acid-rinsed), and homogenized (until liquefied) in a combusted mason jar using a Tissumizer or Polytron blender. Bivalves used in trace element analyses are shucked with stainless steel knives, gonads are removed, and remaining tissue is rinsed with ultrapure water and placed in acid cleaned, plastic coated, glass jars. The sample is then homogenized (until liquefied) using a Brinkmann homogenizer equipped with a titanium blade.

Based on findings by Stephenson (1992) during the RMP Pilot Program, bivalve guts are not depurated before homogenization for tissue analyses, although gonads are removed from organisms for trace metal analyses. Stephenson (1992) found that, with the exception of lead and selenium, no significant differences exist in trace metal concentrations between mussels depurated for 48 hours in clean Granite Canyon seawater before homogenization and undepurated mussels. However, sediment in bivalve guts may contribute to the total tissue contaminant concentration.
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6.5 Analytical Methods

6.5.1 Conventional Water Quality Parameters

Samples for dissolved nutrients are analyzed using the Lachat QuikChem 800 System Nutrient Autoanalyzer (Ranger and Diamond, Lachat Instruments, 1994). The QuickChem methods used are: 31-114-27-1 for silicates, 31-107-06-1 for ammonia, 31-107-04-1 for nitrate/nitrite, and 31-115-01-3 for phosphate. Chlorophyll and phaeophytin are measured using a fluorometric technique with filtered material from 200 mL samples (Parsons et al., 1984). Shipboard measurements for temperature, salinity, pH, and dissolved oxygen content are made using a hand-held Solomat 520 C multi-functional chemistry and water quality monitor. Dissolved organic carbon (DOC) is measured using high-temperature catalytic oxidation with a platinum catalyst (Fitzwater and Martin, 1993). Total suspended solids (TSS) are determined using method 2540D in Standard Methods for the Examination of Water and Wastewater (Greenberg et al., 1992).

A Sea-Bird SBE19 conductivity, temperature, and depth probe (CTD) is used to measure water quality parameters at depths throughout the water column. CTD casts are taken at each site during water and sediment sampling. At each site, the CTD is lowered to approximately one meter below the water surface and allowed to equilibrate to ambient temperature for 3 minutes. The CTD is then lowered to the bottom at approximately 0.15 meters per second, and raised. Only data from the down cast are kept. Data are downloaded onboard the ship, and processed in the laboratory using software supplied by Sea-Bird.

The CTD measures temperature, conductivity, pressure, dissolved oxygen, and backscatter at a sampling rate of two scans per second. These data are edited and averaged into 0.25 m depth bins during processing. Also during processing, salinity (based on conductivity measurements), oxygen, time, and depth (based on pressure) are calculated. Although the CTD data are not detailed in this report, SFEI maintains these data in its database.

6.5.2 Trace Elements

In water, total and dissolved (0.45 μm filtered) concentrations of mercury, arsenic, selenium, chromium, copper, nickel, lead, silver, and zinc are measured. Mercury, arsenic, and selenium samples are obtained from the same field sample. The mercury sub-samples are photo-oxidated with the addition of bromium chloride, and quantified using a cold-vapor atomic fluorescence technique. Arsenic and selenium are analyzed by hydride-generation atomic absorption with cryogenic trap preconcentration based on a method described in Liang et al. (1994) and Cercelius et al. (1986).

Chromium samples are collected separately. The suspended particulates undergo hydrofluoric acid digestion, and the dissolved chromium is co-precipitated with a ferrous hydroxide scavenger (Cranston and Murray, 1978). Chromium is quantified by graphite furnace atomic absorption spectrometry (GFAAS).

The remaining trace elements in water are measured using the APDC/DDDC organic extraction and preconcentration method (Bruland et al., 1985; Flegal et al., 1991) and then quantified by GFAAS.

Results for cadmium, chromium, copper, nickel, lead, silver, and zinc are reported by the laboratory in weight/weight units (µg/kg). For use in this report, those values are reported as µg/L, without taking account of the difference in density between Estuary water and distilled water. This difference was not taken into account because it is much less than the precision of the data, which was on the order of 10%. In some instances, dissolved metal concentrations are reported as higher than total (dissolved + particulate) metal concentrations. This is due to expected analytical variation in the methods of analysis, particularly at concentrations near the detection limits. Such results should be interpreted as no difference between dissolved and total concentrations, or that the total fraction of metals is in the dissolved phase.

Sediments are digested with aqua regia to obtain "near-total" concentrations of aluminum, silver, cadmium, chromium, copper, iron, manganese, nickel, lead, and zinc (Flegal et al., 1981). The metals are quantified by inductively coupled plasma atomic emission spectrometry (ICP-AES) or by ICP-MS. The method chosen for RMP sediment analysis is comparable to standard EPA procedures (Tetra Tech, 1986), but does not decompose the silicate matrix of the sediment. Because of this, any element tightly bound as a naturally occurring silicate may not be fully recovered.

Bivalve tissue samples are digested with aqua regia to obtain near-total concentrations of trace elements similar to techniques used in the California State Mussel Watch Program (e.g., Flegal et al., 1981; Smith et al., 1986) and consistent with the RMP Pilot Program (Stephenson, 1992). The trace metals are quantified by ICP-AES or ICP-MS. Hydride generation coupled with atomic absorption spectroscopy is used to quantify arsenic. Mercury is quantified using a cold-vapor atomic fluorescence technique, and selenium using the methods of Cutter (1986). Butyltins are measured following NOAA Status and Trends Mussel Watch Project methods described in NOAA Technical Memorandum NOS/ORCA/CMBAD71 vol. IV (NOAA, 1993). This technique involves extracting the sample with hexane and the chelating agent tropolone and measuring the butyltin residues by capillary gas chromatography. Concentrations are expressed in total tin per gram of tissue dry weight.

6.5.3 Trace Organics

For water samples, each of the two resin columns (each sample is contained in two parallel resin columns) and filters containing the particulate fraction are spiked with extraction surrogates. In 1998, electron capture detector (ECD) surrogates consisted of PCB 207 for the first fraction, and Polychloronitorobenzene (PCNB) for fractions 2 and 3. The mass spectral detector (MSD) surrogate consisted of deuterated acenaphthalene. The XAD columns are eluted in reverse with methanol and methylene chloride in a method similar to the filter cartridges. The separate extracts are then combined and separated into three fractions. Extraction methods are based upon standard EPA and Axys extraction protocols.

The extracts are subjected to Florisil column chromatography resulting in three fractions, a PCB/aliphatic, a pesticide/aromatic fraction, and a polar third fraction, which contains diazinon and other polar pesticides. Chlorinated hydrocarbons (CH) are analyzed on a Hewlett Packard 6890 capillary gas chromatograph utilizing electron capture detectors (GC/ECD). A single 2 µL splitless injection is directed onto two 60 m x 0.25 mm columns of different polarity (DB-17 and DB-5) using a y-splitter to provide two-dimensional confirmation of each analyte. The quantitation internal standards utilized for the CH analysis are dibromo-octafluorobiphenyl (DOB) for fraction 1, and PCB 209 for fractions 2 and 3. Analyte concentrations are corrected for surrogate losses prior to reporting. PAHs are quantified in the F-2 fraction by analysis on a Hewlett-Packard 6890 capillary gas chromatograph equipped with a 5971A mass spectral detector (GC/MS). A 2 µL splitless injection is chromatographed on a DB-5 column and analyzed in a selected ion monitoring (SIM) mode. The quantitation internal standard utilized for the PAH analysis when samples are at 100 µL is hexamethyl benzene (HMB). Dibromo-octafluorobiphenyl is used as an internal standard for diazinon.

Sediment samples are analyzed based on the methods followed by NOAA's Status and Trends Program. Samples are extracted according to EPA Method 3545 (acclerated solvent extraction) using elevated temperature (100 ºC) and pressure (1500-2000 pso) to achieve analyte recoveries equivalent to those from Soxhlet extraction, using less solvent and taking significantly less time. This extraction procedure is applicable to the extraction of all trace organic compounds of interest to the RMP. Surrogate standards are added prior to extraction to account for methodological analyte losses. ECD surrogates consist of DOBFB (Dibromoctatfluorbiphenyl), PCB 103, and PCB 198. The extract is concentrated and purified using a combined silica/alumina column purification to remove matrix interferences. Internal standard solutions are tetrachloro-m-xylene (TCMX) and dibutyl chlorendate (DBC). Chlorinated hydrocarbons are quantified in sediment extracts via high-resolution capillary gas chromatography using GC/ECD. Dual-column confirmation on 30-m long, 0.25-mm internal diameter fused silica capillary columns with DB-5 and DB-17 bonded phase is conducted.

Tissue samples are homogenized and macerated, and the eluate is dried with sodium sulfate, concentrated, and purified using a combination of EPA Method 3611 alumina column purification and EPA Method 3630 silica gel purification to remove matrix interferences. PAHs and their alkylated homologues in both sediment and tissue extracts are quantified by GC/MS in the SIM (Selected Ion Monitoring) with a temperature-programmable gas chromatograph with a 30-m long, 0.32-mm internal diameter fused silica capillary column with DB-5MS bonded phase. Surrogates for PAHs consist of naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12. In 1998, PCBs in tissue are quantified according to EPA Method 1668 (isotope dilution techniques) using high-resolution gas GC/MS. Pesticides in tissue are quantified via high-resolution capillary gas chromatography using GC/ECD. Dual-column confirmation on 30-m long, 0.25-mm internal diameter fused silica capillary columns with DB-5 and DB-17 bonded phase is conducted on tissue samples also.

6.5.4 Aquatic Bioassays

Water column toxicity is evaluated using a 48-hour bivalve embryo development test and a seven-day growth test using the estuarine mysid Mysidopsis bahia. The bivalve embryo development test is performed according to ASTM standard method E 724-89 (ASTM, 1991). The mysid test is based on EPA test method 1007. Larval Mytilus spp. are used in both wet- and dry-season sampling periods. The mysid growth and survival test consists of an exposure of 7-day old Mysidopsis bahia juveniles to different concentrations of Estuary water in a static system during the period of egg development and is used during both sampling periods. Appropriate salinity adjustments are made for Estuary water from sampling stations with salinities below the test species' optimal ranges. Reference toxicant tests with copper chloride and potassium dichromate are performed for the bivalve and mysid tests, respectively. These tests are used to determine if the responses of the test organisms are relatively consistent over time.

The salinities of the ambient samples and the control/diluent (Evian spring water) are adjusted to 5 ppt using artificial sea salts (Tropic Marin). The test concentrations are 100%, 50%, and control, each with eight replicates, and with 20 larvae per replicate. Waste, dead larvae, excess food, and 80% of the test water are siphoned from the test chambers daily, and general water chemistry parameters of dissolved oxygen, pH, and salinity are recorded before and after each water change.

6.5.5 Sediment Quality Characteristics

Sediment size fractions are determined with a grain-size analyzer based on x-ray transmission (Sedigraph 5100). Total organic carbon is analyzed according to the standard method for the Coulometrics CM 150 Analyzer made by UIC, Inc. This method involves measurements of transmitted light through a cell. The amount of transmitted light is related to the amount of carbon dioxide evolved from a combusted sample. Spectrophotometric analyses of sulfides in sediment porewater are performed using a method adapted from Fonselius (1985) with variations from Standard Methods (APHA, 1985).

6.5.6 Sediment Bioassays

The RMP uses two sediment bioassays: a ten-day acute mortality test using the estuarine amphipod Eohaustorius estuarius exposed to whole sediment using ASTM method E 1367 (ASTM, 1992), and a sediment elutriate test where larval bivalves are exposed to the material dissolved from whole sediment in a water extract using ASTM method E 724-89 (ASTM, 1991). Elutriate solutions are prepared by adding 100 g of sediment to 400 mL of Granite Canyon seawater, shaken for 10 seconds, allowed to settle for 24 hours, and carefully decanted (EPA and COE, 1977; Tetra Tech, 1986). Larval mussels (Mytilus spp.) are used in both sampling periods, with percent normally developed larvae as the measurement endpoint.

6.5.7 Bivalve Condition and Survival

The condition of bivalves is a measure of their general health following exposure to Estuary water for 90-100 days. Measurements are made on subsamples of specimens before deployment and on the deployed specimens following exposure. Dry weight (without the shell) and the volume of the shell cavity of each bivalve is measured. Bivalve tissue is removed from the specimens and dried at 60 ºC in an oven for 48 hours before weighing. Shell cavity volume is calculated by subtracting shell volume of water displaced by a whole live bivalve less the volume of water displaced by the shell alone. The condition index is calculated by taking the ratio of tissue dry weight and the shell cavity volume.

6.6 References

APHA. 1985. Standard Methods for the Examination of Water and Wastewater. 16th Edition. American Public Health Association, Washington, DC. 1268 p.

ASTM. 1991. Designation E 724-89: Standard guide for conducting static acute toxicity tests starting with embryos of four species of saltwater bivalve molluscs. Volume 11.04. American Society for Testing and Materials, Philadelphia, PA.

ASTM. 1992. Designation E 1367: Standard guide for conducting 10-day static sediment toxicity tests with marine and estuarine amphipods. Volume 11.04. American Society for Testing and Materials, Philadelphia, PA.

Bayne, B.L. 1976. Marine Mussels: Their Ecology and Physiology. Cambridge University Press, Cambridge. 506p.

Bruland, K.W., K.H. Coale, and L. Mart. 1985. Analysis of seawater for dissolved cadmium, copper, and lead: An intercomparison of voltametric and atomic absorption methods. Marine Chemistry 17:285-300.

Cercelius, E.A., N.S. Bloom, C.E. Cowan, and E.A. Jeane. 1986. Speciation of Selenium and Arsenic in Natural Waters and Sediments, Volume 2: Arsenic Speciation. EPRI.

Cranston, R.E. and J.W. Murray. 1978. The determination of chromium species in natural waters. Analytica Chimica Acta 99:275-282.

Cutter, G.A. 1986. Speciation of selenium and arsenic in natural waters and sediments. Volume 1: Selenium Speciation. EPRI. EA-4641. Research project 2020-1.

de Lappe, B.W., R.W. Risebrough, A.M. Springer, T.T. Schmidt, J.C. Shropshire, E.F. Letterman, and J. Payne. 1980. The sampling and measurement of hydrocarbons in natural waters. In Hydrocarbons and Halogenated Hydrocarbons in the Aquatic Environment, B.K. Afghan and D. Mackay, eds. Plenum Press, NY, pp. 29-68.

de Lappe, B.W., R.W. Risebrough, and W. Walker II. 1983. A large-volume sampling assembly for the determination of synthetic organic and petroleum compounds in the dissolved and particulate phases of seawater. Can. J. Fish Aquat. Sci. 40(2):322-336.

EPA. 1995. Method 1669: Sampling ambient water for trace metals at EPA water quality criteria levels. EPA 821-R-95-034, United States Environmental Protection Agency, Washington, DC.

EPA and COE. 1977. Technical committee on criteria for dredged and fill material, ecological evaluation of proposed discharge of dredge material into ocean waters; implementation manual of Section 103 of Public Law 92-532 (Marine Protection and Sanctuaries Act 1972), July 1977 (2nd printing April 1978). US Environmental Protection Agency; Environmental Effects Laboratory, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MI.

Fitzwater, S.E. and J.M. Martin. 1993. Notes on the JGOFS North Atlantic bloom experiment--dissolved organic carbon intercomparison. Marine Chemistry 41:179-185.

Flegal, A.R. and V.J. Stukas. 1987. Accuracy and precision of lead isotopic composition measurements in sea water. Marine Chemistry 22:163-177.

Flegal, A.R., L.S. Cutter, and J.H. Martin. 1981. A study of the chemistry of marine sediments and wastewater sludge. Final Report to California State Water Resources Control Board.

Flegal, A.R., G.E. Smith, G.A. Gill, S. Sanudo-Wilhelmy, and L.C.D. Anderson. 1991. Dissolved trace element cycles in the San Francisco Bay Estuary. Marine Chemistry 36:329-363.

Foe, C. and A. Knight. 1986. A method for evaluating the sublethal impact of stress employing Corbicula fluminea. American Malacological Bulletin, Special Edition No. 2: 133-142.

Fonselius, S.H. 1985. Determination of hydrogen sulfide. In Methods of Seawater Analysis. Grasshoff, K., M. Ehrhardt, and K. Kremling, eds. 2nd Edition, pp. 73-81.

Greenberg, A.E. (Editor), L.S. Clesceri, and A.D. Eaton. 1992. Standard Methods for the Examination of Water and Wastewater, 18th Edition. Prepared and published jointly by American Public Health Assoc., American Wastewater Assoc., and Water and Environmental Federation. APHA, Washington, DC.

Infante, A.P., N.C. Guajardo, J.S. Alonso, M.C.M. Navascues, M.P.O. Melero, M.S.M. Cortabitarte, and J.L.O. Narvion. 1993. Analysis of organic water pollutants isolated by XAD-2 resins and activated carbon in the gallego river, Spain. Water Res. 7:1167-1176.

Liang, L., R. Danilchik, and Z.R. Huang. 1994. Elimination of dependence on experimental conditions in the determination of Se in water, sediment, coal and biological samples by hydride generation. Atomic Spectroscopy, July/August:151-155.

NOAA. 1993. Sampling and analytical methods of the National Status and Trends Program National benthic surveillance and mussel watch projects 1984-1992, volume IV: Comprehensive descriptions of trace organic analytical methods. G.G. Lauenstein and A.Y. Cantillo (eds.) NOAA Technical Memorandum NOS ORCA 71. National Oceanic and Atmospheric Administration, Silver Spring, MD.

Parsons, T.R., T. Maita, and C.M. Lalli. 1984. A manual of chemical and biological methods for seawater analysis. Pergamon Press, NY. 173 p.

Ranger, C. and D. Diamond. 1994. Lachat Instruments.

Risebrough, R.W., B.W. de Lappe, and W. Walker II. 1976. Transfer of higher-molecular weight chlorinated hydrocarbons to the marine environment. In Marine Pollutant Transfer, H.L. Windom and R.A. Duce, eds. D.C. Heath Company, Lexington, Massachusetts and Toronto, pp. 261-321.

SFEI. 1999. 1997 Annual Report: San Francisco Estuary Regional Monitoring Program for Trace Substances. RMP Report 37. San Francisco Estuary Institute, Richmond, CA pp. A67-A80.

Smith, D.R., M.D. Stephenson, and A.R. Flegal. 1986. Trace metals in mussels transplanted to San Francisco Bay. Environ. Toxicol. and Chem. 5:129-138.

Stephenson, M. 1992. A report on bioaccumulation of trace metals and organics in bivalves in San Francisco Bay. Submitted to California Regional Water Quality Control Board, San Francisco Bay Region. California Department of Fish and Game, Moss Landing Marine Labs, Moss Landing, CA 95039.

Tetra Tech. 1986. Recommended protocols for measuring selected environmental variables in Puget Sound. Prepared for the Puget Sound Estuary Program by Tetra Tech, Inc., Bellevue, WA.

Table 1. Quality assurance and control summary for laboratory analyses of water (trace elements).

Analysis type: water trace elements, dissolved

Parameter	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)
Ag	16	25	0.0031	ug/L	0.0001	5	0.0004	12	10
	17	26	0.0017	ug/L	*0.0004*	7	0.0010	8	16
	18	26	0.0018	ug/L	0.0000	7	0.0002	9	15
As	16	25	1.71	ug/L	*0.06*	1	0.16	14	-
	17	26	1.44	ug/L	*0.06*	1	0.66	2	-
	18	26	2.12	ug/L	*0.06*	0	-	-	-
Cd	16	25	0.0275	ug/L	0.0001	5	0.0010	3	15
	17	26	0.0128	ug/L	0.0002	7	0.0010	8	8
	18	26	0.0519	ug/L	0.0003	7	0.0263	11	19
Cr	16	25	0.41	ug/L	0.01	7	0.08	12	19
	17	20	0.36	ug/L	0.00	1	0.11	*32*	23
	18	26	0.19	ug/L	*0.03*	3	0.05	*29*	24
Cu	16	25	1.417	ug/L	*0.010*	5	0.049	3	21
	17	26	1.449	ug/L	*0.012*	7	0.043	3	5
	18	26	1.504	ug/L	*0.006*	5	0.122	10	4
Hg	16	25	0.0018	ug/L	0.0001	0	-	-	-
	17	26	0.0015	ug/L	0.0001	0	-	-	-
	18	26	0.0008	ug/L	0.0001	0	-	-	-
Ni	16	25	1.566	ug/L	*0.007*	5	0.143	8	24
	17	26	1.294	ug/L	0.005	7	0.082	5	8
	18	26	1.184	ug/L	0.002	5	0.123	9	2
Pb	16	25	0.065	ug/L	0.001	5	0.004	9	9
	17	26	0.027	ug/L	0.001	7	0.002	6	17
	18	26	0.025	ug/L	0.001	7	0.001	3	9
Se	16	25	0.14	ug/L	*0.02*	2	0.01	-	-
	17	26	0.24	ug/L	*0.02*	0	-	-	-
	18	26	0.15	ug/L	*0.02*	0	-	-	-
Zn	16	26	2.126	ug/L	*0.004*	5	0.203	6	*35*
	17	26	0.384	ug/L	*0.009*	7	0.017	8	14
	18	26	0.760	ug/L	*0.006*	5	0.065	8	18

- = not measured
ND = not detected
values in italics fall outside targets

Table 1 (continued). Quality assurance and control summary for laboratory analyses of water (trace elements).

Analysis type: water trace elements, total

Parameter	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	blank stdev
Ag	16	25	0.0142	ug/L	0.0003	3	0.0007	10	14	0.0001
	17	26	0.0084	ug/L	0.0003	8	0.0008	11	*26*	0.0001
	18	26	0.0089	ug/L	0.0003	7	0.0006	10	18	0.0001
As	16	25	2.66	ug/L	*0.06*	4	0.41	8	10	0.02
	17	26	1.85	ug/L	*0.06*	4	0.06	6	7	0.05
	18	26	3.02	ug/L	*0.06*	6	0.08	3	9	0.01
Cd	16	25	0.0470	ug/L	0.0002	3	0.0020	5	14	0.0001
	17	26	0.0240	ug/L	0.0002	8	0.0046	8	16	0.0001
	18	26	0.0655	ug/L	*0.0011*	7	0.0253	10	9	0.0004
Cr	16	25	9.25	ug/L	0.04	3	0.69	5	21	0.01
	17	26	5.67	ug/L	0.05	4	0.55	12	22	0.02
	18	26	4.64	ug/L	*0.36*	1	7.89	*19*	-	0.12
Cu	16	25	4.013	ug/L	0.002	3	0.056	3	21	0.001
	17	26	3.285	ug/L	0.004	8	0.067	3	4	0.001
	18	26	3.363	ug/L	*0.009*	7	0.867	4	2	0.003
Hg	16	25	0.0116	ug/L	0.0001	-	-	6	4	0.0000
	17	26	0.0101	ug/L	0.0001	-	-	17	7	0.0000
	18	26	0.0090	ug/L	0.0001	-	-	10	7	0.0000
Ni	16	25	5.536	ug/L	0.002	3	0.156	4	*29*	0.001
	17	26	4.356	ug/L	0.004	8	0.128	5	5	0.001
	18	26	4.518	ug/L	0.003	7	1.959	9	2	0.001
Pb	16	25	1.085	ug/L	0.002	3	0.016	6	2	0.001
	17	26	0.645	ug/L	0.001	8	0.016	9	15	0.000
	18	26	0.568	ug/L	0.003	7	0.008	2	18	0.001
Se	16	25	0.18	ug/L	*0.02*	2	0.00	3	10	0.00
	17	26	0.33	ug/L	*0.02*	6	0.02	17	6	0.00
	18	26	0.22	ug/L	*0.02*	6	0.01	2	15	0.00
Zn	16	25	7.938	ug/L	0.007	3	0.425	14	7	0.002
	17	26	5.431	ug/L	*0.008*	8	0.469	13	11	0.003
	18	26	5.135	ug/L	*0.032*	6	0.201	4	16	0.011

- = not measured
ND = not detected
values in italics fall outside targets

Quality Assurance Tables: 1998 Monitoring Results

Monitoring of trace organic contaminants in water is an integral component of the RMP used to describe patterns and trends of organic contaminant concentration and distribution. The integrity and quality of the results depend mainly on successful sample collection, handling, and laboratory analyses.

In 1998, a large portion of the trace organic data was affected by severe blank contamination and matrix interferences that occurred during sample analysis in the laboratory. The organic contaminants most affected were dissolved and particulate PAHs, DDTs, diazinon, HCHs, chlordanes, and chlorpyrifos. For many of these contaminants, the uncertainties from blank contamination and matrix interferences propagate into aggregate measures, such as totals of dissolved and particulate fractions and sums of compounds in contaminant groups (e.g. PCBs, PAHs). For total (dissolved + particulate) concentrations, no result was provided if either the dissolved or particulate fractions were immeasurable due to contamination or interferences, since measurements in both fractions are usually of the same magnitude. Qualifications are made to the data set to prevent the unmeasurable compounds from decreasing sums of contaminant groups with insufficient data. A detailed description on SFEI's treatment of contaminated values is found in section 2.5 (Click on section to go to link).

Table 2a. Quality assurance and control summary for laboratory analyses of water (organics).

Analysis type: water organics, dissolved

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
1-Methylnaphthalene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
1-Methylphenanthrene	16	17	0.3	ng/L	0.3	1	ND	-	-	0.12
	17	18	0.8	ng/L	0.3	2	0.0	0	-	ND
	18	18	0.1	ng/L	0.3	2	0.6	6	-	*1.67*
2,3,5-Trimethylnaphthalene	16	7	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	2.3	ng/L	0.3	2	0.2	5	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
2,6-Dimethylnaphthalene	16	12	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	0.9	ng/L	0.3	2	0.0	1	-	*0.40*
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
2-Methylnaphthalene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	0.4	ng/L	0.3	2	0.0	8	-	0.28
	18	18	ND	ng/L	0.3	2	0.0	0	-	0.18
Acenaphthene	16	7	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	3.0	ng/L	0.3	2	0.0	3	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Acenaphthylene	16	8	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	0.1	ng/L	0.3	2	0.0	0	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Anthracene	16	7	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	0.0	0	-	ND
	18	18	ND	ng/L	0.3	2	0.1	17	-	ND
Benz(a)anthracene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	8	0.6	ng/L	0.3	1	0.0	2	-	ND
	18	0	-	-	-	0	ND	-	-	CE
Benzo(a)pyrene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Benzo(b)fluoranthene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	0.0	2	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Benzo(e)pyrene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Benzo(ghi)perylene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Benzo(k)fluoranthene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Biphenyl	16	14	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	0.6	ng/L	0.3	2	0.0	2	-	ND
	18	18	ND	ng/L	0.3	2	0.0	2	-	ND
Chrysene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	0.0	13	-	ND
Dibenz(a,h)anthracene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Dibenzothiophene	16	7	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	0.0	9	-	0.10
Fluoranthene	16	17	0.9	ng/L	0.3	1	0.1	13	-	ND
	17	18	0.9	ng/L	0.3	2	0.0	3	-	ND
	18	18	2.3	ng/L	0.3	2	0.4	9	-	*0.33*
Fluorene	16	7	0.4	ng/L	0.3	1	ND	-	-	ND
	17	18	6.1	ng/L	0.3	2	0.0	0	-	0.11
	18	18	0.8	ng/L	0.3	2	0.1	11	-	ND
Indeno(1,2,3-cd)pyrene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Naphthalene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Perylene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	18	ND	ng/L	0.3	2	ND	-	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Phenanthrene	16	7	1.1	ng/L	0.3	1	ND	-	-	ND
	17	18	6.4	ng/L	0.3	1	0.1	1	-	*18.41*
	18	18	1.9	ng/L	0.3	2	0.1	6	-	*0.42*
Pyrene	16	17	0.8	ng/L	0.3	1	0.1	13	-	ND
	17	18	0.9	ng/L	0.3	2	0.0	1	-	ND
	18	18	2.4	ng/L	0.3	2	3.6	9	-	*6.17*

Table 2a (continued). Quality assurance and control summary for laboratory analyses of water (organics).

Analysis type: water organics, dissolved

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Hexachlorobenzene	16	8	19.1	pg/L	1.0	0	-	-	-	ND
	17	18	21.5	pg/L	1.0	2	0.0	0	-	0.8
	18	18	13.0	pg/L	1.0	2	0.1	4	-	ND
PCB 008	16	7	1.3	pg/L	1.0	0	-	-	-	ND
	17	2	201.5	pg/L	1.0	0	-	-	-	ND
	18	18	10.5	pg/L	1.0	0	-	-	-	ND
PCB 018	16	7	5.3	pg/L	1.0	0	-	-	-	0.2
	17	16	23.5	pg/L	1.0	0	-	-	-	ND
	18	18	8.1	pg/L	1.0	0	-	-	-	ND
PCB 028	16	11	4.5	pg/L	1.0	1	1.3	*42*	-	ND
	17	16	18.0	pg/L	1.0	1	1.4	7	-	0.2
	18	17	7.9	pg/L	1.0	1	2.1	11	-	ND
PCB 031	16	10	14.5	pg/L	1.0	0	-	-	-	ND
	17	16	15.5	pg/L	1.0	0	-	-	-	ND
	18	17	11.0	pg/L	1.0	0	-	-	-	ND
PCB 044	16	15	1.3	pg/L	1.0	1	ND	-	-	ND
	17	18	1.8	pg/L	1.0	2	1.0	13	-	ND
	18	18	6.9	pg/L	1.0	0	-	-	-	ND
PCB 049	16	15	1.5	pg/L	1.0	1	ND	-	-	ND
	17	18	3.2	pg/L	1.0	2	0.2	6	-	0.3
	18	18	5.5	pg/L	1.0	0	-	-	-	ND
PCB 052	16	14	8.9	pg/L	1.0	1	0.7	16	-	0.2
	17	18	5.1	pg/L	1.0	2	0.5	14	-	*1.5*
	18	18	13.0	pg/L	1.0	0	-	-	-	ND
PCB 060	16	17	1.2	pg/L	1.0	2	0.1	4	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 066	16	17	2.2	pg/L	1.0	2	0.3	14	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	17	3.5	pg/L	1.0	0	-	-	-	ND
PCB 070	16	17	2.4	pg/L	1.0	2	0.6	10	-	ND
	17	18	2.5	pg/L	1.0	2	0.0	0	-	ND
	18	17	5.7	pg/L	1.0	0	-	-	-	ND
PCB 074	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	17	1.6	pg/L	1.0	0	-	-	-	ND
PCB 087	16	17	ND	pg/L	1.0	2	1.7	*71*	-	ND
	17	18	ND	pg/L	1.0	2	0.0	0	-	ND
	18	18	3.1	pg/L	1.0	0	-	-	-	ND
PCB 095	16	16	4.5	pg/L	1.0	2	0.3	6	-	0.3
	17	18	5.6	pg/L	1.0	2	0.5	8	-	*1.0*
	18	17	11.0	pg/L	1.0	0	-	-	-	ND
PCB 097	16	17	ND	pg/L	1.0	2	0.6	18	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	2.8	pg/L	1.0	0	-	-	-	ND
PCB 099	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	4.4	pg/L	1.0	0	-	-	-	ND
PCB 101	16	16	5.0	pg/L	1.0	2	0.7	13	-	0.5
	17	18	1.4	pg/L	1.0	2	0.5	6	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 105	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	3	ND	-	-	ND
	18	18	2.0	pg/L	1.0	2	ND	-	-	ND
PCB 110	16	17	6.2	pg/L	1.0	2	0.5	8	-	0.4
	17	18	3.3	pg/L	1.0	2	0.5	10	-	ND
	18	18	8.1	pg/L	1.0	0	-	-	-	ND
PCB 118	16	17	2.8	pg/L	1.0	2	0.5	19	-	0.3
	17	18	2.5	pg/L	1.0	2	0.3	9	-	ND
	18	18	5.4	pg/L	1.0	0	-	-	-	ND

Table 2a (continued). Quality assurance and control summary for laboratory analyses of water (organics).

Analysis type: water organics, dissolved

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
PCB 128	16	17	2.1	pg/L	1.0	2	0.8	*25*	-	ND
	17	18	ND	pg/L	1.0	3	ND	-	-	ND
	18	18	2.3	pg/L	1.0	2	ND	-	-	ND
PCB 132	16	17	ND	pg/L	1.0	2	0.3	15	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	2.0	pg/L	1.0	0	-	-	-	ND
PCB 138	16	17	3.8	pg/L	1.0	2	1.0	13	-	ND
	17	18	5.0	pg/L	1.0	2	0.5	10	-	ND
	18	18	5.8	pg/L	1.0	0	-	-	-	ND
PCB 141	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 149	16	17	4.2	pg/L	1.0	2	0.9	11	-	0.3
	17	18	1.9	pg/L	1.0	2	0.2	2	-	ND
	18	18	6.8	pg/L	1.0	0	-	-	-	ND
PCB 151	16	17	2.2	pg/L	1.0	2	0.6	17	-	ND
	17	18	ND	pg/L	1.0	2	0.3	8	-	ND
	18	18	2.3	pg/L	1.0	0	-	-	-	ND
PCB 153	16	17	5.1	pg/L	1.0	2	0.7	11	-	0.2
	17	18	3.1	pg/L	1.0	2	0.8	11	-	ND
	18	18	7.9	pg/L	1.0	0	-	-	-	ND
PCB 156	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	0.5	pg/L	1.0	0	-	-	-	ND
PCB 158	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 174	16	17	ND	pg/L	1.0	2	0.4	14	-	ND
	17	18	ND	pg/L	1.0	2	0.1	2	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 177	16	17	ND	pg/L	1.0	2	0.4	17	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 180	16	17	1.6	pg/L	1.0	2	0.4	8	-	ND
	17	18	ND	pg/L	1.0	2	0.1	2	-	ND
	18	18	1.6	pg/L	1.0	0	-	-	-	ND
PCB 183	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 187	16	17	2.0	pg/L	1.0	2	0.5	15	-	ND
	17	18	ND	pg/L	1.0	2	0.1	4	-	ND
	18	18	2.2	pg/L	1.0	0	-	-	-	ND
PCB 194	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 195	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 203	16	17	ND	pg/L	1.0	0	-	-	-	ND
	17	18	ND	pg/L	1.0	0	-	-	-	ND
	18	0	-	-	-	-	-	-	-	CE

Table 2a (continued). Quality assurance and control summary for laboratory analyses of water (organics).

Analysis type: water organics, dissolved

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Aldrin	16	0	-	-	-	0	-	-	-	#N/A
	17	0	-	-	-	0	-	-	-	#N/A
	18	0	-	-	-	0	-	-	-	#N/A
alpha-Chlordane	16	17	12.0	pg/L	1.0	0	-	-	-	ND
	17	18	21.5	pg/L	1.0	2	0.5	3	-	ND
	18	18	25.5	pg/L	1.0	2	10.3	2	-	4.4
alpha-HCH	16	7	75.0	pg/L	1.0	0	-	-	-	ND
	17	18	69.0	pg/L	1.0	2	0.4	1	-	0.3
	18	18	86.5	pg/L	1.0	2	3.5	5	-	1.5
beta-HCH	16	10	83.0	pg/L	1.0	0	-	-	-	ND
	17	18	13.3	pg/L	1.0	2	0.4	4	-	0.6
	18	18	67.8	pg/L	1.0	2	6.7	9	-	ND
cis-Nonachlor	16	16	ND	pg/L	1.0	0	-	-	-	ND
	17	18	2.9	pg/L	1.0	2	0.3	8	-	1.7
	18	18	5.9	pg/L	1.0	2	3.4	16	-	58.1
delta-HCH	16	13	ND	pg/L	1.0	0	-	-	-	ND
	17	18	7.2	pg/L	1.0	2	0.3	5	-	6.2
	18	18	4.8	pg/L	1.0	2	0.7	17	-	3.2
Dieldrin	16	17	36.0	pg/L	1.0	0	-	-	-	ND
	17	18	ND	pg/L	1.0	2	0.1	4	-	ND
	18	18	50.0	pg/L	1.0	2	8.8	4	-	ND
Endrin	16	17	ND	pg/L	1.0	0	-	-	-	ND
	17	18	5.8	pg/L	1.0	2	ND	-	-	0.8
	18	18	ND	pg/L	1.0	2	ND	-	-	216.7
gamma-Chlordane	16	17	11.0	pg/L	1.0	0	-	-	-	ND
	17	18	7.4	pg/L	1.0	2	0.6	6	-	ND
	18	18	14.0	pg/L	1.0	2	4.9	12	-	ND
gamma-HCH	16	8	235.0	pg/L	1.0	0	-	-	-	ND
	17	18	110.0	pg/L	1.0	2	0.4	0	-	0.4
	18	18	160.5	pg/L	1.0	2	17.7	12	-	0.8
Heptachlor	16	14	ND	pg/L	1.0	0	-	-	-	2.2
	17	18	ND	pg/L	1.0	2	ND	-	-	2.2
	18	18	2.1	pg/L	1.0	2	1.2	39	-	2.2
Heptachlor Epoxide	16	17	8.2	pg/L	1.0	0	-	-	-	0.8
	17	18	2.1	pg/L	1.0	0	-	-	-	ND
	18	18	14.5	pg/L	1.0	0	-	-	-	2.2
Mirex	16	17	ND	pg/L	1.0	2	ND	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
o,p'-DDD	16	17	4.6	pg/L	1.0	0	-	-	-	ND
	17	18	12.5	pg/L	1.0	2	0.0	0	-	ND
	18	18	24.0	pg/L	1.0	2	32.5	9	-	2.3
o,p'-DDE	16	17	11.0	pg/L	1.0	2	0.1	2	-	ND
	17	18	3.1	pg/L	1.0	3	1.9	43	-	ND
	18	18	6.1	pg/L	1.0	2	3.5	5	-	62.6
o,p'-DDT	16	14	19.0	pg/L	1.0	2	0.1	2	-	ND
	17	12	7.7	pg/L	1.0	3	1.3	44	-	0.7
	18	17	8.0	pg/L	1.0	2	0.3	4	-	ND
Oxychlordane	16	17	ND	pg/L	1.0	0	-	-	-	ND
	17	18	ND	pg/L	1.0	2	ND	-	-	ND
	18	18	1.9	pg/L	1.0	2	4.6	81	-	ND
p,p'-DDD	16	17	15.0	pg/L	1.0	0	-	-	-	ND
	17	18	34.0	pg/L	1.0	2	0.4	1	-	34.3
	18	18	120.0	pg/L	1.0	2	107.8	12	-	16.5
p,p'-DDE	16	17	47.0	pg/L	1.0	2	1.8	2	-	1.2
	17	18	32.0	pg/L	1.0	3	6.5	31	-	0.4
	18	18	76.0	pg/L	1.0	2	11.0	10	-	2.7
p,p'-DDT	16	17	4.8	pg/L	1.0	0	-	-	-	ND
	17	18	5.8	pg/L	1.0	2	6.6	9	-	0.5
	18	18	6.2	pg/L	1.0	2	0.7	5	-	ND
trans-Nonachlor	16	17	14.0	pg/L	1.0	2	0.4	1	-	ND
	17	18	2.6	pg/L	1.0	3	0.2	41	-	ND
	18	18	9.3	pg/L	1.0	2	0.7	2	-	ND

Table 2b. Quality assurance and control summary for laboratory analyses of water (organics).

