Water Monitoring Section 2000, Jon Leatherbarrow, Sarah Lowe, and RMP staff.

2.1. Background

Water in the San Francisco Estuary has been monitored by the RMP since 1993 to fulfill the general objectives of assessing regional conditions in relation to water quality criteria, characterizing patterns and trends of contaminant concentrations and distribution in the water column, as well as identifying general sources of contamination to the Bay.

In accordance with the recommendations from a five-year external review of the RMP (Bernstein and O'Connor 1997), the RMP objectives were revised to better address specific management questions in the Estuary (*see* RMP Overview). Consequently, a redesign of the RMP monitoring plan began in 2000 to meet the revised RMP objectives (*see* RMP Winter Newsletter 6 (2)). RMP water monitoring in 2000 was conducted during a transitional period between the original monitoring design (1993-1999) and the new design scheduled to be implemented in the summer of 2002. Unlike previous years of RMP monitoring when samples were collected three times annually, water samples in 2000 were collected one time in both the wet- and dry-seasons (February and July) for water quality and trace element analyses. Samples were collected for analyses of organic contaminants once in 2000 during the dry season (July).

Water monitoring was conducted at twenty-six RMP stations throughout the Estuary in 2000 (Figure 1.1). Twenty-two sites were monitored as part of the RMP Status and Trends Monitoring component, while two sites located in the sloughs of the Lower South Bay were monitored in cooperation with the cities of San Jose (C-3-0) and Sunnyvale (C-1-3). In addition, two sites located near the Estuary-watershed interface of the Coyote Creek at Standish Dam (BW10) and in the Alviso Slough, near the mouth of the Guadalupe River (BW15), were monitored as part of the Estuary Interface Pilot Study (EIP Study) (Figure 3.16). Leatherbarrow and Hoenicke (2002) summarized results of the EIP study from water and sediment samples collected between 1996 and 1999. To compare water-monitoring results among the major reaches of the Estuary, RMP stations were grouped into larger segments (Table 1.3).

The contaminants measured in RMP water samples have remained relatively constant over the last few years, except for the addition of methyl mercury in 2000 (Table 1.2). To relate contaminant concentrations to general water quality conditions at the time of sampling, the RMP measured conventional water quality parameters, such as salinity, total suspended solids (TSS) and dissolved organic carbon (DOC) (Figures 2.1-2.3). In addition, the United States Geological Survey (USGS) collected data for five water quality parameters (salinity, temperature, dissolved oxygen, suspended sediments, and phytoplankton biomass) on a monthly basis at several sites within the Bay to complement RMP monitoring activities.

The RMP measured trace elements in water as dissolved (0.45 µm filtered), total, and near-total concentrations (Figures 2.4-2.16). However, instrumentation problems in the laboratory delayed the analyses of 2000 water samples for several cationic trace metals (cadmium, copper, lead, nickel, and zinc). Furthermore, mercury concentrations from July sampling were not available due to precision between duplicate analyses that exceeded quality assurance limits. Consequently, concentration data were only available for arsenic, methyl mercury and selenium from February and July (Figures 2.4, 2.9, and 2.11), and mercury data from February (Figure 2.8) at the time of report production.

Organic contaminant concentrations were measured in water only during dry season sampling and reported as dissolved (1 µm filtered) and total (dissolved + particulate) concentrations (Figures 2.14-2.21). Detailed methods for sample collection and laboratory analysis are described in the Field Sampling Manual for the RMP (David et al. 2001) and a summary of analytical methods is located in the *Description of Methods*.

2.2. Water Quality Guidelines

To evaluate the condition of the Estuary in terms of potential effects on aquatic organisms and human health, contaminant concentrations were compared to various water quality guidelines. Concentrations of dissolved trace elements and total (dissolved + particulate) organic contaminants were compared to water quality criteria (WQC) listed in the U.S. Environmental Protection Agency's California Toxics Rule (CTR) (US EPA 2000). Total water quality criteria were calculated using the conversion table listed in the CTR and total concentrations of six trace elements were compared to those hardness-dependent criteria. When hardness data were unavailable, a hardness of 100 mg/L was assumed for the calculation. A hardness value ceiling of 400 mg/L was used for this report by recommendation of the San Francisco Bay Regional Water Quality Control Board (Regional Board) (Suer, CRWQCBSFB, pers. comm.). Although a water quality criterion for diazinon was not included in the CTR, the guideline concentration of 40,000 ppq developed by the California Department of Fish and Game (Menconi and Cox 1994), was used to evaluate diazinon concentrations in water. Chlorpyrifos and mirex are not listed in the CTR; however, the EPA does have recommended guidelines for these contaminants (US EPA 1999).

Water quality criteria for trace elements differ for samples collected from saltwater, estuarine, or freshwater portions of the Estuary. The San Francisco Bay Water Quality Control Plan (Basin Plan) defines sites as (1) freshwater when the salinity is less than 5 parts per thousand (‰) more than 75% of the time, (2) saltwater when the salinity is greater than 5‰ more than 75% of the time, and (3) estuarine when the salinity is intermediate, estuarine organisms are present for significant periods of time, or when based on an evaluation of the Regional Board. The Basin Plan also states that the lower of the freshwater and saltwater guidelines apply to estuarine locations. RMP monitoring stations were designated as freshwater, saltwater, or estuarine based on an evaluation by the Regional Board.

Most of the contaminants listed in the CTR have several criteria aimed at protecting aquatic life or human health. RMP contaminant data have generally been compared to the lowest criterion for each contaminant. In general, trace element concentrations were compared to 4-day average aquatic life criteria because RMP data were probably indicative of conditions that persist longer than one day. Trace organic contaminant concentrations were compared to the health criteria for the consumption of aquatic organisms only, since RMP stations are all seaward of drinking water intakes in the Delta.