Analysis type: water organics, particulate

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
1-Methylnaphthalene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	16	ND	ng/L	0.3	2	ND	-	-	ND
	18	17	ND	ng/L	0.3	2	0.0	9	-	ND
1-Methylphenanthrene	16	17	0.7	ng/L	0.3	1	ND	-	-	*2.12*
	17	17	1.9	ng/L	0.3	2	0.2	4	-	*2.34*
	18	16	0.6	ng/L	0.3	2	0.1	16	-	*0.33*
2,3,5-Trimethylnaphthalene	16	15	1.1	ng/L	0.3	1	ND	-	-	M
	17	15	1.3	ng/L	0.3	2	0.5	8	-	*1.90*
	18	17	ND	ng/L	0.3	2	ND	-	-	ND
2,6-Dimethylnaphthalene	16	16	1.0	ng/L	0.3	1	ND	-	-	*1.54*
	17	16	ND	ng/L	0.3	2	0.7	*23*	-	*1.83*
	18	17	ND	ng/L	0.3	2	ND	-	-	ND
2-Methylnaphthalene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	16	ND	ng/L	0.3	2	ND	-	-	0.21
	18	17	ND	ng/L	0.3	2	0.1	6	-	0.17
Acenaphthene	16	15	3.1	ng/L	0.3	1	ND	-	-	M
	17	15	1.1	ng/L	0.3	2	0.7	7	-	*1.67*
	18	17	ND	ng/L	0.3	2	ND	-	-	ND
Acenaphthylene	16	15	ND	ng/L	0.3	1	ND	-	-	M
	17	15	ND	ng/L	0.3	2	0.0	8	-	ND
	18	17	ND	ng/L	0.3	2	ND	-	-	ND
Anthracene	16	15	4.3	ng/L	0.3	1	ND	-	-	M
	17	15	1.1	ng/L	0.3	2	0.0	1	-	*0.34*
	18	17	0.6	ng/L	0.3	2	0.0	6	-	0.15
Benz(a)anthracene	16	17	2.5	ng/L	0.3	1	0.0	0	-	ND
	17	17	9.2	ng/L	0.3	1	ND	-	-	ND
	18	0	-	-	-	0	-	-	-	CE
Benzo(a)pyrene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	17	1.6	ng/L	0.3	2	0.8	4	-	ND
	18	18	ND	ng/L	0.3	2	0.1	5	-	ND
Benzo(b)fluoranthene	16	17	3.5	ng/L	0.3	1	0.0	0	-	ND
	17	17	6.2	ng/L	0.3	2	0.7	3	-	ND
	18	17	5.8	ng/L	0.3	2	0.4	6	-	ND
Benzo(e)pyrene	16	17	2.9	ng/L	0.3	1	0.0	0	-	ND
	17	17	4.0	ng/L	0.3	2	0.7	4	-	ND
	18	18	3.6	ng/L	0.3	2	0.2	5	-	ND
Benzo(ghi)perylene	16	17	0.9	ng/L	0.3	1	ND	-	-	ND
	17	17	3.5	ng/L	0.3	2	1.8	6	-	ND
	18	18	1.7	ng/L	0.3	2	0.1	3	-	ND
Benzo(k)fluoranthene	16	17	1.1	ng/L	0.3	1	0.0	0	-	ND
	17	17	2.0	ng/L	0.3	2	0.5	4	-	ND
	18	17	1.8	ng/L	0.3	2	0.1	5	-	ND
Biphenyl	16	17	0.6	ng/L	0.3	1	ND	-	-	*0.48*
	17	16	0.5	ng/L	0.3	2	0.1	7	-	*0.80*
	18	17	ND	ng/L	0.3	2	0.1	10	-	ND
Chrysene	16	17	1.7	ng/L	0.3	1	0.1	5	-	ND
	17	17	2.4	ng/L	0.3	2	0.5	4	-	ND
	18	17	2.2	ng/L	0.3	2	0.1	4	-	ND
Dibenz(a,h)anthracene	16	17	0.4	ng/L	0.3	1	0.0	2	-	ND
	17	17	0.5	ng/L	0.3	2	0.1	6	-	ND
	18	18	0.5	ng/L	0.3	2	0.0	3	-	ND
Dibenzothiophene	16	15	0.5	ng/L	0.3	1	ND	-	-	M
	17	15	ND	ng/L	0.3	2	0.0	0	-	ND
	18	17	ND	ng/L	0.3	2	0.0	11	-	ND
Fluoranthene	16	17	3.6	ng/L	0.3	1	0.0	0	-	ND
	17	17	6.9	ng/L	0.3	2	1.1	4	-	*0.45*
	18	17	6.0	ng/L	0.3	2	0.6	7	-	0.21
Fluorene	16	15	1.4	ng/L	0.3	1	ND	-	-	M
	17	15	1.6	ng/L	0.3	2	1.2	12	-	*5.41*
	18	17	0.6	ng/L	0.3	2	0.1	9	-	ND
Indeno(1,2,3-cd)pyrene	16	17	3.9	ng/L	0.3	1	0.8	*25*	-	ND
	17	17	4.3	ng/L	0.3	2	1.1	4	-	ND
	18	18	3.9	ng/L	0.3	2	0.2	4	-	ND
Naphthalene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	16	ND	ng/L	0.3	2	ND	-	-	ND
	18	17	ND	ng/L	0.3	2	ND	-	-	ND
Perylene	16	17	ND	ng/L	0.3	1	ND	-	-	ND
	17	17	ND	ng/L	0.3	2	0.2	4	-	ND
	18	18	ND	ng/L	0.3	2	ND	-	-	ND
Phenanthrene	16	15	4.4	ng/L	0.3	1	0.0	0	-	M
	17	15	9.8	ng/L	0.3	1	ND	-	-	*30.07*
	18	14	4.1	ng/L	0.3	2	1.7	*25*	-	ND
Pyrene	16	17	4.1	ng/L	0.3	1	0.1	2	-	0.27
	17	17	12.0	ng/L	0.3	2	0.7	3	-	*1.89*
	18	17	7.6	ng/L	0.3	2	0.8	8	-	*0.32*

Table 2b (continued). Quality assurance and control summary for laboratory analyses of water (organics).

Analysis type: water organics, particulate

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Hexachlorobenzene	16	1	ND	pg/L	1.0	1	-	-	-	ND
	17	17	3.2	pg/L	1.0	2	0.5	12	-	*18.3*
	18	18	14.5	pg/L	1.0	2	0.4	3	-	*19.3*
PCB 008	16	0	-	-	-	0	-	-	-	M
	17	0	-	-	-	0	-	-	-	M
	18	12	7.5	pg/L	1.0	0	-	-	-	0.7
PCB 018	16	0	-	-	-	0	-	-	-	M
	17	0	-	-	-	0	-	-	-	M
	18	12	1.0	pg/L	1.0	0	-	-	-	0.7
PCB 028	16	0	-	-	-	0	-	-	-	M
	17	0	-	-	-	0	-	-	-	M
	18	11	10.0	pg/L	1.0	0	-	-	-	0.7
PCB 031	16	0	-	-	-	0	-	-	-	M
	17	0	-	-	-	0	-	-	-	M
	18	11	3.0	pg/L	1.0	0	-	-	-	*1.1*
PCB 044	16	4	27.5	pg/L	1.0	0	-	-	-	ND
	17	17	13.0	pg/L	1.0	0	-	-	-	*52.7*
	18	16	5.5	pg/L	1.0	0	-	-	-	*10.3*
PCB 049	16	0	-	-	-	0	-	-	-	M
	17	9	8.0	pg/L	1.0	0	-	-	-	M
	18	15	3.8	pg/L	1.0	0	-	-	-	*6.7*
PCB 052	16	0	-	-	-	0	-	-	-	M
	17	9	15.0	pg/L	1.0	0	-	-	-	M
	18	15	8.8	pg/L	1.0	0	-	-	-	*5.4*
PCB 060	16	8	3.7	pg/L	1.0	0	-	-	-	ND
	17	17	6.5	pg/L	1.0	0	-	-	-	*1.7*
	18	18	3.6	pg/L	1.0	0	-	-	-	*2.1*
PCB 066	16	7	11.0	pg/L	1.0	0	-	-	-	ND
	17	17	15.0	pg/L	1.0	0	-	-	-	*3.3*
	18	16	8.9	pg/L	1.0	0	-	-	-	*12.0*
PCB 070	16	6	10.9	pg/L	1.0	0	-	-	-	ND
	17	16	19.5	pg/L	1.0	0	-	-	-	*10.6*
	18	16	7.9	pg/L	1.0	0	-	-	-	*6.1*
PCB 074	16	6	ND	pg/L	1.0	0	-	-	-	ND
	17	17	4.6	pg/L	1.0	0	-	-	-	*1.8*
	18	16	3.9	pg/L	1.0	0	-	-	-	*2.5*
PCB 087	16	8	21.0	pg/L	1.0	0	-	-	-	ND
	17	17	16.0	pg/L	1.0	0	-	-	-	*9.7*
	18	18	11.0	pg/L	1.0	0	-	-	-	*12.0*
PCB 095	16	7	18.0	pg/L	1.0	0	-	-	-	ND
	17	17	37.0	pg/L	1.0	0	-	-	-	*33.7*
	18	16	13.0	pg/L	1.0	0	-	-	-	*58.0*
PCB 097	16	8	5.2	pg/L	1.0	0	-	-	-	ND
	17	17	10.0	pg/L	1.0	0	-	-	-	*2.4*
	18	18	8.3	pg/L	1.0	0	-	-	-	*6.5*
PCB 099	16	8	15.0	pg/L	1.0	0	-	-	-	ND
	17	17	21.0	pg/L	1.0	0	-	-	-	*7.1*
	18	18	12.7	pg/L	1.0	0	-	-	-	*8.3*
PCB 101	16	7	72.0	pg/L	1.0	0	-	-	-	ND
	17	17	62.0	pg/L	1.0	0	-	-	-	*11.7*
	18	5	68.0	pg/L	1.0	0	-	-	-	*7.8*
PCB 105	16	8	8.4	pg/L	1.0	3	ND	-	-	ND
	17	17	10.0	pg/L	1.0	2	ND	-	-	ND
	18	18	12.5	pg/L	1.0	2	2.1	9	-	1.0
PCB 110	16	8	21.5	pg/L	1.0	0	-	-	-	ND
	17	17	28.0	pg/L	1.0	0	-	-	-	*6.5*
	18	18	24.5	pg/L	1.0	0	-	-	-	*12.6*
PCB 118	16	8	17.0	pg/L	1.0	0	-	-	-	ND
	17	17	25.0	pg/L	1.0	0	-	-	-	*1.8*
	18	18	27.0	pg/L	1.0	0	-	-	-	*3.9*
PCB 128	16	8	6.3	pg/L	1.0	3	ND	-	-	ND
	17	17	9.8	pg/L	1.0	2	ND	-	-	ND
	18	18	11.0	pg/L	1.0	2	0.0	0	-	ND
PCB 132	16	8	15.0	pg/L	1.0	0	-	-	-	ND
	17	17	14.0	pg/L	1.0	0	-	-	-	*1.0*
	18	18	13.5	pg/L	1.0	0	-	-	-	*2.3*
PCB 138	16	8	29.5	pg/L	1.0	0	-	-	-	ND
	17	17	34.0	pg/L	1.0	0	-	-	-	0.8
	18	18	44.0	pg/L	1.0	0	-	-	-	0.9
PCB 141	16	8	7.9	pg/L	1.0	0	-	-	-	ND
	17	17	6.1	pg/L	1.0	0	-	-	-	*1.9*
	18	18	4.2	pg/L	1.0	0	-	-	-	0.7
PCB 149	16	8	21.5	pg/L	1.0	0	-	-	-	ND
	17	17	32.0	pg/L	1.0	0	-	-	-	*1.8*
	18	18	30.5	pg/L	1.0	0	-	-	-	*4.0*
PCB 151	16	8	6.8	pg/L	1.0	0	-	-	-	ND
	17	17	11.0	pg/L	1.0	0	-	-	-	0.7
	18	18	9.9	pg/L	1.0	0	-	-	-	*1.7*
PCB 153	16	8	32.5	pg/L	1.0	0	-	-	-	ND
	17	17	41.0	pg/L	1.0	0	-	-	-	*4.7*
	18	18	49.0	pg/L	1.0	0	-	-	-	*1.2*
PCB 156	16	8	3.7	pg/L	1.0	0	-	-	-	ND
	17	17	ND	pg/L	1.0	0	-	-	-	ND
	18	18	4.8	pg/L	1.0	0	-	-	-	ND
PCB 158	16	8	ND	pg/L	1.0	0	-	-	-	ND
	17	17	ND	pg/L	1.0	0	-	-	-	ND
	18	18	1.6	pg/L	1.0	0	-	-	-	ND
PCB 174	16	8	6.3	pg/L	1.0	0	-	-	-	ND
	17	17	6.9	pg/L	1.0	0	-	-	-	ND
	18	18	6.2	pg/L	1.0	0	-	-	-	ND
PCB 177	16	8	13.5	pg/L	1.0	0	-	-	-	ND
	17	17	7.5	pg/L	1.0	0	-	-	-	ND
	18	18	10.0	pg/L	1.0	0	-	-	-	ND
PCB 180	16	8	19.6	pg/L	1.0	0	-	-	-	ND
	17	17	22.0	pg/L	1.0	0	-	-	-	ND
	18	18	18.0	pg/L	1.0	0	-	-	-	ND
PCB 183	16	8	2.8	pg/L	1.0	0	-	-	-	ND
	17	17	4.8	pg/L	1.0	0	-	-	-	ND
	18	18	6.1	pg/L	1.0	0	-	-	-	ND
PCB 187	16	8	11.9	pg/L	1.0	0	-	-	-	ND
	17	17	18.0	pg/L	1.0	0	-	-	-	ND
	18	18	23.0	pg/L	1.0	0	-	-	-	ND
PCB 194	16	8	4.8	pg/L	1.0	0	-	-	-	ND
	17	17	12.0	pg/L	1.0	0	-	-	-	ND
	18	0	-	-	-	0	-	-	-	ND
PCB 195	16	8	ND	pg/L	1.0	0	-	-	-	ND
	17	17	ND	pg/L	1.0	0	-	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
PCB 196/203	16	8	7.2	pg/L	1.0	0	-	-	-	ND
	17	17	8.7	pg/L	1.0	0	-	-	-	ND
	18	18	5.6	pg/L	1.0	0	-	-	-	ND
PCB 203	16	0	-	-	-	0	-	-	-	NA
	17	0	-	-	-	0	-	-	-	NA
	18	1	ND	pg/L	1.0	0	-	-	-	NA

Table 2b (continued). Quality assurance and control summary for laboratory analyses of water (organics).

Analysis type: water organics, particulate

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Aldrin	16	0	-	-	-	0	-	-	-	-
	17	0	-	-	-	0	-	-	-	-
	18	0	-	-	-	0	-	-	-	-
alpha-Chlordane	16	15	7.5	pg/L	1.0	3	1.6	10	-	*3.2*
	17	17	61.0	pg/L	1.0	2	15.9	7	-	*10.7*
	18	18	35.5	pg/L	1.0	2	4.2	3	-	*10.9*
alpha-HCH	16	6	5.3	pg/L	1.0	1	6.4	*20*	-	M
	17	17	24.0	pg/L	1.0	2	1.4	4	-	*29.3*
	18	18	3.9	pg/L	1.0	2	0.1	4	-	*3.8*
beta-HCH	16	6	11.0	pg/L	1.0	1	2.1	15	-	M
	17	17	5.4	pg/L	1.0	2	0.3	6	-	*2.7*
	18	18	3.8	pg/L	1.0	2	0.8	*72*	-	ND
cis-Nonachlor	16	14	ND	pg/L	1.0	3	2.8	12	-	ND
	17	17	17.0	pg/L	1.0	2	5.7	9	-	0.9
	18	18	11.5	pg/L	1.0	2	7.4	6	-	0.8
delta-HCH	16	6	ND	pg/L	1.0	1	ND	-	-	M
	17	17	6.2	pg/L	1.0	2	0.3	3	-	*1.7*
	18	18	ND	pg/L	1.0	2	ND	-	-	ND
Dieldrin	16	15	21.5	pg/L	1.0	3	12.0	6	-	ND
	17	17	1.3	pg/L	1.0	2	0.1	7	-	ND
	18	18	5.8	pg/L	1.0	2	0.4	2	-	ND
Endrin	16	14	ND	pg/L	1.0	3	ND	-	-	ND
	17	17	14.0	pg/L	1.0	2	20.9	*40*	-	*4.8*
	18	18	ND	pg/L	1.0	2	9.2	13	-	ND
gamma-Chlordane	16	15	6.1	pg/L	1.0	3	0.5	6	-	ND
	17	17	37.0	pg/L	1.0	2	11.3	5	-	*7.3*
	18	18	21.3	pg/L	1.0	2	11.0	3	-	*7.5*
gamma-HCH	16	6	5.1	pg/L	1.0	1	2.1	15	-	M
	17	17	8.4	pg/L	1.0	2	3.8	7	-	*2.3*
	18	18	4.4	pg/L	1.0	2	0.8	6	-	ND
Heptachlor	16	6	ND	pg/L	1.0	1	ND	-	-	*8.8*
	17	17	ND	pg/L	1.0	2	0.0	0	-	*1.1*
	18	18	1.7	pg/L	1.0	2	0.2	5	-	*1.2*
Heptachlor Epoxide	16	17	ND	pg/L	1.0	3	0.0	0	-	ND
	17	17	4.8	pg/L	1.0	0	-	-	-	*2.1*
	18	18	5.6	pg/L	1.0	0	-	-	-	0.5
Mirex	16	8	ND	pg/L	1.0	0	-	-	-	*69.0*
	17	17	ND	pg/L	1.0	0	-	-	-	ND
	18	18	ND	pg/L	1.0	0	-	-	-	ND
o,p'-DDD	16	15	2.9	pg/L	1.0	3	ND	-	-	ND
	17	17	66.0	pg/L	1.0	2	10.6	4	-	*2.0*
	18	18	32.5	pg/L	1.0	2	29.0	6	-	*1.3*
o,p'-DDE	16	9	3.3	pg/L	1.0	3	ND	-	-	*13.0*
	17	17	15.0	pg/L	1.0	2	0.3	8	-	*8.7*
	18	18	11.5	pg/L	1.0	2	4.6	11	-	*10.9*
o,p'-DDT	16	8	36.0	pg/L	1.0	3	1.4	11	-	ND
	17	17	32.0	pg/L	1.0	2	0.4	10	-	*2.1*
	18	18	12.0	pg/L	1.0	2	0.6	3	-	*1.8*
Oxychlordane	16	14	ND	pg/L	1.0	3	0.1	1	-	ND
	17	17	ND	pg/L	1.0	2	1.4	8	-	ND
	18	18	ND	pg/L	1.0	2	2.8	12	-	ND
p,p'-DDD	16	15	60.8	pg/L	1.0	3	10.1	16	-	*26.7*
	17	17	190.0	pg/L	1.0	2	29.7	3	-	*5.5*
	18	18	160.0	pg/L	1.0	2	77.8	6	-	ND
p,p'-DDE	16	9	330.0	pg/L	1.0	3	0.5	6	-	*7.5*
	17	17	300.0	pg/L	1.0	2	0.7	5	-	*6.1*
	18	18	170.0	pg/L	1.0	2	6.1	5	-	*5.7*
p,p'-DDT	16	15	23.5	pg/L	1.0	3	2.6	8	-	*2.3*
	17	17	120.0	pg/L	1.0	2	31.5	*25*	-	*32.5*
	18	18	28.0	pg/L	1.0	2	1.1	1	-	ND
trans-Nonachlor	16	8	34.0	pg/L	1.0	1	0.7	2	-	*8.5*
	17	17	17.0	pg/L	1.0	2	1.1	7	-	1.0
	18	18	12.0	pg/L	1.0	2	7.2	5	-	*2.1*

Table 3. Quality assurance and control summary for laboratory analyses of sediment.

Analysis type: sediment trace elements

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	blank
Ag	16	26	0.31	mg/kg	*0.03*	3	0.03	*17*	6	0.03
	18	26	0.26	mg/kg	*0.03*	3	0.16	11	5	0.03
Al	16	26	36800	mg/kg	25	3	1398	7	10	21
	18	26	44300	mg/kg	17	3	2131	6	13	12
As	16	26	5.3	mg/kg	0.2	3	1.8	6	5	*0.8*
	18	26	11.0	mg/kg	0.2	3	1.3	10	12	-0.2
Cd	16	26	0.26	mg/kg	*0.03*	3	0.02	6	6	0.03
	18	26	0.20	mg/kg	*0.03*	3	0.08	10	11	0.03
Cr	16	26	121	mg/kg	3	3	13	12	40	2
	18	26	118	mg/kg	2	3	3	3	31	1
Cu	16	26	45	mg/kg	1	3	1	3	20	1
	18	26	40.2	mg/kg	0.9	3	1.6	2	14	0.6
Fe	16	26	42300	mg/kg	4	3	877	3	2	4
	18	26	38200	mg/kg	3	3	153	1	-	*5*
Hg	16	26	0.1180	mg/kg	0.0004	3	0.0274	8	3	*0.0005*
	18	26	0.2640	mg/kg	0.0004	3	0.0080	7	16	-0.0006
Mn	16	26	642.5	mg/kg	0.4	3	31.4	5	10	0.4
	18	26	641.5	mg/kg	0.3	3	2.8	1	13	0.2
Ni	16	26	116	mg/kg	3	3	4	5	5	3
	18	26	102	mg/kg	2	3	1	1	7	2
Pb	16	26	20.00	mg/kg	0.08	3	4.34	13	17	0.08
	18	26	23.00	mg/kg	0.08	3	1.00	5	14	0.08
Se	16	26	0.122	mg/kg	0.002	4	0.004	4	10	0.001
	18	26	0.282	mg/kg	0.002	3	0.013	10	8	0.000
Zn	16	26	132	mg/kg	*25*	3	4	6	10	21
	18	26	126	mg/kg	17	3	1	1	8	12

- = not measured

ND = not detected

values in italics fall outside targets

Table 4. Quality assurance and control summary for laboratory analyses of sediment (organics).

Analysis type: sediment organics

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
1-Methylnaphthalene	16	26	4.5	g/kg	2.3	1	0.8	2	2	1.10
	18	26	7.9	g/kg	2.2	1	2.9	5	*26*	1.10
1-Methylphenanthrene	16	26	11.7	g/kg	1.4	1	10.8	15	*47*	0.69
	18	26	9.6	g/kg	1.4	1	11.1	12	*48*	0.69
2,3,5-Trimethylnaphthalene	16	26	4.9	g/kg	4.4	1	5.3	7	*32*	2.10
	18	26	5.8	g/kg	4.2	1	3.1	4	11	2.10
2,6-Dimethylnaphthalene	16	0	-	-	-	-	-	-	-	-
	18	26	8.0	g/kg	1.3	1	1.7	3	*27*	0.67
2-Methylnaphthalene	16	26	7.1	g/kg	2.3	1	1.4	2	8	1.10
	18	26	14.0	g/kg	2.2	1	2.5	4	*27*	1.10
Acenaphthene	16	26	4.1	g/kg	1.4	1	1.2	2	12	0.68
	18	26	5.8	g/kg	1.4	1	3.2	5	*23*	0.68
Acenaphthylene	16	26	4.7	g/kg	1.3	1	1.9	3	14	0.63
	18	26	12.4	g/kg	1.3	1	5.8	8	*30*	0.63
Anthracene	16	26	11.3	g/kg	1.5	1	4.5	6	*20*	0.74
	18	26	15.6	g/kg	1.5	1	23.7	15	*76*	0.74
Benz(a)anthracene	16	26	50.7	g/kg	0.5	1	7.0	6	*23*	0.24
	18	26	57.7	g/kg	0.5	1	56.9	*25*	*120*	0.27
Benzo(a)pyrene	16	26	68.5	g/kg	1.1	1	4.2	3	16	0.54
	18	26	125.0	g/kg	1.1	1	50.9	17	*55*	0.54
Benzo(b)fluoranthene	16	26	120.0	g/kg	0.8	1	7.8	5	16	0.40
	18	26	138.0	g/kg	0.8	1	73.9	*22*	*113*	0.40
Benzo(e)pyrene	16	26	105.0	g/kg	0.8	1	8.1	5	*42*	0.40
	18	26	83.3	g/kg	0.8	1	27.6	13	*33*	0.40
Benzo(ghi)perylene	16	26	97.6	g/kg	1.9	1	5.7	4	13	0.90
	18	26	140.0	g/kg	1.8	1	41.7	12	*90*	0.90
Benzo(k)fluoranthene	16	26	37.9	g/kg	1.5	1	3.2	3	16	0.73
	18	26	41.9	g/kg	1.5	1	22.7	19	*49*	0.73
Biphenyl	16	26	4.6	g/kg	2.7	1	1.7	3	13	1.30
	18	26	7.0	g/kg	2.6	1	1.1	2	13	1.30
Chrysene	16	26	72.7	g/kg	1.8	1	13.1	10	*26*	0.88
	18	26	71.3	g/kg	1.8	1	100.1	*34*	*183*	0.88
Dibenz(a,h)anthracene	16	26	13.0	g/kg	1.8	1	1.6	2	*32*	0.85
	18	26	11.8	g/kg	1.7	1	10.6	13	*34*	0.85
Dibenzothiophene	16	26	4.5	g/kg	2.1	1	1.4	2	*21*	1.00
	18	26	4.7	g/kg	2.0	1	2.4	4	14	1.00
Fluoranthene	16	26	122.0	g/kg	1.4	1	10.3	5	*46*	0.68
	18	26	204.0	g/kg	1.4	1	13.4	3	*64*	0.68
Fluorene	16	26	8.3	g/kg	2.3	1	3.6	5	*23*	1.10
	18	26	10.7	g/kg	2.2	1	4.9	7	20	1.10
Indeno(1,2,3-cd)pyrene	16	26	107.0	g/kg	1.9	1	7.4	4	*20*	0.89
	18	26	82.0	g/kg	1.8	1	29.0	12	*57*	0.89
Naphthalene	16	26	15.1	g/kg	1.2	1	1.5	2	*20*	*1.90*
	18	26	25.7	g/kg	1.2	1	0.4	0	20	*2.17*
Perylene	16	26	48.8	g/kg	0.9	1	3.5	5	20	0.44
	18	26	63.6	g/kg	0.9	1	18.0	14	*43*	0.44
Phenanthrene	16	26	43.7	g/kg	1.1	1	8.8	8	*24*	0.54
	18	26	70.6	g/kg	1.0	1	30.4	12	*99*	0.54
Pyrene	16	26	177.0	g/kg	1.7	1	15.9	6	*42*	0.83
	18	26	265.0	g/kg	1.7	1	20.5	4	*50*	0.83

Table 4 (continued). Quality assurance and control summary for laboratory analyses of sediment (organics).

Analysis type: sediment organics

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Hexachlorobenzene	16	26	0.2	g/kg	0.1	1	-	-	*20*	0.08
	18	26	0.2	g/kg	0.2	1	0.0	17	*29*	*0.21*
PCB 008	16	26	0.3	g/kg	0.3	1	0.2	2	*42*	0.14
	18	26	0.3	g/kg	0.3	1	0.5	6	*62*	*0.67*
PCB 018	16	26	0.3	g/kg	0.3	1	0.2	2	*51*	0.16
	18	26	0.3	g/kg	0.4	1	0.3	4	*85*	0.26
PCB 028	16	26	0.1	g/kg	0.1	1	0.4	3	*44*	0.06
	18	26	0.2	g/kg	0.1	1	0.1	2	*28*	*0.35*
PCB 031	16	26	0.2	g/kg	0.2	1	-	-	14	0.09
	18	26	0.2	g/kg	0.2	1	0.0	17	*21*	*0.36*
PCB 033	16	26	0.3	g/kg	0.2	1	-	-	-	0.13
	18	26	0.3	g/kg	0.3	1	0.0	17	-	*0.57*
PCB 044	16	26	0.5	g/kg	0.4	1	0.4	4	13	0.23
	18	26	0.5	g/kg	0.5	1	0.1	2	*25*	*0.92*
PCB 049	16	26	0.2	g/kg	0.2	1	-	-	*47*	0.09
	18	26	0.2	g/kg	0.2	1	0.0	17	*49*	*0.55*
PCB 052	16	26	0.3	g/kg	0.3	1	0.4	5	19	0.18
	18	26	0.4	g/kg	0.4	1	0.4	5	*28*	0.35
PCB 056	16	26	0.2	g/kg	0.2	1	0.0	12	-	0.11
	18	26	0.3	g/kg	0.2	1	0.0	17	-	*0.56*
PCB 060	16	26	0.2	g/kg	0.2	1	0.1	*23*	-	0.12
	18	26	0.3	g/kg	0.3	1	0.0	17	-	*0.56*
PCB 066	16	26	0.2	g/kg	0.2	1	0.3	3	13	0.08
	18	26	0.3	g/kg	0.2	1	0.3	3	*26*	*0.20*
PCB 070	16	26	0.2	g/kg	0.2	1	0.1	*24*	-	0.09
	18	26	0.4	g/kg	0.2	1	0.1	14	-	*0.54*
PCB 074	16	26	0.2	g/kg	0.2	1	0.1	4	-	0.10
	18	26	0.2	g/kg	0.2	1	0.0	17	-	*0.55*
PCB 087	16	26	0.4	g/kg	0.4	1	-	-	*69*	0.19
	18	26	0.4	g/kg	0.4	1	0.1	*25*	*62*	0.35
PCB 095	16	26	0.2	g/kg	0.2	1	0.1	9	*23*	0.11
	18	26	0.6	g/kg	0.2	1	2.0	*82*	17	*0.56*
PCB 097	16	26	0.2	g/kg	0.2	1	0.1	*25*	-	0.10
	18	26	0.2	g/kg	0.2	1	0.1	*37*	-	*0.55*
PCB 099	16	26	0.4	g/kg	0.3	1	-	-	18	0.18
	18	26	0.3	g/kg	0.4	1	0.1	13	17	0.20
PCB 101	16	26	0.2	g/kg	0.1	1	0.3	3	18	0.08
	18	26	0.7	g/kg	0.2	1	2.1	*45*	*36*	*0.38*
PCB 105	16	26	0.4	g/kg	0.4	1	0.1	2	13	0.21
	18	26	0.4	g/kg	0.4	1	0.4	5	*25*	0.28
PCB 110	16	26	1.0	g/kg	0.2	1	0.3	5	4	0.08
	18	26	0.7	g/kg	0.2	1	0.2	*20*	14	*0.54*
PCB 118	16	26	0.6	g/kg	0.3	1	0.1	2	12	0.14
	18	26	0.6	g/kg	0.3	1	0.7	12	*26*	*0.38*
PCB 128	16	26	0.1	g/kg	0.1	1	0.2	2	*22*	0.06
	18	26	0.2	g/kg	0.1	1	0.4	5	*28*	*0.33*
PCB 132	16	26	0.4	g/kg	0.4	1	-	-	-	0.19
	18	26	0.4	g/kg	0.4	1	0.1	17	-	*0.60*
PCB 138	16	26	1.0	g/kg	0.2	1	0.4	5	14	0.12
	18	26	1.0	g/kg	0.3	1	0.4	5	*27*	*0.56*
PCB 141	16	26	0.1	g/kg	0.1	1	0.1	*30*	-	0.07
	18	26	0.1	g/kg	0.1	1	0.0	17	-	*0.53*
PCB 149	16	26	0.8	g/kg	0.2	1	0.1	7	6	0.12
	18	26	0.5	g/kg	0.3	1	0.1	7	10	0.23
PCB 151	16	26	1.0	g/kg	0.9	1	-	-	*100*	0.50
	18	26	1.0	g/kg	1.0	1	0.1	17	*39*	0.75
PCB 153	16	26	1.2	g/kg	0.3	1	0.3	3	15	0.15
	18	26	0.9	g/kg	0.3	1	0.6	8	19	*0.58*
PCB 156	16	26	0.2	g/kg	0.2	1	-	-	4	0.12
	18	26	0.3	g/kg	0.3	1	0.0	17	*40*	*0.56*
PCB 158	16	26	0.3	g/kg	0.3	1	-	-	-	0.14
	18	26	0.3	g/kg	0.3	1	0.0	17	-	*0.57*
PCB 170	16	26	0.2	g/kg	0.2	1	0.1	1	12	0.09
	18	26	0.3	g/kg	0.2	1	0.4	5	16	*0.28*
PCB 174	16	26	0.2	g/kg	0.2	1	0.1	14	-	0.10
	18	26	0.2	g/kg	0.2	1	0.0	17	-	*0.55*
PCB 177	16	26	0.4	g/kg	0.3	1	0.0	7	-	0.18
	18	26	0.4	g/kg	0.4	1	0.0	3	-	*0.59*
PCB 180	16	26	0.8	g/kg	0.1	1	0.7	7	*34*	0.06
	18	26	0.3	g/kg	0.1	1	0.3	4	*34*	*0.20*
PCB 183	16	26	0.1	g/kg	0.1	1	-	-	15	0.05
	18	26	0.3	g/kg	0.1	1	0.0	17	13	*0.53*
PCB 187	16	26	0.6	g/kg	0.2	1	0.5	6	*20*	0.12
	18	26	0.7	g/kg	0.3	1	0.4	6	*21*	*0.56*
PCB 194	16	26	0.2	g/kg	0.1	1	0.0	12	20	0.08
	18	26	0.2	g/kg	0.2	1	0.0	18	*28*	*0.18*
PCB 195	16	26	0.1	g/kg	0.1	1	0.1	2	*22*	0.06
	18	26	0.1	g/kg	0.1	1	0.4	4	*50*	*0.20*
PCB 200	16	26	0.3	g/kg	0.3	1	0.0	9	-	0.15
	18	26	0.3	g/kg	0.3	1	0.0	17	-	0.22
PCB 203	16	26	0.1	g/kg	0.1	1	0.4	*70*	-	0.07
	18	26	0.2	g/kg	0.2	1	0.0	17	-	*0.19*

Table 4 (continued). Quality assurance and control summary for laboratory analyses of sediment (organics).

Analysis type: sediment organics

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Aldrin	16	26	0.1	g/kg	0.1	1	-	-	12	0.05
	18	26	0.1	g/kg	0.1	1	0.0	17	*28*	*0.32*
alpha-Chlordane	16	26	0.4	g/kg	0.4	1	0.0	1	-	0.20
	18	26	0.4	g/kg	0.4	1	0.1	17	-	0.20
alpha-HCH	16	26	0.1	g/kg	0.1	1	-	-	-	0.07
	18	26	0.2	g/kg	0.2	1	0.0	17	-	*0.54*
beta-HCH	16	26	0.2	g/kg	0.2	1	0.0	16	-	0.10
	18	26	0.2	g/kg	0.2	1	0.0	17	-	*0.55*
cis-Nonachlor	16	26	0.1	g/kg	0.1	1	0.0	2	-	0.07
	18	26	0.1	g/kg	0.1	1	0.0	17	-	*0.18*
delta-HCH	16	26	0.3	g/kg	0.3	1	-	-	-	0.15
	18	26	0.3	g/kg	0.3	1	0.0	17	-	*0.58*
Dieldrin	16	26	0.6	g/kg	0.6	1	0.0	1	12	0.32
	18	26	0.6	g/kg	0.6	1	0.0	0	*69*	0.41
Endrin	16	26	0.6	g/kg	0.6	1	-	-	-	0.32
	18	26	0.7	g/kg	0.7	1	0.1	17	-	0.66
gamma-Chlordane	16	26	0.2	g/kg	0.1	1	0.0	2	-	0.08
	18	26	0.2	g/kg	0.2	1	0.0	17	-	0.13
gamma-HCH	16	26	0.2	g/kg	0.2	1	-	-	-	0.09
	18	26	0.2	g/kg	0.2	1	0.0	17	-	*0.20*
Heptachlor	16	26	0.1	g/kg	0.2	1	-	-	-	0.08
	18	26	0.2	g/kg	0.2	1	0.0	17	-	0.10
Heptachlor Epoxide	16	26	0.1	g/kg	0.1	1	-	-	-	0.04
	18	26	0.1	g/kg	0.1	1	0.0	17	-	*0.67*
Mirex	16	26	0.3	g/kg	0.2	1	0.1	19	-	0.13
	18	26	0.3	g/kg	0.3	1	0.0	17	-	0.22
o,p'-DDD	16	26	0.2	g/kg	0.2	1	-	-	10	0.08
	18	26	0.2	g/kg	0.2	1	0.0	17	*22*	*0.38*
o,p'-DDE	16	26	0.3	g/kg	0.3	1	-	-	-	0.15
	18	26	0.3	g/kg	0.3	1	0.0	17	-	*0.40*
o,p'-DDT	16	26	0.2	g/kg	0.1	1	0.9	*81*	-	0.07
	18	26	0.2	g/kg	0.2	1	0.0	17	-	0.14
Oxychlordane	16	26	0.1	g/kg	0.1	1	-	-	*66*	0.04
	18	26	0.1	g/kg	0.1	1	0.0	17	*79*	*0.52*
p,p'-DDD	16	26	3.6	g/kg	0.5	1	0.1	2	17	0.28
	18	26	1.5	g/kg	0.5	1	0.4	*40*	*48*	0.32
p,p'-DDE	16	26	2.4	g/kg	0.2	1	0.1	3	20	0.12
	18	26	1.3	g/kg	0.2	1	0.1	5	19	0.14
p,p'-DDT	16	26	5.1	g/kg	0.3	1	0.4	8	*M*	0.18
	18	26	2.5	g/kg	0.4	1	3.4	*90*	*M*	*0.61*
trans-Nonachlor	16	26	0.1	g/kg	0.1	1	0.0	1	*102*	0.06
	18	26	0.2	g/kg	0.1	1	0.0	17	*103*	*0.18*

*stdev from MS/M matrix spike duplicates

Table 5. Quality assurance and control summary for laboratory analyses of bivalves (trace elements).

Analysis type: tissue trace elements

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	blank
Zn	16	13	0.04	mg/kg	*0.03*	1	0.00	15	*11*	0.00
Ag	18	15	0.31	mg/kg	*0.03*	-	-	4	*21*	0.00
Ag	15	18	824.8	mg/kg	1.2	2	136.9	12	*23*	0.2
Al	16	13	468.7	mg/kg	0.5	1	62.6	23	*18*	0.1
Al	18	15	690.6	mg/kg	0.5	-	-	25	*67*	0.0
Al	16	13	13.1	mg/kg	0.9	1	0.2	2	13	0.0
As	18	15	9.2	mg/kg	0.4	-	-	1	4	0.0
As	16	13	3.733	mg/kg	*0.006*	1	0.032	4	11	0.000
Cd	18	15	4.664	mg/kg	*0.008*	-	-	17	4	-0.001
Cd	16	13	2.1	mg/kg	0.2	1	0.2	7	19	0.0
Cr	18	15	3.1	mg/kg	0.2	-	-	22	*29*	0.0
Cr	16	13	67.48	mg/kg	0.02	1	0.42	6	5	0.00
Cu	18	15	18.51	mg/kg	0.03	-	-	2	2	0.00
Cu	16	13	0.14	mg/kg	0.02	1	0.00	3	12	0.00
Hg	18	15	0.20	mg/kg	0.04	-	-	5	17	0.00
Hg	16	13	2.42	mg/kg	0.03	1	0.13	3	11	0.00
Ni	18	15	4.45	mg/kg	0.04	-	-	7	12	0.00
Ni	16	13	0.69	mg/kg	0.04	1	0.06	12	9	0.00
Pb	18	15	1.85	mg/kg	0.05	-	-	24	*29*	0.00
Pb	16	13	5.0	mg/kg	0.9	1	0.2	11	*35*	0.0
Se	18	15	4.6	mg/kg	1.1	-	-	10	22	0.0
Se	16	13	137.78	mg/kg	0.03	1	4.99	6	5	0.00
Zn	18	15	295.82	mg/kg	0.11	-	-	5	8	0.00
Zn	16	15	5	ng of Sn/g	1	1	0.4	-	-	ND
MBT	18	15	2	ng of Sn/g	2	1	0.6	-	-	ND
MBT	16	15	1	ng of Sn/g	1	1	0.4	-	-	ND
DBT	18	15	3	ng of Sn/g	2	1	1.7	-	-	ND
DBT	16	15	8	ng of Sn/g	2	1	0.6	-	-	ND
TBT	18	15	22	ng of Sn/g	2	1	0.6	-	-	ND
TBT	16	15	ND	ng of Sn/g	1	1	0.6	-	-	ND
TTBT	18	15	ND	ng of Sn/g	2	1	0.6	-	-	ND

- = not measured
ND = not detected
values in italics fall outside targets

Table 6. Quality assurance and control summary for laboratory analyses of bivalves (organics).