2.3. Aquatic Bioassays

In the first five years of RMP monitoring, ambient water toxicity was assessed by determining percent normal development and percent survival of aquatic organisms exposed to water samples collected from different reaches of the Bay. In 1998, the RMP

modified its monitoring strategy in order to allocate more resources for the Episodic Toxicity Pilot Study, which began studying the effects of episodic events on water toxicity in the winter of 1996-97 (*see* Gunther and Ogle 2000).

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

2.4. Trends in Water Quality

The waters of the San Francisco Estuary have been sampled from the same sites since 1989 to determine general spatial and temporal patterns in contaminant concentrations. Flegal et al. (1991) measured concentrations of several trace elements in 1989 and 1990 as a preliminary study of trace element cycling within the San Francisco Estuary. In 1991 and 1992, samples were collected under the State's Bay Protection and Toxic Cleanup Program (BPTCP), which functioned as a Pilot Regional Monitoring Program and a precursor to the current RMP.

The RMP has focused on temporal trends in contamination by measuring contaminant concentrations on seasonal and annual time scales. Total concentrations of several trace elements and organic contaminants have been averaged for different Bay segments, including the Rivers, Northern Estuary, Central Bay, and South Bay. Mean concentrations and ranges were plotted for each RMP water sampling date from 1989 through July 2000 (Figures 2.23-2.39).

2.5. Water Monitoring Results in the San Francisco Estuary, 2000.

2.5.1. Water Quality in the Estuary

The hydrologic conditions in the San Francisco Estuary during water year 2000 were similar to previous years of RMP monitoring, characterized by heavy precipitation and runoff in the winter and early-spring months, followed by drier conditions in the summer months. During wet-season RMP water sampling in early February, the Sacramento-San Joaquin Delta outflow to the Bay ranged from approximately 30,000-40,000 cfs, resulting in salinity less than 2 practical salinity units (psu) at RMP stations in the Delta and Suisun Bay (Figure 2.1). Winter storms typically produce increased surface runoff and river discharge, which can mobilize and transport loads of suspended sediments and dissolved constituents to the Bay. Accordingly, dissolved organic carbon (DOC) concentrations were higher in February samples compared to July samples at RMP stations heavily influenced by freshwater tributary inputs, which includes stations in the Rivers, the Northern Estuary, and the Estuary Interface (Figure 2.2). Stations in the Estuary Interface and Southern Sloughs had higher wet-season DOC concentrations (> 4 mg/L) than other RMP stations. Total suspended solids (TSS) concentrations, however, were generally lower in February samples, with a maximum concentration of only 65 mg/L at Petaluma River (BD15), compared to dry-season samples collected in July [maximum = 316 mg/L at Petaluma River (BD15)] (Figure 2.3). Although the mean daily outflow for the month of February was well above the 41-year average net Delta outflow

index (Le 2001), outflow was below average until approximately a week after RMP winter sampling, when flow quickly increased and peaked at 164,000 cfs. By the time RMP summer sampling occurred in July, outflow decreased to typical dry-season flows of 6,500-8,300 cfs.

2.5.2. Contaminant concentrations in Water

Concentrations of several contaminants of concern for the San Francisco Bay, such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), chlorinated pesticides, mercury, and selenium have historically been high in RMP water samples collected from the southern reaches of the Estuary relative to other segments. The RMP Estuary Interface Pilot Study, conducted from 1996-1999, focused on evaluating potential contaminant contributions from the watersheds of the Guadalupe River and Coyote Creek through the collection and analysis of contaminant data from the Estuary Interface stations (BW10 and BW15). The results from RMP water monitoring in 2000, in the following discussion, were generally consistent with the pilot study findings summarized by Leatherbarrow and Hoenicke (2002).

Trace Elements

As mentioned previously, only concentration data for arsenic, methyl mercury and selenium from February and July (Figures 2.4, 2.9, and 2.11), and mercury data from February (Figure 2.8) were available at the time of report production.

Dissolved and total arsenic concentrations were generally lower in February samples compared to July samples (Figure 2.4). Because arsenic predominantly exists in the dissolved phase, a decrease in concentrations in the wet season was most likely caused by dilution of dissolved constituents in the water column from increased freshwater flow from the tributaries. The maximum concentrations of dissolved (3.2 µg/L) and total (6.9 µg/L) arsenic were measured at Petaluma River (BD15) in July. Dry-season concentrations of dissolved arsenic were also elevated in the Southern Sloughs and Lower South Bay compared to other RMP stations.

Because mercury has high affinity for particle surfaces, the distribution and concentrations of total mercury at RMP stations have historically followed general patterns of distribution of TSS concentrations. Similar patterns were observed with wet-season water samples in 2000, in which total mercury concentrations ranged from 0.0022 µg/L to 0.034 µg/L (Figure 2.8b). However, the maximum total mercury concentration (0.034 µg/L) measured at Guadalupe River (BW15) was over twice as high as concentrations at all other RMP stations, except Petaluma River (BD15) (0.025 µg/L). High concentrations of dissolved and total mercury at Guadalupe River (BW15) have consistently been measured by the RMP as part of the Estuary Interface Pilot Study, and are indicative of the potential impacts from the inoperative New Almaden mercury-mining district in the Guadalupe River watershed (Leatherbarrow and Hoenicke 2002, CRWQCBSFB 2000). Mercury concentrations were also high at RMP stations in the Northern Estuary.

Dissolved concentrations of methyl mercury in samples from Standish Dam (BW10) and Sunnyvale (C-1-3) were relatively high during February sampling compared to other RMP stations (Figure 2.9a). In the Northern Estuary and Rivers, dissolved methyl mercury was only detected in samples collected in February. In contrast, total

methyl mercury concentrations were generally higher during dry-season sampling, with an observed gradient of decreasing concentrations from the Estuary Interface and Southern Sloughs to the South Bay and a maximum concentration measured at San Jose (C-3-0) (0.46 ng/L) (Figure 2.9b). This may be explained to some extent by generally similar patterns of suspended solids (TSS). Sacramento River (BG20) water, however, had a higher concentration of total methyl mercury in February than in July. Relatively high mercury and methyl mercury concentrations measured in the Northern Estuary and Rivers during February suggest that wet-season conditions influence the transport of these contaminants from the Central Valley watersheds to the Bay. This is supported by findings from a study by Domagalski (1999), which found relatively high concentrations of mercury and methyl mercury in Sacramento River water collected during periods of high river flows and runoff compared to the dry season.