Analysis type: tissue organics

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
1-Methylnaphthalene	16	15	7.0	g/kg	5.0	-	-	-	-	ND
	18	14	ND	g/kg	5.0	-	-	-	-	ND
1-Methylphenanthrene	16	15	9.3	g/kg	5.0	-	-	-	-	ND
	18	14	6.2	g/kg	5.0	1	1.3	*20*	-	ND
2,3,5-Trimethylnaphthalene	16	15	ND	g/kg	5.0	-	-	-	-	ND
	18	14	ND	g/kg	5.0	-	-	-	-	ND
2,6-Dimethylnaphthalene	16	15	5.9	g/kg	5.0	-	-	-	-	ND
	18	14	ND	g/kg	5.0	-	-	-	-	ND
2-Methylnaphthalene	16	15	8.7	g/kg	5.0	2	2.0	13	-	2.37
	18	14	6.5	g/kg	5.0	-	-	-	-	ND
Acenaphthene	16	15	ND	g/kg	5.0	-	-	-	-	ND
	18	14	5.5	g/kg	5.0	-	-	-	-	ND
Acenaphthylene	16	15	ND	g/kg	5.0	-	-	-	-	ND
	18	14	ND	g/kg	5.0	-	-	-	-	ND
Anthracene	16	15	6.0	g/kg	5.0	-	-	-	*66*	ND
	18	14	7.7	g/kg	5.0	2	0.6	7	*78*	ND
Benz(a)anthracene	16	15	11.5	g/kg	5.0	1	1.0	13	*38*	ND
	18	14	9.8	g/kg	5.0	2	2.8	*8*	*15*	ND
Benzo(a)pyrene	16	15	5.7	g/kg	5.0	1	0.2	4	3	ND
	18	14	7.5	g/kg	5.0	2	1.3	6	*7*	ND
Benzo(b)fluoranthene	16	15	6.8	g/kg	5.0	1	0.5	4	10	ND
	18	14	9.9	g/kg	5.0	2	4.7	*8*	*15*	ND
Benzo(e)pyrene	16	15	15.3	g/kg	5.0	1	0.0	0	*24*	ND
	18	14	8.9	g/kg	5.0	2	4.8	9	*0*	ND
Benzo(ghi)perylene	16	15	7.6	g/kg	5.0	1	0.3	5	0	ND
	18	14	10.1	g/kg	5.0	2	0.7	4	*3*	ND
Benzo(k)fluoranthene	16	15	10.7	g/kg	5.0	-	-	-	15	ND
	18	14	8.9	g/kg	5.0	2	1.2	15	*4*	ND
Biphenyl	16	15	5.2	g/kg	5.0	-	-	-	-	ND
	18	14	ND	g/kg	5.0	-	-	-	-	ND
Chrysene	16	15	22.7	g/kg	5.0	1	3.3	11	*24*	ND
	18	14	14.8	g/kg	5.0	2	4.4	*10*	*7*	ND
Dibenz(a,h)anthracene	16	15	15.1	g/kg	5.0	-	-	-	-	ND
	18	14	7.3	g/kg	5.0	1	11.6	*79*	-	ND
Dibenzothiophene	16	15	ND	g/kg	5.0	-	-	-	-	ND
	18	14	ND	g/kg	5.0	-	-	-	-	ND
Fluoranthene	16	15	23.4	g/kg	5.0	1	3.5	7	*34*	ND
	18	14	28.4	g/kg	5.0	2	8.4	7	*5*	ND
Fluorene	16	15	7.4	g/kg	5.0	-	-	-	-	ND
	18	14	5.8	g/kg	5.0	-	-	-	-	ND
Indeno(1,2,3-cd)pyrene	16	15	7.0	g/kg	5.0	-	-	-	*16*	ND
	18	14	6.9	g/kg	5.0	2	2.4	*21*	*16*	ND
Naphthalene	16	15	13.7	g/kg	5.0	2	1.6	11	*20*	*5.00*
	18	14	5.9	g/kg	5.0	-	-	-	*73*	ND
Perylene	16	15	6.6	g/kg	5.0	1	0.4	6	17	ND
	18	14	13.1	g/kg	5.0	2	1.7	13	*10*	ND
Phenanthrene	16	15	19.1	g/kg	5.0	3	0.3	*24*	*35*	ND
	18	14	15.7	g/kg	5.0	2	0.7	3	*19*	ND
Pyrene	16	15	26.6	g/kg	5.0	1	1.7	3	*21*	ND
	18	14	33.3	g/kg	5.0	2	9.5	8	*8*	ND

Table 6 (continued). Quality assurance and control summary for laboratory analyses of bivalves (organics).

Analysis type: tissue organics

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Hexachlorobenzene	16	16	1.3	g/kg	0.3	-	-	-	12	ND
	18	15	ND	g/kg	0.7	-	-	-	12	ND
PCB 008	16	15	3.6	g/kg	1.0	3	0.2	9	42	2.81
	18	14	1.7	g/kg	1.0	1	0.6	24	10	0.26
PCB 017/18	16	15	2.3	g/kg	1.0	2	0.2	13	-	1.36
	18	14	2.7	g/kg	1.0	2	0.4	18	-	0.41
PCB 020/33	16	15	1.9	g/kg	1.0	1	0.2	11	-	0.91
	18	14	2.0	g/kg	1.0	2	0.2	6	-	0.38
PCB 028/31	16	15	3.1	g/kg	1.3	3	0.5	21	13	2.67
	18	14	4.8	g/kg	1.9	2	0.4	4	6	1.34
PCB 044	16	15	2.7	g/kg	1.0	1	0.1	10	9	ND
	18	14	1.9	g/kg	1.0	2	0.4	14	9	0.37
PCB 049	16	15	2.4	g/kg	1.0	1	0.1	6	-	ND
	18	14	2.5	g/kg	1.0	2	0.4	8	-	0.28
PCB 052	16	15	3.5	g/kg	1.0	1	0.2	8	19	ND
	18	14	3.6	g/kg	1.0	2	0.2	4	17	0.33
PCB 056/60	16	15	2.1	g/kg	1.0	-	-	-	-	ND
	18	14	1.9	g/kg	1.0	2	0.1	6	-	0.62
PCB 066	16	15	1.9	g/kg	1.0	-	-	-	2	ND
	18	14	1.6	g/kg	1.0	2	0.2	6	18	0.42
PCB 070	16	15	2.4	g/kg	1.0	1	0.1	11	-	ND
	18	14	2.3	g/kg	1.0	2	0.5	8	-	0.33
PCB 074	16	15	1.7	g/kg	1.0	-	-	-	-	ND
	18	14	1.7	g/kg	1.0	2	0.4	15	-	0.34
PCB 087	16	15	1.5	g/kg	1.0	-	-	-	3	ND
	18	14	1.9	g/kg	1.0	2	0.3	4	13	0.71
PCB 095	16	15	3.9	g/kg	1.0	1	0.3	9	-	ND
	18	14	5.0	g/kg	1.0	2	0.7	6	-	0.34
PCB 097	16	15	1.9	g/kg	1.0	1	0.0	0	-	ND
	18	14	2.6	g/kg	1.0	2	0.3	6	-	0.72
PCB 099	16	15	3.5	g/kg	1.0	1	0.0	1	-	ND
	18	14	4.8	g/kg	1.0	2	0.2	2	-	0.35
PCB 090/101	16	15	5.5	g/kg	1.0	1	0.1	3	-	ND
	18	14	7.1	g/kg	1.0	2	1.0	4	-	0.43
PCB 105	16	15	1.7	g/kg	1.0	-	-	-	14	ND
	18	14	1.5	g/kg	1.0	2	0.2	14	11	0.88
PCB 110	16	15	4.7	g/kg	1.0	1	0.1	4	17	ND
	18	14	7.0	g/kg	1.0	2	0.6	3	21	0.79
PCB 118	16	15	3.5	g/kg	1.0	1	0.1	4	4	ND
	18	14	4.9	g/kg	1.0	2	0.1	2	11	0.82
PCB 128	16	15	1.3	g/kg	1.0	-	-	-	4	ND
	18	14	1.5	g/kg	1.0	2	0.2	11	13	1.57
PCB 132/153	16	15	11.0	g/kg	1.0	2	0.0	2	-	ND
	18	-	-	g/kg	-	-	-	-	-	-
PCB 138/158	16	15	5.8	g/kg	1.0	2	0.2	8	42	ND
	18	14	7.5	g/kg	1.0	2	1.5	9	75	1.27
PCB 141	16	15	2.3	g/kg	1.0	-	-	-	-	ND
	18	14	1.6	g/kg	1.0	2	0.2	22	-	1.15
PCB 149	16	15	7.8	g/kg	1.0	1	0.7	12	-	ND
	18	14	11.4	g/kg	1.0	2	1.1	3	-	0.77
PCB 151	16	15	2.4	g/kg	1.0	2	0.0	1	-	ND
	18	14	2.6	g/kg	1.0	2	0.4	4	-	0.42
PCB 156	16	15	1.2	g/kg	1.0	-	-	-	-	ND
	18	14	1.2	g/kg	1.0	-	-	-	-	1.76
PCB 170/190	16	15	1.2	g/kg	1.0	-	-	-	8	ND
	18	14	1.6	g/kg	1.0	1	0.4	28	22	2.02
PCB 174	16	15	1.4	g/kg	1.0	-	-	-	-	ND
	18	14	1.2	g/kg	1.0	-	-	-	-	1.75
PCB 177	16	15	1.6	g/kg	1.0	-	-	-	-	ND
	18	14	2.3	g/kg	1.0	2	0.3	7	-	1.83
PCB 180	16	15	2.8	g/kg	1.0	1	0.1	4	8	ND
	18	14	2.5	g/kg	1.0	2	0.4	16	13	1.79
PCB 183	16	15	1.6	g/kg	1.0	-	-	-	-	ND
	18	14	2.0	g/kg	1.0	2	0.4	14	-	1.49
PCB 187	16	15	3.2	g/kg	1.0	1	0.2	10	7	ND
	18	14	5.1	g/kg	1.0	2	1.2	10	12	1.27
PCB 194	16	15	1.3	g/kg	1.0	-	-	-	-	ND
	18	14	1.3	g/kg	1.0	-	-	-	-	2.63
PCB 195	16	15	ND	g/kg	1.0	-	-	-	2	ND
	18	14	ND	g/kg	1.0	-	-	-	7	2.44
PCB 196/203	16	15	1.8	g/kg	1.0	-	-	-	-	ND
	18	14	1.4	g/kg	1.0	-	-	-	-	2.13
PCB 201	16	15	ND	g/kg	1.0	-	-	-	-	ND
	18	14	1.7	g/kg	1.0	-	-	-	-	1.64

Table 6 (continued). Quality assurance and control summary for laboratory analyses of bivalves (organics).

parameters	cruise #	# samples	median field sample	units	median MDL	# replicates	stdev replicates	precision (RSD%)	accuracy (%error)	average blank
Aldrin	16	16	ND	g/kg	0.3	-	-	-	*26*	ND
	18	15	ND	g/kg	0.7	-	-	-	*22*	ND
alpha-Chlordane	16	16	5.9	g/kg	0.3	-	1.3	*35*	18	ND
	18	15	2.6	g/kg	0.5	1	0.0	3	*30*	ND
alpha-HCH	16	16	0.5	g/kg	0.2	1	0.0	6	*32*	ND
	18	15	0.6	g/kg	0.5	1	0.2	*23*	*25*	ND
beta-HCH	16	16	0.5	g/kg	0.2	1	0.0	8	*32*	ND
	18	15	1.1	g/kg	0.4	-	-	-	*28*	ND
cis-Nonachlor	16	16	3.0	g/kg	0.2	1	-	-	*45*	ND
	18	15	1.9	g/kg	0.5	-	0.2	*30*	*27*	ND
delta-HCH	16	16	ND	g/kg	0.1	-	-	-	*45*	ND
	18	15	ND	g/kg	0.3	-	-	-	*20*	ND
Dieldrin	16	16	9.5	g/kg	0.3	1	1.6	14	12	ND
	18	15	7.0	g/kg	0.5	1	0.3	6	*22*	ND
Endrin	16	16	0.9	g/kg	0.7	-	-	-	*20*	ND
	18	15	ND	g/kg	*1.4*	-	-	-	5	ND
gamma-Chlordane	16	16	4.3	g/kg	0.3	1	0.4	13	16	ND
	18	15	2.8	g/kg	0.5	1	0.0	3	*23*	ND
gamma-HCH	16	16	0.8	g/kg	0.2	1	0.0	3	*26*	ND
	18	15	0.6	g/kg	0.4	1	0.0	1	-	ND
Heptachlor	16	16	ND	g/kg	0.4	-	-	-	11	ND
	18	15	ND	g/kg	0.7	-	-	-	*22*	ND
Heptachlor Epoxide	16	16	1.3	g/kg	0.3	1	0.4	*79*	18	ND
	18	15	ND	g/kg	0.5	-	-	-	*20*	ND
Mirex	16	16	ND	g/kg	0.6	-	-	-	14	ND
	18	15	ND	g/kg	*1.2*	-	-	-	18	ND
o,p'-DDD	16	14	5.4	g/kg	0.2	1	1.1	18	-	ND
	18	15	4.7	g/kg	0.4	1	2.1	*132*	-	ND
o,p'-DDE	16	16	1.2	g/kg	0.3	1	0.1	5	*24*	ND
	18	15	1.6	g/kg	0.6	1	0.1	*30*	*27*	ND
o,p'-DDT	16	16	3.4	g/kg	0.3	1	0.1	2	7	ND
	18	15	2.4	g/kg	0.5	-	-	-	19	ND
Oxychlordane	16	16	1.1	g/kg	0.3	1	0.1	18	9	ND
	18	15	1.0	g/kg	0.6	-	-	-	15	ND
p,p'-DDD	16	16	8.9	g/kg	0.3	1	0.1	1	*21*	ND
	18	15	13.7	g/kg	0.5	1	0.2	2	*12*	ND
p,p'-DDE	16	16	29.7	g/kg	0.3	1	1.3	5	15	ND
	18	15	27.0	g/kg	0.6	1	0.4	3	*22*	ND
p,p'-DDT	16	16	3.6	g/kg	0.4	1	1.5	*33*	9	ND
	18	15	2.5	g/kg	0.8	1	0.0	0	15	ND
trans-Nonachlor	16	16	6.5	g/kg	0.2	1	0.5	11	*10*	ND
	18	15	5.1	g/kg	0.3	1	0.0	2	*18*	ND

Note: Pesticides (incl. Hexachlorobenzene) for tissue are from GERG only. The average blank value is the average of the two columns (db5 and db17).

Table 7. Reference toxicant and QA information for the aquatic bioassays.

		EC50 mg/L	EC25 mg/L	Salinity ( )	Blank survival	QA Notes:
February						salinity was adjusted to 20
	Mysidopsis bahia	5.9-6.7	ND	20	93 – 5%	for all samples
July						
	Mysidopsis bahia	3.8-6.6	2.8-3.5	20	98%	

EC50 = Concentration of reference toxicant at which 50% of the organisms show effects

EC25 = Concentration of reference toxicant at which 25% of the organisms show effects

Table 8. Physical/chemical measurements of test solutions and QA information for the sediment bioassays.

ND is below the detection limit of 0.01 mg/L.

		LC50 (EC50) for CdCl2 mg/L	Diss. O2 mg/L ^	pH ^	Salinity ( ) ^	Unionized Ammonia mg/L	QA Notes
February							
	Eohaustorius estuarius	3.49	8.8-8.6	8.0-8.2	16-22*	0.008	Amphipod survival in all control smaples was 97 – 4%, indicating test organisms were healthy and not affected by test conditions.
	Mytilus galloprovincialis embryos	5.86	8.8-7.8*	8.1-8.2	34-34	ND	Mean % normal development of test controls was 84 – 5%, above protocol minimum of 70%.
July							
	Strongylocentrotus purpuratus	<1	8.0-7.8	8.1-8.2	34-34	0.069	Mean % normal development of test controls was 92 – 3%, above protocol minimum of 70%.
	Eohaustorius estuarius	5.96	8.6-8.5	7.8-7.9	20-20	0.003	Amphipod survival in all in al control samples was 98 – 4% indicating test organisms were healthy and not affected by test conditions.
	Mytilus galloprovincialis embryos	2.90	8.2-9.4*	8.0-8.1	28-28	ND	Mean % normal development of test controls was 102 – 4%, above protocol minimum of 70%.

^ LC50 = Lethal effects concentration of reference toxicant at which 50% of the organisms die in survival tests
EC50 = Effects concentration of reference toxicant at which 50% of the organisms exhibit effects in development tests.

* measurements for control given at start and end of experiments, respectively

measurement outside of target quality control range for experiment

1998 RMP Data: Conventional Water Quality

Table 1. Conventional water quality parameters, 1998. NA = not analyzed, ND = not detected, . = no data.

Station Code	Station	Date	Cruise	Ammonia	Chlorophyll-a	Conductivity	DO	DOC	Hardness	Nitrate	Nitrite	pH	Phaeophytin	Phosphate	Salinity (by salinometer)	Salinity (by SCT)	Silicates	Temperature	TSS
				mg/L	mg/m3	µmho	mg/L	µg/L	mg/L	mg/L	mg/L	pH	mg/m3	mg/L	psu	o/oo	mg/L	°C	mg/L
BG20	Sacramento River	2/4/98	16	0.06	1.9	80	9.7	3159.0	47	0.3	0.009	7.5	2.6	0.06	ND	0.0	8	10.6	111
BG30	San Joaquin River	2/4/98	16	0.10	0.8	9770	9.8	4882.0	67	0.6	0.015	7.6	2.2	0.07	ND	0.0	7	10.8	50
BF40	Honker Bay	2/3/98	16	0.06	1.2	120	9.5	3219.0	59	0.3	0.010	7.5	2.0	0.05	ND	0.0	8	10.7	45
BF20	Grizzly Bay	2/3/98	16	0.07	1.4	190	9.8	3297.0	64	0.3	0.010	7.5	2.3	0.05	ND	0.0	8	10.8	62
BF10	Pacheco Creek	2/3/98	16	0.08	1.2	140	9.8	3231.0	62	0.4	0.012	7.6	2.6	0.06	ND	0.0	8	10.7	87
BD50	Napa River	2/3/98	16	0.15	1.4	1670	9.5	4000.0	156	0.8	0.031	7.5	5.1	0.10	ND	0.8	9	11.3	110
BD40	Davis Point	2/2/98	16	0.11	1.3	9700	9.7	3057.0	194	0.4	0.014	7.7	1.7	0.07	ND	0.6	9	10.7	66
BD30	Pinole Point	2/2/98	16	0.08	0.9	10930	10.2	2726.0	.	0.4	0.009	7.8	1.4	0.10	6.3	6.2	7	11.3	24
BD20	San Pablo Bay	2/2/98	16	0.11	1.1	7600	10.2	2480.0	767	0.4	0.015	7.5	3.7	0.08	4.3	4.2	8	11.1	88
BD15	Petaluma River	2/2/98	16	0.42	2.6	1570	7.3	10840.0	195	1.1	0.064	7.8	16.9	0.59	ND	0.7	7	11.4	190
BC60	Red Rock	1/29/98	16	0.14	1.4	20270	9.4	2726.0	.	0.4	0.019	7.8	1.1	0.13	12.5	12.1	5	11.9	19
BC41	Point Isabel	1/29/98	16	0.11	1.4	29070	9.2	2366.0	.	0.3	0.014	7.8	3.7	0.15	18.2	18.0	4	12.4	53
BC30	Richardson Bay	1/29/98	16	0.12	0.9	36200	8.6	1880.0	.	0.2	0.018	7.5	0.9	0.15	22.6	22.6	3	13.4	6
BC20	Golden Gate	-	16	Not sampled due to bad weather.															
BC10	Yerba Buena Island	1/29/98	16	0.14	1.9	33600	NA	2414.0	.	0.4	0.017	7.9	1.2	0.17	20.4	21.1	4	13.3	13
BB70	Alameda	1/29/98	16	0.16	1.7	33440	9.9	2366.0	.	0.3	0.019	7.9	1.3	0.17	21.2	21.0	3	13.4	17
BB30	Oyster Point	1/27/98	16	0.15	3.2	31110	9.8	2216.0	.	0.4	0.024	7.8	1.4	0.17	19.6	19.5	4	12.4	11
BB15	San Bruno Shoal	1/27/98	16	0.19	2.9	30490	10.2	2354.0	.	0.6	0.035	7.8	1.8	0.21	19.2	19.0	4	12.2	10
BA40	Redwood Creek	1/27/98	16	0.20	2.6	30210	9.8	2096.0	.	0.6	0.038	7.7	1.1	0.23	19.2	19.0	3	12.5	5
BA30	Dumbarton Bridge	1/28/98	16	0.19	2.9	29830	10.1	2805.0	.	0.9	0.045	7.5	1.0	0.30	19.2	19.0	2	13.4	37
BA20	South Bay	1/27/98	16	0.20	2.6	30470	9.4	2871.0	.	1.0	0.050	7.7	3.0	0.31	19.2	19.0	5	13.6	38
BA10	Coyote Creek	1/28/98	16	0.20	3.6	29940	9.3	2997.0	.	1.0	0.047	7.6	1.5	0.32	19.0	18.6	5	13.6	20
C-3-0	San Jose	1/28/98	16	0.58	7.2	11630	6.4	4630.0	.	4.4	0.160	7.6	9.6	0.79	8.4	6.7	8	14.8	369
C-1-3	Sunnyvale	1/28/98	16	0.38	9.7	23590	7.7	3663.0	.	2.4	0.107	7.6	17.4	0.50	14.4	14.5	6	13.9	389
BW10	Standish Dam	2/5/98	16	0.10	6.2	532600	9.2	4252.0	175	2.3	0.033	7.7	4.1	0.13	ND	0.1	8	12.3	318
BW15	Guadalupe River	2/5/98	16	0.10	1.6	465700	5.0	6186.0	223	2.0	0.013	7.8	3.7	0.08	ND	0.1	9	12.8	150
BG20	Sacramento River	4/16/98	17	0.05	7.8	199	8.9	1780.0	74	NA	0.005	7.6	4.1	0.03	ND	0.0	7	13.1	29
BG30	San Joaquin River	4/16/98	17	0.05	2.0	223	8.4	3141.0	67	NA	0.009	7.4	2.3	0.05	ND	0.0	6	14.3	23
BF40	Honker Bay	4/15/98	17	0.03	6.7	170	8.1	2078.0	68	NA	0.006	7.8	2.8	0.02	ND	0.0	7	14.7	28
BF20	Grizzly Bay	4/15/98	17	0.02	7.8	210	8.1	1732.0	67	NA	0.006	7.9	3.0	0.04	ND	0.0	7	14.7	61
BF10	Pacheco Creek	4/15/98	17	0.05	3.8	200	6.5	2925.0	68	NA	0.009	7.6	4.4	0.04	ND	0.0	6	13.5	37
BD50	Napa River	4/15/98	17	0.02	31.6	2770	5.9	2432.0	288	NA	0.012	7.7	11.5	0.04	ND	1.4	2	13.2	113
BD40	Davis Point	4/14/98	17	0.05	63.8	8370	0.6	1982.0	828	NA	0.021	7.8	27.3	0.03	5.0	4.7	3	13.2	443
BD30	Pinole Point	4/14/98	17	0.01	48.3	11220	0.8	1774.0	.	NA	0.021	8.5	23.1	0.03	5.7	6.4	3	13.9	98
BD20	San Pablo Bay	4/14/98	17	0.05	32.5	6820	0.8	2012.0	674	NA	0.019	8.3	10.4	0.03	3.9	3.7	2	13.9	91
BD15	Petaluma River	4/14/98	17	0.02	75.6	10150	1.4	2432.0	.	NA	0.014	9.0	39.9	0.02	5.8	5.8	3	14.9	265
BC60	Red Rock	4/21/98	17	0.02	29.7	15670	14.6	1916.0	.	NA	0.024	8.0	12.0	0.01	8.6	9.0	4	17.6	34
BC41	Point Isabel	4/21/98	17	0.02	22.5	22500	13.9	1714.0	.	NA	0.029	8.3	10.4	0.00	13.2	13.7	3	17.8	33
BC30	Richardson Bay	4/21/98	17	0.02	5.5	27780	12.2	1772.0	.	NA	0.036	8.5	1.8	0.01	16.6	16.8	2	17.3	11
BC20	Golden Gate	4/21/98	17	0.04	2.9	42750	7.9	1105.0	.	NA	0.063	7.7	1.3	0.02	27.6	27.7	1	12.9	3
BC10	Yerba Buena Island	4/20/98	17	0.03	24.9	28510	13.1	1700.0	.	NA	0.038	8.0	5.4	0.02	15.6	17.6	3	16.9	23
BB70	Alameda	4/20/98	17	0.02	14.6	27920	11.1	1768.0	.	NA	0.039	8.3	3.0	0.02	17.1	27.9	1	14.4	4
BB30	Oyster Point	4/20/98	17	0.03	4.3	27080	11.7	2162.0	.	NA	0.036	8.4	0.6	0.04	16.4	16.7	0	17.0	1
BB15	San Bruno Shoal	4/20/98	17	0.02	11.7	27250	11.2	2462.0	.	NA	0.037	8.3	0.5	0.07	17.7	16.8	0	16.1	5
BA40	Redwood Creek	4/22/98	17	0.02	12.1	28010	9.8	2126.0	.	NA	0.037	8.4	1.2	0.06	16.9	17.3	1	16.7	8
BA30	Dumbarton Bridge	4/22/98	17	0.02	34.2	23890	9.3	3015.0	.	NA	0.048	8.4	15.1	0.12	13.6	14.5	1	17.4	37
BA20	South Bay	4/22/98	17	0.05	34.2	21740	9.5	2781.0	.	NA	0.054	8.2	8.2	0.16	12.3	13.1	2	19.7	32
BA10	Coyote Creek	4/22/98	17	0.09	38.4	19580	9.8	3267.0	.	NA	0.055	8.4	14.8	0.18	12.7	11.7	1	19.4	36
C-3-0	San Jose	4/23/98	17	0.29	131.5	8290	6.5	4024.0	845	NA	0.106	8.0	43.1	0.35	3.7	4.6	6	17.4	400
C-1-3	Sunnyvale	4/23/98	17	0.18	246.0	8730	5.9	5699.0	950	NA	0.148	8.0	50.4	0.56	4.1	4.9	4	19.1	424
BW10	Standish Dam	4/13/98	17	0.05	10.1	422	1.2	4588.0	147	NA	0.023	7.5	6.5	0.05	ND	0.1	4	13.8	666
BW15	Guadalupe River	4/13/98	17	0.06	8.8	317	0.8	4276.0	135	NA	0.017	7.1	6.7	0.05	ND	0.0	4	13.7	59
BG20	Sacramento River	7/29/98	18	0.03	2.7	170	8.6	2023.9	48	0.3	0.043	7.5	2.3	0.05	ND	0.0	7	21.7	26
BG30	San Joaquin River	7/29/98	18	0.04	3.3	140	7.6	2162.0	47	0.3	0.025	7.7	3.1	0.05	ND	0.0	8	22.4	28
BF40	Honker Bay	7/28/98	18	0.01	3.2	28	8.3	1975.8	59	0.3	0.040	7.8	3.8	0.05	ND	0.0	7	21.1	95
BF20	Grizzly Bay	7/28/98	18	0.01	5.0	1040	7.5	2107.9	121	0.3	0.013	7.9	9.6	0.07	ND	0.4	6	20.0	371
BF10	Pacheco Creek	7/28/98	18	ND	4.0	620	7.5	2089.9	85	0.3	0.039	7.9	6.4	0.06	ND	0.2	6	21.9	126
BD50	Napa River	7/28/98	18	0.06	4.7	13100	5.1	2144.0	.	0.3	0.015	8.1	5.5	0.07	6.6	7.5	4	21.0	109
BD40	Davis Point	7/27/98	18	0.07	5.7	922400	10.8	1915.8	.	0.2	0.011	7.9	3.0	0.06	14.1	13.8	.	19.5	71
BD30	Pinole Point	7/27/98	18	0.06	3.7	25	10.7	1543.4	.	0.2	0.008	7.5	2.0	0.05	15.1	15.5	2	20.4	14
BD20	San Pablo Bay	7/27/98	18	0.04	10.3	24	10.2	1783.6	.	0.2	0.008	8.0	1.9	0.07	14.3	14.5	2	21.1	30
BD15	Petaluma River	7/27/98	18	0.06	27.7	19730	8.3	2984.7	.	0.1	0.007	8.0	11.1	0.09	11.5	11.8	2	24.8	370
BC60	Red Rock	7/23/98	18	0.07	4.5	30000	7.5	1591.5	.	0.2	0.009	7.8	2.4	0.07	17.0	19.0	4	18.7	37
BC41	Point Isabel	7/23/98	18	0.06	1.4	40260	6.6	1333.2	.	0.2	0.006	7.9	1.9	0.06	25.8	25.7	2	16.1	11
BC30	Richardson Bay	7/22/98	18	0.09	1.5	41650	5.0	1231.1	.	0.2	0.006	8.2	3.0	0.06	27.1	26.8	2	15.6	7
BC20	Golden Gate	7/22/98	18	0.07	5.2	47140	4.5	1129.0	.	0.2	0.003	8.1	3.9	0.05	30.7	30.7	1	13.0	1
BC10	Yerba Buena Island	7/22/98	18	0.09	1.8	39180	6.8	1483.4	.	0.2	0.006	8.3	0.9	0.07	25.4	25.0	2	17.3	4
BB70	Alameda	7/22/98	18	0.09	2.3	39970	6.5	1321.2	.	0.2	0.006	8.3	1.0	0.07	25.6	25.6	2	17.5	1
BB30	Oyster Point	7/20/98	18	0.07	1.2	37880	5.0	1687.5	.	0.2	0.007	7.9	0.9	0.07	23.9	24.6	2	18.2	6
BB15	San Bruno Shoal	7/20/98	18	0.04	1.8	35600	5.2	1999.8	.	0.1	0.003	8.0	1.2	0.06	22.1	22.6	.	20.3	5
BA40	Redwood Creek	7/20/98	18	0.03	2.8	32950	7.7	2654.4	.	0.3	0.012	8.0	2.7	0.24	20.5	20.7	4	22.7	20
BA30	Dumbarton Bridge	7/21/98	18	0.08	2.7	32720	7.3	2906.7	.	0.4	0.015	7.9	1.6	0.27	20.1	20.5	5	22.1	16
BA20	South Bay	7/20/98	18	0.13	8.3	30770	7.0	3345.1	.	0.6	0.038	9.9	3.0	0.39	18.5	19.1	5	24.0	46
BA10	Coyote Creek	7/20/98	18	0.14	6.1	29400	4.3	3423.1	.	0.7	0.045	7.9	4.2	0.41	18.0	18.2	5	24.2	34
C-3-0	San Jose	7/21/98	18	0.81	2.3	8540	2.8	5447.0	974	2.5	0.225	7.6	8.4	0.50	4.4	4.8	9	23.5	163
C-1-3	Sunnyvale	7/21/98	18	0.64	6.3	11000	0.4	5921.4	.	.	0.207	7.7	13.6	0.84	6.4	6.2	8	23.5	227
BW10	Standish Dam	7/30/98	18	0.04	29.8	1250	9.4	3170.9	388	2.9	0.034	8.9	6.7	.	ND	0.5	5	20.6	86
BW15	Guadalupe River	7/30/98	18	0.06	9.4	1200	8.9	1759.6	500	3.0	0.025	7.9	7.1	.	ND	0.5	9	21.7	94

1998 RMP Data: Trace Elements (Dissolved) in Water Samples

Table 2. Dissolved concentrations of trace elements in water, 1998. ND = not detected.

[illegible]	[illegible]	[illegible]	[illegible]	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BG20	Sacramento River	2/4/98	16	0.0030	1.48	0.01	0.96	1.3	0.0018	1.4	0.122	0.14	1.8
BG30	San Joaquin River	2/4/98	16	0.0050	1.74	0.01	1.40	1.9	0.0039	1.9	0.254	0.16	3.4
BF40	Honker Bay	2/3/98	16	0.0050	1.54	0.01	1.82	1.6	0.0039	1.1	0.221	0.12	3.4
BF20	Grizzly Bay	2/3/98	16	0.0050	1.47	0.01	1.55	1.4	0.0037	0.9	0.193	0.11	2.7
BF10	Pacheco Creek	2/3/98	16	0.0040	1.62	0.01	1.28	1.5	0.0030	1.2	0.155	0.19	2.4
BD50	Napa River	2/3/98	16	0.0040	1.60	0.01	1.05	1.4	0.0039	2.2	0.264	0.13	3.5
BD40	Davis Point	2/2/98	16	0.0030	1.54	0.01	1.23	1.8	0.0032	1.7	0.193	0.12	2.6
BD30	Pinole Point	2/2/98	16	0.0010	1.44	0.02	0.23	1.3	0.0017	1.3	0.029	0.07	0.9
BD20	San Pablo Bay	2/2/98	16	0.0020	1.43	0.02	0.42	1.3	0.0014	1.0	0.074	0.10	1.3
BD15	Petaluma River	2/2/98	16	0.0060	2.69	0.02	2.90	2.4	0.0143	7.3	0.403	0.16	6.9
BC60	Red Rock	1/29/98	16	0.0030	1.66	0.03	0.19	1.5	0.0012	2.1	0.034	0.14	1.1
BC41	Point Isabel	1/29/98	16	0.0030	1.39	0.03	0.15	1.0	0.0008	1.3	0.021	0.10	1.0
BC30	Richardson Bay	1/29/98	16	0.0030	1.56	0.03	0.09	1.3	0.0012	1.3	0.010	0.06	2.1
BC20	Golden Gate	-	16	Not sampled due to bad weather.									
BC10	Yerba Buena Island	1/29/98	16	0.0030	1.74	0.04	0.14	1.3	0.0006	1.6	0.025	0.11	2.0
BB70	Alameda	1/29/98	16	0.0030	1.67	0.03	0.11	1.2	0.0008	1.4	0.011	0.09	1.3
BB30	Oyster Point	1/27/98	16	0.0020	1.86	0.04	0.10	1.2	0.0008	1.5	0.011	0.12	0.9
BB15	San Bruno Shoal	1/27/98	16	0.0040	1.88	0.05	0.11	1.8	0.0009	2.0	0.019	0.15	1.6
BA40	Redwood Creek	1/27/98	16	0.0030	2.13	0.05	0.10	1.6	0.0008	1.9	0.023	0.17	1.4
BA30	Dumbarton Bridge	1/28/98	16	0.0030	2.45	0.06	0.14	1.7	0.0011	2.3	0.056	0.21	2.1
BA20	South Bay	1/27/98	16	0.0020	2.40	0.06	0.12	1.9	0.0012	2.4	0.052	0.31	3.0
BA10	Coyote Creek	1/28/98	16	0.0040	2.53	0.07	0.45	1.7	0.0023	2.3	0.136	0.25	3.0
C-3-0	San Jose	1/28/98	16	0.0020	2.86	0.05	0.22	1.8	0.0037	3.3	0.185	0.91	19.5
C-1-3	Sunnyvale	1/28/98	16	0.0030	2.73	0.06	0.50	1.8	0.0034	2.4	0.240	0.64	8.4
BW10	Standish Dam	2/5/98	16	0.0020	2.35	0.01	0.87	1.4	0.0031	3.0	0.079	0.78	1.4
BW15	Guadalupe River	2/5/98	16	0.0010	1.25	0.01	0.98	0.9	0.0154	2.8	0.077	1.89	2.4
BG20	Sacramento River	4/16/98	17	0.0040	1.20	0.00	0.26	1.2	0.0015	1.0	0.047	0.27	0.4
BG30	San Joaquin River	4/16/98	17	0.0040	1.31	0.01	1.07	1.4	0.0070	1.1	0.094	0.37	0.6
BF40	Honker Bay	4/15/98	17	0.0010	1.19	0.01	0.57	1.3	0.0016	1.1	0.074	0.15	0.5
BF20	Grizzly Bay	4/15/98	17	0.0010	1.31	0.01	3.84	1.2	0.0016	0.9	0.094	0.20	0.6
BF10	Pacheco Creek	4/15/98	17	0.0010	1.29	0.01	0.70	1.3	0.0020	1.0	0.075	0.31	0.4
BD50	Napa River	4/15/98	17	0.0010	1.44	0.00	0.90	1.5	0.0015	1.4	0.059	0.24	0.4
BD40	Davis Point	4/14/98	17	0.0000	1.22	0.01	0.22	1.5	0.0006	1.4	0.006	0.28	0.2
BD30	Pinole Point	4/14/98	17	0.0010	1.48	0.01	0.29	1.5	0.0010	1.4	0.019	0.22	0.2
BD20	San Pablo Bay	4/14/98	17	0.0040	1.19	0.01	0.11	1.2	0.0012	1.1	0.027	0.23	0.3
BD15	Petaluma River	4/14/98	17	0.0010	2.10	0.01	0.37	2.2	0.0015	1.7	0.020	0.26	0.2
BC60	Red Rock	4/21/98	17	0.0040	1.37	0.01	0.38	1.6	0.0010	1.2	0.004	0.17	0.1
BC41	Point Isabel	4/21/98	17	0.0040	1.32	0.01	0.23	1.4	0.0010	1.1	0.002	0.11	0.1
BC30	Richardson Bay	4/21/98	17	0.0040	1.60	0.02	0.36	1.4	0.0030	1.1	0.006	0.13	0.1
BC20	Golden Gate	4/21/98	17	0.0040	1.64	0.03	0.14	0.5	0.0006	0.6	0.005	0.09	0.6
BC10	Yerba Buena Island	4/20/98	17	0.0040	1.27	0.02	0.23	1.2	0.0008	1.1	0.005	0.17	0.1
BB70	Alameda	4/20/98	17	0.0040	1.44	0.02	0.22	1.5	0.0014	1.3	0.007	0.16	0.2
BB30	Oyster Point	4/20/98	17	0.0040	1.70	0.03	0.29	2.0	0.0013	1.7	0.016	0.23	0.3
BB15	San Bruno Shoal	4/20/98	17	0.0040	1.85	0.03	0.20	2.1	0.0009	1.8	0.014	0.19	0.3
BA40	Redwood Creek	4/22/98	17	0.0010	1.53	0.02	0.09	1.9	0.0037	1.7	0.013	0.22	0.5
BA30	Dumbarton Bridge	4/22/98	17	0.0020	2.52	0.02	0.29	2.8	0.0009	2.4	0.034	0.43	0.8
BA20	South Bay	4/22/98	17	0.0020	2.35	0.03	0.33	2.9	0.0024	2.7	0.043	0.45	0.9
BA10	Coyote Creek	4/22/98	17	0.0020	2.29	0.03	0.25	2.5	0.0015	2.4	0.043	0.46	0.9
C-3-0	San Jose	4/23/98	17	0.0010	2.47	0.02	0.65	2.2	0.0017	3.0	0.091	0.95	3.4
C-1-3	Sunnyvale	4/23/98	17	0.0010	3.08	0.03	0.49	3.5	0.0018	3.2	0.101	2.30	2.6
BW10	Standish Dam	4/13/98	17	0.0010	1.19	0.01	0.61	1.3	0.0017	1.7	0.110	0.53	1.6
BW15	Guadalupe River	4/13/98	17	0.0020	0.83	0.02	0.96	1.5	0.0052	2.1	0.332	0.96	5.6
BG20	Sacramento River	7/29/98	18	0.0000	2.04	0.01	1.12	1.5	0.0011	1.0	0.113	0.17	1.0
BG30	San Joaquin River	7/29/98	18	0.0010	1.83	0.01	0.63	1.4	0.0011	0.9	0.099	0.15	0.9
BF40	Honker Bay	7/28/98	18	0.0010	1.99	0.01	0.65	1.4	0.0019	0.9	0.071	0.08	0.7
BF20	Grizzly Bay	7/28/98	18	0.0010	2.42	0.01	0.17	1.5	0.0008	0.8	0.048	0.11	0.7
BF10	Pacheco Creek	7/28/98	18	0.0010	1.91	0.01	0.52	1.4	0.0008	0.7	0.032	0.16	0.4
BD50	Napa River	7/28/98	18	0.0010	2.06	0.02	0.19	1.7	0.0003	1.2	0.008	0.16	0.6
BD40	Davis Point	7/27/98	18	0.0020	2.19	0.04	0.16	1.5	0.0007	1.3	0.005	0.09	0.6
BD30	Pinole Point	7/27/98	18	0.0020	2.14	0.06	0.14	1.5	0.0007	1.4	0.006	0.11	0.5
BD20	San Pablo Bay	7/27/98	18	0.0030	2.24	0.04	0.20	1.6	0.0009	1.4	0.012	0.11	0.6
BD15	Petaluma River	7/27/98	18	0.0030	3.21	0.07	0.19	3.1	0.0021	2.8	0.031	0.14	1.0
BC60	Red Rock	7/23/98	18	0.0020	2.04	0.05	0.18	1.2	0.0008	1.2	0.005	0.08	0.4
BC41	Point Isabel	7/23/98	18	0.0020	1.91	0.05	0.13	0.9	0.0004	1.0	0.010	ND	0.8
BC30	Richardson Bay	7/22/98	18	0.0020	1.85	0.06	0.14	0.7	0.0004	0.9	0.012	0.09	0.6
BC20	Golden Gate	7/22/98	18	0.0010	1.72	0.07	0.16	0.4	0.0005	0.6	0.009	ND	0.3
BC10	Yerba Buena Island	7/22/98	18	0.0030	2.10	0.07	0.11	0.9	0.0005	1.0	0.012	0.11	0.8
BB70	Alameda	7/22/98	18	0.0020	1.99	0.05	0.12	1.0	0.0005	1.1	0.012	0.12	0.7
BB30	Oyster Point	7/20/98	18	0.0020	1.95	0.05	0.15	1.1	0.0006	1.1	0.011	0.13	0.6
BB15	San Bruno Shoal	7/20/98	18	0.0040	2.58	0.06	0.18	1.6	0.0011	1.5	0.015	0.18	0.6
BA40	Redwood Creek	7/20/98	18	0.0060	3.52	0.06	0.29	2.3	0.0016	2.0	0.026	0.26	0.9
BA30	Dumbarton Bridge	7/21/98	18	0.0060	3.78	0.06	0.24	2.3	0.0010	2.1	0.036	0.26	1.1
BA20	South Bay	7/20/98	18	0.0050	4.34	0.08	0.41	3.3	0.0011	3.1	0.078	0.41	1.9
BA10	Coyote Creek	7/20/98	18	0.0040	4.40	0.09	0.22	2.7	0.0069	2.7	0.077	0.46	1.7
C-3-0	San Jose	7/21/98	18	0.0010	3.52	0.03	0.34	1.5	0.0008	6.0	0.271	1.08	22.5
C-1-3	Sunnyvale	7/21/98	18	0.0010	4.80	0.04	0.45	2.3	0.0018	4.9	0.241	1.28	14.2
BW10	Standish Dam	7/30/98	18	0.0010	2.60	0.01	0.26	1.2	0.0007	2.2	0.179	2.15	1.3
BW15	Guadalupe River	7/30/98	18	0.0010	1.37	0.01	0.37	1.2	0.0006	2.8	0.065	6.13	1.1

1998 RMP Data: Trace Elements (Total) in Water Samples

Table 3. Total or near total [s] concentrations of trace elements in water, 1998. M = matrix interference, NA = not analyzed, ND = not detected, B = blank contamination >10% of measured concentration.