As in past years, the highest concentrations of dissolved and total selenium were measured at the Estuary Interface stations during both seasons, with an apparent spatial gradient of decreasing concentrations towards the Central Bay (Figure 2.11). Maximum concentrations of dissolved (7.7 µg/L) and total (8.0 µg/L) selenium, measured at Guadalupe River (BW15) in July, were the highest concentrations of selenium measured by the RMP since its inception in 1993. High selenium concentrations in Estuary Interface water samples may result from weathering of marine shales in the Coast Ranges that line the Santa Clara Valley (Anderson 1998).

Organic Contaminants

Similar to previous RMP results, concentrations of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) were highest in the southern segments of the Estuary, which lie adjacent to watersheds with extensive urban development (Figures 2.13 and 2.14). Maximum concentrations of dissolved PAHs (8.4 ng/L) and PCBs (498 pg/L) were measured at San Jose (C-3-0), while maximum concentrations of total PAHs (147 ng/L) and PCBs (3,050 pg/L) were measured at Guadalupe River (BW15).

Concentrations of several chlorinated pesticides, such as chlordane, DDT, and dieldrin were highest at the Estuary Interface stations (Figures 2.15, 2.16, and 2.20, respectively). Standish Dam (BW10) in Coyote Creek had the highest concentrations of dissolved and total chlordanes (830 pg/L and 1290 pg/L, respectively), dissolved DDTs (685 pg/L), and dissolved and total dieldrin (410 pg/L and 413 pg/L, respectively). The maximum concentration of total DDT (9,270 pg/L) at Guadalupe River (BW15) was slightly higher than the concentration measured in the Standish Dam (BW10) sample (8,820 pg/L). Dissolved and total hexachlorocyclohexanes (HCHs) were highest at San Jose (C-3-0) (~ 270 pg/L).

Concentrations of diazinon and chlorpyrifos, two organophosphorous insecticides used extensively for agricultural and urban applications, were highest at Standish Dam (BW10) on Coyote Creek and San Jose (C-3-0), located near the mouth of the creek (Figure 2.17 and 2.19). Coyote Creek, which drains a watershed of approximately 320 square miles into the Lower South Bay, is the largest watershed in the Santa Clara Basin. The watershed is comprised predominantly of agricultural land between the hills of the Diablo range and San Jose, where heavily urbanized areas lie adjacent to the Bay. Chlorpyrifos concentrations also showed a distinct spatial gradient of decreasing

concentrations from the Rivers to the Central Bay. The observed concentration gradients indicate that watersheds in the Central Valley, as well as watersheds of local tributaries, most likely contain sources that contribute these pesticides to the tributaries.

2.5.3. Contaminant Trends in Water

A main objective of the RMP is to determine patterns and trends in contaminant concentrations and distribution in the San Francisco Estuary. For this report, average concentrations and ranges are shown for selected contaminants using available data from 1989 through 2000 (Figures 2.22-2.38). Average concentrations of arsenic and cadmium (Figures 2.22 and 2.23, respectively) were generally higher during dry-season sampling, most likely because of the waning effects of dilution as freshwater flows to the Bay decrease during the summer months. High average concentrations of diazinon during the wet season (Figure 2.35) were most likely indicative of episodic pulses of diazinon that get washed into the Bay during winter storms.

One important seasonal and spatial pattern seen in RMP monitoring is the occurrence of peak concentrations of several dissolved trace elements measured at Petaluma River (BD15) in the wet-season. During periods of increased freshwater flow, dissolved concentrations of copper, lead, nickel, mercury, silver, and zinc have been historically high at Petaluma River (BD15) compared to other sites. These elevated dissolved metal concentrations have typically coincided with maximum concentrations of DOC, which is evidence of the influence of DOC as a transport mechanism for dissolved metals, such as copper (Kuwabara et al. 1989). From 1997-1999, wet-season concentrations of dissolved nickel and lead in Petaluma River samples were the highest concentrations of those metals measured at any RMP station in each of those three years. Dissolved trace element data from 2000 RMP monitoring were not yet available to evaluate if this pattern continued; however, the DOC concentration measured at Petaluma River (BD15) in February was lower than previous years and approximately equal to the bay-wide average. Therefore, dissolved metal concentrations are not expected to be high at Petaluma River (BD15) relative to other RMP stations.

Although trends have been apparent for some contaminants, analyses of annual and long-term trends are complicated by substantial hydrologic variations that occur from year to year. Particle-associated contaminants are dependent on sediment dynamics throughout the Estuary and the seasonal and episodic nature of sediment pulses from the tributaries. Variability in contaminant concentrations can arise from the influence of multiple factors, such as fluctuations in stream flow and erosional/depositional processes, which influence water quality parameters, such as TSS and DOC.

Recent studies have focused on determining long-term trends of selected contaminants with available data from the pilot regional monitoring studies (Flegal et al. 1991) and RMP. Steding et al. (2000) used isotopic compositions of lead to determine that no significant decrease in dissolved lead concentrations has occurred in San Francisco Bay waters since 1989. This is thought to be due to benthic remobilization from sediments in the Bay and lengthy retention times of lead in the watersheds adjacent to the Bay and in the Central Valley. Squire et al. (2001) used time series models to provide further evidence of relatively constant concentrations of lead in the Estuary and show that dissolved silver concentrations have significantly decreased over the last decade.