[illegible]	[illegible]	[illegible]	[illegible]	Ag [s]	As	Cd [s]	Cr	Cu [s]	Hg	Ni [s]	Pb [s]	Se	Zn [s]
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
BG20	Sacramento River	2/4/98	16	0.0190	3.35	0.05	19.77	6.7	0.0189	11.8	1.75	0.18	16.1
BG30	San Joaquin River	2/4/98	16	0.0120	2.38	0.03	8.34	4.1	0.0096	5.2	0.82	0.20	7.6
BF40	Honker Bay	2/3/98	16	0.0140	2.19	0.03	12.89	4.4	0.0116	5.1	0.93	0.13	10.3
BF20	Grizzly Bay	2/3/98	16	0.0140	2.46	0.03	14.36	4.5	0.0136	5.2	1.18	0.13	11.0
BF10	Pacheco Creek	2/3/98	16	0.0170	2.80	0.05	13.40	5.1	0.0121	6.0	1.21	0.21	12.9
BD50	Napa River	2/3/98	16	0.0140	3.69	0.05	17.47	6.4	0.0370	8.9	3.58	0.22	23.2
BD40	Davis Point	2/2/98	16	0.0130	2.53	0.03	9.08	4.4	0.0114	5.8	1.09	0.18	9.3
BD30	Pinole Point	2/2/98	16	0.0110	1.84	0.02	4.52	2.9	0.0057	3.9	0.62	0.14	3.8
BD20	San Pablo Bay	2/2/98	16	0.0230	3.07	0.04	17.80	5.4	0.0226	6.4	2.08	0.17	13.7
BD15	Petaluma River	2/2/98	16	0.0430	5.33	0.10	55.96	9.5	0.0632	28.5	4.72	0.26	35.3
BC60	Red Rock	1/29/98	16	0.0090	2.06	0.03	4.58	2.9	0.0077	4.8	0.64	0.15	4.8
BC41	Point Isabel	1/29/98	16	0.0170	2.44	0.04	9.43	3.9	0.0208	6.8	1.74	0.13	8.3
BC30	Richardson Bay	1/29/98	16	0.0060	1.73	0.03	1.57	2.1	0.0031	2.1	0.28	0.10	2.7
BC20	Golden Gate	-	16	Not sampled due to bad weather.									
BC10	Yerba Buena Island	1/29/98	16	0.0100	1.98	0.04	3.05	2.2	0.0055	3.5	0.67	0.15	4.2
BB70	Alameda	1/29/98	16	0.0090	1.68	0.04	2.84	1.9	0.0049	2.9	0.43	0.10	3.1
BB30	Oyster Point	1/27/98	16	0.0080	2.08	0.04	1.86	2.0	0.0039	2.8	0.37	0.14	2.2
BB15	San Bruno Shoal	1/27/98	16	0.0100	2.12	0.06	1.03	2.2	0.0037	2.9	0.31	0.17	3.1
BA40	Redwood Creek	1/27/98	16	0.0100	2.07	0.06	1.42	2.1	0.0032	3.3	0.28	0.18	2.3
BA30	Dumbarton Bridge	1/28/98	16	0.0190	2.82	0.08	6.07	3.4	0.0137	6.0	1.16	0.26	7.5
BA20	South Bay	1/27/98	16	0.0180	2.67	0.08	5.97	3.6	0.0107	6.1	1.08	0.20	7.6
BA10	Coyote Creek	1/28/98	16	0.0260	2.73	0.08	3.86	3.0	0.0089	5.2	0.81	0.30	6.2
C-3-0	San Jose	1/28/98	16	0.1490	9.37	0.12	59.62	12.6	0.2120	26.9	9.48	1.20	71.5
C-1-3	Sunnyvale	1/28/98	16	0.1950	7.11	0.15	60.42	15.5	0.1570	28.8	12.76	0.88	58.7
BW10	Standish Dam	2/5/98	16	0.0520	6.68	0.16	48.75	10.2	0.0636	43.8	7.10	1.02	39.6
BW15	Guadalupe River	2/5/98	16	0.0480	3.01	0.12	25.91	8.1	0.7300	27.6	6.82	2.28	37.6
BG20	Sacramento River	4/16/98	17	0.0070	ND	0.02	4.91	3.2	0.0006	3.7	0.42	ND	4.8
BG30	San Joaquin River	4/16/98	17	0.0060	1.45	0.01	2.65	2.5	0.0049	3.0	0.38	0.43	3.3
BF40	Honker Bay	4/15/98	17	0.0080	1.67	0.02	5.43	3.2	0.0063	4.2	0.54	0.21	5.1
BF20	Grizzly Bay	4/15/98	17	0.0110	2.32	0.03	10.22	5.3	0.0120	9.4	1.27	0.18	9.2
BF10	Pacheco Creek	4/15/98	17	0.0080	1.72	0.02	6.00	3.4	0.0073	4.0	0.58	0.32	5.6
BD50	Napa River	4/15/98	17	0.0140	3.23	0.04	20.04	8.0	0.0251	12.7	2.56	0.33	15.7
BD40	Davis Point	4/14/98	17	0.0980	7.69	0.14	74.94	20.2	0.0900	36.3	6.55	0.51	50.2
BD30	Pinole Point	4/14/98	17	0.0160	2.35	0.04	22.39	5.4	0.0157	9.3	1.67	0.31	12.7
BD20	San Pablo Bay	4/14/98	17	0.0190	2.74	0.04	15.88	6.5	M	11.0	2.11	0.33	14.7
BD15	Petaluma River	4/14/98	17	0.0850	5.36	0.08	44.28	15.4	0.0328	25.6	5.90	0.41	35.5
BC60	Red Rock	4/21/98	17	0.0070	0.94	0.03	5.16	3.3	0.0082	4.6	0.78	0.24	5.7
BC41	Point Isabel	4/21/98	17	0.0090	1.93	0.02	5.99	3.0	0.0073	4.5	0.82	0.22	5.8
BC30	Richardson Bay	4/21/98	17	0.0050	1.71	0.02	2.15	1.9	0.0046	2.3	0.34	0.16	2.5
BC20	Golden Gate	4/21/98	17	0.0020	1.29	0.02	0.29	0.6	0.0008	0.8	0.05	B	0.7
BC10	Yerba Buena Island	4/20/98	17	0.0040	1.52	0.02	2.69	2.1	0.0030	2.4	0.35	0.19	2.6
BB70	Alameda	4/20/98	17	0.0030	1.44	NA	0.50	1.7	0.0011	1.8	0.14	0.19	1.5
BB30	Oyster Point	4/20/98	17	0.0030	1.65	0.02	NA	2.3	0.0012	1.9	0.09	0.24	0.8
BB15	San Bruno Shoal	4/20/98	17	0.0030	1.88	0.02	0.38	2.4	0.0023	2.0	0.11	0.27	1.0
BA40	Redwood Creek	4/22/98	17	0.0070	1.56	0.02	1.01	2.1	0.0006	2.1	0.22	0.23	1.6
BA30	Dumbarton Bridge	4/22/98	17	0.0160	2.34	0.07	5.92	4.1	0.0359	4.8	0.71	0.53	5.3
BA20	South Bay	4/22/98	17	0.0150	2.76	0.07	4.68	4.5	0.0129	6.0	0.80	0.57	6.9
BA10	Coyote Creek	4/22/98	17	0.0500	2.54	0.06	6.62	5.4	0.0153	7.8	1.28	0.65	9.3
C-3-0	San Jose	4/23/98	17	0.1360	5.90	0.12	65.01	15.1	0.1130	32.6	9.47	1.37	50.2
C-1-3	Sunnyvale	4/23/98	17	0.1650	6.48	0.14	64.56	17.8	0.1410	36.8	10.75	2.41	53.6
BW10	Standish Dam	4/13/98	17	0.0630	7.52	0.36	100.86	20.0	0.0641	49.0	15.85	0.96	87.1
BW15	Guadalupe River	4/13/98	17	0.0480	1.51	0.11	11.94	6.6	0.0604	13.8	5.57	1.21	28.5
BG20	Sacramento River	7/29/98	18	0.0030	2.31	0.03	4.71	2.8	0.0052	2.9	0.50	0.16	4.6
BG30	San Joaquin River	7/29/98	18	0.0020	2.23	0.02	4.08	2.1	0.0021	1.8	0.32	0.19	3.4
BF40	Honker Bay	7/28/98	18	0.0080	3.40	0.04	13.03	6.3	0.0219	9.1	1.15	0.15	16.5
BF20	Grizzly Bay	7/28/98	18	0.0250	7.38	0.11	39.96	15.3	0.0094	24.1	3.76	0.27	94.1
BF10	Pacheco Creek	7/28/98	18	0.0140	3.70	0.05	13.97	7.7	0.0237	11.9	1.67	0.22	21.0
BD50	Napa River	7/28/98	18	0.0180	3.45	0.05	2.63	6.8	0.0230	11.2	1.59	0.24	20.8
BD40	Davis Point	7/27/98	18	0.0210	3.44	0.07	14.78	5.5	0.0227	9.7	1.39	0.17	14.2
BD30	Pinole Point	7/27/98	18	0.0050	2.24	0.06	2.38	2.1	0.0040	3.1	0.34	0.12	4.5
BD20	San Pablo Bay	7/27/98	18	0.0090	2.59	0.07	4.64	3.4	0.0066	5.2	0.79	0.15	8.5
BD15	Petaluma River	7/27/98	18	0.0490	7.65	0.11	63.89	14.6	0.0501	26.5	5.95	0.26	91.3
BC60	Red Rock	7/23/98	18	0.0080	2.64	0.07	4.99	2.9	0.0107	4.9	0.55	0.13	7.8
BC41	Point Isabel	7/23/98	18	0.0050	2.19	0.06	1.04	1.4	0.0048	2.1	0.28	0.09	3.4
BC30	Richardson Bay	7/22/98	18	0.0030	1.86	0.07	1.30	1.3	0.0021	1.8	0.23	0.09	2.3
BC20	Golden Gate	7/22/98	18	0.0020	1.64	0.06	0.29	0.4	0.0010	0.6	0.05	0.06	0.8
BC10	Yerba Buena Island	7/22/98	18	0.0040	1.92	0.07	0.71	1.3	0.0023	1.6	0.16	0.12	2.0
BB70	Alameda	7/22/98	18	0.0050	2.09	0.07	0.72	1.2	0.0020	1.4	0.13	0.13	1.7
BB30	Oyster Point	7/20/98	18	0.0050	2.09	0.06	1.02	1.2	0.0021	1.5	0.15	0.14	1.7
BB15	San Bruno Shoal	7/20/98	18	0.0080	2.50	0.06	0.85	2.0	0.0032	2.2	0.18	0.16	1.8
BA40	Redwood Creek	7/20/98	18	0.0120	3.56	0.10	3.18	3.5	0.0070	4.3	0.58	0.27	5.0
BA30	Dumbarton Bridge	7/21/98	18	0.0100	3.81	0.10	2.99	3.6	0.0085	4.4	0.50	0.32	4.8
BA20	South Bay	7/20/98	18	0.0220	4.75	0.12	9.90	6.2	0.0277	10.5	1.31	0.44	14.0
BA10	Coyote Creek	7/20/98	18	0.0160	5.10	0.11	7.09	5.4	0.0169	8.7	1.44	0.49	13.0
C-3-0	San Jose	7/21/98	18	0.0860	5.18	0.08	28.07	8.3	0.0656	22.8	5.40	1.31	98.6
C-1-3	Sunnyvale	7/21/98	18	0.1000	7.22	0.06	50.74	10.8	0.0761	27.9	5.50	1.69	18.0
BW10	Standish Dam	7/30/98	18	0.0190	3.52	0.07	3.58	6.3	0.0161	13.7	4.48	2.33	55.4
BW15	Guadalupe River	7/30/98	18	0.0270	2.24	0.05	10.30	6.6	0.0635	14.5	4.12	6.79	24.7

Table 4. Dissolved PAH concentrations in water samples, 1998.
LPAH = low molecular weight PAHs, HPAH = high molecular weight PAHs, B = blank contamination, not included in sums and calculations, ***b*** = blank signal measured but small relative to sample.
CE = coeluted, M = matrix interference, ND = not detected, NS = not sampled, S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.
For method detection limits, refer to ***QA Tables*** .

				ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
BG20	Sacramento River	2/4/98	16	S	S	M	ND	ND	ND	M	M	M	M	M	M	M	M	0.71	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG30	San Joaquin River	2/4/98	16	S	S	ND	ND	ND	ND	M	M	M	M	M	M	M	M	0.49	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF20	Grizzly Bay	2/3/98	16	S	S	M	ND	ND	ND	M	M	M	M	M	M	M	M	0.37	0.35	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.35	ND	ND
BD50	Napa River	2/3/98	16	S	S	0.80	ND	ND	ND	5.7	M	M	M	M	M	M	M	0.49	1.9	ND	ND	0.86	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND
BD40	Davis Point	2/2/98	16	S	S	0.30	ND	ND	ND	2.7	M	M	ND	M	M	M	M	0.35	1.1	ND	ND	0.48	ND	ND	ND	ND	ND	ND	ND	0.62	ND	ND
BD30	Pinole Point	2/2/98	16	S	S	M	ND	ND	ND	M	M	M	M	M	M	M	M	ND	0.82	ND	ND	0.35	ND	ND	ND	ND	ND	ND	ND	0.48	ND	ND
BD20	San Pablo Bay	2/2/98	16	S	S	ND	ND	ND	ND	0.40	M	M	M	M	M	M	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD15	Petaluma River	2/2/98	16	S	S	ND	ND	ND	ND	1.0	M	M	M	M	M	M	M	0.49	2.2	ND	ND	0.79	ND	ND	0.39	ND	ND	ND	ND	0.69	0.34	ND
BC60	Red Rock	1/29/98	16	3.8	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.40	0.93	ND	2.4	0.50	ND	0.78	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND
BC20	Golden Gate	1/29/98	16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
BC10	Yerba Buena Island	1/29/98	16	19	7.4	ND	ND	ND	ND	ND	ND	1.4	0.30	ND	0.30	1.4	3.7	0.32	12	1.8	0.37	3.3	ND	ND	ND	ND	ND	ND	ND	6.2	ND	ND
BB70	Alameda	1/29/98	16	5.1	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.50	1.3	ND	3.3	0.51	ND	0.78	ND	ND	ND	ND	ND	ND	ND	2.0	ND	ND
BA40	Redwood Creek	1/27/98	16	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1	ND	ND	0.91	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND
BA30	Dumbarton Bridge	1/28/98	16	6.2	2.1	ND	ND	ND	ND	ND	ND	0.50	ND	ND	ND	0.90	0.58	ND	4.1	0.36	ND	1.1	ND	0.31	0.41	ND	ND	ND	ND	1.6	0.33	ND
BA10	Coyote Creek	1/28/98	16	46	15	ND	ND	ND	ND	ND	ND	ND	ND	0.39	0.30	ND	3.9	11	30	0.87	0.69	23	ND	0.33	0.40	ND	ND	ND	0.36	4.3	0.32	ND
C-3-0	San Jose	1/28/98	16	12	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	1.4	ND	10	0.69	0.55	2.8	ND	0.88	1.2	ND	ND	ND	ND	2.9	1.1	ND
BW10	Standish Dam	2/5/98	16	S	S	ND	ND	ND	ND	M	M	M	M	M	M	M	M	0.83	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BW15	Guadalupe River	2/5/98	16	S	S	ND	ND	ND	ND	0.50	M	M	M	M	M	M	M	0.73	1.4	ND	ND	0.72	ND	ND	ND	ND	ND	ND	ND	0.66	ND	ND
BG20	Sacramento River	4/16/98	17	S	S	0.60	ND	ND	B	B	1.0	1.9	ND	ND	ND	2.4	CE	ND	1.0	CE	ND	0.41	ND	ND	ND	ND	ND	ND	ND	0.54	ND	ND
BG30	San Joaquin River	4/16/98	17	S	S	0.80	ND	ND	B	B	2.9	4.5	0.30	0.77	0.90	7.4	CE	13	20	CE	0.78	16	ND	ND	ND	ND	ND	ND	ND	3.6	ND	ND
BF20	Grizzly Bay	4/15/98	17	S	S	0.50	ND	ND	B	B	1.0	1.4	ND	ND	ND	2.1	CE	0.79	1.5	CE	ND	0.85	ND	ND	ND	ND	ND	ND	ND	0.63	ND	ND
BD50	Napa River	4/15/98	17	S	S	0.70	ND	0.37	B	B	1.2	3.0	0.30	ND	0.30	3.7	CE	3.7	17	CE	ND	13	ND	ND	ND	ND	ND	ND	ND	3.7	ND	ND
BD40	Davis Point	4/14/98	17	S	S	0.80	ND	ND	ND	3.7 ***b***	5.7	8.0	0.40	0.37	ND	12	CE	2.0	8.3	CE	ND	6.4	ND	ND	0.30	ND	ND	ND	ND	1.6	ND	ND
BD30	Pinole Point	4/14/98	17	S	S	0.90	ND	ND	ND	4.0 ***b***	4.7	8.2	0.50	ND	ND	14	CE	0.50	0.89	CE	ND	0.40	ND	ND	ND	ND	ND	ND	ND	0.49	ND	ND
BD20	San Pablo Bay	4/14/98	17	S	S	0.60	ND	ND	ND	3.2 ***b***	4.6	7.0	0.40	ND	ND	10	CE	0.39	1.6	CE	ND	0.71	ND	ND	ND	ND	ND	ND	ND	0.87	ND	ND
BD15	Petaluma River	4/14/98	17	S	S	0.30	ND	ND	ND	B	2.0	2.3	ND	ND	ND	6.9	CE	0.33	1.9	CE	ND	0.55	ND	ND	0.29	ND	ND	ND	ND	0.53	0.29	0.23
BC60	Red Rock	4/21/98	17	S	S	0.50	ND	ND	B	ND	0.60	1.4	ND	ND	ND	1.6	CE	ND	0.56	CE	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.56	ND	ND
BC20	Golden Gate	4/21/98	17	S	S	0.30	ND	ND	ND	B	0.80	0.90	ND	0.42	ND	1.8	CE	0.35	0.69	CE	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.69	ND	ND
BC10	Yerba Buena Island	4/20/98	17	S	S	0.40	ND	ND	ND	B	1.0	1.9	ND	ND	ND	3.6	CE	0.72	1.5	CE	ND	0.38	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND
BB70	Alameda	4/20/98	17	S	S	0.90	ND	ND	B	B	1.0	1.9	ND	ND	ND	3.5	CE	0.58	0.69	CE	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.69	ND	ND
BA40	Redwood Creek	4/22/98	17	S	S	0.50	ND	ND	B	B	2.6	3.0	0.40	0.43	0.40	5.3	CE	6.3	13	CE	ND	10	ND	ND	ND	ND	ND	ND	ND	2.6	ND	ND
BA30	Dumbarton Bridge	4/22/98	17	S	S	0.30	ND	ND	ND	B	3.2	2.7	ND	ND	ND	6.2	CE	0.90	1.6	CE	ND	0.66	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND
BA10	Coyote Creek	4/22/98	17	S	S	3.7	ND	1.0	2.2 ***b***	8.3 ***b***	5.6	12	0.40	0.62	0.50	15	CE	1.1	3.2	CE	ND	1.1	ND	ND	0.37	ND	ND	0.30	ND	1.1	0.29	ND
C-3-0	San Jose	4/23/98	17	S	S	0.90	ND	0.50	B	B	2.0	4.1	0.50	ND	ND	5.9	CE	0.53	5.9	CE	ND	1.8	ND	0.42	0.68	ND	ND	ND	ND	2.0	0.62	0.40
BW10	Standish Dam	4/13/98	17	S	S	1.5	ND	0.32	B	4.5 ***b***	4.3	9.3	ND	0.51	ND	13	CE	1.0	1.8	CE	ND	1.1	ND	ND	0.42	ND	ND	ND	ND	ND	ND	0.28
BW15	Guadalupe River	4/13/98	17	S	S	4.7	ND	2.2	4.5 ***b***	10 ***b***	6.6	13	1.0	0.90	1.0	17	CE	4.8	25	CE	0.79	11	ND	0.82	1.5	ND	ND	ND	0.52	9.4	0.63	0.61
BG20	Sacramento River	7/29/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.40	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BG30	San Joaquin River	7/29/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.50	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BF20	Grizzly Bay	7/28/98	18	S	S	0.50	ND	ND	0.39	ND	ND	ND	ND	ND	ND	0.50	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BD50	Napa River	7/28/98	18	S	S	0.50	ND	0.37	1.0	ND	ND	1.1	0.40	ND	ND	1.4	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	3.3 ***b***	ND	ND
BD40	Davis Point	7/27/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	0.48	0.50	0.80	CE	B	S	CE	0.29	B	ND	ND	ND	ND	ND	ND	ND	4.9 ***b***	ND	ND
BD30	Pinole Point	7/27/98	18	S	S	ND	ND	ND	0.44	ND	ND	0.40	ND	ND	ND	0.90	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BD20	San Pablo Bay	7/27/98	18	S	S	ND	ND	ND	0.39	ND	ND	ND	ND	ND	ND	0.60	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BD15	Petaluma River	7/27/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.60	CE	ND	S	CE	ND	B	ND	0.43	0.64	ND	ND	ND	ND	B	ND	ND
BC60	Red Rock	7/23/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	CE	B	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	27 ***b***	ND	ND
BC20	Golden Gate	7/22/98	18	S	S	ND	ND	ND	ND	ND	0.60	0.70	ND	0.35	0.30	1.5	CE	B	S	CE	0.26	B	ND	ND	ND	ND	ND	ND	ND	3.7 ***b***	ND	ND
BC10	Yerba Buena Island	7/22/98	18	S	S	ND	ND	ND	0.44	ND	ND	1.4	ND	ND	ND	1.4	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	6.6 ***b***	ND	ND
BB70	Alameda	7/22/98	18	S	S	ND	ND	ND	ND	0.40	2.0	2.6	ND	ND	ND	5.5	CE	B	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BA40	Redwood Creek	7/20/98	18	S	S	ND	ND	ND	ND	0.30	1.3	1.5	ND	ND	ND	3.4	CE	B	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BA30	Dumbarton Bridge	7/21/98	18	S	S	ND	ND	ND	ND	0.30	1.4	1.8	ND	ND	ND	4.7	CE	ND	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BA10	Coyote Creek	7/20/98	18	S	S	ND	ND	ND	ND	0.40	1.9	2.7	ND	ND	ND	6.4	CE	B	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
C-3-0	San Jose	7/21/98	18	S	S	ND	ND	ND	ND	ND	0.70	0.90	ND	ND	0.30	2.7	CE	B	S	CE	ND	B	ND	0.33	0.42	ND	ND	ND	ND	2.8 ***b***	ND	ND
BW10	Standish Dam	7/30/98	18	S	S	0.60	ND	ND	0.39	ND	ND	ND	ND	ND	0.30	0.50	CE	B	S	CE	ND	B	ND	ND	ND	ND	ND	ND	ND	B	ND	ND
BW15	Guadalupe River	7/30/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.40	CE	ND	S	CE	0.39	B	ND	0.48	0.63	ND	ND	ND	ND	3.3 ***b***	ND	ND

Table 5. Total (dissolved + particulate) PAH concentrations in water samples, 1998.
LPAH = low molecular weight PAHs, HPAH = high molecular weight PAHs, B = blank contamination, not included in sums and calculations, ***b*** = blank signal measured but small relative to sample.
CE = coeluted, M = matrix interference, ND = not detected, NS = not sampled, S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.
For method detection limits, refer to ***QA Tables*** .

				ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
BG20	Sacramento River	2/4/98	16	S	S	B	ND	ND	ND	B	1.7	5.0	M	5.8	0.80	2.1	4.1	B	5.0	0.45	0.61	1.0 ***b***	ND	0.46	ND	ND	ND	ND	0.62	1.3	0.51	ND
BG30	San Joaquin River	2/4/98	16	S	S	B	ND	ND	ND	B	7.7	20	1.2	12	1.2	4.9	7.0	B	2.1	ND	ND	B	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND
BF20	Grizzly Bay	2/3/98	16	S	S	B	ND	ND	ND	B	4.4	6.3	M	6.5	1.0	3.1	4.7	B	3.0	ND	ND	B	ND	ND	0.56	ND	ND	ND	0.46	1.3	ND	ND
BD50	Napa River	2/3/98	16	S	S	2.6 ***b***	ND	1.2	2.0	B	5.3	11	M	16	1.1	6.2	7.6	B	50	3.7	3.8	12 ***b***	ND	2.8	2.7	0.59	0.61	ND	4.5	13	4.1	2.5
BD40	Davis Point	2/2/98	16	S	S	B	ND	ND	ND	B	2.4	5.3	ND	3.9	0.60	2.0	3.1	B	10	0.76	0.82	2.5 ***b***	ND	0.74	0.76	ND	ND	ND	0.67	2.2	1.0	0.44
BD30	Pinole Point	2/2/98	16	S	S	B	ND	ND	ND	B	3.3	7.8	0.50	7.9	0.70	3.3	5.6	B	11	ND	0.55	2.7 ***b***	ND	0.79	0.83	ND	ND	ND	1.5	2.7	1.4	0.78
BD20	San Pablo Bay	2/2/98	16	S	S	B	ND	0.53	0.71	B	8.0	9.3	M	10	1.0	M	5.7	B	66	5.0	4.3	12 ***b***	4.9	5.4	8.6	1.2	0.91	ND	5.6	10	6.0	2.6
BD15	Petaluma River	2/2/98	16	S	S	B	ND	ND	ND	1.0 ***b***	M	M	M	M	M	M	M	0.49 ***b***	36	2.5	2.5	7.1 ***b***	ND	3.1	2.8	ND	ND	ND	3.9	6.7	5.1	2.4
BC60	Red Rock	1/29/98	16	20	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.40	2.2	ND	18	1.1	1.1	3.4 ***b***	ND	2.2	2.9	0.85	0.34	ND	ND	3.5	1.8	0.67
BC20	Golden Gate	1/29/98	16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
BC10	Yerba Buena Island	1/29/98	16	53	11	ND	ND	ND	ND	ND	ND	1.4	0.30	0.50	0.30	1.8	6.1	B	42	5.3	2.4	8.3 ***b***	ND	3.2	4.6	1.5	0.60	ND	0.38	11	4.0	1.2
BB70	Alameda	1/29/98	16	28	3.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.50	2.8	ND	24	2.7	1.3	4.3 ***b***	ND	2.4	3.5	1.1	0.40	ND	ND	5.0	2.8	0.90
BA40	Redwood Creek	1/27/98	16	32	3.2	ND	ND	ND	0.34	ND	ND	ND	ND	0.34	ND	ND	2.2	B	29	2.5	1.5	5.5 ***b***	ND	3.5	3.8	1.2	0.48	ND	ND	5.4	3.9	1.6
BA30	Dumbarton Bridge	1/28/98	16	89	12	B	ND	ND	0.45	ND	ND	1.1	0.40	1.3	ND	1.6	6.2	B	77	7.1	3.8	14 ***b***	ND	6.5	9.0	3.3	1.1	ND	8.2	11	9.1	3.9
BA10	Coyote Creek	1/28/98	16	86	18	ND	ND	ND	ND	ND	ND	ND	ND	0.80	0.30	ND	6.1	B	68	4.3	2.5	29 ***b***	ND	4.0	5.5	1.8	0.68	ND	1.6	9.5	5.8	2.4
C-3-0	San Jose	1/28/98	16	300	37	B	ND	0.67	1.8	B	0.60	1.1	1.4	4.6	0.50	2.8	19	B	260	24	13	17 ***b***	19	20	29	20	4.7	4.3	28	38	26	16
BW10	Standish Dam	2/5/98	16	S	S	2.0 ***b***	ND	ND	ND	13 ***b***	M	M	M	M	M	M	M	8.7 ***b***	54	6.1	6.4	ND	2.0	6.1	5.7	1.4	1.6	ND	10	ND	6.6	7.2
BW15	Guadalupe River	2/5/98	16	S	S	B	ND	0.54	1.0	B	3.7	7.6	M	14	0.80	3.0	6.1	0.73 ***b***	110	8.3	6.5	21 ***b***	3.7	7.4	7.1	1.9	2.0	ND	12	19	10	8.4
BG20	Sacramento River	4/16/98	17	S	S	0.60 ***b***	ND	ND	B	B	1.0 ***b***	1.9 ***b***	ND	ND	ND	B	CE	ND	5.2	CE	0.47	B	0.32	0.35	0.61	ND	ND	ND	ND	B	0.34	ND
BG30	San Joaquin River	4/16/98	17	S	S	0.80 ***b***	ND	ND	B	B	B	B	0.30	B	0.90	B	CE	B	23	CE	0.78	B	ND	ND	0.36	ND	ND	ND	ND	B	ND	ND
BF20	Grizzly Bay	4/15/98	17	S	S	0.50 ***b***	ND	ND	B	B	B	B	ND	B	ND	B	CE	B	16	CE	0.81	B	ND	0.5	1.5	0.47	ND	ND	0.28	3.5 ***b***	1.1	0.32
BD50	Napa River	4/15/98	17	S	S	B	ND	0.37	B	B	B	B	0.30	B	0.60	B	CE	B	50	CE	2.4	B	ND	2.9	4.9	1.8	ND	ND	1.9	11 ***b***	3.8	1.0
BD40	Davis Point	4/14/98	17	S	S	B	ND	ND	ND	B	B	21 ***b***	0.40	3.2 ***b***	ND	B	CE	B	140	CE	8.5	28 ***b***	7.3	13	20	6.4	1.0	3.7	12	22 ***b***	17	5.1
BD30	Pinole Point	4/14/98	17	S	S	B	ND	ND	ND	17 ***b***	4.7 ***b***	8.2 ***b***	0.50	M	M	14 ***b***	CE	B	36	CE	1.8	B	1.6	3.6	6.2	1.7	0.42	0.90	3.5	B	4.2	3.2
BD20	San Pablo Bay	4/14/98	17	S	S	B	ND	ND	ND	B	B	B	0.40	B	ND	B	CE	B	40	CE	2.0	B	0.62	4.0	6.1	2.0	0.50	ND	3.3	5.5 ***b***	4.3	3.1
BD15	Petaluma River	4/14/98	17	S	S	B	ND	ND	ND	B	B	13 ***b***	0.30	1.7 ***b***	ND	B	CE	B	120	CE	8.5	20 ***b***	5.5	13	19	6.5	0.71	1.4	8.8	18 ***b***	13	3.1
BC60	Red Rock	4/21/98	17	S	S	0.50 ***b***	ND	ND	B	ND	B	1.4 ***b***	ND	B	ND	B	CE	B	23	CE	1.1	B	0.39	2.4	3.6	1.2	0.35	ND	2.0	B	3.3	2.2
BC20	Golden Gate	4/21/98	17	S	S	0.30 ***b***	ND	ND	ND	ND	0.8 ***b***	0.9 ***b***	ND	B	ND	B	CE	B	14	CE	ND	B	ND	0.4	0.67	ND	ND	ND	ND	3.0 ***b***	0.43	0.34
BC10	Yerba Buena Island	4/20/98	17	S	S	0.40 ***b***	ND	ND	ND	B	B	B	ND	B	ND	B	CE	6.6 ***b***	31	CE	0.65	19 ***b***	ND	1.2	2.1	0.57	ND	ND	0.93	B	1.6	1.1
BB70	Alameda	4/20/98	17	S	S	B	ND	ND	B	B	B	B	ND	B	ND	B	CE	B	18	CE	0.62	B	ND	1.5	2.5	0.73	ND	ND	1.3	4.3 ***b***	2.1	1.6
BA40	Redwood Creek	4/22/98	17	S	S	B	ND	ND	B	B	B	B	0.80	1.7 ***b***	0.40	B	CE	B	150	CE	8.7	28 ***b***	4.4	14	20	6.0	0.89	ND	25	19 ***b***	17	4.3
BA30	Dumbarton Bridge	4/22/98	17	S	S	B	ND	ND	ND	B	B	B	ND	1.7 ***b***	0.50	B	CE	B	78	CE	4.6	13 ***b***	2.4	7.8	12	4.1	0.49	ND	7.6	12 ***b***	12	2.7
BA10	Coyote Creek	4/22/98	17	S	S	3.7 ***b***	ND	1.0	2.2 ***b***	8.3 ***b***	5.6 ***b***	12 ***b***	0.40	0.62 ***b***	0.50	15 ***b***	CE	1.1 ***b***	3.2	CE	ND	1.1 ***b***	ND	ND	0.37	ND	ND	0.30	ND	1.1 ***b***	0.29	ND
C-3-0	San Jose	4/23/98	17	S	S	B	ND	0.50	B	B	B	B	1.0	3.4 ***b***	1.6	B	CE	B	300	CE	15	32 ***b***	28	35	40	13	2.5	7.1	56	28 ***b***	35	10
BW10	Standish Dam	4/13/98	17	S	S	1.5 ***b***	M	0.32	B	4.5 ***b***	4.3 ***b***	9.3 ***b***	M	0.51 ***b***	M	13 ***b***	CE	22 ***b***	250	CE	17	42 ***b***	13	29	42	10	2.0	13	16	39 ***b***	19	8.3
BW15	Guadalupe River	4/13/98	17	S	S	B	ND	2.2	5.0 ***b***	10 ***b***	B	B	1.0	3.3 ***b***	3.2	B	CE	13 ***b***	290	CE	33	49 ***b***	15	29	45	14	2.0	4.8	17	50 ***b***	21	8.1
BG20	Sacramento River	7/29/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.40	CE	ND	5.6	CE	0.46	B	ND	0.41	0.57	ND	ND	ND	ND	B	ND	0.27
BG30	San Joaquin River	7/29/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.50	CE	ND	5.6	CE	0.45	B	ND	0.45	0.64	ND	ND	ND	ND	B	ND	ND
BF20	Grizzly Bay	7/28/98	18	S	S	1.4	ND	0.39	1.3	0.40	ND	0.50	0.30	1.3	0.60	1.7	CE	B	91	CE	7.0	B	ND	8.2	12	3.5	1.0	ND	8.8	B	7.1	4.0
BD50	Napa River	7/28/98	18	S	S	0.50	ND	0.37	1.0	ND	ND	1.1	0.40	0.71	ND	2.1	CE	B	45	CE	3.0	B	ND	4.0	6.1	1.9	0.58	ND	0.72	11 ***b***	3.9	1.9
BD40	Davis Point	7/27/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	1.2	0.50	1.4	CE	B	86	CE	3.3	B	ND	4.3	6.6	2.1	0.65	ND	2.7	12 ***b***	4.3	2.0
BD30	Pinole Point	7/27/98	18	S	S	ND	ND	ND	0.44	ND	ND	0.40	ND	ND	ND	0.90	CE	ND	8.8	CE	0.48	B	ND	0.58	0.92	ND	ND	ND	ND	B	0.41	ND
BD20	San Pablo Bay	7/27/98	18	S	S	ND	ND	ND	0.39	ND	ND	ND	ND	ND	ND	0.60	CE	ND	13	CE	0.69	B	ND	1.0	1.6	0.51	ND	ND	ND	B	0.76	0.38
BD15	Petaluma River	7/27/98	18	S	S	1.4	ND	0.77	1.5	0.50	0.30	0.70	0.50	1.4	0.60	1.5	CE	M	6.0	CE	M	B	6.5	8.0	0.64	M	1.0	ND	8.7	B	7.3	4.0
BC60	Red Rock	7/23/98	18	S	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	CE	B	46	CE	0.93	B	ND	1.5	2.4	0.79	ND	ND	ND	30 ***b***	1.3	0.59
BC20	Golden Gate	7/22/98	18	S	S	ND	ND	ND	ND	ND	0.60	0.70	ND	0.77	0.30	1.8	CE	B	40	CE	0.26	B	ND	ND	0.39	ND	ND	ND	ND	4.6 ***b***	ND	ND
BC10	Yerba Buena Island	7/22/98	18	S	S	ND	ND	ND	0.44	ND	ND	1.4	ND	ND	ND	1.4	CE	ND	12	CE	0.41	B	ND	0.48	0.80	ND	ND	ND	ND	7.8 ***b***	ND	ND
BB70	Alameda	7/22/98	18	S	S	ND	ND	ND	ND	0.40	2.5	2.6	ND	0.87	ND	5.5	CE	B	9.3	CE	0.40	B	ND	0.50	0.80	ND	ND	ND	0.50	B	0.51	ND
BA40	Redwood Creek	7/20/98	18	S	S	M	M	M	M	0.30	1.3	1.5	M	M	M	3.4	CE	B	33	CE	1.9	B	0.29	2.6	4.2	1.3	0.35	ND	3.1	B	3.2	1.7
BA30	Dumbarton Bridge	7/21/98	18	S	S	ND	ND	ND	0.34	0.60	2.3	2.6	ND	0.8	0.60	5.5	CE	B	43	CE	2.2	B	0.68	3.7	6.0	1.9	0.60	ND	4.7	B	4.8	2.4
BA10	Coyote Creek	7/20/98	18	S	S	0.40	ND	ND	0.35	0.80	3.0	3.6	ND	1.3	0.70	7.4	CE	B	62	CE	2.9	B	3.0	5.1	8.5	2.6	0.72	0.60	6.5	B	6.3	3.0
C-3-0	San Jose	7/21/98	18	S	S	0.90	ND	0.44	1.0	0.60	1.3	1.6	ND	2.3	1.1	4.2	CE	B	150	CE	7.4	B	6.5	13	21	6.3	1.8	ND	16	24 ***b***	15	6.7
BW10	Standish Dam	7/30/98	18	S	S	1.9	ND	0.51	1.5	ND	ND	ND	ND	0.55	0.70	1.4	CE	B	60	CE	3.9	B	2.6	4.2	6.3	1.9	0.73	ND	4.7	B	3.9	3.1
BW15	Guadalupe River	7/30/98	18	S	S	0.40	ND	ND	0.39	ND	ND	ND	ND	0.59	ND	0.9	CE	B	46	CE	2.8	B	ND	3.9	6.4	1.8	0.50	ND	3.2	10 ***b***	3.8	2.0

Draft 1998 RMP Data: Dissolved PCB concentrations in water samples

Table 6. Dissolved PCB concentrations in water samples, 1998.

CE = coelution, NA = not analyzed, NS = not sampled, ND = not detected, M = matrix interference, Q = outside QA limits.

B = significant blank signal, sample value used with extra caution, ***b*** = blank signal measured but small relative to sample.