2.5.4. Comparison to Water Quality Guidelines

Most water samples collected during RMP monitoring in 2000 had concentrations exceeding at least one of the water quality guidelines (Table 2.1). Five out of 25 samples (20%) analyzed for trace elements exceeded the mercury guideline for freshwater (0.012 µg/L) in February (Table 2.2). Concentrations of mercury and selenium in Guadalupe River (BW15) water samples exceeded guidelines. In fact, all water samples collected from the Estuary Interface stations (BW10 and BW15) exceeded water quality guidelines for total PCBs, total chlordanes, total DDTs, p,p'-DDE, and dieldrin (Table 2.3). Furthermore, 14 out of 18 water samples (78%) collected in 2000 had total PCB concentrations that exceeded the PCB criterion of 170 pg/L.

2.5.5. Effects of Contaminants on Aquatic Organisms

The RMP evaluated potential water toxicity at six stations located in the northern and southern reaches of the Bay in 2000 (Figure 2.22). Toxicity tests using *Americamysis bahia* (formerly *Mysidopsis bahia*) indicated that no significant water toxicity occurred during RMP monitoring. However, RMP monitoring was not designed to characterize episodic events, such as storm discharge or applications of pesticides, which have been linked to increased toxicity in the San Francisco Estuary (Gunther and Ogle 2000).

Episodic Toxicity Pilot Study monitoring in 2000 (*see* Ogle et al. 2002) was conducted on water samples collected immediately after storms or surface runoff events from the Napa River and Pacheco Slough, both of which drain watersheds in the northern region of the Estuary. Long-term monitoring was also conducted at Mallard Island, which lies just downstream from the confluence of the Sacramento and San Joaquin River. Toxicity was observed in two out of 11 samples (18%) from Napa River, three out of 12 samples (25%) from Pacheco Slough, and two out of 56 samples (3.6%) from Mallard Island. Compared to results from previous years, this was a reduction in toxicity of Bay water to *Americamysis bahia* that Ogle et al. (2002) attributed to the reduced use of these organophosphate pesticides in the watersheds of the Estuary. At each of the stations, only one sample had concentrations of diazinon and/or chlorpyrifos that exceeded the LC50 for those contaminants. While some toxicity may have been caused by the presence of organophosphate pesticides, the cause of toxicity in the four remaining samples was not determined in the study. This suggests that other factors, such as unidentified contaminants or synergistic effects of several contaminants, may contribute to toxicity to organisms in the San Francisco Estuary.

References

Andersen, D.W. 1998. Natural levels of nickel, selenium, and arsenic in the southern San Francisco Bay area. Prepared for the City of San Jose, Environmental Services Department. San Jose, CA.

Bernstein, B. and J. O'Connor. 1997. Five-year program review: Regional Monitoring Program for Trace Substances in the San Francisco Estuary. Prepared for the San Francisco Estuary Institute. Richmond,CA. http://www.sfei.org/rmp/reports/five_year_review.html/five_year_review.pdf

CRWQCBSFB. 1995. San Francisco Bay Basin, Region 2: Water Quality Control Plan. California Regional Water Quality Control Board, San Francisco Bay Region. Oakland, CA.

CRWQCBSFB. 2000. Watershed management of mercury in the San Francisco Bay Estuary: Total Maximum Daily Load. Report to U.S. EPA. California Regional Water Quality Control Board, San Francisco Bay Region. Oakland, CA.

David, N., D. Bell, and J. Gold. 2001. Field sampling manual for the Regional Monitoring Program for Trace Substances. Prepared for the San Francisco Estuary Institute. Richmond, CA.

Flegal, A.R., G.A. Gill, G.J. Smith, S. Sanudo-Wilhelmy, G. Scelfo, and L.D. Anderson. 1991. Trace element cycles in the San Francisco Bay Estuary: Results from a preliminary study in 1989-1990. Final Report to the State Water Resources Control Board. Institute of Marine Sciences, University of California Santa Cruz, Santa Cruz, CA.

Gunther, A.J. and S.Ogle. 2000. Episodic toxicity in the San Francisco Bay system. Prepared for the Regional Monitoring Program for Trace Substances and the San Francisco Estuary Institute. Richmond, CA.

Ogle, R.S., A.J. Gunther, R. Hoenicke, J. Cotsifas, J.Gold, P. Salop, D. Bell, B. Thompson, and S. Hansen. 2002. Technical Report. Ambient water toxicity in the San Francisco Bay system. San Francisco Estuary Institute. Oakland, CA.

Le, K. 2001. Delta hydrology. Interagency Ecological Program Newsletter. Sacramento, CA. 14 (2). p. 10-12.

Leatherbarrow, J.E. and R.Hoenicke. 2002. Draft Technical Report. Results of the Estuary Interface Pilot Study, 1996-1999. San Francisco Estuary Institute. Oakland, CA.

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.

Squire, S., G.H. Scelfo, J. Revenaugh, and A.R. Flegal. 2001. Decadal trends of silver contamination in San Francisco Bay surface waters: comparison with lead. *submitted to* Environmental Science and Technology.

Steding. D., C.E. Dunlap, and A.R. Flegal. 2000. New isotopic evidence for chronic lead contamination in the San Francisco Bay estuary system: implications for the persistence of past industrial lead emissions in the biosphere. Proc. Natl. Acad. Sci. USA. 97 (21).

US EPA. 1999. National recommended water quality criteria – correction. Office of Water. United States Environmental Protection Agency. EPA 822-Z-99-001.

US EPA. 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. Federal Register Vol. 65, No. 97, May 18, 2000. United States Environmental Protection Agency.