For method detection limits, refer to ***QA Tables*** .

Station Code	Station	Date	Cruise	Sum of PCBs (SFEI)	PCB 008	PCB 018	PCB 028	PCB 031	PCB 044	PCB 049	PCB 052	PCB 060	PCB 066	PCB 070	PCB 074	PCB 087	PCB 095	PCB 097	PCB 099	PCB 101	PCB 105	PCB 110	PCB 118	PCB 128	PCB 132	PCB 138	PCB 141	PCB 149	PCB 151	PCB 153	PCB 156	PCB 158	PCB 170	PCB 174	PCB 177	PCB 180	PCB 183	PCB 187	PCB 194	PCB 195	PCB 203	Hexachlorobenzene
				pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l	pg/l
BG20	Sacramento River	2/4/98	16	20	M	M	M	M	ND	ND	M	ND	ND	ND	ND	ND	2.9	ND	ND	4.0	ND	2.2	ND	3.2	ND	2.4	ND	3.1	ND	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	M
BG30	San Joaquin River	2/4/98	16	16	M	M	ND	8.5	ND	ND	ND	ND	2.9	ND	ND	ND	ND	ND	ND	ND	ND	2.7	ND	ND	ND	ND	ND	ND	ND	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	M
BF20	Grizzly Bay	2/3/98	16	29	M	M	ND	5.7	ND	ND	2.1	ND	ND	3.3	ND	ND	1.8	ND	ND	3.2	ND	3.1	ND	2.9	ND	2.3	ND	2.7	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	M
BD50	Napa River	2/3/98	16	29	M	M	M	M	M	M	M	ND	ND	5.4	ND	ND	4.0	ND	ND	ND	ND	3.7	3.0	ND	ND	ND	ND	4.0	ND	4.2	ND	ND	ND	ND	ND	2.3	ND	2.2	ND	ND	ND	M
BD40	Davis Point	2/2/98	16	18	M	M	M	M	ND	ND	2.9	ND	ND	ND	ND	ND	1.4	ND	ND	2.2	ND	3.0	ND	2.1	ND	1.7	ND	2.5	ND	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	M
BD30	Pinole Point	2/2/98	16	14	M	M	ND	2.6	ND	2.9	2.0	ND	ND	ND	ND	ND	3.0	ND	ND	1.4	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.7
BD20	San Pablo Bay	2/2/98	16	12	M	M	M	M	ND	ND	ND	ND	ND	ND	ND	ND	2.8	ND	2.2	ND	ND	ND	1.8	ND	ND	2.7	ND	ND	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	M
BD15	Petaluma River	2/2/98	16	47	M	M	M	M	2.6	ND	M	1.8	2.4	ND	ND	ND	4.3	ND	3.4	4.5	ND	6.2	2.8	ND	ND	4.9	ND	4.2	2.0	5.7	ND	ND	ND	ND	ND	ND	ND	2.1	ND	ND	ND	M
BC60	Red Rock	1/29/98	16	110	3.3	3.4	5.1	10	4.8	4.7	11	1.5	2.5	3.9	1.7	1.9	7.2	2.3	4.3	8.2	ND	6.3	3.1	3.0	1.1	4.5	ND	5.4	3.0	5.1	1.1	ND	ND	ND	ND	1.6	ND	1.7	ND	ND	ND	8.2
BC20	Golden Gate	1/29/98	16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
BC10	Yerba Buena Island	1/29/98	16	230	3.3	6.4	9.2	23	13	9.0	25	4.4	7.6	9.6	3.6	5.5	17	5.2	6.7	17	1.8	13	7.5	2.2	2.3	7.5	ND	8.6	4.5	8.5	1.2	ND	ND	1.2	1.2	2.4	ND	2.4	ND	ND	ND	5.8
BB70	Alameda	1/29/98	16	99	1.3	3.4	3.8	13	4.1	4.1	8.9	1.2	2.9	2.7	1.1	1.7	7.0	2.2	1.7	7.8	ND	5.9	3.4	1.8	1.1	3.8	ND	5.0	2.7	5.3	1.0	ND	ND	ND	ND	1.2	ND	1.3	ND	ND	ND	50
BA40	Redwood Creek	1/27/98	16	190	ND	5.3	6.7	21	9.0	7.4	19	2.0	7.0	5.8	3.5	3.9	13	4.0	4.5	15	4.2	12	8.8	2.5	1.6	7.1	ND	7.5	4.0	10	1.2	ND	ND	ND	ND	2.0	ND	2.5	ND	ND	ND	7.8
BA30	Dumbarton Bridge	1/28/98	16	110	ND	5.2	6.2	16	4.9	7.5	11	1.7	3.1	2.4	2.2	1.9	5.2	1.7	2.2	6.5	1.2	6.7	3.4	1.0	ND	3.8	ND	3.4	2.2	4.6	ND	ND	ND	ND	ND	1.3	ND	1.4	ND	ND	ND	77
BA10	Coyote Creek	1/28/98	16	190	ND	6.0	8.7	25	8.0	8.5	17	2.5	5.0	6.7	2.4	3.9	11	4.0	6.9	14	1.9	11	7.1	1.7	2.0	8.4	ND	8.2	3.8	10	1.2	ND	ND	ND	1.3	2.1	ND	2.9	ND	ND	ND	30
C-3-0	San Jose	1/28/98	16	520	21	25	26	77	25	23	43	6.6	14	13	5.4	7.6	26	8.1	14	30	3.3	23	15	3.5	5.4	23	ND	18	8.4	21	2.3	2.1	3.6	3.8	3.3	8.2	2.3	8.0	ND	ND	ND	45
BW10	Standish Dam	2/5/98	16	95	M	M	3.9	M	ND	ND	5	1.8	2.2	ND	ND	3.6	4.9	3.6	ND	6.0	ND	6.8	ND	3.7	2.1	8.4	ND	12	4.2	8.9	ND	ND	2.0	3.3	2.3	5.6	ND	4.6	ND	ND	ND	M
BW15	Guadalupe River	2/5/98	16	930	M	M	M	M	M	M	M	ND	ND	ND	ND	ND	Q	ND	ND	Q	15	100	33	22	36	120	ND	130	56	130	ND	15	33	41	34	78	15	63	11	ND	ND	M
BG20	Sacramento River	4/16/98	17	28	M	Q	10	10	1.8	ND	ND	ND	ND	ND	ND	ND	3.3 ***B***	ND	ND	ND	ND	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	31
BG30	San Joaquin River	4/16/98	17	46	M	Q	13	13	ND	3.6	5.1 ***B***	ND	ND	ND	ND	ND	4.0 ***B***	2.4	ND	ND	ND	2.8	2.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	23
BF20	Grizzly Bay	4/15/98	17	26	M	Q	3.5	3.5	ND	ND	ND	ND	ND	ND	ND	3.9	3.3 ***B***	ND	ND	ND	ND	3.2	ND	ND	ND	4.6	ND	ND	ND	3.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30
BD50	Napa River	4/15/98	17	110	M	Q	12	12	7.8	3.8	7.4 ***B***	2.0	1.8	3.9	ND	1.8	6.5 ***B***	2.5	3.5	8.2	ND	6.2	3.8	ND	ND	7.5	ND	5.4	ND	6.0	ND	3.1	ND	ND	ND	ND	ND	1.7	ND	ND	ND	6.2
BD40	Davis Point	4/14/98	17	79	M	2.5	21	21	ND	3.0	4.2 ***B***	ND	ND	2.8	ND	ND	5.8 ***B***	ND	ND	ND	ND	3.6	2.9	ND	ND	5.6	ND	3.0	ND	3.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	13
BD30	Pinole Point	4/14/98	17	62	M	7.7	18	18	ND	2.1	2.0 ***B***	ND	ND	2.0	ND	ND	3.8 ***B***	ND	ND	ND	ND	2.1	2.0	ND	ND	2.2	ND	ND	ND	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10
BD20	San Pablo Bay	4/14/98	17	53	M	4.6	7.3	7.3	ND	ND	5.6 ***B***	ND	ND	2.9	ND	ND	4.5 ***B***	ND	ND	5.8	ND	3.8	3.2	ND	ND	2.6	ND	2.4	ND	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.6
BD15	Petaluma River	4/14/98	17	120	M	Q	26	26	ND	3.2	3.0 ***B***	8.2	4.7	4.8	3.0	3.8	7.5 ***B***	ND	ND	ND	ND	5.5	4.5	ND	ND	9.3	ND	4.3	ND	4.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8
BC60	Red Rock	4/21/98	17	40	NA	4.2	3.9	5.8	1.7	2.7	5.5 ***B***	ND	ND	ND	ND	ND	2.7 ***B***	ND	1.4	2.8	ND	2.6	2.0	ND	ND	1.7	ND	1.3	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	59
BC20	Golden Gate	4/21/98	17	42	NA	7.5	5.1	6.0	1.7	2.9	7.5 ***B***	ND	1.1	2.5	1.7	1.3	ND	ND	ND	ND	ND	2.2	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	150
BC10	Yerba Buena Island	4/20/98	17	39	M	M	M	M	3.7	3.3	7.5 ***B***	3.5	2.1	2.3	ND	ND	6.9 ***B***	ND	2.9	ND	ND	ND	ND	ND	1.7	5.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BB70	Alameda	4/20/98	17	35	M	M	M	M	ND	3.7	Q	4.2	2.8	3.2	ND	ND	8.9 ***B***	ND	ND	3.3	ND	2.7	ND	ND	ND	6.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BA40	Redwood Creek	4/22/98	17	73	M	Q	23	23	2.8	ND	4.8 ***B***	2.2	ND	4.7	ND	ND	4.0 ***B***	2.1	ND	ND	ND	2.2	ND	ND	ND	3.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	21
BA30	Dumbarton Bridge	4/22/98	17	58	M	Q	21	21	4.1	ND	ND	ND	ND	2.9	ND	ND	3.6 ***B***	ND	ND	2.9	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.8
BA10	Coyote Creek	4/22/98	17	140	M	Q	21	21	6.9	5.1	5.0 ***B***	ND	ND	ND	ND	3.0	8.2 ***B***	ND	ND	8.4	ND	7.0	5.4	ND	ND	13	ND	10	3.4	9.0	ND	ND	ND	3.6	ND	3.9	ND	3.4	ND	ND	ND	69
C-3-0	San Jose	4/23/98	17	460	53	Q	38	38	25	12	28 ***b***	8.6	11	12	4.7	9.1	25 ***b***	8.2	11	15	2.9	22	14	ND	6.5	25	3.8	21	8.1	21	2.4	2.4	4.5	5.4	4.8	6.4	2.5	9.2	ND	ND	2.4	160
BW10	Standish Dam	4/13/98	17	140	M	14	7.3	8.7	6.2	4.7	6.2 ***B***	ND	7.5	ND	ND	ND	12 ***b***	ND	ND	6.6	ND	8.7	4.7	ND	4.0	11	ND	11	4.0	13	ND	ND	ND	4.4	ND	4.6	ND	ND	ND	ND	ND	22
BW15	Guadalupe River	4/13/98	17	430	M	43	36	36	25	7.7	13 ***B***	5.4	5.8	15	6.3	8.4	27 ***b***	5.2	7.8	26	3.6	21	12	ND	8.0	19	3.8	23	7.7	21	3.0	ND	4.2	6.5	4.0	7.4	3.0	8.7	ND	ND	2.8	160
BG20	Sacramento River	7/29/98	18	260	6.2	5	8.6	12	26	12	46	4.6	8.4	22	3.0	14	Q	6.8	10	1.9	3.8	24	8.4	2.4	3.4	6.1	ND	11	3.0	6.2	ND	ND	ND	1.0	ND	1.1	ND	2.0	ND	ND	CE	20
BG30	San Joaquin River	7/29/98	18	120	5.5	5.3	6.7	12	6.8	4.2	13	ND	4.4	5.7	1.1	2.9	8.7	1.4	3.8	ND	3.2	6.4	4.8	2.1	1.5	4.4	ND	4.8	1.7	6.2	1.0	ND	ND	ND	ND	1.5	ND	2.2	ND	ND	CE	18
BF20	Grizzly Bay	7/28/98	18	170	25	8.2	23	7.1	7.2	5.2	16	ND	2.9	5.8	1.6	2.9	11	1.8	4.2	ND	1.9	7.9	4.4	2.3	1.8	6.0	ND	6.4	1.8	7.3	1.4	ND	ND	ND	1.1	2.1	ND	2.7	ND	ND	CE	15
BD50	Napa River	7/28/98	18	150	11	4.6	16	7.6	6.9	5.5	14	ND	3.6	5.2	1.5	3.0	11	3.0	5.1	ND	2.0	8.7	5.6	2.5	2.3	6.2	ND	6.9	2.3	9.0	1.1	ND	ND	ND	1.1	2.2	ND	2.9	ND	ND	CE	6.0
BD40	Davis Point	7/27/98	18	810	15	19	33	22	120	45	200	12	22	67	9.1	40	Q	24	23	3.5	6.4	66	14	3.1	12.0	7.6	ND	22	6.6	9.1	ND	ND	ND	ND	ND	2.0	ND	2.5	ND	ND	CE	9.0
BD30	Pinole Point	7/27/98	18	100	1.0	2.7	1.2	6.2	4.4	3.5	9.1	ND	2.5	4.7	ND	2.9	11	2.7	4.2	ND	1.9	6.8	5.4	2.2	2.0	5.4	ND	6.6	2.3	8.1	1.2	ND	ND	ND	ND	1.6	ND	2.2	ND	ND	CE	1.6
BD20	San Pablo Bay	7/27/98	18	450	6.5	6.7	11	9.4	64	22	100	3.4	11	36	5.8	26	Q	15	15	1.8	4.9	42	10	3.4	9.5	8.9	ND	18	5.9	11	ND	ND	ND	ND	ND	1.9	ND	2.9	ND	ND	CE	8.3
BD15	Petaluma River	7/27/98	18	180	3.0	2.6	3.9	6.0	8.0	5.9	13	ND	3.5	7.6	2.0	4.0	16	3.7	8.5	ND	2.9	13	8.1	3.1	3.8	11	ND	12	3.4	14	2.6	ND	1.7	1.5	2.1	4.3	2.0	5.3	1.2	ND	CE	3.3
BC60	Red Rock	7/23/98	18	120	3.4	3.6	7.2	6.8	3.6	5.4	8.4	ND	2.5	6.2	ND	2.4	13	1.6	4.3	ND	2.3	8.3	5.4	2.3	1.5	5.0	ND	6.9	2.1	7.6	1.1	ND	ND	ND	ND	1.6	1.2	2.2	ND	ND	CE	5.2
BC20	Golden Gate	7/22/98	18	73	20	12	5.1	11	2.9	2.1	5.4	ND	1.6	3.6	1.6	ND	3.7	ND	ND	ND	ND	1.7	1.6	ND	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	CE	100
BC10	Yerba Buena Island	7/22/98	18	130	6.6	5.6	5.6	11	6.1	5.6	12	ND	5.0	5.7	1.6	3.1	11	2.8	4.5	ND	1.6	7.1	5.4	1.4	2.0	5.6	ND	6.3	2.6	8.5	ND	ND	ND	ND	ND	1.5	ND	1.9	ND	ND	CE	7.0
BB70	Alameda	7/22/98	18	130	Q	28	12	21	9.2	4.2	6.4	ND	3.3	8.1	4.4	3.1	8.2	1.5	1.6	ND	2.0	3.3	3.7	ND	ND	4.8	ND	1.8	ND	2.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	CE	370
BA40	Redwood Creek	7/20/98	18	82	23	12	6.8	13	4.3	2.6	3.4	ND	ND	2.8	1.5	1.0	3.4	ND	ND	ND	ND	1.8	1.6	ND	ND	2.5	ND	1.1	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	CE	170
BA30	Dumbarton Bridge	7/21/98	18	58	11	7.9	4.9	8.3	3.3	2.1	1.5	ND	ND	2.2	1.6	1.1	3.4	ND	1.0	ND	ND	2.2	1.7	ND	ND	1.5	ND	1.4	ND	1.6	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	CE	180
BA10	Coyote Creek	7/20/98	18	93	17	9.2	6.9	15.0	4.5	2.8	4.5	ND	1.3	4.0	1.7	1.7	4.1	1.1	1.6	ND	ND	3.0	2.7	ND	1.0	3.0	ND	2.7	ND	3.8	ND	ND	ND	ND	ND	ND	ND	1.5	ND	ND	CE	210
C-3-0	San Jose	7/21/98	18	690	20	44	38	140	45	31	54	12	20	ND	10	13	37	10	16	1.4	6.2	34	20	4.8	9.0	26	2.7	26	8.9	26	3.9	1.3	3.3	4.0	3.1	7.7	2.7	9.2	1.7	ND	CE	93
BW10	Standish Dam	7/30/98	18	360	3.7	15	M	M	ND	13	61	9.3	M	M	M	8.5	M	8.3	17	21	6.4	31	13	4.6	9.2	25	3.9	31	9.2	25	3.6	1.7	4.4	6.8	3.9	11	3.0	10	1.7	ND	CE	13
BW15	Guadalupe River	7/30/98	18	720	10	16	32	120	24	20	49	4.8	14	39	27	11	Q	5	26	53	8.0	40	21	7.1	9.4	35	4.5	39	10	35	5.3	2.2	4.8	6.5	4.5	12	4.3	13	2.5	ND	CE	13

Draft 1998 RMP Data: Total (dissolved + particulate) PCB concentrations in water samples

Table 7. Total (dissolved + particulate) PCB concentrations in water samples, 1998.

CE = coelution, ND = not detected, NS = not sampled, M = matrix interference, Q = outside QA limits, B = blank contamination, not included in sums and calculations.

B = significant blank signal, sample value used with extra caution, ***b*** = blank signal measured but small relative to sample, S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

For method detection limits, refer to ***QA Tables*** .

				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
BG20	Sacramento River	2/4/98	16	150	M	M	M	M	M	M	M	ND	13	7.3	ND	B	18	ND	6.3	4.0	B	10	12	B	B	12	B	9.0	4.1	14	ND	ND	10	ND	14	8.2	ND	5.0	ND	ND	ND	M
BG30	San Joaquin River	2/4/98	16	75	M	M	M	8.5	Q	M	M	ND	10	10	ND	B	8.0	ND	B	Q	B	8.6	6.0	ND	ND	6.5	ND	ND	ND	12	ND	ND	ND	ND	ND	5.3	ND	ND	ND	ND	ND	M
BF20	Grizzly Bay	2/3/98	16	S	M	M	M	5.7	M	M	2.1	ND	6.0	10	ND	B	B	B	B	3.2	B	7.1	4.6	B	ND	7.1	ND	2.7	ND	10	ND	ND	3.6	ND	ND	3.4	ND	5.7	ND	ND	ND	M
BD50	Napa River	2/3/98	16	S	M	M	M	M	M	M	M	18	M	5.4	M	21	4.0	5.4	B	Q	Q	36	25	B	14	74	14	70	10	86	6.3	ND	33	28	24	79	8.1	29	28	8.6	ND	M
BD40	Davis Point	2/2/98	16	130	M	M	M	M	6.1	M	2.9	ND	5.6	12	ND	7.2	B	4.9	B	2.2	ND	14	9.0	B	3.4	14	4.2	16	4.3	8.9	3.2	ND	3.2	3.2	ND	3.7	ND	3.3	ND	ND	ND	M
BD30	Pinole Point	2/2/98	16	S	M	M	ND	2.6	ND	2.9	2.0	ND	ND	ND	ND	ND	3.0	ND	ND	1.4	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.7
BD20	San Pablo Bay	2/2/98	16	470	M	M	M	M	18	M	M	7.3	11	15	8.2	21	29	8.4	B	Q	18	34	25	B	16	50	8.2	30	9.3	55	4.1	2.7	14	9.3	13	31	5.6	18	10	ND	ND	M
BD15	Petaluma River	2/2/98	16	S	M	M	M	M	2.6	ND	M	1.8	2.4	ND	ND	ND	4.3	ND	3.4	4.5	ND	6.2	2.8	ND	ND	4.9	ND	4.2	2.0	5.7	ND	ND	ND	ND	ND	ND	ND	2.1	ND	ND	ND	M
BC60	Red Rock	1/29/98	16	S	3.3	3.4	5.1	10	4.8	4.7	11	1.5	2.5	3.9	1.7	1.9	7.2	2.3	4.3	8.2	ND	6.3	3.1	3.0	1.1	4.5	ND	5.4	3.0	5.1	1.1	ND	ND	ND	ND	1.6	ND	1.7	ND	ND	ND	8.2
BC20	Golden Gate	1/29/98	16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
BC10	Yerba Buena Island	1/29/98	16	S	3.3	6.4	9.2	23	13	9.0	25	4.4	7.6	10	3.6	5.5	17	5.2	6.7	17	1.8	13	7.5	2.2	2.3	7.5	ND	8.6	4.5	8.5	1.2	ND	ND	1.2	1.2	2.4	ND	2.4	ND	ND	ND	5.8
BB70	Alameda	1/29/98	16	S	1.3	3.4	3.8	13	4.1	4.1	8.9	1.2	2.9	2.7	1.1	1.7	7.0	2.2	1.7	7.8	ND	5.9	3.4	1.8	1.1	3.8	ND	5.0	2.7	5.3	1.0	ND	ND	ND	ND	1.2	ND	1.3	ND	ND	ND	50
BA40	Redwood Creek	1/27/98	16	S	ND	5.3	6.7	21	9.0	7.4	19	2.0	7.0	5.8	3.5	3.9	13	4.0	4.5	15	4.2	12	8.8	2.5	1.6	7.1	ND	7.5	4.0	10	1.2	ND	ND	ND	ND	2.0	ND	2.5	ND	ND	ND	7.8
BA30	Dumbarton Bridge	1/28/98	16	S	ND	5.2	6.2	16	4.9	7.5	11	1.7	3.1	2.4	2.2	1.9	5.2	1.7	2.2	6.5	1.2	6.7	3.4	1.0	ND	3.8	ND	3.4	2.2	4.6	ND	ND	ND	ND	ND	1.3	ND	1.4	ND	ND	ND	77
BA10	Coyote Creek	1/28/98	16	S	ND	6.0	8.7	25	8.0	8.5	17	2.5	5.0	6.7	2.4	3.9	11	4.0	6.9	14	1.9	11	7.1	1.7	2.0	8.4	ND	8.2	3.8	10	1.2	ND	ND	ND	1.3	2.1	ND	2.9	ND	ND	ND	30
C-3-0	San Jose	1/28/98	16	S	21	25	26	77	25	23	43	6.6	14	13	5.4	7.6	26	8.1	14	30	3.3	23	15	3.5	5.4	23	ND	18	8.4	21	2.3	2.1	3.6	3.8	3.3	8.2	2.3	8.0	ND	ND	ND	45
BW10	Standish Dam	2/5/98	16	2700	M	M	3.9	M	M	M	5.0	15	32	M	M	71	89	30	65	6.0	71	120	46	B	100	270	65	230	88	290	31	18	120	160	85	320	80	160	83	40	ND	M
BW15	Guadalupe River	2/5/98	16	5700	M	M	M	M	M	M	M	27	73	62	31	110	200	55	120	Q	100	430	180	140	230	630	98	550	210	650	63	54	230	240	160	500	100	310	120	61	ND	M
BG20	Sacramento River	4/16/98	17	75	M	Q	10	10	8.9 ***B***	4.1	6.1 ***b***	ND	1.9 ***B***	4.1 ***B***	1.9 ***B***	B	B	2.1 ***B***	B	Q	B	4.6 ***B***	3.6 ***B***	B	1.9 ***B***	3.3	B	2.2 ***B***	ND	5.2 ***B***	ND	ND	ND	ND	ND	2.0	ND	ND	ND	ND	ND	31 ***b***
BG30	San Joaquin River	4/16/98	17	S	M	Q	13	13	5.8 ***B***	3.6	5.1 ***B***	ND	3.0 ***B***	6.6 ***B***	4.6 ***B***	B	B	2.4 ***b***	B	Q	B	7.4 ***B***	8.1 ***B***	B	B	4.2	ND	ND	ND	5.3 ***B***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30 ***B***
BF20	Grizzly Bay	4/15/98	17	120	M	Q	3.5	3.5	10 ***B***	5.8	3.9 ***b***	2.2 ***B***	5.8 ***B***	6.3 ***B***	2.7 ***B***	7.3 ***B***	B	2.2 ***B***	B	Q	B	8.2 ***B***	5.7 ***B***	B	3.9 ***B***	13	2.8 ***B***	5.5 ***B***	2.4	12 ***B***	ND	ND	2.7	ND	ND	4.8	ND	4.4	2.2	ND	ND	32 ***B***
BD50	Napa River	4/15/98	17	520	M	Q	12	12	16 ***B***	13	14 ***B***	8.7 ***B***	14 ***B***	21 ***B***	6.3 ***B***	11 ***B***	31 ***B***	11 ***B***	22 ***B***	8.2	11	30 ***B***	26 ***b***	10	13 ***b***	42	5.1 ***B***	36 ***b***	10	47 ***B***	4.4	3.1	10	8.4	7.5	22	5.4	20	12	ND	ND	6.2 ***b***
BD40	Davis Point	4/14/98	17	1400	M	2.5	21	21	50 ***B***	3.0	4.2 ***B***	21 ***b***	45 ***b***	29 ***B***	25 ***b***	41 ***B***	110 ***B***	19 ***B***	53 ***B***	Q	37	85 ***b***	58 ***b***	34	44 ***b***	120	14 ***B***	79 ***b***	29	120 ***b***	16	7.6	34	26	27	76	21	57	40	8.8	ND	35 ***B***
BD30	Pinole Point	4/14/98	17	370	M	7.7	18	18	38 ***B***	15	2.0 ***B***	6.5 ***B***	11 ***B***	2.0 ***b***	ND	11 ***B***	B	ND	B	Q	7.4	22 ***B***	19 ***B***	8.9	12 ***b***	29	ND	29 ***b***	8.6	39 ***B***	ND	ND	7.1	6.9	7.1	17	ND	11	7.7	ND	ND	39 ***B***
BD20	San Pablo Bay	4/14/98	17	340	M	4.6	7.3	7.3	ND	M	5.6 ***B***	ND	15 ***B***	25 ***B***	ND	16 ***B***	B	ND	B	5.8	10	32 ***B***	28 ***b***	12	14 ***b***	37	ND	34 ***b***	11	41 ***B***	ND	ND	ND	ND	ND	18	ND	16	ND	ND	ND	21 ***B***
BD15	Petaluma River	4/14/98	17	1400	M	Q	26	26	50 ***B***	3.2	3.0 ***B***	28 ***b***	51 ***b***	55 ***B***	22 ***b***	40 ***B***	89 ***B***	16 ***B***	46 ***B***	Q	40	78 ***b***	67 ***b***	30	46 ***b***	120	13 ***B***	100 ***b***	30	130 ***b***	15	7.0	29	25	27	64	24	66	32	7.3	ND	14 ***B***
BC60	Red Rock	4/21/98	17	350	M	4.2	3.9	5.8	10 ***B***	8.7	13 ***B***	4.1 ***B***	10 ***B***	22 ***B***	ND	7.5 ***B***	B	10 ***B***	13 ***B***	2.8	9.3	17 ***B***	21 ***b***	5.5	10 ***B***	29	6.1 ***B***	28 ***b***	8.8	38 ***B***	ND	ND	7.1	6.0	6.2	15	4.8	15	6.6	ND	ND	61 ***B***
BC20	Golden Gate	4/21/98	17	84	M	7.5	5.1	6.0	B	11	7.5 ***B***	ND	4.7 ***B***	2.5 ***b***	5.6 ***B***	3.9 ***B***	B	B	B	Q	B	4.5 ***B***	7.7 ***B***	2.2	2.0 ***B***	3.6	ND	3.3 ***B***	ND	5.4 ***B***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	150 ***b***
BC10	Yerba Buena Island	4/20/98	17	1000	M	M	M	M	42 ***B***	42	76 ***B***	3.5 ***b***	67 ***b***	55 ***B***	ND	54 ***B***	B	19 ***B***	B	Q	B	49 ***B***	49 ***b***	29	45 ***b***	93	26 ***b***	62 ***b***	32	100 ***b***	ND	ND	26	ND	18	50	19	29	21	ND	ND	2.2 ***B***
BB70	Alameda	4/20/98	17	150	M	M	M	M	5.8 ***B***	10	15 ***b***	4.2 ***b***	11 ***B***	12 ***B***	ND	7.0 ***B***	B	4.1 ***B***	B	3.3	B	7.8 ***B***	6.9 ***B***	ND	4.3 ***B***	16	3.3 ***b***	6.8 ***B***	3.0	12 ***B***	ND	ND	2.8	ND	ND	4.6	ND	5.4	ND	ND	ND	7.9 ***B***
BA40	Redwood Creek	4/22/98	17	680	M	Q	23	23	14 ***B***	M	4.8 ***B***	14 ***B***	27 ***B***	12 ***B***	7.8 ***B***	19 ***B***	41 ***B***	13 ***B***	22 ***B***	Q	19	34 ***B***	32 ***b***	14	25 ***b***	64	9 ***B***	49 ***b***	11	67 ***b***	8.6	4.0	ND	13	14	31	12	31	14	3.5	ND	21 ***b***
BA30	Dumbarton Bridge	4/22/98	17	790	M	Q	21	21	19 ***B***	39	65 ***b***	12 ***B***	26 ***B***	15 ***B***	10 ***B***	19 ***B***	44 ***B***	13 ***B***	25 ***B***	2.9	17	30 ***B***	35 ***b***	16	20 ***b***	59	12 ***B***	42 ***b***	17	72 ***b***	5.7	4.0	15	12	15	31	ND	35	16	3.8	ND	11 ***B***
BA10	Coyote Creek	4/22/98	17	S	M	Q	21	21	6.9 ***b***	5.1	5.0 ***B***	ND	ND	ND	ND	3.0 ***b***	8.2 ***B***	ND	ND	8.4	ND	7.0 ***b***	5.4 ***b***	ND	ND	13	ND	10 ***b***	3.4	9.0 ***b***	ND	ND	ND	3.6	ND	3.9	ND	3.4	ND	ND	ND	69 ***b***
C-3-0	San Jose	4/23/98	17	4300	53	Q	38	38	58 ***B***	12	28 ***b***	72 ***b***	160 ***b***	49 ***B***	22 ***B***	110 ***B***	210 ***B***	78 ***b***	130 ***b***	15	100	310 ***b***	220 ***b***	79	140 ***b***	410	52 ***b***	330 ***b***	110	410 ***b***	57	26	120	100	88	260	72	210	110	36	2.4	170 ***B***
BW10	Standish Dam	4/13/98	17	7000	M	14	7.3	8.7	77 ***B***	4.7	6.2 ***B***	68 ***b***	81 ***b***	140 ***b***	56 ***b***	140 ***b***	330 ***B***	61 ***b***	100 ***b***	6.6	130	360 ***b***	220 ***b***	140	290 ***b***	670	110 ***b***	640 ***b***	130	700 ***b***	71	44	270	310	170	670	150	420	280	91	ND	25 ***B***
BW15	Guadalupe River	4/13/98	17	6100	M	43	36	36	110 ***B***	7.7	13 ***B***	59 ***b***	71 ***b***	140 ***b***	28 ***b***	140 ***b***	320 ***B***	74 ***b***	120 ***b***	26	100	360 ***b***	210 ***b***	110	220 ***b***	560	100 ***b***	490 ***b***	130	660 ***b***	170	39	190	230	130	470	110	320	200	69	2.8	170 ***B***
BG20	Sacramento River	7/29/98	18	310	6.2	5.4	11	14 ***B***	27 ***B***	12 ***b***	48 ***B***	4.6 ***b***	11 ***B***	24 ***B***	3.0 ***b***	15 ***B***	2.5 ***B***	6.8 ***b***	11 ***B***	1.9	5.3	27 ***B***	12 ***B***	3.6	4.8 ***B***	11	ND	14 ***B***	3.0 ***b***	12 ***B***	ND	ND	1.3	1.0	1.1	4.1	ND	4.1	1.2	ND	CE	110 ***B***
BG30	San Joaquin River	7/29/98	18	190	5.5	5.3	12	14 ***B***	8.0 ***B***	4.2 ***b***	15 ***B***	ND	6.8 ***B***	8.1 ***B***	1.1 ***b***	4.3 ***B***	12 ***B***	1.4 ***b***	5.8 ***B***	Q	4.9	10 ***B***	8.6 ***B***	3.3	3.2 ***B***	10	ND	8.9 ***B***	3.1 ***B***	13 ***B***	1.0	ND	1.7	1.4	1.4	5.4	ND	5.0	1.3	ND	CE	30 ***B***
BF20	Grizzly Bay	7/28/98	18	1100	36	16	51	29 ***b***	23 ***B***	18 ***B***	36 ***B***	5.2 ***B***	32 ***B***	33 ***B***	13 ***B***	20 ***B***	40 ***B***	17 ***B***	33 ***B***	Q	24	64 ***B***	63 ***b***	23	23 ***B***	100	7.9	64 ***b***	16 ***B***	93 ***b***	8.1	5.0	23	15	19	55	13	46	19	5.9	CE	72 ***B***
BD50	Napa River	7/28/98	18	640	20	6.5	29	16 ***B***	16 ***B***	12 ***B***	23 ***B***	1.8 ***B***	19 ***B***	18 ***B***	5.1 ***B***	11 ***B***	26 ***B***	11 ***B***	22 ***B***	Q	14	38 ***B***	37 ***B***	14	14 ***B***	54	4.1	40 ***B***	11 ***B***	59 ***b***	4.2	3.1	13	9.1	11	31	7.6	27	12	3.0	CE	17 ***B***
BD40	Davis Point	7/27/98	18	1400	25	21	47	31 ***B***	130 ***B***	54 ***B***	210 ***B***	15 ***B***	39 ***B***	83 ***B***	15 ***B***	55 ***B***	33 ***B***	35 ***B***	46 ***B***	3.5	20	110 ***B***	50 ***B***	15	29 ***B***	64	4.8	66 ***b***	19 ***B***	65 ***b***	5.4	3.7	13	10	11	33	8.2	30	12	3.1	CE	26 ***B***
BD30	Pinole Point	7/27/98	18	230	1.0	2.7	5.2	8.2 ***B***	6.3 ***B***	5.7 ***B***	13 ***B***	ND	6.6 ***B***	9.4 ***B***	ND	5.5 ***B***	17 ***B***	4.7 ***B***	8.8 ***B***	Q	5.4	14 ***B***	13 ***B***	5.3	5.9 ***B***	17	ND	16 ***B***	5.4 ***B***	22 ***b***	4.1	ND	2.7	2.1	2.7	8.0	2.3	8.8	2.8	ND	CE	3.6 ***B***
BD20	San Pablo Bay	7/27/98	18	700	6.5	6.7	18	12 ***B***	67 ***B***	26 ***B***	110 ***B***	3.4 ***b***	18 ***B***	44 ***B***	7.4 ***B***	31 ***B***	11 ***B***	19 ***B***	23 ***B***	1.8	11	56 ***B***	24 ***B***	10	17 ***B***	32	2.0	36 ***B***	12 ***B***	38 ***b***	5.8	1.5	5.4	4.3	5.4	15	4.6	17	4.6	ND	CE	14 ***B***
BD15	Petaluma River	7/27/98	18	2100	19	7.5	54	35 ***b***	23 ***B***	30 ***B***	44 ***B***	8.4 ***B***	63 ***B***	56 ***B***	21 ***B***	35 ***B***	73 ***B***	38 ***B***	79 ***B***	Q	44	120 ***B***	140 ***b***	41	46 ***b***	220	16	130 ***b***	35 ***b***	210 ***b***	19	12	53	34	43	110	33	110	40	13	CE	34 ***B***
BC60	Red Rock	7/23/98	18	370	11	3.6	17	10 ***B***	6.8 ***B***	9.2 ***B***	14 ***B***	ND	10 ***B***	14 ***B***	2.4 ***B***	6.3 ***B***	22 ***B***	5.2 ***B***	13 ***B***	Q	8.7	22 ***B***	20 ***B***	8.3	8.0 ***B***	27	2.0	23 ***B***	7.6 ***B***	34 ***b***	6.9	1.6	5.8	4.4	5.3	15	5.5	14	5.1	ND	CE	6.9 ***B***
BC20	Golden Gate	7/22/98	18	130	20	12	5.1	11 ***b***	8.2 ***B***	2.1 ***b***	5 ***b***	ND	B	3.6 ***b***	1.6 ***b***	B	10 ***B***	B	B	Q	2.9	6.2 ***B***	7.7 ***B***	3.6	3.4 ***B***	6.2	B	5.5 ***B***	ND	10 ***B***	ND	ND	ND	ND	ND	2.8	ND	2.1	ND	ND	CE	100 ***b***
BC10	Yerba Buena Island	7/22/98	18	250	6.6	5.6	10	14 ***B***	7.6 ***B***	7.8 ***B***	16 ***B***	ND	8.5 ***B***	10 ***B***	3.1 ***B***	5.5 ***B***	16 ***B***	4.6 ***B***	8.1 ***B***	Q	4.4	13 ***B***	12 ***B***	4.1	5.2 ***B***	17	ND	14 ***B***	5.4 ***B***	22 ***b***	2.8	ND	3.3	2.8	2.8	8.8	2.4	8.4	2.6	ND	CE	8.5 ***B***
BB70	Alameda	7/22/98	18	250	Q	28	12	21 ***b***	9.2 ***b***	B	9 ***B***	4.1 ***B***	8.1 ***B***	16 ***B***	8.7 ***B***	B	B	4.4 ***B***	4.6 ***B***	Q	7.1	12 ***B***	13 ***B***	4.3	5.9 ***B***	16	3.1	12 ***B***	4.8 ***B***	17 ***b***	3.6	ND	ND	ND	ND	5.5	ND	6.1	ND	ND	CE	370 ***B***
BA40	Redwood Creek	7/20/98	18	530	23	12	6.8	13 ***b***	10 ***B***	10 ***B***	20 ***B***	7.5 ***B***	16 ***B***	14 ***B***	5.6 ***B***	15 ***B***	36 ***B***	8.5 ***B***	19 ***B***	Q	13	25 ***B***	30 ***B***	11	15 ***B***	47	4.3	31 ***B***	11 ***B***	49 ***b***	3.9	ND	9.2	6.1	11	17	ND	22	6.1	ND	CE	280 ***B***
BA30	Dumbarton Bridge	7/21/98	18	470	11	7.9	4.9	8.3 ***b***	9.0 ***B***	2.1 ***b***	23 ***B***	4.3 ***B***	8.7 ***B***	9.1 ***B***	11 ***B***	15 ***B***	12 ***B***	8.3 ***B***	6.1 ***B***	Q	13	28 ***B***	28 ***B***	11	16 ***B***	46	4.3	32 ***B***	11 ***B***	53 ***b***	4.2	1.0	10	6.3	10	19	8.6	25	7.0	ND	CE	480 ***b***
BA10	Coyote Creek	7/20/98	18	1200	17	9.2	6.9	15 ***b***	22 ***B***	2.8 ***b***	5 ***b***	20 ***B***	51 ***B***	22 ***B***	22 ***B***	36 ***B***	71 ***B***	20 ***B***	47 ***B***	Q	35	73 ***B***	70 ***b***	29	45 ***b***	120	10	94 ***b***	26 ***b***	120 ***b***	7.7	7.0	26	19	27	52	19	53	19	5.9	CE	520 ***b***
C-3-0	San Jose	7/21/98	18	4700	20	44	38	140 ***b***	45 ***b***	31 ***b***	54 ***b***	142 ***b***	20 ***b***	M	10 ***b***	130 ***B***	37 ***b***	97 ***b***	200 ***b***	1.4	130	340 ***b***	290 ***b***	110	160 ***b***	530	73	390 ***b***	130 ***b***	470 ***b***	48	38	140	120	110	280	80	160	89	39	CE	230 ***B***
BW10	Standish Dam	7/30/98	18	4000	11	29	M	M	M	13 ***b***	61 ***b***	29 ***B***	M	M	M	59 ***B***	M	53 ***B***	92 ***B***	21	52	220 ***b***	150 ***b***	64	120 ***b***	460	84	390 ***b***	120 ***b***	400 ***b***	59	36	190	200	110	470	100	260	130	60	CE	44 ***B***
BW15	Guadalupe River	7/30/98	18	2400	20	22	60	150 ***B***	43 ***B***	36 ***B***	72 ***B***	11 ***B***	58 ***B***	75 ***B***	43 ***B***	37 ***B***	60 ***B***	28 ***B***	82 ***B***	53	33	120 ***B***	110 ***b***	33	53 ***b***	220	30	170 ***b***	51 ***b***	210 ***b***	19	14	64	61	47	150	38	110	50	16	CE	23 ***B***

Table 8. Dissolved pesticide concentrations in water samples, 1998.