Table 2.1. Water quality guidelines. California Toxics Rule water quality criteria (US EPA, May 18, 2000) are listed except where noted. Human health criteria were based on (1) human consumption of either water and organisms or organisms only and (2) an upper bound risk assessment of one person in a million (10-6) for carcinogens. Aquatic life criteria were based on (1) protection of the presence and uses of fresh and salt water aquatic organisms and (2) concentrations required to prevent eliciting effects from exposure for durations of 1-hour or 4-days. Dissolved trace element criteria are listed (except for the mercury and selenium aquatic life value). Total trace element criteria (not shown) may be calculated using the procedures specified in the proposed California Toxics Rule. Guidelines for organic compounds are listed on a total basis (dissolved + particulate). Units are µg/L. Bold and italicized values are hardness dependent criteria and are calculated for this table using a hardness value of 100 mg/L.

Parameter	Aquatic Life				Human Health (10^{-6} risk for carcinogens)	
	Fresh Water		Salt Water		Fresh Water	Salt & Fresh Water
	1-hour	4-day	1-hour	4-day	Water & Organisms	Organisms only
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***	4.8	3.1	1300	.
Hg [A]	2.4	0.012	2.1	0.025	0.05	0.051
Ni	***470***	***52***	74	8	610	4600
Pb	***65***	***2.5***	210	8.1	.	.
Se [B]		5	290	71	.	.
Zn	***120***	***120***	90	81	.	.
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)fluoranthen	.	.	.	.	0.0044	0.049
Benzo(k)fluoranthen	.	.	.	.	0.0044	0.049
Beta-HCH	.	.	.	.	0.014	0.046
Chlordane	2.4	0.0043	0.09	0.004	0.00057	0.00059
Chlorpyrifos [C]	0.083	0.041	0.011	0.0056	.	.
Chrysene	.	.	.	.	0.0044	0.049
Dibenz(a,h)anthrace	.	.	.	.	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)pyre	.	.	.	.	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 [C]	.	0.001	.	0.001	.	.
Total PCBs	.	0.014	.	0.03	0.00017	0.00017

[A] Mercury Aquatic Life values are from the San Francisco Basin Plan, 1995 and are for total recoverable mercury.
[B] Selenium values are region-specific criteria as outlined in the National Toxics Rule: values are for total recoverable selenium results and fresh water criteria apply to the whole estuary into the Delta.
[C] Chlorpyrifos and mirex are not listed in the proposed CTR but EPA criteria do exist for them.

Table 2.2. Summary of trace elements that were above water quality criteria (WQC) and guidelines for RMP water samples in 2000. Data for cadmium, copper, nickel, lead, silver and zinc were not available at time of report production due to analytical problems in the laboratory. WQC used in this comparison are from the U.S. EPA California Toxics Rule (2000) 304(a) Criteria. Only compounds that were above criteria or guidelines are listed. ● = above guideline, - = not available (note: these were qualified data and were not evaluated), NS = not sampled.

			Total Trace Elements			
			Mercury		Selenium	
		WQC (µg/L)	0.012		5	
	Code	Station	February	July	February	July
Estuary	BW10	Standish Dam		-		
Interface	BW15	Guadalupe River	●	-		●
Southern	C-1-3	Sunnyvale		-		
Sloughs	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	NS	-		
	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		-		

Table 2.3. Summary of trace organic contaminants that were above water quality criteria (WQC) and guidelines for RMP water samples in 2000. WQC used in this comparison are from the U.S. EPA California Toxics Rule (2000) 304(a) Criteria. Only compounds that were above criteria or guidelines are listed. ● = above guideline. NS = not sampled.

			Total PCBs	Dieldrin	Total Chlordanes	Total DDTs	p,p'-DDE
		WQC (pg/L)	0.00017	0.00014	0.00059	0.00059	0.00059
	Code	Station	July	July	July	July	July
Estuary	BW10	Standish Dam	●	●	●	●	●
Interface	BW15	Guadalupe River	●	●	●	●	●
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	NS				
	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					

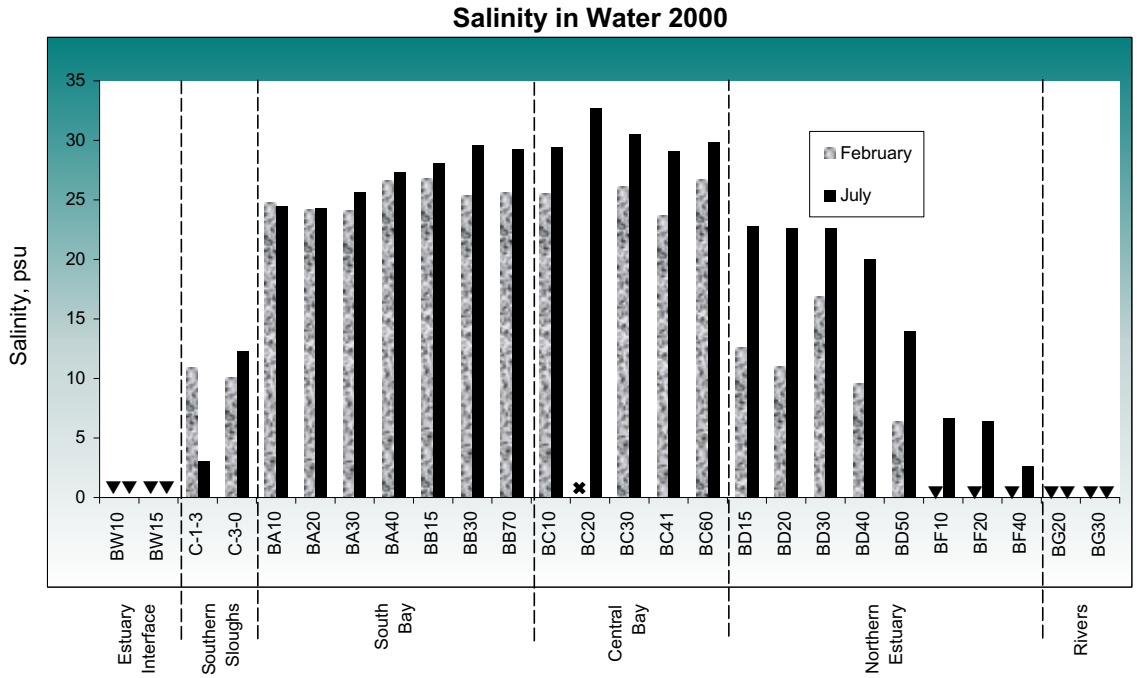


Figure 2.1. Salinity in practical salinity units (psu) at each RMP water station in February and July of 2000. ▼ = indicates salinity was < 2 psu. ✖ = not sampled. Salinities ranged from below detection to 33 psu. The highest salinity was measured at Golden Gate (BC20) in July.

Source Data: See Data Table 1

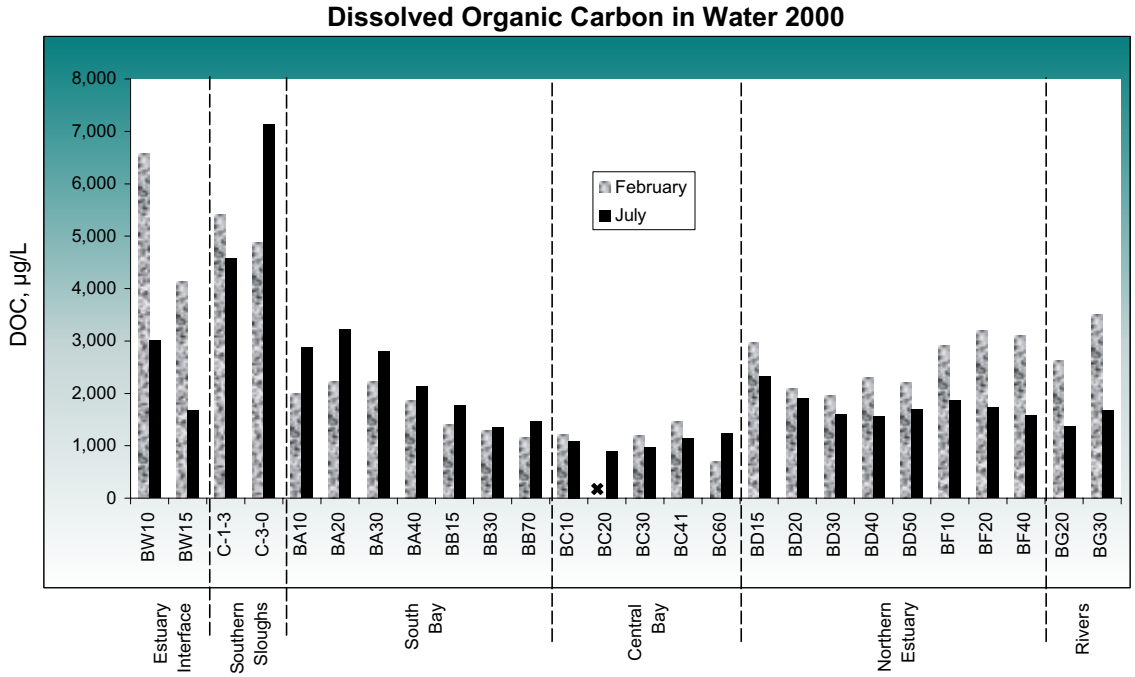


Figure 2.2. Dissolved organic carbon (DOC) in micrograms per liter (µg/L) at each RMP water station in February and July of 2000. DOC ranged from 710 µg/L to 7,130 µg/L. The highest concentration was measured at San Jose (C-3-0) in July and the lowest was measured at Red Rock (BC60) in February. Average concentrations were highest in the Southern Sloughs (5,850 µg/L) and lowest in the Central Bay

Source Data: See Data Table 1

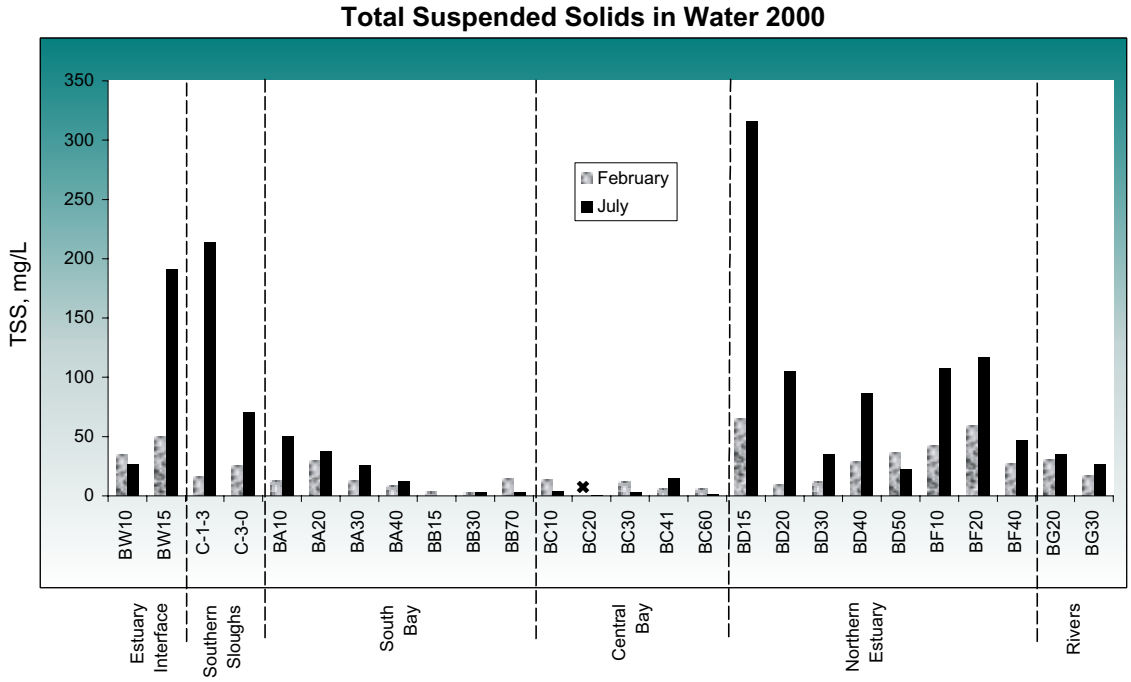


Figure 2.3. Total suspended solids (TSS) in milligrams per liter (mg/L) at each RMP water station in February and July of 2000. ✖ = not sampled. TSS concentrations ranged from 0 to 316 mg/L. The highest concentration was measured at Sunnyvale (C-1-3) and the lowest was measured at San Bruno Shoal (BB15) in July. Average concentrations were highest in the Southern Sloughs (142 mg/L) and lowest in the Central Bay (4.8 mg/L) in July.