B = blank contamination, not included in sums and calculations, ***b*** = blank signal measured but small relative to sample, M = matrix intereference.

NA = not analyzed, ND = not detected, NS = not sampled, Q = outside QA limits, S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.

For method detection limits, refer to ***QA Tables*** .

				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
BG20	Sacramento River	2/4/98	16	ND	M	120	ND	22	Q	5.9	79	8.1	26	ND	2.8	ND	10	ND	13	ND	47	M	47	ND	M	11	ND	ND
BG30	San Joaquin River	2/4/98	16	B	M	73	ND	ND	Q	11	42	20	8.1	ND	ND	5.1	3.0	M	ND	ND	S	M	M	ND	M	6.6	ND	ND
BF20	Grizzly Bay	2/3/98	16	ND	M	16	ND	Q	Q	3.7	7.9	4.2	13	ND	4.3	ND	8.2	Q	ND	ND	S	M	M	ND	M	36	ND	ND
BD50	Napa River	2/3/98	16	ND	M	66	ND	ND	Q	3.3	53	10	53	ND	16	ND	29	Q	8.2	ND	S	M	M	ND	M	ND	73	ND
BD40	Davis Point	2/2/98	16	ND	M	38	ND	Q	Q	ND	38	ND	20	ND	8.8	ND	9.0	ND	2.4	ND	210	M	ND	4.2	210	27	ND	ND
BD30	Pinole Point	2/2/98	16	B	M	47	ND	ND	Q	10	37	ND	ND	ND	ND	ND	ND	ND	ND	ND	44	M	44	ND	M	4.3	ND	ND
BD20	San Pablo Bay	2/2/98	16	B	M	32	ND	2.6	Q	14	8.8	6.9	ND	ND	ND	ND	ND	M	ND	ND	S	M	M	M	M	ND	ND	ND
BD15	Petaluma River	2/2/98	16	280 ***b***	M	73	Q	16	Q	15	42	ND	54	13	11	13	13	M	3.8	ND	S	M	M	M	M	37	ND	ND
BC60	Red Rock	1/29/98	16	310 ***b***	4000	160	12	24	Q	57	60	4.8	55	16	11	ND	14	ND	14	ND	230	54	79	ND	100	66	ND	ND
BC20	Golden Gate	1/29/98	16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	S	NS	NS	NS	NS	NS	NS	NS
BC10	Yerba Buena Island	1/29/98	16	410 ***b***	3500	170	21	11	Q	70	47	17	95	31	21	ND	19	ND	24	ND	370	110	120	ND	140	94	ND	ND
BB70	Alameda	1/29/98	16	270 ***b***	3600	100	Q	12	Q	51	34	4.2	59	15	15	ND	12	ND	17	ND	300	71	110	ND	120	69	ND	ND
BA40	Redwood Creek	1/27/98	16	230 ***b***	7100	85	4.6	4.6	Q	37	35	4.2	100	21	13	2.2	21	ND	41	4.6	420	75	87	ND	260	96	22	ND
BA30	Dumbarton Bridge	1/28/98	16	490 ***b***	7000	75	5.4	10	Q	32	28	ND	170	12	6.6	ND	13	ND	130	9.2	720	62	330	ND	330	84	ND	ND
BA10	Coyote Creek	1/28/98	16	450 ***b***	7300	170	19	17	Q	65	53	16	92	9.0	13	4.7	22	ND	35	7.9	650	110	78	ND	460	90	7.9	ND
C-3-0	San Jose	1/28/98	16	1500 ***b***	10000	400	51	24	Q	170	130	22	260	96	56	ND	45	ND	62	ND	2400	150	460	14	1800	180	ND	ND
BW10	Standish Dam	2/5/98	16	120 ***b***	M	340	12	58	Q	36	230	ND	74	12	16	3.2	23	M	ND	20	S	M	M	M	M	7.5	ND	ND
BW15	Guadalupe River	2/5/98	16	25 ***b***	M	660	ND	36	Q	14	600	14	170	60	12	4.0	Q	ND	ND	91	S	M	M	M	M	ND	ND	ND
BG20	Sacramento River	4/16/98	17	ND	790	S	16	5.2	Q	B	43	13	48	24	8.0	B	7.4	3.0	3.2	ND	150	50	7.4	B	81	2.0	150	ND
BG30	San Joaquin River	4/16/98	17	1.7	M	S	5.9	ND	Q	B	30	1.8	35	16	5.7	B	3.8	4.0	1.7	ND	280	87	6.1	B	180	ND	44	ND
BF20	Grizzly Bay	4/15/98	17	ND	M	S	22	14	Q	B	72	6.0	60	23	28	B	5.6	ND	ND	ND	180	55	12	B	110	1.9	ND	ND
BD50	Napa River	4/15/98	17	2.4	490	S	26	Q	Q	B	70	280	61	24	13	B	12	ND	5.8	ND	170	69	12	B	83	ND	ND	ND
BD40	Davis Point	4/14/98	17	ND	200	S	8.8	10	Q	B	34	180	18	8.1	5.5	B	ND	ND	ND	ND	130	40	9.1	B	77	ND	ND	ND
BD30	Pinole Point	4/14/98	17	ND	M	S	4.7	ND	Q	B	17	ND	11	8.2	2.8	ND	ND	ND	ND	ND	160	37	32	B	87	ND	27	ND
BD20	San Pablo Bay	4/14/98	17	ND	NA	S	10	ND	Q	B	32	1.9	30	16	5.5	B	4.3	ND	ND	ND	170	56	14	ND	100	ND	ND	ND
BD15	Petaluma River	4/14/98	17	ND	ND	S	4.7	ND	Q	B	26	ND	14	6.1	2.8	ND	ND	3.3	2.0	ND	120	13	14	B	89	ND	6.7	ND
BC60	Red Rock	4/21/98	17	ND	390	S	13	3.1	Q	B	24	ND	37	21	6.7	ND	2.2	4.9	2.6	ND	270	120	10	B	130	ND	10	ND
BC20	Golden Gate	4/21/98	17	ND	73	S	2.4	ND	Q	B	3.9	ND	10	4.4	3.6	ND	ND	ND	2.2	ND	270	130	63	B	67	ND	4.8	ND
BC10	Yerba Buena Island	4/20/98	17	ND	M	S	12	ND	Q	B	33	ND	36	22	14	ND	ND	ND	ND	ND	840	390	44	53 ***b***	350	ND	19	ND
BB70	Alameda	4/20/98	17	ND	ND	20	Q	ND	Q	ND	20	ND	68	32	36	ND	ND	ND	ND	ND	450	380	ND	35 ***b***	33	ND	50	ND
BA40	Redwood Creek	4/22/98	17	ND	M	S	3.5	ND	Q	B	2.8	140	18	5.4	2.0	B	ND	8.1	ND	ND	280	97	20	B	150	ND	ND	ND
BA30	Dumbarton Bridge	4/22/98	17	ND	M	S	ND	2.1	Q	B	7.0	ND	28	10	3.8	ND	ND	8.8	5.0	ND	470	53	37	B	360	ND	17	ND
BA10	Coyote Creek	4/22/98	17	7.1	M	S	29	5.1	Q	B	86	26	200	70	44	14 ***b***	32	18	20	2.5	800	170	37	B	580	ND	16	ND
C-3-0	San Jose	4/23/98	17	6.5	M	S	36	10	Q	B	110	18	190	77	41	B	42	ND	26	4.4	1700	69	25	B	1600	ND	21	ND
BW10	Standish Dam	4/13/98	17	1.5	M	S	25	8.7	Q	B	98	12	140	53	37	B	8.5	14	21	ND	770	120	47	B	590	ND	ND	ND
BW15	Guadalupe River	4/13/98	17	2.9	4500	S	Q	30	Q	B	240	160	230	69	62	28 ***b***	36	10	24	ND	1460	140	10	B	1300	1.4	ND	ND
BG20	Sacramento River	7/29/98	18	490	860	S	26 ***b***	B	Q	B	110 ***b***	14	110	33	16	B	14	6.0	36 ***b***	ND	370	45	28	13 ***b***	280	150	ND	ND
BG30	San Joaquin River	7/29/98	18	480	ND	780	24 ***b***	B	Q	320 ***b***	120 ***b***	290	270	48	21	B	42	31	69 ***b***	51	300	30	34	21 ***b***	210	140	ND	ND
BF20	Grizzly Bay	7/28/98	18	200	770	300	34 ***b***	B	Q	160 ***b***	89 ***b***	8.4	90	40	15	B	10	7.9	B	ND	380	81	27	B	270	100	B	ND
BD50	Napa River	7/28/98	18	250	850	280	24 ***b***	B	Q	160 ***b***	79 ***b***	12	120	46	17	B	12	13	23 ***b***	ND	510	150	77	B	280	98	ND	ND
BD40	Davis Point	7/27/98	18	120	560	S	B	B	Q	B	85 ***b***	7.8	56	12	16	B	7.3	3.9	B	3.9	340	110	64	B	160	38	ND	ND
BD30	Pinole Point	7/27/98	18	140	590	S	32 ***b***	B	Q	B	59 ***b***	ND	110	29	14	B	11	12	23 ***b***	7.4	580	210	140	B	220	74	B	ND
BD20	San Pablo Bay	7/27/98	18	150	ND	440	31 ***b***	B	Q	300 ***b***	73 ***b***	25	96	8.4	3.3	ND	9.1	30	42 ***b***	3.1	470	150	130	18 ***b***	170	66	B	ND
BD15	Petaluma River	7/27/98	18	37	940	300	38 ***b***	B	Q	160 ***b***	91 ***b***	6.2	83	32	11	B	9.4	ND	B	1.8	330	93	92	B	140	58	B	ND
BC60	Red Rock	7/23/98	18	74	570	S	B	B	Q	B	49 ***b***	ND	37	8.4	6.8	B	5.8	ND	B	2.2	350	92	110	B	140	42	B	ND
BC20	Golden Gate	7/22/98	18	ND	M	S	B	ND	Q	B	B	1.5	5.0	2.6	1.2	B	ND	ND	ND	ND	190	110	26	ND	49	ND	ND	ND
BC10	Yerba Buena Island	7/22/98	18	65	400	100	B	B	Q	B	31 ***b***	ND	63	22	10	B	6.9	4.2	B	2.1	550	250	140	B	150	37	B	ND
BB70	Alameda	7/22/98	18	ND	M	S	B	ND	Q	B	B	ND	10	6.0	2.2	ND	1.5	ND	ND	ND	220	110	30	ND	81	ND	ND	ND
BA40	Redwood Creek	7/20/98	18	ND	M	S	B	ND	Q	B	B	ND	15	7.1	2.9	ND	2.1	1.1	B	ND	180	43	6.2	B	130	ND	ND	ND
BA30	Dumbarton Bridge	7/21/98	18	ND	M	S	B	ND	Q	B	B	ND	17	7.7	3.4	B	2.5	ND	B	ND	180	6.3	28	B	140	ND	ND	ND
BA10	Coyote Creek	7/20/98	18	ND	M	S	B	B	Q	B	B	ND	29	14	6.2	B	6.1	ND	ND	ND	390	50	18	B	320	ND	ND	ND
C-3-0	San Jose	7/21/98	18	3.6	M	320	33 ***b***	B	Q	150 ***b***	130 ***b***	ND	160	55	34	B	19	ND	35 ***b***	ND	1800	B	84	29 ***b***	1700	ND	B	ND
BW10	Standish Dam	7/30/98	18	1400	14000	2300	410 ***b***	B	Q	1200 ***b***	510 ***b***	68	1200	530	220	B	140	ND	280 ***b***	34	280	36	72	B	170	420	ND	ND
BW15	Guadalupe River	7/30/98	18	160	1700	540	54 ***b***	B	Q	270 ***b***	190 ***b***	6.1	450	90	60	B	58	13	120 ***b***	92	120	17	62	B	35	190	ND	ND

Table 9. Total (dissolved + particulate) pesticide concentrations in water samples, 1998.
B = blank contamination, not included in sums and calculations, ***b*** = blank signal measured but small relative to sample, M = matrix intereference.
ND = not detected, NS = not sampled, Q = outside QA limits, S = compounds generally comprising a significant portion of sum not quantifiable, sum not calculated.
For method detection limits, refer to ***QA Tables*** .

				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
BG20	Sacramento River	2/4/98	16	110 ***b***	2100	S	ND	22 ***b***	Q	B	850 ***b***	37 ***b***	100	ND	8.2	ND	81 ***b***	M	13	ND	S	M	47	M	M	200	ND	ND
BG30	San Joaquin River	2/4/98	16	B	1600	S	ND	ND	Q	B	440 ***b***	B	S	B	3.8	5.1	B	M	ND	ND	S	M	M	M	M	25	ND	ND
BF20	Grizzly Bay	2/3/98	16	ND	2400	S	13	B	Q	B	230 ***b***	B	21	ND	7.6	ND	B	Q	ND	ND	S	M	M	M	M	61	ND	ND
BD50	Napa River	2/3/98	16	B	1400	S	ND	25 ***b***	Q	B	1200 ***b***	B	400	B	26	ND	360 ***b***	Q	8.2	ND	S	M	M	M	M	43	73	ND
BD40	Davis Point	2/2/98	16	260 ***b***	1000	S	5.7	14 ***b***	O	B	300 ***b***	B	S	ND	15	M	B	M	2.4	M	S	M	M	4.2	210	34	M	ND
BD30	Pinole Point	2/2/98	16	B	600	S	ND	B	Q	B	B	ND	S	B	ND	ND	ND	M	ND	ND	S	M	44	M	M	10	ND	ND
BD20	San Pablo Bay	2/2/98	16	B	1600	S	M	B	37	14 ***b***	540 ***b***	6.9 ***b***	S	M	M	M	B	M	ND	M	S	M	M	M	M	M	M	ND
BD15	Petaluma River	2/2/98	16	B	600	S	5.7	16 ***b***	O	B	42 ***b***	B	54	13 ***b***	11	13	13 ***b***	M	3.8	ND	S	M	M	M	M	43	ND	ND
BC60	Red Rock	1/29/98	16	B	4000	S	33	24 ***b***	Q	B	60 ***b***	39 ***b***	S	B	17	ND	14 ***b***	ND	14	ND	240	57	79	ND	100	76	ND	ND
BC20	Golden Gate	1/29/98	16	NS	NS	S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
BC10	Yerba Buena Island	1/29/98	16	B	3500	S	52	11 ***b***	O	B	47 ***b***	170 ***b***	140	51 ***b***	36	5.4	19 ***b***	ND	24	ND	390	110	130	ND	140	110	ND	ND
BB70	Alameda	1/29/98	16	B	3600	S	22	12 ***b***	Q	B	34 ***b***	85 ***b***	S	B	21	ND	12 ***b***	ND	27	ND	320	74	120	ND	120	84	ND	ND
BA40	Redwood Creek	1/27/98	16	310 ***b***	7100	S	4.6	4.6 ***b***	Q	B	35 ***b***	53 ***b***	330	97 ***b***	100	28	21 ***b***	ND	74	9.3	480	100	100	ND	270	120	22	ND
BA30	Dumbarton Bridge	1/28/98	16	490 ***b***	7000	S	5.4	10 ***b***	O	32 ***b***	28 ***b***	ND	S	12 ***b***	6.6	ND	13 ***b***	ND	130	9.2	S	62	330	ND	330	84	ND	ND
BA10	Coyote Creek	1/28/98	16	B	7300	S	40	17 ***b***	Q	B	53 ***b***	34 ***b***	320	66 ***b***	84	37	22 ***b***	B	90	10	680	120	89	6.5	470	100	7.9	ND
C-3-0	San Jose	1/28/98	16	1800 ***b***	10000	S	51	24 ***b***	Q	B	130 ***b***	76 ***b***	360	130 ***b***	120	ND	45 ***b***	ND	62	ND	2500	180	460	14	1800	340	ND	ND
BW10	Standish Dam	2/5/98	16	B	M	S	91	230 ***b***	O	B	5400 ***b***	56 ***b***	720	130 ***b***	35	3.2	530 ***b***	M	ND	20	S	M	M	M	M	42	ND	ND
BW15	Guadalupe River	2/5/98	16	210 ***b***	M	S	ND	150 ***b***	Q	B	3200 ***b***	B	1000	B	41	4.0	780 ***b***	M	43	100	S	M	M	M	M	26	ND	ND
BG20	Sacramento River	4/16/98	17	ND	790	S	48	B	27 ***b***	B	320	B	120	58 ***b***	25 ***b***	B	17	B	3.2 ***b***	ND	S	B	16 ***b***	B	89 ***b***	2.0	B	ND
BG30	San Joaquin River	4/16/98	17	B	52	S	37	B	Q	B	280	B	130	58 ***b***	28 ***b***	B	11	16 ***b***	1.7 ***b***	ND	S	B	B	B	190 ***b***	ND	220 ***b***	ND
BF20	Grizzly Bay	4/15/98	17	B	M	S	57	B	21 ***b***	B	350	520 ***b***	170	46 ***b***	B	B	13	12 ***b***	ND	ND	S	B	B	B	B	5.4	ND	ND
BD50	Napa River	4/15/98	17	B	580	S	92	B	42 ***b***	B	570	B	200	79 ***b***	50 ***b***	B	28	10 ***b***	B	ND	S	B	B	B	B	2.0	B	ND
BD40	Davis Point	4/14/98	17	B	450	S	240	58 ***b***	130 ***b***	B	1800	500 ***b***	310	130 ***b***	86 ***b***	B	42	8.2 ***b***	10 ***b***	ND	190	B	22 ***b***	B	88 ***b***	10	79 ***b***	ND
BD30	Pinole Point	4/14/98	17	B	M	S	89	B	Q	B	350	B	170	72 ***b***	30 ***b***	32 ***b***	23	ND	B	2.7	S	B	B	B	95 ***b***	7.5	27 ***b***	20
BD20	San Pablo Bay	4/14/98	17	B	ND	S	86	B	Q	B	440	B	170	77 ***b***	43 ***b***	B	32	ND	B	2.0	S	B	B	ND	B	ND	ND	ND
BD15	Petaluma River	4/14/98	17	B	ND	S	180	35 ***b***	O	B	1200	B	280	140 ***b***	78 ***b***	40 ***b***	17	3.3 ***b***	B	2.8	190	68 ***b***	B	B	100 ***b***	ND	200 ***b***	ND
BC60	Red Rock	4/21/98	17	B	440	S	61	B	16 ***b***	B	310	B	140	61 ***b***	32 ***b***	13 ***b***	14	B	2.6 ***b***	ND	S	120 ***b***	B	B	B	ND	B	ND
BC20	Golden Gate	4/21/98	17	B	73	S	13	B	B	B	35	350 ***b***	S	B	B	10 ***b***	6.3	14 ***b***	2.2 ***b***	ND	S	B	B	B	B	6.4	4.8 ***b***	ND
BC10	Yerba Buena Island	4/20/98	17	B	M	S	23	B	Q	B	690	B	97	39 ***b***	B	4.2 ***b***	25	ND	B	ND	S	B	B	53 ***b***	B	ND	B	ND
BB70	Alameda	4/20/98	17	B	52	190	19	B	B	65 ***b***	80	B	130	63 ***b***	B	6.8 ***b***	2.0	ND	B	ND	S	B	B	35 ***b***	44 ***b***	ND	50 ***b***	ND
BA40	Redwood Creek	4/22/98	17	ND	180	S	3.5	B	25 ***b***	B	300	140 ***b***	S	5.4 ***b***	2.0 ***b***	B	8.5	8.1 ***b***	ND	ND	S	97 ***b***	20 ***b***	B	150 ***b***	ND	ND	ND
BA30	Dumbarton Bridge	4/22/98	17	B	73	S	55	B	Q	B	260	B	310	120 ***b***	82 ***b***	28 ***b***	28	8.8 ***b***	31 ***b***	7.2	S	B	B	B	380 ***b***	ND	97 ***b***	ND
BA10	Coyote Creek	4/22/98	17	B	M	S	88	5.1 ***b***	O	B	86	B	420	190 ***b***	120 ***b***	14 ***b***	32	18 ***b***	34 ***b***	8.3	S	B	B	B	590 ***b***	ND	16 ***b***	ND
C-3-0	San Jose	4/23/98	17	B	550	S	330	47 ***b***	O	B	2100	B	1100	430 ***b***	350 ***b***	B	120	ND	87 ***b***	22	S	B	B	B	1700 ***b***	2.5	150 ***b***	6.3
BW10	Standish Dam	4/13/98	17	22 ***b***	2900	S	720	170 ***b***	O	B	9400	1200 ***b***	5700	2000 ***b***	1540 ***b***	B	1500	14 ***b***	220 ***b***	49	S	B	B	B	B	14	ND	35
BW15	Guadalupe River	4/13/98	17	B	6600	S	460	170 ***b***	Q	B	6600	900 ***b***	3100	860 ***b***	850 ***b***	230 ***b***	950	B	140 ***b***	20	S	B	B	B	1500 ***b***	2.7	160 ***b***	15
BG20	Sacramento River	7/29/98	18	510 ***b***	860	S	B	B	B	B	210 ***b***	38	S	B	B	B	B	6.0 ***b***	41 ***b***	ND	370	45 ***b***	28	13 ***b***	280	160	ND	ND
BG30	San Joaquin River	7/29/98	18	500 ***b***	ND	980	30 ***b***	B	B	370 ***b***	240 ***b***	310	S	B	B	B	B	B	75 ***b***	51	300	30 ***b***	36	21 ***b***	210	150	ND	ND
BF20	Grizzly Bay	7/28/98	18	320 ***b***	770	3200	150 ***b***	B	66 ***b***	1100 ***b***	1400 ***b***	430	270	110 ***b***	B	B	36 ***b***	18 ***b***	B	ND	410	B	35	B	280	160	B	1.5
BD50	Napa River	7/28/98	18	310 ***b***	850	1200	60 ***b***	B	24 ***b***	450 ***b***	550 ***b***	130	S	B	B	B	B	B	32 ***b***	ND	530	B	81	B	280	110	ND	ND
BD40	Davis Point	7/27/98	18	160 ***b***	560	S	B	B	17 ***b***	B	570 ***b***	95	S	B	B	B	B	3.9 ***b***	B	3.9	350	B	67	B	160	61	ND	2.8
BD30	Pinole Point	7/27/98	18	B	590	S	38 ***b***	B	B	B	140 ***b***	13	S	B	B	B	B	B	26 ***b***	7.4	630	B	140	B	230	78	B	ND
BD20	San Pablo Bay	7/27/98	18	170 ***b***	ND	750	43 ***b***	B	B	380 ***b***	250 ***b***	43	S	B	3.3 ***b***	6.7 ***b***	B	30 ***b***	48 ***b***	3.1	520	B	130	54 ***b***	180	73	B	ND
BD15	Petaluma River	7/27/98	18	37 ***b***	1170	3100	210 ***b***	B	150 ***b***	750 ***b***	1400 ***b***	570	230	110 ***b***	B	B	43 ***b***	ND	B	1.8	350	B	110	B	150	58	B	ND
BC60	Red Rock	7/23/98	18	99 ***b***	570	S	B	B	B	B	210 ***b***	23	S	B	B	B	B	B	B	2.2	400	B	120	B	140	48	B	ND
BC20	Golden Gate	7/22/98	18	B	M	S	B	B	B	B	B	2	S	B	B	B	B	B	ND	ND	200	B	26	6.3 ***b***	49	ND	ND	ND
BC10	Yerba Buena Island	7/22/98	18	B	400	190	B	B	B	B	73 ***b***	7	S	B	B	B	B	B	B	2.1	600	250 ***b***	150	B	150	39	B	ND
BB70	Alameda	7/22/98	18	B	M	S	B	B	B	B	B	ND	S	B	B	5.1 ***b***	B	8.1 ***b***	ND	ND	240	B	33	6.7 ***b***	81	ND	ND	ND
BA40	Redwood Creek	7/20/98	18	B	M	S	B	B	B	B	B	9	S	49 ***b***	B	13 ***b***	B	1.1 ***b***	B	3.2	210	B	10	B	130	ND	ND	ND
BA30	Dumbarton Bridge	7/21/98	18	B	M	S	B	B	B	B	B	11	S	52 ***b***	B	B	B	ND	B	3.2	200	B	33	B	140	ND	ND	ND
BA10	Coyote Creek	7/20/98	18	B	M	S	B	B	14 ***b***	B	B	32	320	130 ***b***	85 ***b***	B	45 ***b***	ND	15 ***b***	5.3	420	B	23	B	330	ND	ND	ND
C-3-0	San Jose	7/21/98	18	B	340	3200	170 ***b***	B	56 ***b***	810 ***b***	2000 ***b***	82	730	280 ***b***	190 ***b***	B	99 ***b***	ND	72 ***b***	7.8	1900	B	90	41 ***b***	1800	ND	B	6.9
BW10	Standish Dam	7/30/98	18	1700 ***b***	15000	9900	1100 ***b***	B	150 ***b***	3300 ***b***	4000 ***b***	1100	3400	1200 ***b***	840 ***b***	B	670 ***b***	ND	410 ***b***	56	300	36 ***b***	74	B	190	580	64 ***b***	5.4
BW15	Guadalupe River	7/30/98	18	220 ***b***	1700	1800	150 ***b***	B	34 ***b***	680 ***b***	740 ***b***	170	910	220 ***b***	190 ***b***	B	150 ***b***	40 ***b***	140 ***b***	99	140	17 ***b***	73	B	42	220	140 ***b***	ND

1998 RMP Data: Aquatic Bioassay

Table 10. Aquatic bioassay results, 1998.

NA = not available.

Station Code	Station	Date	Cruise	Mean % Survival	Mean % Survival (Control)
				Mysidopsis bahia	
BG30	San Joaquin River	-	16	NA	NA
BF20	Grizzly Bay	2/3/98	16	98	93
BD30	Pinole Point	2/2/98	16	100	93
BA30	Dumbarton Bridge	1/28/98	16	100	93
C-3-0	San Jose	1/28/98	16	88	93
C-1-3	Sunnyvale	1/28/98	16	93	93
BG30	San Joaquin River	7/29/98	18	100	98
BF20	Grizzly Bay	7/28/98	18	90	98
BD30	Pinole Point	7/27/98	18	100	95
BA30	Dumbarton Bridge	7/21/98	18	80	93
C-3-0	San Jose	7/21/98	18	88	93
C-1-3	Sunnyvale	7/21/98	18	80	93

Table 11. General characteristics of sediment samples, 1998. . = no data.

Station Code	Station	Date	Cruise	% Clay (<4µm)	% Gravel+Shell (>2mm)	% Sand (63µm-2mm)	% Silt (4µm-63µm)	Depth	Ammonia	Hydrogen Sulfide	pH	TOC	Total Sulfide	Total Nitrogen
				%	%	%	%	m	mg/L	mg/L	pH	%	mg/L	%
BA10	Coyote Creek	2/11/98	16	61	0	2	37	5	0.3	0.04	7.6	1.6	0.3	0.2
BA21	South Bay	2/10/98	16	71	0	3	26	6	0.4	0.04	7.5	1.4	0.2	0.2
BA30	Dumbarton Bridge	2/10/98	16	61	0	3	35	7	0.0	0.01	7.9	1.3	0.1	0.1
BA41	Redwood Creek	2/10/98	16	65	0	3	32	3	0.1	0.01	8.2	1.3	0.3	0.2
BB15	San Bruno Shoal	2/10/98	16	59	0	8	33	12	1.4	0.16	7.3	1.3	0.7	0.2
BB30	Oyster Point	2/10/98	16	49	0	25	25	9	0.1	0.00	8.8	1.1	0.2	0.1
BB70	Alameda	2/10/98	16	46	0	26	28	10	0.3	0.02	8.2	1.1	0.4	0.1
BC11	Yerba Buena Island	2/9/98	16	46	0	26	28	6	0.3	0.01	7.7	1.2	0.1	0.2
BC21	Horseshoe Bay	2/9/98	16	23	0	57	21	12	0.1	0.09	7.5	0.7	0.6	0.1
BC32	Richardson Bay	2/9/98	16	41	0	16	43	1	0.2	0.05	7.6	1.2	0.4	0.1
BC41	Point Isabel	2/9/98	16	59	0	9	32	2	4.4	0.05	7.4	1.1	0.2	0.1
BC60	Red Rock	2/9/98	16	26	0	56	17	11	0.1	0.02	8.4	1.3	0.7	0.1
BD15	Petaluma River	2/6/98	16	68	0	4	28	4	0.6	0.03	7.5	1.5	0.2	0.2
BD22	San Pablo Bay	2/6/98	16	52	0	12	35	3	0.8	0.01	8.0	1.3	0.2	0.1
BD31	Pinole Point	2/6/98	16	39	0	30	31	7	1.9	0.06	7.3	1.2	0.3	0.1
BD41	Davis Point	2/6/98	16	19	0	67	14	7	0.9	0.01	8.2	0.8	0.4	0.1
BD50	Napa River	2/6/98	16	49	0	26	25	4	0.9	0.01	8.3	2.3	0.3	0.2
BF10	Pacheco Creek	2/5/98	16	11	0	78	10	4	0.1	0.47	5.5	0.8	0.5	0.0
BF21	Grizzly Bay	2/5/98	16	66	0	1	33	3	2.1	0.02	7.6	1.7	0.2	0.1
BF40	Honker Bay	2/5/98	16	57	0	2	41	3	0.1	0.03	7.5	1.7	0.2	0.2
BG20	Sacramento River	2/5/98	16	11	0	77	11	8	0.2	0.03	7.8	0.6	0.2	0.0
BG30	San Joaquin River	2/5/98	16	35	0	30	35	5	1.2	0.02	7.5	0.6	0.2	0.0
BW10	Standish Dam	2/4/98	16	22	0	44	34	0	2.4	0.00	8.5	1.2	0.1	0.1
BW15	Guadalupe River	2/4/98	16	78	0	1	21	0	1.8	0.00	8.9	2.2	0.1	0.2
C-1-3	Sunnyvale	2/11/98	16	39	0	33	28	3	1.5	0.01	7.5	1.3	0.1	0.1
C-3-0	San Jose	2/11/98	16	44	0	34	22	3	0.1	0.00	8.7	0.8	0.1	0.1
BA10	Coyote Creek	8/4/98	18	51	19	7	23	5	0.9	0.10	7.4	1.5	0.5	0.2
BA21	South Bay	8/4/98	18	66	0	3	31	6	0.5	0.04	7.7	1.4	0.4	0.2
BA30	Dumbarton Bridge	8/4/98	18	42	3	35	20	7	1.7	0.04	7.4	1.3	0.2	0.2
BA41	Redwood Creek	8/4/98	18	49	8	20	23	3	0.1	0.06	7.9	1.2	0.9	0.2
BB15	San Bruno Shoal	8/4/98	18	74	0	4	22	12	5.1	0.03	7.0	1.5	0.1	0.2
BB30	Oyster Point	8/4/98	18	35	10	40	15	9	0.6	0.05	7.3	0.9	0.2	0.1
BB70	Alameda	8/3/98	18	50	0	30	21	10	0.3	0.01	7.9	0.9	0.1	0.1
BC11	Yerba Buena Island	8/3/98	18	55	5	17	23	6	0.5	0.07	7.4	1.5	0.3	0.2
BC21	Horseshoe Bay	8/3/98	18	14	0	74	11	12	0.1	0.02	7.6	0.5	0.2	0.1
BC32	Richardson Bay	8/3/98	18	47	0	17	37	1	0.1	0.02	7.6	1.1	0.2	0.1
BC41	Point Isabel	8/3/98	18	50	0	18	33	2	0.3	0.01	7.6	1.1	0.1	0.1
BC60	Red Rock	7/31/98	18	4	0	94	2	11	0.2	0.03	7.4	0.1	0.1	0.0
BD15	Petaluma River	7/31/98	18	61	0	5	34	4	0.8	0.02	7.7	1.1	0.2	0.1
BD22	San Pablo Bay	7/31/98	18	27	0	52	20	3	0.2	0.02	7.9	1.3	0.3	0.2
BD31	Pinole Point	7/31/98	18	31	0	51	19	7	1.2	0.05	7.1	1.1	0.2	0.1
BD41	Davis Point	7/31/98	18	9	2	83	5	7	0.3	0.03	7.7	0.3	0.2	0.0
BD50	Napa River	7/31/98	18	65	0	8	26	4	0.8	0.06	7.6	1.7	0.4	0.2
BF10	Pacheco Creek	7/30/98	18	12	18	63	7	4	0.1	0.08	7.1	0.5	0.2	0.0
BF21	Grizzly Bay	7/30/98	18	63	0	2	35	3	0.0	0.19	6.9	1.6	0.4	0.1
BF40	Honker Bay	7/30/98	18	61	0	3	36	3	0.4	0.07	7.7	1.8	0.6	0.2
BG20	Sacramento River	7/30/98	18	4	0	92	4	8	0.2	0.01	7.7	1.3	0.1	0.2
BG30	San Joaquin River	7/30/98	18	26	0	53	21	5	0.4	0.23	6.8	1.4	0.5	0.1
BW10	Standish Dam	8/6/98	18	50	0	13	37	0	2.2	0.1	7.4	.	0.4	.
BW15	Guadalupe River	8/6/98	18	79	0	0	21	0	1.0	0.0	7.7	.	0.2	.
C-1-3	Sunnyvale	8/5/98	18	48	0	34	18	3	11.8	0.0	8.1	.	0.2	.
C-3-0	San Jose	8/5/98	18	65	0	4	30	3	5.2	0.0	7.7	1.6	0.7	0.2

Table 12. Concentrations of trace elements for sediment samples, 1998. B = blank contamination >10% of measured concentration.

Station Code	Station	Date	Cruise	% Solids - As, Hg, Se	% Solids - Ag, Al, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Zn	Ag	Al	As	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Se	Zn
				%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BA10	Coyote Creek	2/11/98	16	31	29	0.38	66400	4.5	0.56	216	76	69500	0.19	1160	228	30.0	0.13	212.0
BA21	South Bay	2/10/98	16	35	31	0.47	62300	4.6	0.38	197	66	63400	0.19	1330	185	29.0	0.12	200.0
BA30	Dumbarton Bridge	2/10/98	16	41	40	0.33	44300	4.0	0.18	129	44	42800	0.13	679	110	19.0	0.12	134.0
BA41	Redwood Creek	2/10/98	16	40	38	0.42	46500	4.1	0.17	148	53	51600	0.13	599	133	26.0	0.12	158.0
BB15	San Bruno Shoal	2/10/98	16	41	39	0.36	41000	4.4	0.16	163	47	44500	0.10	1000	114	19.0	0.06	137.0
BB30	Oyster Point	2/10/98	16	45	47	0.31	31400	3.8	0.16	90	37	32000	0.12	345	82	14.0	0.12	102.0
BB70	Alameda	2/10/98	16	47	47	0.28	36600	5.6	0.17	121	41	39900	0.11	557	103	17.0	0.12	118.0
BC11	Yerba Buena Island	2/9/98	16	50	51	0.32	28500	4.4	0.32	94	38	29000	0.12	303	74	28.0	0.12	102.0
BC21	Horseshoe Bay	2/9/98	16	63	62	0.15	22800	5.2	0.21	87	25	30200	0.10	359	72	65.0	0.10	93.5
BC32	Richardson Bay	2/9/98	16	46	46	0.20	34900	5.4	0.18	116	41	41700	0.11	533	103	18.0	0.10	118.0
BC41	Point Isabel	2/9/98	16	44	41	0.35	41200	5.9	0.17	132	50	47800	0.13	586	123	22.0	0.12	143.0
BC60	Red Rock	2/9/98	16	59	49	0.26	30600	6.1	0.14	114	29	46100	0.05	816	118	14.0	0.06	111.0
BD15	Petaluma River	2/6/98	16	40	39	0.37	47900	7.5	0.36	137	60	46100	0.21	816	136	29.0	0.13	150.0
BD22	San Pablo Bay	2/6/98	16	49	46	0.37	40500	8.7	0.31	114	56	41800	0.17	523	97	20.0	0.16	131.0
BD31	Pinole Point	2/6/98	16	48	47	0.18	36800	6.2	0.21	116	49	43100	0.11	653	112	14.0	0.11	122.0
BD41	Davis Point	2/6/98	16	56	56	0.11	27800	5.3	0.20	98	29	37600	0.05	632	100	11.0	0.08	103.0
BD50	Napa River	2/6/98	16	49	41	0.37	47300	7.0	0.46	130	67	48700	0.12	845	119	25.0	0.15	152.0
BF10	Pacheco Creek	2/5/98	16	72	71	0.10	16400	3.6	0.16	82	18	29300	0.05	302	68	7.0	0.06	70.6
BF21	Grizzly Bay	2/5/98	16	39	45	0.25	62000	7.2	0.34	150	61	49000	0.12	1200	130	23.0	0.13	140.0
BF40	Honker Bay	2/5/98	16	42	39	0.33	53500	6.7	0.38	154	75	56200	0.12	1530	153	21.0	0.12	178.0
BG20	Sacramento River	2/5/98	16	68	66	0.06	25100	6.0	0.26	105	30	32500	0.05	617	100	7.7	0.09	97.5
BG30	San Joaquin River	2/5/98	16	59	58	0.10	36500	7.6	0.21	105	41	35000	0.22	517	72	5.4	0.19	76.3
BW10	Standish Dam	2/4/98	16	61	55	0.20	26900	5.3	0.36	94	34	33000	0.08	600	132	21.0	0.17	110.0
BW15	Guadalupe River	2/4/98	16	39	37	0.69	54600	5.0	0.42	177	66	57800	0.34	1380	165	41.0	0.17	234.0
C-1-3	Sunnyvale	2/11/98	16	50	49	0.31	36800	3.1	0.26	120	45	41400	0.12	911	109	20.0	0.16	135.0
C-3-0	San Jose	2/11/98	16	52	52	0.64	31800	3.8	0.39	130	39	39000	0.19	958	126	23.0	0.15	133.0
BA10	Coyote Creek	8/4/98	18	39	40	0.38	60600	9.1	0.22	154	48	47800	0.39	1360	137	30.0	0.34	166.0
BA21	South Bay	8/4/98	18	37	41	0.34	50400	11.0	0.17	135	44	B	0.34	1430	124	9.3	0.31	149.0
BA30	Dumbarton Bridge	8/4/98	18	45	43	0.38	48300	9.7	0.17	128	42	42000	0.39	857	115	12.0	0.23	144.0
BA41	Redwood Creek	8/4/98	18	46	48	0.46	39900	8.7	0.19	105	34	B	0.31	762	90	24.0	0.26	114.0
BB15	San Bruno Shoal	8/4/98	18	34	38	0.34	49200	14.0	0.16	132	47	B	0.24	919	122	16.0	0.35	144.0
BB30	Oyster Point	8/4/98	18	55	54	0.26	34900	8.4	0.17	98	28	B	0.19	408	85	16.0	0.27	94.9
BB70	Alameda	8/3/98	18	47	48	0.33	44900	9.2	0.23	132	40	B	0.30	437	104	29.0	0.28	127.0
BC11	Yerba Buena Island	8/3/98	18	40	44	0.27	43700	8.2	0.16	107	36	B	0.19	502	87	25.0	0.28	108.0
BC21	Horseshoe Bay	8/3/98	18	63	64	0.14	26300	8.2	0.23	89	19	B	0.14	281	69	25.0	0.15	90.2
BC32	Richardson Bay	8/3/98	18	43	46	0.20	40800	12.0	0.17	112	37	B	0.19	519	94	18.0	0.28	109.0
BC41	Point Isabel	8/3/98	18	45	48	0.24	41000	11.0	0.19	116	40	B	0.25	399	100	24.0	0.30	125.0
BC60	Red Rock	7/31/98	18	73	79	ND	14800	11.0	0.05	63	8	B	0.06	494	73	12.0	0.06	64.0
BD15	Petaluma River	7/31/98	18	35	41	0.24	55200	14.0	0.20	137	54	B	0.27	961	128	24.0	0.27	146.0
BD22	San Pablo Bay	7/31/98	18	50	50	0.23	51700	18.0	0.24	120	48	B	0.30	482	98	23.0	0.29	129.0
BD31	Pinole Point	7/31/98	18	50	52	0.16	39200	12.0	0.17	102	39	B	0.19	614	101	7.3	0.20	113.0
BD41	Davis Point	7/31/98	18	70	70	0.07	24500	7.5	0.10	100	15	B	0.06	453	88	7.6	0.08	83.6
BD50	Napa River	7/31/98	18	43	45	0.36	66900	18.0	0.29	154	66	B	0.32	707	129	31.0	0.34	164.0
BF10	Pacheco Creek	7/30/98	18	62	58	0.07	30900	8.2	0.14	100	23	B	0.08	576	85	10.0	0.10	83.8
BF21	Grizzly Bay	7/30/98	18	40	49	0.25	53700	19.0	0.26	136	62	B	0.29	1090	135	22.0	0.33	152.0
BF40	Honker Bay	7/30/98	18	39	47	0.25	60400	19.0	0.30	144	61	B	0.33	1110	132	21.0	0.30	151.0
BG20	Sacramento River	7/30/98	18	71	75	0.04	16800	11.0	0.13	88	13	B	0.03	464	89	6.9	0.06	75.6
BG30	San Joaquin River	7/30/98	18	52	55	0.13	36100	4.3	0.24	109	35	B	0.14	669	103	15.0	0.17	102.0
BW10	Standish Dam	8/6/98	18	39	44	0.41	54400	9.3	0.48	143	52	42900	0.31	962	149	36.0	0.52	184.0
BW15	Guadalupe River	8/6/98	18	36	41	0.44	64600	11.0	0.34	170	56	50100	0.82	1270	150	39.0	0.48	197.0
C-1-3	Sunnyvale	8/5/98	18	43	42	0.26	40700	7.0	0.19	111	34	34400	0.26	904	98	24.0	0.20	125.0
C-3-0	San Jose	8/5/98	18	41	41	2.00	61200	11.0	2.10	176	67	46400	0.76	533	132	50.0	0.45	256.0