Source Data: See Data Table 1

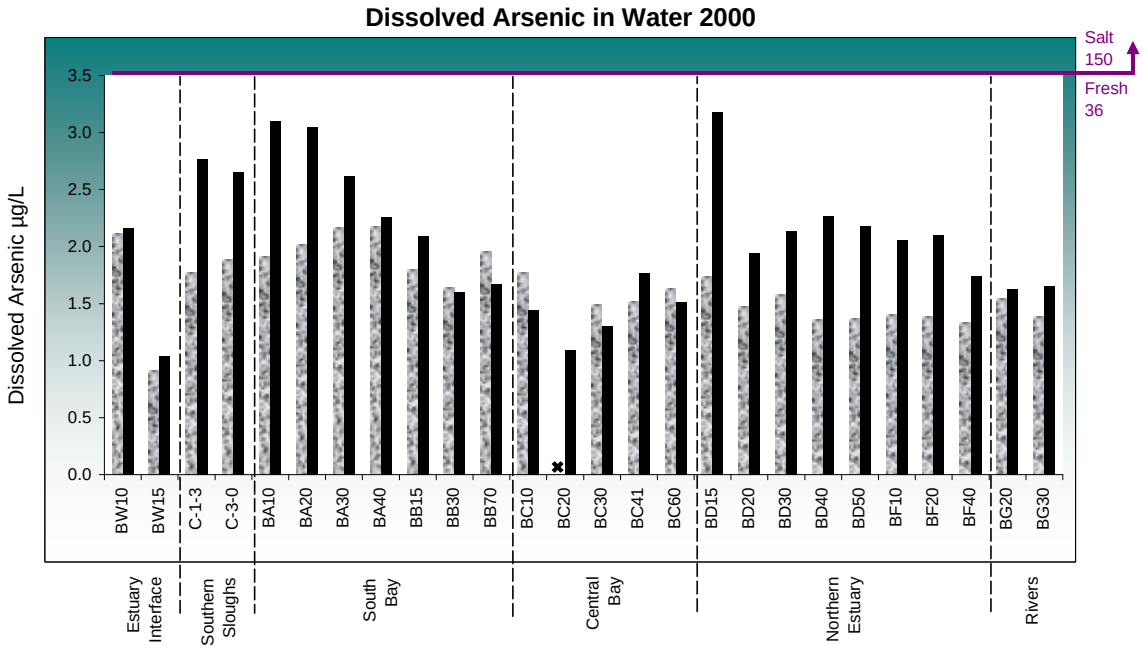


Figure 2.4a. Dissolved arsenic (As) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.91 to 3.2 µg/L. The highest concentration was measured at Petaluma River (BD15) in July and the lowest was measured at Guadalupe River (BW15) in February. Average concentrations were highest in the Southern Sloughs (2.7 µg/L) in July and lowest in the Northern Estuary (1.46 µg/L) in February. All samples were below the 4-day average WQC for dissolved arsenic (saltwater 36 ppb, freshwater 150 ppb).

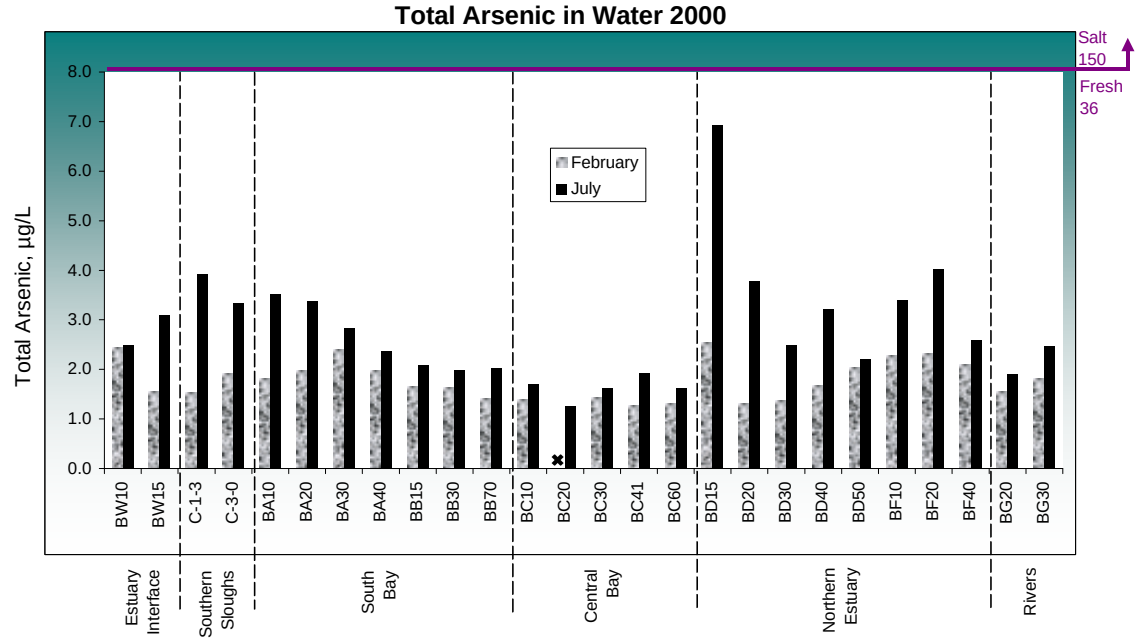


Figure 2.4b. Total arsenic (As) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 1.25 to 6.9 µg/L. The highest concentration was measured at Petaluma River (BD15) and the lowest was measured at Golden Gate (BC20), both in July. Average concentrations were highest in the Southern Sloughs (3.6 µg/L) in July and lowest in the Central Bay (1.4 µg/L) in February. All samples were below the 4-day average WQC for total arsenic (saltwater 36 ppb, freshwater 150 ppb).