1998 RMP Data: PAHs in Sediment Samples

Table 13. PAH concentrations in sediment samples, 1998. b = blank contamination <10% of measured concentration, B = blank contamination >10% of measured concentration, LPAH = low molecular weight PAHs. HPAH = high molecular weight PAHs, ND = not detected, NP = not provided. For method detection limits, refer to ***QA Tables.***

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
				%	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BA10	Coyote Creek	2/11/98	16	48	681	126	6	B	7	12	NP	11	4	3	11	4	7	43	19	555	24	50	72	87	40	42	67	21	8	32	56	55
BA21	South Bay	2/10/98	16	47	1402	220	6	b 19	5	9	NP	9	4	14	61	5	10	65	14	1183	66	101	169	234	72	108	120	40	14	42	106	110
BA30	Dumbarton Bridge	2/10/98	16	49	1396	162	5	b 21	4	7	NP	6	6	9	19	5	8	58	13	1234	70	81	166	224	80	133	130	44	14	44	123	125
BA41	Redwood Creek	2/10/98	16	45	1632	176	5	b 19	4	6	NP	ND	6	13	23	6	9	65	22	1457	77	88	214	286	88	152	143	47	17	49	150	146
BB15	San Bruno Shoal	2/10/98	16	50	1595	178	6	b 25	5	8	NP	ND	7	14	21	6	10	64	13	1417	79	97	197	270	92	139	156	52	17	54	126	137
BB30	Oyster Point	2/10/98	16	51	2644	399	6	b 25	6	8	NP	ND	10	26	80	11	21	171	34	2245	142	153	360	485	124	225	202	69	22	65	196	201
BB70	Alameda	2/10/98	16	54	2550	275	5	b 20	5	7	NP	7	6	20	61	7	12	100	25	2275	182	244	306	415	128	248	219	89	27	66	168	183
BC11	Yerba Buena Island	2/9/98	16	56	1679	165	5	B	5	8	NP	6	8	11	20	6	9	b 76	12	1515	76	83	258	308	79	193	129	41	14	46	144	143
BC21	Horseshoe Bay	2/9/98	16	65	2358	442	7	b 24	8	11	NP	10	29	18	61	16	24	196	38	1916	121	132	384	442	100	170	162	50	15	54	139	147
BC32	Richardson Bay	2/9/98	16	55	1818	190	5	b 21	4	7	NP	ND	7	13	28	6	10	77	13	1628	91	110	249	320	99	163	163	53	18	56	149	157
BC41	Point Isabel	2/9/98	16	49	1514	180	5	b 23	5	7	NP	ND	10	11	24	5	9	70	12	1334	74	85	201	260	80	141	129	44	15	49	127	130
BC60	Red Rock	2/9/98	16	69	356	37	ND	B	ND	4	NP	ND	2	3	4	ND	3	18	3	318	18	24	42	54	21	29	35	13	4	20	29	30
BD15	Petaluma River	2/6/98	16	46	650	41	ND	B	ND	3	NP	ND	2	4	6	ND	4	b 19	3	609	27	29	66	124	44	57	60	17	7	29	78	70
BD22	San Pablo Bay	2/6/98	16	51	3953	332	8	b 40	6	10	NP	8	9	28	39	10	16	b 133	24	3622	158	176	421	640	228	536	330	102	44	103	464	420
BD31	Pinole Point	2/6/98	16	55	590	66	3	B	3	5	NP	ND	3	4	9	2	5	b 27	5	524	27	35	68	93	31	68	47	15	6	35	52	47
BD41	Davis Point	2/6/98	16	67	160	23	ND	B	2	4	NP	ND	2	ND	2	ND	2	b 9	3	137	7	10	19	24	8	9	12	4	2	19	13	12
BD50	Napa River	2/6/98	16	46	2358	496	5	B	6	11	NP	9	26	5	71	17	30	b 253	63	1861	131	129	396	389	90	195	153	51	20	91	110	107
BF10	Pacheco Creek	2/5/98	16	73	227	21	ND	B	ND	2	NP	ND	1	1	4	ND	3	b 8	2	206	12	24	22	37	14	16	21	8	3	20	15	13
BF21	Grizzly Bay	2/5/98	16	50	523	44	ND	B	3	6	NP	ND	3	3	4	ND	4	b 18	3	479	19	25	54	71	29	59	44	13	6	57	55	48
BF40	Honker Bay	2/5/98	16	51	602	47	ND	B	3	5	NP	ND	2	3	5	ND	4	b 20	4	555	23	32	69	86	33	58	51	15	6	63	64	55
BG20	Sacramento River	2/5/98	16	74	252	12	ND	B	ND	2	NP	ND	ND	ND	2	ND	ND	b 8	ND	240	8	10	23	54	15	19	21	6	3	28	29	24
BG30	San Joaquin River	2/5/98	16	65	135	2	ND	B	ND	ND	NP	ND	ND	ND	ND	ND	ND	B	2	132	3	4	10	12	4	5	6	2	ND	73	7	6
BW10	Standish Dam	2/4/98	16	71	186	51	3	B	5	8	NP	7	1	ND	2	ND	3	b 15	8	135	8	17	23	28	11	9	17	5	3	ND	1	13
BW15	Guadalupe River	2/4/98	16	48	1366	121	5	B	5	10	NP	8	5	8	11	5	7	b 48	9	1245	51	79	162	216	85	105	139	42	17	52	150	148
C-1-3	Sunnyvale	2/11/98	16	57	996	125	5	B	6	10	NP	10	3	4	9	5	8	42	23	871	49	73	113	129	57	86	106	36	13	42	79	90
C-3-0	San Jose	2/11/98	16	55	1180	134	4	B	4	9	NP	12	4	6	14	4	10	44	23	1046	51	66	122	177	69	118	122	38	12	60	98	114
BA10	Coyote Creek	8/4/98	18	44	1406	206	8	b 34	10	b 19	10	6	5	15	15	4	11	58	11	1200	b 58	64	228	310	90	68	113	32	10	41	118	69
BA21	South Bay	8/4/98	18	45	1564	236	10	b 38	11	b 20	9	8	7	16	19	5	12	71	13	1328	b 63	71	222	292	125	83	139	40	12	50	141	89
BA30	Dumbarton Bridge	8/4/98	18	46	2369	302	9	b 42	11	b 19	10	7	8	23	29	7	13	105	19	2067	b 117	114	374	516	191	114	217	49	19	65	176	114
BA41	Redwood Creek	8/4/98	18	52	2542	332	9	b 42	10	b 17	9	8	16	28	37	6	15	116	19	2210	b 119	123	383	480	226	130	208	86	20	71	228	136
BB15	San Bruno Shoal	8/4/98	18	44	1865	240	9	b 43	12	b 22	11	ND	7	18	19	5	11	71	13	1626	b 75	80	276	401	159	92	161	44	14	62	166	96
BB30	Oyster Point	8/4/98	18	57	1440	165	6	b 26	6	b 11	8	5	6	12	12	4	7	53	9	1275	b 56	55	194	265	130	84	138	42	12	59	150	90
BB70	Alameda	8/3/98	18	49	3476	432	10	b 44	11	b 20	9	11	12	38	62	8	15	162	29	3044	b 183	174	566	731	299	167	292	71	29	87	274	172
BC11	Yerba Buena Island	8/3/98	18	39	4632	1163	28	b 124	89	149	33	12	68	17	71	25	67	b 481	ND	3469	257	295	625	547	366	215	483	118	31	130	234	168
BC21	Horseshoe Bay	8/3/98	18	63	2410	355	9	b 26	10	15	11	35	12	15	36	8	16	b 120	43	2055	124	118	342	437	228	130	237	56	16	81	171	116
BC32	Richardson Bay	8/3/98	18	52	2395	285	9	b 34	10	b 18	10	8	10	19	33	6	13	100	14	2111	b 104	117	371	466	206	124	215	62	18	81	217	131
BC41	Point Isabel	8/3/98	18	50	2044	272	6	b 27	8	b 13	9	8	8	15	38	6	11	110	14	1772	b 125	109	295	365	182	107	195	48	16	64	170	97
BC60	Red Rock	7/31/98	18	83	70	4	ND	B	ND	2	1	ND	ND	ND	1	ND	ND	B	ND	66	4	4	10	13	5	4	7	2	1	6	7	4
BD15	Petaluma River	7/31/98	18	45	1236	141	6	b 22	7	11	7	ND	6	6	16	5	8	b 48	ND	1095	58	78	128	167	114	78	129	42	11	78	133	80
BD22	San Pablo Bay	7/31/98	18	50	6260	454	10	b 64	7	14	6	5	13	42	69	11	18	b 197	ND	5806	343	330	649	929	823	463	839	190	55	216	574	395
BD31	Pinole Point	7/31/98	18	54	1011	112	4	B	4	9	5	5	5	7	14	4	8	b 47	ND	899	53	59	123	140	93	59	97	34	9	64	104	63
BD41	Davis Point	7/31/98	18	72	166	17	ND	B	ND	2	ND	ND	ND	ND	2	ND	2	b 10	ND	150	9	9	24	28	12	8	16	3	ND	18	14	8
BD50	Napa River	7/31/98	18	44	1636	192	7	b 21	7	14	8	7	8	8	20	6	12	b 75	ND	1444	78	95	204	265	149	96	182	40	12	114	128	82
BF10	Pacheco Creek	7/30/98	18	68	677	153	2	B	2	5	3	4	5	1	14	5	10	b 91	12	524	39	32	178	154	18	13	26	9	1	25	19	11
BF21	Grizzly Bay	7/30/98	18	50	807	92	5	B	5	9	6	5	3	4	8	3	7	b 31	8	714	35	43	92	117	63	45	73	18	7	84	88	50
BF40	Honker Bay	7/30/98	18	49	862	94	4	B	5	10	5	5	3	3	7	3	7	b 30	11	769	35	45	90	112	61	52	83	18	8	114	101	50
BG20	Sacramento River	7/30/98	18	78	33	2	ND	B	ND	2	ND	ND	ND	ND	ND	ND	ND	B	ND	31	2	2	5	6	1	2	2	ND	ND	7	3	1
BG30	San Joaquin River	7/30/98	18	60	509	63	2	B	3	6	3	ND	3	1	4	2	6	b 32	ND	446	18	30	89	84	26	23	36	12	5	63	40	21
BW10	Standish Dam	8/6/98	18	51	787	121	6	B	9	b 16	8	8	4	4	7	4	8	41	8	666	b 27	49	98	115	51	48	72	36	6	33	83	47
BW15	Guadalupe River	8/6/98	18	46	1123	190	8	28	10	b 20	11	10	5	8	11	5	12	53	10	932	b 46	58	2	197	91	74	138	45	10	51	140	79
C-1-3	Sunnyvale	8/5/98	18	52	1198	131	6	B	7	b 14	6	6	4	7	11	4	8	49	9	1067	b 49	58	197	239	89	62	124	32	10	37	105	64
C-3-0	San Jose	8/5/98	18	42	3650	745	14	65	14	b 34	25	34	12	26	45	12	37	121	307	2906	b 133	148	452	604	279	206	334	95	31	116	309	198

Table 14. PCB concentrations in sediment samples, 1998. ND = not detected. For method detection limits, refer to ***QA Tables*** .

				%	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BA10	Coyote Creek	2/11/98	16	48	43.8	ND	ND	2.1	ND	1.0	0.9	1.0	ND	0.4	0.4	1.1	1.5	8.6	0.9	2.5	ND	ND	2.4	ND	9.9	0.7	ND	ND	2.2	0.6	1.3	ND	1.8	ND	ND	0.4	0.5	0.6	1.3	0.3	0.9	ND	ND	ND	0.7	0.3
BA21	South Bay	2/10/98	16	47	14.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.7	ND	1.0	ND	ND	ND	ND	ND	4.0	1.0	ND	ND	1.6	ND	0.9	ND	1.9	ND	ND	0.4	ND	0.5	1.1	ND	0.7	0.6	ND	ND	ND	ND
BA30	Dumbarton Bridge	2/10/98	16	49	12.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.5	ND	ND	ND	ND	ND	ND	ND	1.8	1.1	ND	0.3	1.6	ND	1.7	0.6	2.0	ND	ND	ND	ND	0.4	0.8	ND	0.8	ND	ND	ND	0.4	ND
BA41	Redwood Creek	2/10/98	16	45	22.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	2.4	ND	0.8	2.9	ND	2.1	1.3	ND	0.6	2.2	ND	1.7	ND	3.0	0.3	ND	0.6	ND	ND	1.3	0.4	1.3	0.6	ND	ND	ND	ND
BB15	San Bruno Shoal	2/10/98	16	50	6.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.9	0.5	ND	ND	1.1	ND	0.7	ND	1.4	ND	ND	ND	ND	ND	0.8	ND	0.6	ND	ND	ND	0.3	ND
BB30	Oyster Point	2/10/98	16	51	10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	1.1	0.8	ND	ND	1.2	0.4	0.8	ND	1.4	ND	ND	0.5	0.2	ND	0.9	ND	0.8	0.3	ND	ND	ND	ND
BB70	Alameda	2/10/98	16	54	14.2	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.5	ND	ND	ND	2.2	ND	0.5	1.7	0.5	1.2	0.8	ND	ND	1.4	ND	1.0	ND	1.3	0.2	ND	ND	0.3	ND	1.1	ND	0.9	0.6	ND	ND	ND	ND
BC11	Yerba Buena Island	2/9/98	16	56	20.4	ND	ND	0.7	ND	ND	ND	ND	ND	ND	ND	0.6	0.7	ND	ND	1.0	ND	0.7	1.8	ND	1.2	1.2	0.5	0.4	1.7	0.6	1.7	ND	2.3	ND	ND	ND	0.5	0.7	1.9	0.4	1.0	0.6	ND	ND	0.3	ND
BC21	Horseshoe Bay	2/9/98	16	65	4.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	0.4	0.7	0.2	ND	0.7	ND	0.6	ND	0.6	ND	ND	0.2	ND	ND	0.4	0.1	0.2	ND	ND	ND	ND	ND
BC32	Richardson Bay	2/9/98	16	55	6.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND	ND	ND	1.1	ND	0.9	0.9	ND	ND	0.9	ND	0.5	ND	0.8	ND	ND	ND	ND	ND	0.4	ND	0.5	ND	ND	ND	ND	ND
BC41	Point Isabel	2/9/98	16	49	12.1	ND	ND	ND	ND	ND	0.5	ND	ND	ND	0.3	ND	ND	ND	0.4	ND	ND	ND	ND	ND	1.3	2.4	ND	ND	1.9	ND	1.8	ND	1.2	ND	ND	ND	0.3	ND	1.2	ND	0.8	ND	ND	ND	ND	0.2
BC60	Red Rock	2/9/98	16	69	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD15	Petaluma River	2/6/98	16	46	3.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	0.5	ND	ND	0.4	ND	ND	ND	0.7	ND	ND	ND	ND	ND	ND	ND	0.6	0.3	ND	ND	ND	ND
BD22	San Pablo Bay	2/6/98	16	51	5.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.4	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	ND	1.0	ND	0.8	ND	0.9	ND	ND	ND	ND	ND	0.4	ND	0.7	0.3	ND	ND	ND	0.2
BD31	Pinole Point	2/6/98	16	55	3.6	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	0.6	ND	0.4	ND	0.5	ND	ND	0.3	0.3	ND	0.4	ND	0.5	ND	ND	ND	ND	ND
BD41	Davis Point	2/6/98	16	67	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	0.2
BD50	Napa River	2/6/98	16	46	9.3	ND	ND	ND	ND	ND	ND	ND	0.6	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	1.4	0.5	ND	ND	0.8	ND	0.9	ND	1.6	ND	ND	ND	0.3	ND	0.9	0.4	0.5	0.5	ND	ND	0.4	0.3
BF10	Pacheco Creek	2/5/98	16	73	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	ND	ND	0.2	ND	ND	ND	ND	0.7	0.2	ND	ND	0.3	ND	0.3	ND	0.3	ND	ND	ND	ND	ND	0.3	ND	0.2	0.2	ND	ND	ND	0.1
BF21	Grizzly Bay	2/5/98	16	50	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	ND	ND	ND	ND	0.3	0.3	ND	0.4	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	ND	0.4	ND
BF40	Honker Bay	2/5/98	16	51	3.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND	ND	ND	1.0	ND	ND	ND	0.7	ND	0.4	ND	0.8	ND	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8
BG20	Sacramento River	2/5/98	16	74	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	0.1	ND	ND	ND	0.2	ND	ND	ND
BG30	San Joaquin River	2/5/98	16	65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BW10	Standish Dam	2/4/98	16	71	26.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	0.5	8.0	ND	0.7	ND	ND	1.5	ND	5.8	0.5	ND	0.3	1.3	0.4	1.0	ND	1.3	ND	ND	0.4	0.4	0.3	1.2	0.3	1.0	0.4	ND	ND	0.4	0.1
BW15	Guadalupe River	2/4/98	16	48	42.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	1.4	4.4	ND	ND	3.8	ND	9.5	1.5	ND	0.8	3.4	ND	2.5	1.2	3.4	0.6	ND	1.1	ND	1.0	3.1	0.7	1.7	0.8	ND	ND	1.0	0.3
C-1-3	Sunnyvale	2/11/98	16	57	22.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	2.8	ND	1.3	0.2	ND	1.4	ND	5.4	1.1	0.7	0.4	1.5	0.3	1.5	ND	1.4	ND	ND	0.3	0.3	0.4	1.0	0.2	0.9	0.4	ND	ND	0.4	ND
C-3-0	San Jose	2/11/98	16	55	102.5	ND	3.3	3.6	2.6	0.6	2.7	3.1	4.5	0.9	0.5	2.9	3.7	ND	2.3	4.2	1.6	2.2	6.0	2.1	5.6	5.2	1.5	2.5	5.5	1.7	7.4	1.6	6.3	ND	0.4	2.2	2.1	2.0	5.5	1.4	2.7	1.2	ND	0.3	0.8	ND
BA10	Coyote Creek	8/4/98	18	44	9.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	0.4	ND	ND	ND	ND	ND	1.9	0.7	0.4	0.3	1.7	ND	1.0	ND	1.5	ND	ND	0.2	ND	0.3	ND	ND	0.8	ND	ND	ND	ND	ND
BA21	South Bay	8/4/98	18	45	3.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	0.4	0.3	ND	ND	0.6	ND	0.4	ND	0.9	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND	ND	ND
BA30	Dumbarton Bridge	8/4/98	18	46	7.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	0.7	0.6	ND	ND	1.1	ND	0.8	ND	1.5	ND	ND	ND	ND	ND	0.6	0.3	0.7	ND	ND	ND	ND	ND
BA41	Redwood Creek	8/4/98	18	52	4.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.414	0.4	ND	0.4	0.4	ND	ND	0.7	ND	0.4	ND	0.8	ND	ND	0.2	ND	ND	0.4	ND	0.6	ND	ND	ND	ND	ND
BB15	San Bruno Shoal	8/4/98	18	44	4.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	0.4	0.4	ND	ND	0.9	ND	0.5	ND	0.9	ND	ND	ND	ND	ND	0.5	ND	0.6	ND	ND	ND	ND	ND
BB30	Oyster Point	8/4/98	18	57	7.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	0.6	0.2	ND	0.8	ND	0.7	1.1	ND	0.3	0.9	0.1	0.8	ND	0.9	ND	ND	0.2	0.2	ND	0.3	0.2	0.3	ND	ND	ND	ND	ND
BB70	Alameda	8/3/98	18	49	14.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	ND	0.5	0.4	0.3	0.7	1.2	0.5	1.4	0.9	ND	0.5	1.9	ND	1.1	ND	2.0	ND	ND	ND	ND	ND	1.0	ND	1.2	0.3	ND	ND	ND	ND
BC11	Yerba Buena Island	8/3/98	18	39	30.2	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	0.6	1.6	ND	1.5	2.1	1.3	1.4	3.1	1.5	3.4	3.0	ND	1.1	2.9	ND	1.6	ND	2.3	ND	ND	0.4	0.3	ND	0.8	ND	0.7	ND	ND	ND	ND	ND
BC21	Horseshoe Bay	8/3/98	18	63	6.3	ND	ND	0.4	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.4	0.4	ND	ND	ND	ND	0.4	1.3	ND	ND	0.6	ND	1.1	ND	0.8	ND	ND	ND	ND	ND	0.2	ND	0.3	ND	ND	ND	0.1	ND
BC32	Richardson Bay	8/3/98	18	52	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	0.4	ND	ND	ND	0.4	ND	ND	ND	ND	ND	0.2	0.1	0.3	ND	ND	ND	ND	ND
BC41	Point Isabel	8/3/98	18	50	3.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND	ND	0.3	0.3	ND	ND	0.5	ND	0.3	ND	0.5	ND	ND	ND	ND	ND	0.3	ND	0.4	ND	ND	ND	ND	ND
BC60	Red Rock	7/31/98	18	83	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD15	Petaluma River	7/31/98	18	45	3.6	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	1.0	ND	0.7	ND	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD22	San Pablo Bay	7/31/98	18	50	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	0.4	ND	ND	ND	0.3	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND
BD31	Pinole Point	7/31/98	18	54	3.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND	ND	0.5	ND	ND	ND	ND	ND	ND	ND	0.7	ND	1.3	ND	ND	ND
BD41	Davis Point	7/31/98	18	72	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD50	Napa River	7/31/98	18	44	3.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND	0.7	ND	0.6	ND	0.9	ND	ND	ND	ND	ND	ND	ND	0.9	ND	ND	ND	ND	0.3
BF10	Pacheco Creek	7/30/98	18	68	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF21	Grizzly Bay	7/30/98	18	50	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND	0.5	ND	ND	ND	0.4	ND	ND	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF40	Honker Bay	7/30/98	18	49	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND	0.1	ND	0.9	ND	ND	ND	ND	ND
BG20	Sacramento River	7/30/98	18	78	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG30	San Joaquin River	7/30/98	18	60	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	ND	ND	ND	ND	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	ND	0.5
BW10	Standish Dam	8/6/98	18	51	24.1	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	0.8	0.8	ND	0.5	1.0	ND	ND	1.3	ND	2.3	1.3	0.4	0.6	2.5	ND	2.1	ND	2.7	ND	ND	ND	0.7	0.8	1.9	0.5	1.3	0.9	ND	ND	0.5	0.2
BW15	Guadalupe River	8/6/98	18	46	26.4	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.7	0.9	ND	ND	1.5	0.5	ND	ND	0.5	1.6	1.8	ND	0.8	2.6	0.6	2.3	ND	2.8	ND	ND	ND	0.7	1.0	2.6	0.6	1.4	2.2	ND	ND	1.0	ND
C-1-3	Sunnyvale	8/5/98	18	52	10.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	0.4	ND	ND	2.8	ND	ND	ND	ND	0.7	1.0	0.3	ND	1.0	ND	0.9	ND	1.2	ND	ND	0.3	ND	ND	0.6	0.4	0.6	ND	ND	ND	ND	ND
C-3-0	San Jose	8/5/98	18	42	269.1	ND	ND	6.5	ND	3.1	10.0	8.6	15.1	3.5	1.8	10.5	14.8	5.2	7.8	11.8	5.3	6.3	18.0	6.3	17.3	13.8	3.7	6.4	18.2	4.7	15.1	4.0	17.6	1.8	1.4	ND	4.4	4.5	13.7	ND	5.9	ND	ND	0.5	1.5	ND

1998 RMP Data: Pesticides in Sediment Samples

Table 15. Pesticide concentrations in sediment samples, 1998. M = matrix interference, ND = not detected. For method detection limits, refer to ***QA Tables*** .

Station Code	Station	Date	Cruise	% Solids	Sum of DDTs (SFEI)	o,p'-DDD	o,p'-DDE	o,p'-DDT	p,p'-DDD	p,p'-DDE	p,p'-DDT	Sum of Chlordanes	alpha-Chlordane	gamma-Chlordane	cis-Nonachlor	trans-Nonachlor	Heptachlor	Heptachlor Epoxide	Oxychlordane	Aldrin	Dieldrin	Endrin	alpha-HCH	beta-HCH	delta-HCH	gamma-HCH	Mirex
				%	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BA10	Coyote Creek	2/11/98	16	48	19.6	ND	ND	2.4	5.5	11.7	M	6.0	ND	3.0	0.4	2.7	ND	ND	ND	ND	1.9	ND	ND	1.1	ND	ND	ND
BA21	South Bay	2/10/98	16	47	4.9	ND	ND	0.8	4.1	ND	M	3.8	1.4	1.3	ND	1.1	ND	ND	ND	ND	0.8	ND	ND	ND	ND	ND	ND
BA30	Dumbarton Bridge	2/10/98	16	49	7.5	ND	ND	0.9	3.2	3.3	M	1.6	0.6	0.6	ND	0.5	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	1.8
BA41	Redwood Creek	2/10/98	16	45	5.4	ND	ND	ND	3.2	2.2	M	0.6	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9
BB15	San Bruno Shoal	2/10/98	16	50	2.8	ND	ND	ND	2.8	ND	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BB30	Oyster Point	2/10/98	16	51	6.8	ND	ND	2.4	2.7	1.8	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8
BB70	Alameda	2/10/98	16	54	7.5	ND	ND	1.5	3.6	2.4	M	0.6	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND
BC11	Yerba Buena Island	2/9/98	16	56	6.4	ND	ND	0.9	4.0	1.5	M	0.6	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6
BC21	Horseshoe Bay	2/9/98	16	65	3.1	ND	ND	ND	2.0	1.1	M	0.1	ND	ND	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BC32	Richardson Bay	2/9/98	16	55	4.0	ND	ND	ND	2.4	1.6	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	ND	ND	ND
BC41	Point Isabel	2/9/98	16	49	10.3	ND	ND	2.6	4.8	2.9	M	0.6	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5
BC60	Red Rock	2/9/98	16	69	1.8	ND	ND	ND	0.5	1.3	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD15	Petaluma River	2/6/98	16	46	10.4	ND	0.4	ND	7.4	2.5	M	1.1	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5
BD22	San Pablo Bay	2/6/98	16	51	5.7	ND	ND	0.9	2.7	2.2	M	0.2	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.0
BD31	Pinole Point	2/6/98	16	55	6.4	ND	ND	ND	3.6	2.8	M	0.7	0.4	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.9
BD41	Davis Point	2/6/98	16	67	2.7	ND	ND	ND	0.9	1.8	M	1.0	0.4	0.3	ND	0.3	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND
BD50	Napa River	2/6/98	16	46	7.3	ND	ND	ND	3.8	3.5	M	0.9	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF10	Pacheco Creek	2/5/98	16	73	1.7	ND	ND	ND	0.9	0.8	M	0.4	ND	0.2	ND	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF21	Grizzly Bay	2/5/98	16	50	7.0	ND	ND	0.6	3.4	3.0	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF40	Honker Bay	2/5/98	16	51	10.6	ND	ND	1.0	4.4	5.2	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG20	Sacramento River	2/5/98	16	74	1.5	ND	ND	ND	0.6	1.0	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG30	San Joaquin River	2/5/98	16	65	ND	ND	ND	ND	ND	ND	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BW10	Standish Dam	2/4/98	16	71	23.9	2.4	ND	1.3	7.0	13.2	M	7.7	3.1	2.3	0.4	2.0	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND
BW15	Guadalupe River	2/4/98	16	48	19.0	1.8	ND	2.8	6.4	8.0	M	7.1	2.6	2.4	ND	2.0	ND	ND	0.3	ND	0.8	ND	ND	2.8	ND	ND	0.6
C-1-3	Sunnyvale	2/11/98	16	57	14.8	ND	ND	1.4	4.0	9.3	M	9.9	3.6	3.1	0.2	2.6	0.2	0.2	ND	ND	0.9	ND	ND	ND	ND	ND	ND
C-3-0	San Jose	2/11/98	16	55	32.3	ND	ND	ND	20.8	11.5	M	2.7	1.8	ND	ND	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8
BA10	Coyote Creek	8/4/98	18	44	7.3	ND	ND	0.7	3.1	3.5	M	2.5	0.8	0.7	ND	0.7	ND	0.3	ND	ND	ND	ND	0.4	ND	ND	ND	ND
BA21	South Bay	8/4/98	18	45	2.9	ND	ND	ND	1.6	1.3	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BA30	Dumbarton Bridge	8/4/98	18	46	5.4	ND	ND	ND	2.6	2.8	M	0.7	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BA41	Redwood Creek	8/4/98	18	52	1.6	ND	ND	ND	0.9	0.7	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BB15	San Bruno Shoal	8/4/98	18	44	ND	ND	ND	ND	ND	ND	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BB30	Oyster Point	8/4/98	18	57	1.2	ND	ND	ND	0.6	0.5	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BB70	Alameda	8/3/98	18	49	4.0	ND	ND	ND	2.5	1.5	M	0.5	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BC11	Yerba Buena Island	8/3/98	18	39	1.2	ND	ND	ND	ND	1.2	M	2.0	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7
BC21	Horseshoe Bay	8/3/98	18	63	1.5	ND	ND	0.6	ND	0.9	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND
BC32	Richardson Bay	8/3/98	18	52	1.8	ND	ND	ND	1.0	0.8	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BC41	Point Isabel	8/3/98	18	50	2.0	ND	ND	ND	1.2	0.9	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BC60	Red Rock	7/31/98	18	83	0.5	ND	ND	ND	ND	0.5	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD15	Petaluma River	7/31/98	18	45	1.4	ND	ND	ND	ND	1.4	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD22	San Pablo Bay	7/31/98	18	50	2.1	ND	ND	0.2	1.0	0.9	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD31	Pinole Point	7/31/98	18	54	3.5	ND	ND	ND	1.3	2.2	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD41	Davis Point	7/31/98	18	72	0.9	ND	ND	ND	0.4	0.5	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BD50	Napa River	7/31/98	18	44	4.3	ND	ND	ND	2.2	2.1	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF10	Pacheco Creek	7/30/98	18	68	1.3	ND	ND	ND	ND	1.3	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF21	Grizzly Bay	7/30/98	18	50	2.3	ND	ND	ND	ND	2.3	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BF40	Honker Bay	7/30/98	18	49	7.1	ND	ND	ND	3.2	3.9	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2
BG20	Sacramento River	7/30/98	18	78	ND	ND	ND	ND	ND	ND	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG30	San Joaquin River	7/30/98	18	60	1.7	ND	ND	ND	ND	1.7	M	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BW10	Standish Dam	8/6/98	18	51	19.7	2.0	ND	0.9	8.1	8.8	M	7.2	2.9	2.2	ND	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BW15	Guadalupe River	8/6/98	18	46	11.8	1.2	ND	ND	5.0	5.6	M	2.9	1.6	ND	ND	1.4	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND
C-1-3	Sunnyvale	8/5/98	18	52	6.1	ND	ND	ND	2.8	3.4	M	2.5	1.0	0.8	ND	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C-3-0	San Jose	8/5/98	18	42	37.2	ND	ND	1.4	11.0	24.8	M	6.7	6.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 16. Sediment bioassay data for 1998 RMP Cruises. . = no data. For physical/chemical measurements of test solutions and QA information, refer to ***QA Tables*** .

Station Code	Station	Date	Cruise	Mean % Normal Development	SD - % Normal Development	Mean % Survival	SD - % Survival	Mean % Normal Development	SD - % Normal Development
				Mytilus galloprovincialis		***Eohaustorius estuarius***		***Strongylocentrotus purpuratus***	
BA10	Coyote Creek	2/11/98	16	0 *	0	70 *	12	93	3
BA21	South Bay	2/10/98	16	74	6	61 *	7	71	31
BA41	Redwood Creek	2/10/98	16	71	14	69 *	8	93	3
BB15	San Bruno Shoal	2/10/98	16	75	8	71	21	71	34
BB70	Alameda	2/10/98	16	72 *	3	75 *	11	97	2
BC11	Yerba Buena Island	2/9/98	16	83	6	62 *	12	94	5
BC21	Horseshoe Bay	2/9/98	16	75	5	89	4	97	3
BC60	Red Rock	2/9/98	16	74 *	6	92	10	96	1
BD41	Davis Point	2/6/98	16	33 *	8	97	3	86	13
BD50	Napa River	2/6/98	16	0 *	0	58 *	21	67 *	8
BF21	Grizzly Bay	2/5/98	16	0 *	0	27 *	12	98	1
BG20	Sacramento River	2/5/98	16	0 *	0	95	4	94	3
BG30	San Joaquin River	2/5/98	16	0 *	0	90	7	27 *	29
C-1-3	Sunnyvale	-	16	.	.	.	.	.	.
C-3-0	San Jose	2/11/98	16	0 *	0	61 *	18	6 *	4
-	Control	-	16	84	5	97	4	92	3
BA10	Coyote Creek	8/4/98	18	0 *	0	71 *	15	.	.
BA21	South Bay	8/4/98	18	73 *	7	46 *	31	.	.
BA41	Redwood Creek	8/4/98	18	98	5	56	27	.	.
BB15	San Bruno Shoal	8/4/98	18	90 *	5	83	15	.	.
BB70	Alameda	8/3/98	18	95	7	83	10	.	.
BC11	Yerba Buena Island	8/3/98	18	0 *	0	35 *	22	.	.
BC21	Horseshoe Bay	8/3/98	18	102	5	93	8	.	.
BC60	Red Rock	7/31/98	18	106	3	94	5	.	.
BD41	Davis Point	7/31/98	18	101	1	98	3	.	.
BD50	Napa River	7/31/98	18	14 *	3	78 *	12	.	.
BF21	Grizzly Bay	7/30/98	18	0 *	0	86 *	7	.	.
BG20	Sacramento River	7/30/98	18	0 *	0	93	6	.	.
BG30	San Joaquin River	7/30/98	18	0 *	0	91	4	.	.
C-1-3	Sunnyvale	8/5/98	18	0 *	0	88	4	.	.
C-3-0	San Jose	8/5/98	18	0 *	0	93	11	.	.
-	Control	-	18	102	4	98	4	.	.

* Sample mean was significantly different than control mean based on separate variance t-test (1-tailed, alpha = 0.01).

1998 RMP Data: Condition Index and Survival

Table 17. Bivalve condition index and survival, 1998. . = no data, NA = not analyzed, NS = not sampled. IS = Insufficient bivalves for deployment (BG20, BG30, and BF20).
T-0 = time of bivalve deployment into the Estuary from the source indicated under station name heading.

Station Code	Station	Date	Cruise	Species	Condition Index Mean	Condition Index Standard Error	Survival Per Species
							%
BG20	Sacramento River	4/24/98	16	CFLU	IS	IS	IS
BG30	San Joaquin River	4/24/98	16	CFLU	IS	IS	IS
BF20	Grizzly Bay	4/24/98	16	CFLU	IS	IS	1
BD50	Napa River	4/23/98	16	CGIG	NS	NS	0
BD40	Davis Point	4/28/98	16	CGIG	NS	NS	0
BD30	Pinole Point	4/23/98	16	CGIG	0.111	0.004	1
BD31	Pinole Point	4/23/98	16	MCAL	NS	NS	0
BD20	San Pablo Bay	4/23/98	16	CGIG	0.119	0.008	1
BD15	Petaluma River	4/23/98	16	CGIG	NS	NS	0
BC61	Red Rock	4/23/98	16	MCAL	NS	NS	0
BC21	Horseshoe Bay	4/23/98	16	MCAL	0.099	0.003	1
BC10	Yerba Buena Island	4/22/98	16	MCAL	NS	NS	NA
BB71	Alameda	4/22/98	16	MCAL	0.118	0.004	1
BA40	Redwood Creek	4/22/98	16	MCAL	IS	IS	0
BA30	Dumbarton Bridge	4/22/98	16	MCAL	IS	IS	0
BA10	Coyote Creek	4/22/98	16	CGIG	0.131	0.006	1
T-0	Lake Chabot	-	16	CFLU	NS	NS	NS
T-0	Tomales Bay	1/9/98	16	CGIG	0.081	0.004	.
T-0	Bodega Head	1/9/98	16	MCAL	0.105	0.002	.
BG20	Sacramento River	9/18/98	18	CFLU	0.086	0.003	NA
BG30	San Joaquin River	9/18/98	18	CFLU	0.052	0.005	NA
BF20	Grizzly Bay	9/4/98	18	CGIG	NS	NS	0
BD50	Napa River	9/3/98	18	CGIG	0.074	0.003	1
BD40	Davis Point	9/1/98	18	CGIG	NS	NS	0
BD30	Pinole Point	9/3/98	18	MCAL	0.054	0.001	1
BD20	San Pablo Bay	9/3/98	18	CGIG	0.103	0.005	1
BD15	Petaluma River	9/3/98	18	CGIG	NS	NS	0
BC61	Red Rock	9/3/98	18	MCAL	0.068	0.002	1
BC21	Horseshoe Bay	9/3/98	18	MCAL	0.131	0.002	1
BC10	Yerba Buena Island	9/2/98	18	MCAL	0.079	0.002	1
BB71	Alameda	9/2/98	18	MCAL	0.078	0.003	1
BA40	Redwood Creek	9/2/98	18	MCAL	0.072	0.001	1
BA30	Dumbarton Bridge	9/2/98	18	MCAL	0.057	0.003	1
BA10	Coyote Creek	9/2/98	18	CGIG	0.065	0.006	1
T-0	Lake Chabot	-	18	CFLU	NS	NS	NS
T-0	Tomales Bay	5/25/98	18	CGIG	0.152	0.006	.
T-0	Bodega Head	5/26/98	18	MCAL	0.092	0.002	.

CGIG--***Crassostrea gigas*** , CFLU--***Corbicula fluminea*** , MCAL--***Mytilus californianus***

Table 18. Trace element concentrations in bivalve tissues, 1998. . = no data, M = matrix interference, NS = not sampled, ND = not detected. Units expressed as dry weight.
T-0 = time of bivalve deployment into the Estuary from the source indicated under station name heading. *Tins are reported in terms of total tin.

Station Code	Station	Date	Cruise	Species	Lipid	Moisture	Ag	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	DBT	MBT	TBT	TTBT
					%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg Sn*	µg/kg Sn*	µg/kg Sn*	µg/kg Sn*
BG20	Sacramento River	4/24/98	16	CFLU	4.5	90	ND	4243	M	2.6	15.6	97	0.164	12.2	1.9	4.9	136	4	4	7	ND
BG30	San Joaquin River	4/24/98	16	CFLU	2.2	94	ND	3769	M	1.8	12.5	86	0.214	8.1	1.7	4.7	70	5	7	ND	ND
BF20	Grizzly Bay	4/24/98	16	CFLU	NS	91	0.05	792	M	1.4	2.6	73	0.175	5.0	0.5	4.0	146	20	38	7	ND
BD50	Napa River	-	16	CGIG			No data due to one percent species survival.														
BD40	Davis Point	-	16	CGIG			No data due to zero percent species survival.														
BD30	Pinole Point	4/23/98	16	CGIG	.	.	2.27	484	M	7.5	1.7	168	0.193	2.0	0.8	3.3	771	.	.	.	.
BD30	Pinole Point	4/23/98	16	MCAL	5.7	87	.	.	.	.	.	.	.	.	.	.	.	1	ND	25	ND
BD20	San Pablo Bay	4/23/98	16	CGIG	7.6	90	1.24	399	M	5.2	1.2	107	0.125	1.7	0.5	5.1	480	1	ND	20	ND
BD15	Petaluma River	-	16	CGIG			No data due to zero percent species survival.														
BC61	Red Rock	-	16	MCAL			No data due to zero percent species survival.														
BC21	Horseshoe Bay	4/23/98	16	MCAL	3.1	87	ND	1427	M	3.5	4.9	10	0.166	6.1	1.8	5.7	130	2	ND	29	ND
BC10	Yerba Buena Island	-	16	MCAL			No data due to loss of mooring at sample site. It probably got removed by Bay Bridge crews.														
BB71	Alameda	4/22/98	16	MCAL	4.1	86	ND	873	M	3.1	3.3	11	0.154	5.0	1.5	3.9	140	2	ND	39	ND
BA40	Redwood Creek	4/22/98	16	MCAL	4.2	86	.	.	.	.	.	.	.	.	.	.	.	2	ND	14	ND
BA30	Dumbarton Bridge	4/22/98	16	MCAL	3.0	88	.	.	.	.	.	.	.	.	.	.	.	1	ND	10	ND
BA10	Coyote Creek	4/22/98	16	CGIG	9.2	86	2.65	269	M	4.0	1.0	144	0.118	1.3	0.6	6.4	663	ND	ND	9	ND
T-0	Putah Creek	12/23/97	16	CFLU	.	.	.	.	M	.	.	.	0.203	.	.	2.5	.	.	.	.	.
T-0	Tomales Bay	1/9/98	16	CGIG	6.2	87	1.11	73	M	5.2	0.6	62	0.224	0.9	0.3	1.7	427	ND	ND	2	ND
T-0	Bodega Head	1/9/98	16	MCAL	3.1	87	0.09	185	M	3.9	1.4	5	0.113	1.7	0.6	2.2	110	ND	ND	5	ND
T-0	Lake Chabot	1/23/98	16	CFLU	3.3	92	0.03	22	.	0.7	0.2	44	0.136	1.3	0.2	2.2	96	ND	ND	ND	ND
BG20	Sacramento River	9/18/98	18	CFLU	7.1	.	0.19	2551	.	2.4	20.5	155	.	10.8	2.3	.	175	19	19	7	ND
BG20	Sacramento River	9/18/98	18	CGIG	.	.			9.5				0.236			4.3					
BG30	San Joaquin River	9/18/98	18	CFLU	4.9	.	0.59	4932	B	4.9	30.1	269	0.345	14.8	3.8	5.6	278	61	188	52	ND
BF20	Grizzly Bay	-	18	CFLU			No data due to a lack of species from an "uncontaminated" site.														
BD50	Napa River	9/3/98	18	CGIG	6.5	.	4.32	366	4.8	11.2	1.7	396	0.338	2.1	0.9	3.6	1560	4	6	26	ND
BD40	Davis Point	9/1/98	18	CGIG	.	.	.	.	.	.	.	.	.	.	.	.	.	ND	ND	57	ND
BD30	Pinole Point	9/3/98	18	CGIG	.	.	4.84	578	B	9.9	1.6	403	0.275	2.2	1.2	2.8	1306	.	.	.	.
BD30	Pinole Point	9/3/98	18	MCAL	8.6	.	0.13	1182	5.0	5.6	4.5	19	0.262	5.6	2.2	2.2	326	ND	3	20	ND
BD20	San Pablo Bay	9/3/98	18	CGIG	7.3	.	5.77	433	5.2	8.8	1.9	440	0.172	1.9	1.0	4.2	1325	3	4	24	ND
BD15	Petaluma River	-	19	CGIG			No data due to one percent species survival.														
BC61	Red Rock	9/3/98	18	MCAL	3.9	.	0.16	1603	8.3	5.7	5.7	16	0.269	5.8	2.7	3.6	296	3	ND	31	ND
BC21	Horseshoe Bay	9/3/98	18	MCAL	5.2	.	0.16	605	7.9	4.2	3.0	14	0.194	3.2	2.3	5.1	239	3	1	32	ND
BC10	Yerba Buena Island	9/2/98	18	MCAL	4.8	.	0.24	1289	8.0	4.7	4.9	17	0.193	5.5	3.0	4.6	285	6	5	83	ND
BB71	Alameda	9/2/98	18	MCAL	4.5	.	0.22	691	5.5	3.8	3.1	14	0.213	5.2	1.7	3.1	291	4	ND	52	ND
BA40	Redwood Creek	9/2/98	18	MCAL	4.6	.	0.31	1473	6.8	3.1	4.1	15	0.255	4.5	1.8	3.8	250	2	ND	16	ND
BA30	Dumbarton Bridge	9/2/98	18	MCAL	3.3	.	0.31	1460	4.8	4.6	5.0	15	0.233	6.8	2.4	4.1	313	2	2	14	ND
BA10	Coyote Creek	9/2/98	18	CGIG	5.4	.	5.76	381	4.3	10.0	1.1	327	0.295	2.4	1.3	4.4	1220	ND	ND	6	ND
T-0	Tomales Bay	5/25/98	18	CGIG	.	.	1.28	88	7.8	4.2	0.7	92	0.230	1.0	0.8	3.9	390	ND	ND	ND	.
T-0	Bodega Head	5/26/98	18	MCAL	.	.	0.16	106	7.5	3.2	1.2	10	0.210	2.4	1.0	2.5	189	ND	2	11	.
T-0	Lake Chabot	5/25/98	18	CFLU			No more ***C. fluminea*** were found at Lake Chabot.														

CGIG--***Crassostrea gigas***, CFLU--***Corbicula fluminea***, MCAL--***Mytilus californianus***

Table 19. PAH concentrations in bivalve tissues, 1998.
. = no data, NS = not sampled, ND = not detected, NA = not analyzed, Q = data point outside data quality objective, LPAH = low molecular weight PAHs, B = Blank Contamination.
Units expressed as dry weight.
T-0 = time of bivalve deployment into the Estuary from the source indicated under station name heading. For method detection limits, refer to ***QA Tables.***

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					%	%			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BG20	Sacramento River	4/24/98	16	CFLU	4.5	90	151	88	5	22	10	17	6	ND	ND	ND	ND	ND	ND	21	6	63	ND	10	26	27	ND	ND	ND	ND	ND	ND	ND	ND
BG30	San Joaquin River	4/24/98	16	CFLU	2.2	94	162	85	ND	19	7	14	ND	ND	ND	ND	6	ND	ND	19	20	77	6	9	21	35	ND	ND	ND	ND	ND	ND	6	ND
BF20	Grizzly Bay	4/24/98	16	CFLU	NS	91		Data from Grizzly Bay could not be used due to a very high contamination at the "clean" site.																										
BD50	Napa River	-	16	CGIG							No data due to one percent species survival.													No data due to one percent species survival.										
BD40	Davis Point	-	16	CGIG							No data due to zero percent species survival.													No data due to zero percent species survival.										
BD30	Pinole Point	4/23/98	16	MCAL	5.7	87	211	26	ND	B	ND	B	ND	ND	ND	ND	ND	ND	ND	26	ND	185	13	26	54	48	ND	16	16	ND	ND	6	5	ND
BD20	San Pablo Bay	4/23/98	16	CGIG	7.6	90	473	43	ND	12	ND	8	ND	ND	ND	ND	ND	ND	ND	24	ND	386	5	9	13	14	ND	ND	7	ND	ND	ND	8	ND
BD15	Petaluma River	-	16	CGIG							No data due to zero percent species survival.													No data due to zero percent species survival.										
BC61	Red Rock	-	16	MCAL							No data due to zero percent species survival.													No data due to zero percent species survival.										
BC21	Horseshoe Bay	4/23/98	16	MCAL	3.1	87	78	23	ND	B	ND	B	ND	ND	ND	ND	ND	ND	ND	23	ND	55	8	31	48	59	6	15	13	ND	ND	7	7	ND
BC10	Yerba Buena Island	-	16	MCAL				No data due to loss of mooring at sample site. It probably got removed by Bay Bridge crews.																										
BB71	Alameda	4/22/98	16	MCAL	4.1	86	76	14	ND	B	ND	B	ND	ND	ND	ND	ND	ND	ND	14	ND	58	ND	25	9	10	ND	ND	6	ND	ND	ND	7	ND
BA40	Redwood Creek	4/22/98	16	MCAL	4.2	86	95	32	ND	13	ND	9	ND	ND	ND	ND	ND	ND	ND	11	ND	63	ND	17	8	11	5	ND	7	ND	ND	ND	9	6
BA30	Dumbarton Bridge	4/22/98	16	MCAL	3	88	94	13	ND	B	ND	B	ND	ND	ND	ND	ND	ND	ND	13	ND	81	ND	30	10	11	ND	6	7	ND	ND	ND	11	7
BA10	Coyote Creek	4/22/98	16	CGIG	9.2	86	365	59	ND	14	5	10	ND	ND	ND	ND	6	ND	ND	25	ND	305	12	37	63	80	11	37	33	11	ND	ND	14	8
T-0	Lake Chabot	12/23/97	16	CFLU	6.2	87	264	126	5	28	9	17	6	ND	ND	ND	ND	ND	7	45	9	138	28	23	50	31	ND	ND	6	ND	ND	ND	ND	ND
T-0	Tomales Bay	1/9/98	16	CGIG	3.1	87	135	28	ND	8	ND	6	ND	ND	ND	ND	ND	ND	ND	13	ND	107	ND	7	22	17	ND	ND	ND	ND	15	ND	ND	ND
T-0	Bodega Head	1/9/98	16	MCAL	3.3	92	36	36	ND	19	ND	9	ND	ND	ND	ND	ND	ND	ND	8	ND	.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG20	Sacramento River	9/18/98	18	CFLU	7.1	89	187	30	ND	10	ND	ND	ND	ND	ND	ND	9	ND	ND	11	ND	157	10	19	35	47	ND	9	8	9	6	ND	8	6
BG30	San Joaquin River	9/18/98	18	CFLU	4.9	93	179	34	ND	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	14	ND	146	9	13	28	38	ND	9	12	9	ND	9	10	8
BF20	Grizzly Bay	-	18	CFLU						No data due to a lack of species from an "uncontaminated" site.													No data due to a lack of species from an "uncontaminated" site.											
BD50	Napa River	9/3/98	18	CGIG	6.5	93	550	48	ND	ND	ND	ND	ND	ND	ND	ND	8	ND	5	27	8	502	34	39	153	152	8	36	34	11	11	13	11	ND
BD40	Davis Point	9/1/98	18	CGIG	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BD30	Pinole Point	9/3/98	18	MCAL	8.6	92	516	37	ND	ND	ND	ND	ND	ND	ND	ND	9	ND	ND	22	6	479	31	35	139	108	20	38	42	18	6	15	16	11
BD20	San Pablo Bay	9/3/98	18	CGIG	7.3	89	391	21	ND	ND	ND	ND	ND	ND	ND	ND	5	ND	ND	16	ND	371	25	26	96	86	13	38	39	14	7	15	12	ND
BD15	Petaluma River	-	18	CGIG							No data due to one percent species survival.													No data due to one percent species survival.										
BC61	Red Rock	9/3/98	18	MCAL	3.9	86	85	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	ND	74	7	11	12	13	6	5	9	5	ND	ND	7	ND
BC21	Horseshoe Bay	9/3/98	18	MCAL	5.2	81	74	23	ND	ND	ND	ND	ND	ND	ND	ND	6	ND	ND	17	ND	51	5	11	13	11	5	ND	5	ND	ND	ND	ND	ND
BC10	Yerba Buena Island	9/2/98	18	MCAL	4.8	88	234	89	ND	6	ND	6	ND	ND	6	ND	20	ND	6	45	ND	146	15	15	42	33	7	6	9	5	7	ND	7	ND
BB71	Alameda	9/2/98	18	MCAL	4.5	87	143	29	ND	6	ND	ND	ND	ND	ND	ND	5	ND	ND	18	ND	114	8	17	19	18	7	7	9	5	8	ND	11	5
BA40	Redwood Creek	9/2/98	18	MCAL	4.6	86	81	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	ND	70	5	8	12	15	6	ND	7	ND	ND	ND	9	7
BA30	Dumbarton Bridge	9/2/98	18	MCAL	3.3	89	109	6	ND	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	103	7	13	15	19	8	8	10	6	ND	ND	10	6
BA10	Coyote Creek	9/2/98	18	CGIG	5.4	91	727	39	ND	ND	ND	ND	ND	ND	ND	ND	8	ND	ND	24	7	688	41	42	115	142	27	101	95	31	23	14	40	16
T-0	Lake Chabot	-	18	CFLU							No more ***C. fluminea*** were found at Lake Chabot.													No more ***C. fluminea*** were found at Lake Chabot.										
T-0	Tomales Bay	5/26/98	18	CGIG	.	86	44	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	ND	33	ND	ND	20	13	ND	ND	ND	ND	ND	ND	ND	ND
T-0	Bodega Head	5/26/98	18	MCAL	.	87	15	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6	ND	9	ND	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

CGIG--***Crassostrea gigas*** , CFLU--***Corbicula fluminea*** , MCAL--***Mytilus californianus***

1998 RMP Data: PCBs in Bivalve Tissue Samples

Table 20. PCB concentrations in bivalve tissues, 1998.

. = no data, NS = not sampled, ND = not detected, NA = not analyzed, B = Blank Contamination, b = Blank contamination less than 10% of measured concentration.

Units expressed as dry weight. T-0 = time of bivalve deployment into the Estuary from the source indicated under station name heading.

For method detection limits, refer to ***QA Tables*** .

Station Code	Station	Date	Cruise	Species	Lipid	Moisture	Sum of PCBs (SFEI)	PCB 008	PCB 017/18	PCB [illegible]	PCB [illegible]	PCB [illegible]	PCB [illegible]	PCB 031	PCB 033	PCB 044	PCB 049	PCB 052	PCB 056/60	PCB 060	PCB 066	PCB 070	PCB 074	PCB 077/110	PCB 087	PCB [illegible]	PCB [illegible]	PCB 095	PCB 097	PCB [illegible]	PCB 099	PCB 101
					%	%	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BG20	Sacramento River	4/24/98	16	CFLU	4.5	90	88	B	B	B	.	.	B	.	.	6.0	4.3	4.8	2.5	.	1.9	2.9	1.7	.	1.8	.	3.6	4.6	2.7	.	2.5	.
BG30	San Joaquin River	4/24/98	16	CFLU	NS	94	69	B	B	B	.	.	B	.	.	3.4	2.0	2.5	ND	.	ND	ND	ND	.	ND	.	3.1	3.5	2.4	.	2.6	.
BF20	Grizzly Bay	4/24/98	16	CFLU	6.3	91		Grizzly Bay data could not be used due to a very high concentration at the "clean" site.																								Grizzly Bay data could r
BD50	Napa River	-	16	CGIG				No data due to one percent species survival.																								No
BD40	Davis Point	-	16	CGIG				No data due to zero percent species survival.																								No
BD30	Pinole Point	4/23/98	16	MCAL	5.7	87	72	B	B	B	.	.	B	.	.	2.0	2.8	4.0	1.6	.	ND	2.0	1.7	.	1.2	.	7.3	5.0	1.8	.	3.6	.
BD20	San Pablo Bay	4/23/98	16	CGIG	7.6	90	54	1.9	2.0	1.5	.	.	3.7	.	.	1.2	1.6	2.1	ND	.	ND	1.5	ND	.	ND	.	3.8	2.7	1.2	.	2.6	.
BD15	Petaluma River	-	16	CGIG				No data due to one percent species survival.																								No
BC61	Red Rock	-	16	MCAL				No data due to zero percent species survival.																								No
BC21	Horseshoe Bay	4/23/98	16	MCAL	3.1	87	21	B	ND	ND	.	.	B	.	.	ND	ND	ND	ND	.	ND	ND	ND	.	ND	.	2.0	1.2	ND	.	1.3	.
BC10	Yerba Buena Island	-	16	MCAL				No data due to loss of mooring at sample site. It probably got removed by Bay Bridge crews.																								No data due to loss of r
BB71	Alameda	4/22/98	16	MCAL	4.1	86	59	B	ND	B	.	.	B	.	.	1.2	1.6	2.0	ND	.	ND	1.5	ND	.	1.1	.	4.7	2.9	1.7	.	2.7	.
BA40	Redwood Creek	4/22/98	16	MCAL	4.2	86	101	3.0	2.3	2.1	.	.	4.4	.	.	1.7	2.5	3.1	ND	.	1.4	2.5	ND	.	1.6	.	6.8	3.9	1.9	.	4.5	.
BA30	Dumbarton Bridge	4/22/98	16	MCAL	3.0	88	74	B	B	B	.	.	B	.	.	1.3	1.6	2.3	1.2	.	ND	2.0	ND	.	1.4	.	5.5	3.0	1.9	.	3.5	.
BA10	Coyote Creek	4/22/98	16	CGIG	9.2	86	221	2.6	3.8	2.5	.	.	6.3	.	.	3.5	5.1	6.8	6.4	.	3.0	4.8	2.3	.	4.3	.	15.0	11.0	3.7	.	9.7	.
T-0	Lake Chabot	12/23/97	16	CFLU	6.2	87	201	B	B	B	.	.	B	.	.	11.7	5.6	10.3	2.8	.	4.1	7.2	2.4	.	4.3	.	14.1	13.4	7.1	.	5.7	.
T-0	Tomales Bay	1/9/98	16	CGIG	3.1	87	8	1.4	1.4	1.0	.	.	2.7	.	.	ND	ND	ND	ND	.	ND	ND	ND	.	ND	.	ND	ND	ND	.	ND	.
T-0	Bodega Head	1/9/98	16	MCAL	3.3	92	6	B	B	ND	.	.	B	.	.	ND	ND	ND	ND	.	ND	ND	ND	.	ND	.	ND	ND	ND	.	ND	.
BG20	Sacramento River	9/18/98	18	CFLU	7.1	89	101	1.8	4.9	2.4	.	.	4.8	.	.	7.6	2.5	4.8	2.1	.	2.1	2.4	1.7	.	1.5	.	8.5	8.3	5.2	.	5.0	.
BG30	San Joaquin River	9/18/98	18	CFLU	4.9	93	81	3.3	3.5	ND	.	.	11.7	.	.	4.6	2.8	3.7	2.3	.	2.9	3.1	2.2	.	1.9	.	4.7	5.2	3.1	.	3.3	.
BF20	Grizzly Bay	-	18	CFLU				No data due to a lack of species from an "uncontaminated" site.																								No data due to
BD50	Napa River	9/3/98	18	CGIG	6.5	93	43	1.2	1.6	1.5	.	.	B	.	.	2.3	3.1	4.7	1.6	.	1.3	2.6	1.5	.	B	.	6.8	8.2	B	.	4.2	.
BD40	Davis Point	9/1/98	18	CGIG	NA	NA	NA	NA	NA	NA	.	.	NA	.	.	NA	NA	NA	NA	.	NA	NA	NA	.	NA	.	NA	NA	NA	.	NA	.
BD30	Pinole Point	9/3/98	18	MCAL	8.6	92	45	1.2	1.7	2.0	.	.	B	.	.	1.5	2.3	3.7	1.2	.	1.6	2.3	1.9	.	B	.	9.5	6.8	B	.	6.4	.
BD20	San Pablo Bay	9/3/98	18	CGIG	7.3	89	45	1.3	1.3	1.4	.	.	B	.	.	1.9	2.5	3.5	1.9	.	1.4	2.3	1.3	.	B	.	10.7	6.2	B	.	5.8	.
BD15	Petaluma River	-	18	CGIG				No data due to one percent species survival.																								No
BC61	Red Rock	9/3/98	18	MCAL	3.9	86	17	ND	ND	1.1	.	.	B	.	.	ND	1.2	1.5	ND	.	ND	1.0	ND	.	B	.	4.3	2.7	B	.	3.0	.
BC21	Horseshoe Bay	9/3/98	18	MCAL	5.2	81	14	ND	ND	ND	.	.	B	.	.	ND	1.2	1.7	ND	.	ND	1.0	ND	.	ND	.	4.4	2.2	B	.	2.4	.
BC10	Yerba Buena Island	9/2/98	18	MCAL	4.8	88	60	1.6	1.7	2.0	.	.	4.7	.	.	1.4	1.9	2.5	1.0	.	1.2	1.5	1.1	.	1.5	.	6.3	3.6	1.5	.	3.9	.
BB71	Alameda	9/2/98	18	MCAL	4.5	87	.	B	B	B	.	.	B	.	.	B	B	B	B	.	B	B	B	.	B	.	B	B	B	.	B	.
BA40	Redwood Creek	9/2/98	18	MCAL	4.6	86	63	1.4	2.7	1.6	.	.	5.3	.	.	1.2	2.5	1.9	ND	.	1.0	1.6	ND	.	1.7	.	6.9	2.7	1.7	.	4.7	.
BA30	Dumbarton Bridge	9/2/98	18	MCAL	3.3	89	.	B	B	B	.	.	B	.	.	B	B	B	B	.	B	B	B	.	B	.	B	B	B	.	B	.
BA10	Coyote Creek	9/2/98	18	CGIG	5.4	91	.	B	B	B	.	.	B	.	.	B	B	B	B	.	B	B	B	.	B	.	26.7 b	15.3 b	B	.	16.5 b	.
T-0	Lake Chabot	-	18	CFLU				No more ***C. fluminea*** were found at Lake Chabot.																								No mo
T-0	Tomales Bay	5/26/98	18	CGIG	.	86	1	ND	ND	ND	.	.	1.2	.	.	ND	ND	ND	ND	.	ND	ND	ND	.	ND	.	ND	ND	ND	.	ND	.
T-0	Bodega Head	5/26/98	18	MCAL	.	87	.	ND	ND	ND	.	.	ND	.	.	ND	ND	ND	ND	.	ND	ND	ND	.	ND	.	ND	ND	ND	.	ND	.

CGIG--***Crassostrea gigas*** , CFLU--***Corbicula fluminea*** , MCAL--***Mytilus californianus***

Table 20. PCB concentration in bivalve tissues, 1998.

Station Code	PCB 105	PCB 110	PCB 114/153	PCB 118	PCB 123/149	PCB 128	PCB 132/137	PCB 132/153	PCB 138	PCB 138/158	PCB 138/160	PCB 141	PCB 141/179	PCB 149	PCB 151	PCB 156	PCB 156/171
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BG20	ND	3.8	.	3.1	.	ND	.	19.1	.	7.3	.	ND	.	5.1	2.1	ND	.
BG30	ND	3.7	.	3.8	.	ND	.	19.5	.	6.4	.	ND	.	5.4	2.1	ND	.
BF20	l not be used due to a very high concentration at the "clean" site.																
BD50	o data due to one percent species survival.																
BD40	o data due to zero percent species survival.																
BD30	ND	5.1	.	2.6	.	ND	.	11.0	.	3.8	.	ND	.	8.0	2.5	ND	.
BD20	ND	3.4	.	1.7	.	ND	.	8.8	.	2.7	.	ND	.	5.3	1.9	ND	.
BD15	o data due to one percent species survival.																
BC61	o data due to zero percent species survival.																
BC21	ND	1.6	.	1.2	.	ND	.	5.1	.	2.8	.	ND	.	3.0	1.0	ND	.
BC10	mooring at sample site. It probably got removed by Bay Bridge crews.												.				
BB71	ND	4.0	.	2.5	.	ND	.	9.8	.	4.6	.	ND	.	6.2	2.9	ND	.
BA40	1.1	6.2	.	4.1	.	1.0	.	14.9	.	8.4	.	ND	.	10.1	3.1	ND	.
BA30	1.1	4.7	.	3.5	.	ND	.	12.8	.	5.8	.	ND	.	7.8	3.5	ND	.
BA10	1.7	13.5	.	7.4	.	1.6	.	34.0	.	12.7	.	2.3	.	25.4	7.5	ND	.
T-0	2.6	14.1	.	15.7	.	1.5	.	35.4	.	16.0	.	ND	.	9.7	2.4	1.0	.
T-0	ND	ND	.	ND	.	ND	.	2.0	.	ND	.	ND	.	ND	ND	ND	.
T-0	.	ND	.	ND	.	ND	.	1.6	.	1.4	.	ND	.	ND	3.6	ND	.
BG20	1.9	7.8	.	9.9	.	B	.	.	.	16.9 b	.	ND	.	13.9	2.3	ND	.
BG30	1.7	5.4	.	5.7	.	ND	.	.	.	B	.	ND	.	7.7	2.0	ND	.
BF20	o a lack of species from an "uncontaminated" site.																
BD50	B	B	.	B	.	ND	.	.	.	B	.	ND	.	B	2.6	ND	.
BD40	NA	NA	.	NA	.	NA	.	.	.	NA	.	NA	.	NA	NA	NA	.
BD30	B	B	.	B	.	B	.	.	.	B	.	B	.	15.4 b	3.4	ND	.
BD20	B	B	.	B	.	B	.	.	.	B	.	ND	.	17.9 b	4.0	ND	.
BD15	o data due to one percent species survival.																
BC61	ND	B	.	B	.	B	.	.	.	B	.	ND	.	B	1.9	ND	.
BC21	ND	B	.	B	.	ND	.	.	.	B	.	ND	.	B	1.5	ND	.
BC10	1.1	5.4	.	4.2	.	B	.	.	.	B	.	ND	.	9.3	2.6	ND	.
BB71	B	B	.	B	.	B	.	.	.	B	.	ND	.	B	B	ND	.
BA40	1.3	5.9	.	5.3	.	B	.	.	.	B	.	ND	.	11.3	2.6	ND	.
BA30	B	B	.	B	.	B	.	.	.	B	.	ND	.	B	B	B	.
BA10	B	23.8 b	.	B	.	B	.	.	.	23.8 b	.	B	.	40.6 b	B	ND	.
T-0	ore ***C. fluminea*** were found at Lake Chabot.																
T-0	ND	ND	.	ND	.	ND	.	.	.	ND	.	ND	.	ND	ND	ND	.
T-0	ND	ND	.	ND	.	ND	.	.	.	ND	.	ND	.	ND	ND	ND	.

Station Code	PCB 156/157/200	PCB 157/173	PCB 157/180	PCB 158	PCB 170	PCB 170/190	PCB 174	PCB 177	PCB 180	PCB 183	PCB 187	PCB 194	PCB 195	PCB 196/208	PCB 196/203	PCB 201	PCB 203
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BG20	.	.	.	.	.	ND	ND	ND	3.4	1.3	3.2	ND	ND	.	ND	ND	.
BG30	.	.	.	.	.	ND	ND	2.1	3.1	ND	3.3	ND	ND	.	ND	ND	.
BF20	Grizzly Bay data could not be used due to a very high concentration at the "clean" site.																
BD50	No data due to one percent species survival.																
BD40	No data due to zero percent species survival.																
BD30	.	.	.	.	.	ND	ND	1.3	2.3	ND	3.0	ND	ND	.	ND	ND	.
BD20	.	.	.	.	.	ND	ND	1.1	1.5	ND	2.1	ND	ND	.	ND	ND	.
BD15	No data due to one percent species survival.																
BC61	No data due to zero percent species survival.																
BC21	.	.	.	.	.	ND	ND	ND	ND	ND	1.6	ND	ND	.	ND	ND	.
BC10	No data due to loss of mooring at sample site. It probably got removed by Bay Bridge crews.																
BB71	.	.	.	.	.	1.4	ND	1.3	1.7	1.1	2.4	1.3	ND	.	ND	ND	.
BA40	.	.	.	.	.	ND	ND	1.7	2.4	1.6	4.4	ND	ND	.	ND	ND	.
BA30	.	.	.	.	.	1.0	ND	1.6	1.9	1.9	3.8	ND	ND	.	1.0	ND	.
BA10	.	.	.	.	.	ND	1.4	4.0	5.6	2.3	10.7	ND	ND	.	ND	ND	.
T-0	.	.	.	.	.	1.2	ND	1.0	5.9	1.3	3.0	ND	ND	.	1.8	ND	.
T-0	.	.	.	.	.	ND	ND	ND	ND	ND	ND	ND	ND	.	ND	ND	.
T-0	.	.	.	.	.	ND	ND	ND	ND	ND	ND	ND	ND	.	ND	ND	.
BG20	.	.	.	.	.	B	B	B	B	B	B	ND	ND	.	B	ND	.
BG30	.	.	.	.	.	B	B	B	B	ND	B	ND	ND	.	B	ND	.
BF20	No data due to a lack of species from an "uncontaminated" site.																
BD50	.	.	.	.	.	ND	ND	ND	ND	B	B	ND	ND	.	ND	ND	.
BD40	.	.	.	.	.	NA	NA	NA	NA	NA	NA	NA	NA	.	NA	NA	.
BD30	.	.	.	.	.	B	ND	B	B	B	B	B	ND	.	B	ND	.
BD20	.	.	.	.	.	ND	ND	B	B	B	B	ND	ND	.	ND	ND	.
BD15	No data due to one percent species survival.																
BC61	.	.	.	.	.	ND	ND	B	ND	B	B	ND	ND	.	ND	ND	.
BC21	.	.	.	.	.	ND	ND	B	ND	ND	B	ND	ND	.	ND	ND	.
BC10	.	.	.	.	.	ND	ND	B	B	B	B	ND	ND	.	ND	ND	.
BB71	.	.	.	.	.	B	ND	B	B	B	B	ND	ND	.	B	B	.
BA40	.	.	.	.	.	B	ND	B	B	B	B	ND	ND	.	ND	ND	.
BA30	.	.	.	.	.	B	ND	B	B	B	B	ND	ND	.	ND	ND	.
BA10	.	.	.	.	.	B	ND	B	B	B	B	ND	ND	.	B	ND	.
T-0	No more ***C. fluminea*** were found at Lake Chabot.																
T-0	.	.	.	.	.	ND	ND	ND	ND	ND	ND	ND	ND	.	ND	ND	.
T-0	.	.	.	.	.	ND	ND	ND	ND	ND	ND	ND	ND	.	ND	ND	.

CGIG--***Cr***

1998 RMP Data: Pesticides in Bivalve Tissue Samples

Table 21. Pesticide concentrations in bivalve tissues, 1998. . = no data, NS = not sampled, ND = not detected. Units expressed as dry weight.
T-0 = time of bivalve deployment into the Estuary from the source indicated under station name heading. For method detection limits, refer to ***QA Tables*** .

Station Code	Station	Date	Cruise	Species	Lipid	Moisture	Sum of DDTs (SFEI)	o,p'-DDD	o,p'-DDE	o,p'-DDT	p,p'-DDD	p,p'-DDE	p,p'-DDT	Sum of Chlordanes (SFEI)	alpha-Chlordane	gamma-Chlordane	cis-Nonachlor	trans-Nonachlor	Heptachlor	Heptachlor Epoxide	Oxychlordane	Sum of Cycpent (SFEI)	Aldrin	Dieldrin	Endrin	Sum of HCH (SFEI)	alpha-HCH	beta-HCH	delta-HCH	gamma-HCH	Hexachlorobenzene	Mirex
					%	%	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BG20	Sacramento River	4/24/98	16	CFLU	4.5	90	161	ND	3.0	10.0	11.2	121.9	14.6	19	4.5	3.6	2.7	7.8	ND	ND	ND	6.8	ND	6.8	ND	1.3	ND	ND	ND	1.3	ND	ND
BG30	San Joaquin River	4/24/98	16	CFLU	NS	94	163	5.5	2.2	8.1	13.0	117.8	16.3	13	3.0	2.3	2.3	5.5	ND	ND	ND	3.0	ND	3.0	ND	1.5	ND	ND	ND	1.5	ND	ND
BF20	Grizzly Bay	4/24/98	16	CFLU	6.3	91	214	13.7	0.7	17.3	10.8	148.3	22.8	39	11.3	7.1	4.9	14.0	ND	ND	1.6	5.6	ND	5.6	ND	3.0	ND	ND	ND	3.0	1.3	ND
BD50	Napa River	4/23/98	16	CGIG	.	.	156	15.7	0.5	5.1	27.8	94.9	12.0	32	7.2	6.2	3.3	11.5	ND	2.5	1.5	13.3	ND	13.3	ND	1.8	0.7	0.4	ND	0.7	ND	ND
BD40	Davis Point	-	16	CGIG	No data due to zero percent species survival.																											
BD30	Pinole Point	4/23/98	16	MCAL	5.7	87	140	11.1	1.3	6.4	21.9	84.1	14.8	29	7.7	6.3	3.4	9.2	ND	2.2	0.6	11.1	ND	10.3	0.8	1.0	0.5	ND	ND	0.5	ND	ND
BD20	San Pablo Bay	4/23/98	16	CGIG	7.6	90	126	9.9	1.4	6.0	21.5	76.5	10.4	25	7.6	5.0	3.0	7.7	ND	1.0	1.0	10.4	ND	9.4	1.0	1.1	0.6	ND	ND	0.5	ND	ND
BD15	Petaluma River	-	16	CGIG	No data due to one percent species survival.																											
BC61	Red Rock	-	16	MCAL	No data due to zero percent species survival.																											
BC21	Horseshoe Bay	4/23/98	16	MCAL	3.1	87	34	3.3	1.3	2.9	5.6	18.5	2.4	8	2.4	1.5	0.9	2.2	ND	0.4	0.3	9.6	ND	9.6	ND	1.5	0.4	0.6	ND	0.6	ND	ND
BC10	Yerba Buena Island	-	16	MCAL	No data due to loss of mooring at sample site. It probably got removed by Bay Bridge crews.																											
BB71	Alameda	4/22/98	16	MCAL	4.1	86	52	5.3	1.7	3.3	8.0	30.2	3.5	13	4.6	3.0	ND	4.4	ND	0.9	0.6	10.9	ND	10.9	ND	2.0	0.5	0.5	ND	1.0	ND	ND
BA40	Redwood Creek	4/22/98	16	MCAL	4.2	86	50	4.4	1.0	3.4	9.7	29.2	2.6	29	9.7	6.0	3.4	7.4	ND	1.6	1.2	14.9	ND	14.9	ND	1.9	0.4	0.5	ND	1.0	ND	ND
BA30	Dumbarton Bridge	4/22/98	16	MCAL	3.0	88	40	3.7	0.8	2.7	8.2	21.5	3.3	22	7.6	5.0	2.6	5.3	ND	1.1	0.9	11.3	ND	11.3	ND	0.9	ND	0.3	ND	0.7	ND	ND
BA10	Coyote Creek	4/22/98	16	CGIG	9.2	86	183	13.3	1.1	12.0	29.9	106.9	19.4	96	30.6	20.4	12.3	27.2	ND	2.9	2.9	15.6	ND	15.6	ND	1.9	0.5	0.3	ND	1.2	ND	ND
T-0	Lake Chabot	1/23/98	16	CFLU	6.2	87	25	.	ND	2.1	4.6	14.1	3.7	34	9.3	6.0	4.9	8.5	ND	3.1	2.0	12.3	ND	12.3	ND	1.7	ND	ND	ND	1.7	ND	ND
T-0	Tomales Bay	1/23/98	16	CGIG	3.1	87	21	.	ND	1.3	3.0	14.9	1.7	4	0.6	0.4	0.6	2.1	ND	ND	ND	1.3	ND	1.3	ND	0.5	0.5	ND	ND	ND	ND	ND
T-0	Bodega Head	1/23/98	16	MCAL	3.3	92	17	1.2	0.6	ND	1.5	12.8	1.0	5	1.5	0.9	ND	1.3	ND	1.4	ND	4.0	ND	4.0	ND	2.4	0.8	1.3	ND	0.3	ND	ND
BG20	Sacramento River	9/18/98	18	CFLU	7.1	.	299	12.7	5.4	8.1	35.6	209.2	27.9	19	5.5	2.8	ND	10.9	ND	ND	ND	9.1	ND	9.1	ND	3.7	ND	ND	ND	3.7	ND	ND
BG30	San Joaquin River	9/18/98	18	CFLU	4.9	.	117	3.1	ND	ND	14.4	91.5	8.4	5	ND	ND	ND	5.4	ND	ND	ND	5.9	ND	5.9	ND	.	ND	ND	ND	ND	ND	ND
BF20	Grizzly Bay	-	18	CFLU	No data due to a lack of species from an "uncontaminated" site.																											
BD50	Napa River	9/3/98	18	CGIG	6.5	.	89	10.3	1.6	2.1	25.5	45.3	4.7	9	ND	2.0	2.4	4.5	ND	ND	ND	5.7	ND	5.7	ND	.	ND	ND	ND	ND	ND	ND
BD40	Davis Point	9/1/98	18	CGIG	.	.	225	20.9	ND	7.2	50.7	133.0	13.0	19	2.2	4.3	2.8	9.7	ND	ND	ND	7.0	ND	7.0	ND	.	ND	ND	ND	ND	ND	ND
BD30	Pinole Point	9/3/98	18	MCAL	8.6	.	165	13.2	3.4	3.8	40.7	94.4	9.1	15	2.6	4.1	1.6	6.5	ND	ND	ND	6.5	ND	6.5	ND	0.6	ND	ND	ND	0.6	ND	ND
BD20	San Pablo Bay	9/3/98	18	CGIG	7.3	.	137	10.9	2.8	1.9	34.3	81.4	6.0	11	1.5	2.4	1.4	5.4	ND	ND	ND	4.9	ND	4.9	ND	1.1	1.1	ND	ND	ND	ND	ND
BD15	Petaluma River	-	18	CGIG	No data due to one percent species survival.																											
BC61	Red Rock	9/3/98	18	MCAL	3.9	.	48	4.7	1.1	ND	13.7	26.0	2.5	7	2.6	2.4	ND	2.2	ND	ND	ND	8.6	ND	8.6	ND	1.2	0.6	ND	ND	0.6	ND	ND
BC21	Horseshoe Bay	9/3/98	18	MCAL	5.2	.	26	0.1	0.4	ND	8.7	15.0	1.4	5	1.2	1.6	0.7	1.4	ND	ND	ND	5.4	ND	5.4	ND	1.4	0.9	ND	ND	0.6	ND	ND
BC10	Yerba Buena Island	9/2/98	18	MCAL	4.8	.	38	4.7	ND	0.6	11.0	19.8	2.3	7	1.7	2.4	0.4	2.2	ND	ND	ND	7.2	ND	7.2	ND	0.4	ND	ND	ND	0.4	ND	ND
BB71	Alameda	9/2/98	18	MCAL	4.5	.	42	4.0	0.8	ND	11.7	23.7	2.2	10	2.7	2.8	1.9	2.5	ND	ND	ND	11.0	ND	11.0	ND	1.3	0.6	ND	ND	0.8	ND	ND
BA40	Redwood Creek	9/2/98	18	MCAL	4.6	.	44	4.3	0.7	ND	10.8	27.0	1.3	19	5.7	3.9	3.5	5.5	ND	ND	0.8	8.8	ND	8.8	ND	1.6	ND	1.1	ND	0.5	ND	ND
BA30	Dumbarton Bridge	9/2/98	18	MCAL	3.3	.	40	3.8	ND	ND	10.0	24.9	1.0	17	6.3	5.5	ND	5.1	ND	ND	ND	12.4	ND	12.4	ND	.	ND	ND	ND	ND	ND	ND
BA10	Coyote Creek	9/2/98	18	CGIG	5.4	.	165	5.5	2.6	2.8	38.7	110.8	4.8	61	15.0	15.0	10.5	19.7	ND	ND	1.3	7.6	ND	7.6	ND	2.6	0.6	ND	ND	2.0	ND	ND
T-0	Lake Chabot	-	18	CFLU	No more ***C. fluminea*** were found at Lake Chabot.																											
T-0	Tomales Bay	9/3/98	18	CGIG	.	.	8	0.6	ND	ND	1.4	5.3	1.0	2	0.9	0.9	ND	0.6	ND	ND	ND	4.1	ND	4.1	ND	2.6	1.2	1.4	ND	ND	ND	ND
T-0	Bodega Head	9/3/98	18	MCAL	.	.	12	0.9	ND	0.4	1.3	8.5	1.2	1	ND	ND	ND	0.9	ND	ND	ND	0.5	ND	0.5	ND	0.4	ND	0.4	ND	ND	ND	ND