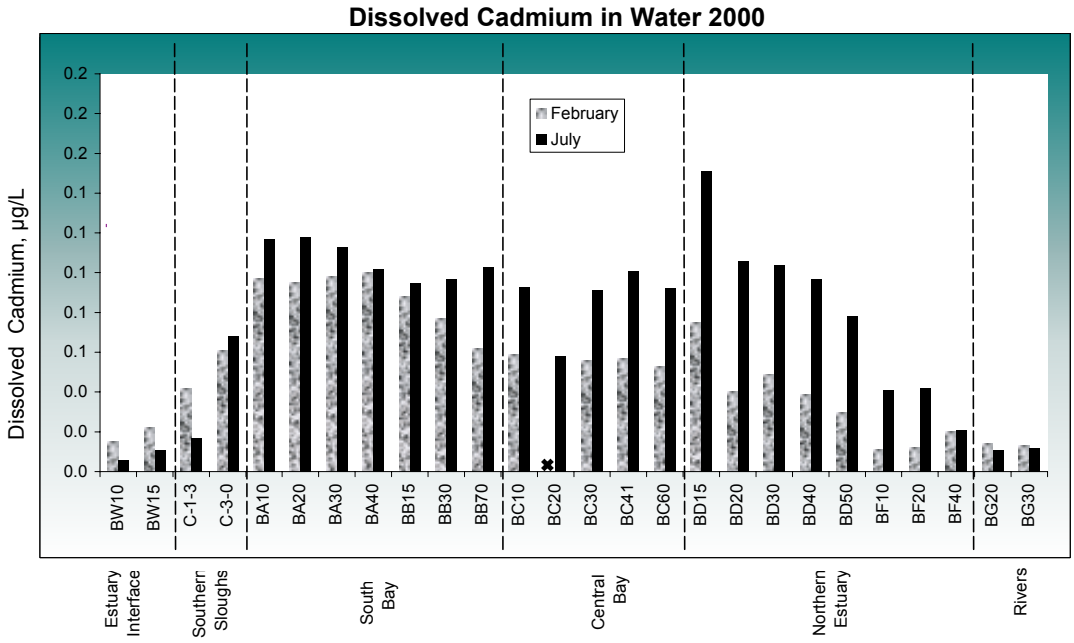


Figure 2.5a. Dissolved cadmium (Cd) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.010 to 0.15 ppb. The highest concentration was measured at Petaluma River (BD15) and the lowest was measured at Standish Dam (BW10) in July. Average concentrations were highest in the South Bay (0.11 ppb) in July and lowest at the Estuary Interface (0.0085 ppb) in July.

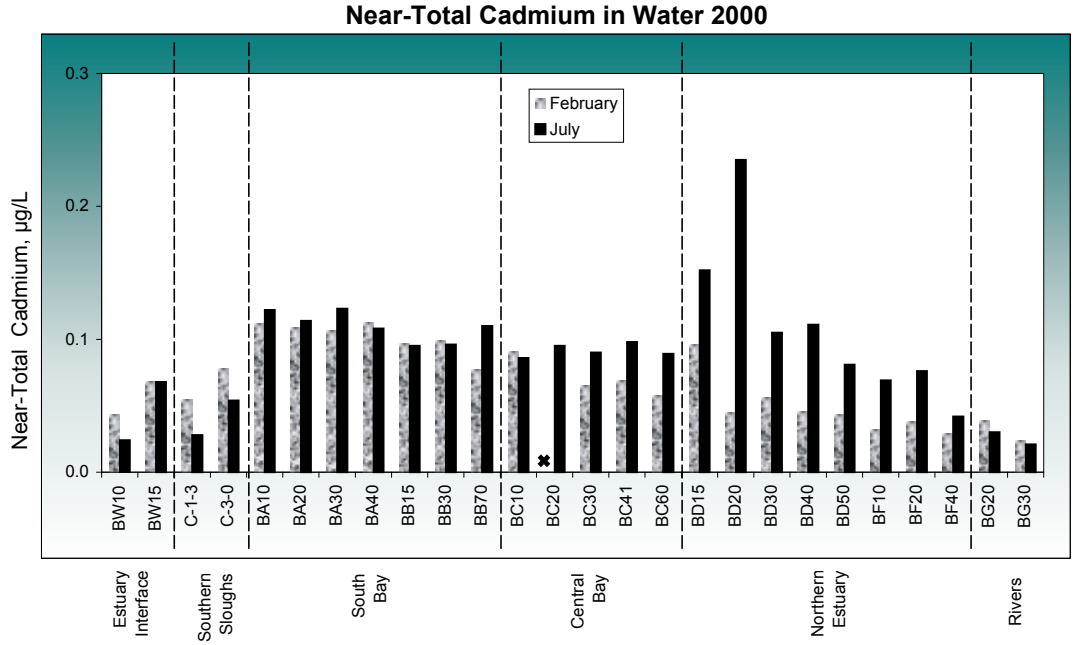


Figure 2.5b. Near-total cadmium (Cd) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.021 to 0.24 ppb. The highest concentration was measured at San Pablo Bay (BD20) and the lowest was measured at San Joaquin River (BG30) in July. Average concentrations were highest in the South Bay (0.11 ppb) in July and lowest at the River Stations (0.025 ppb) in July.

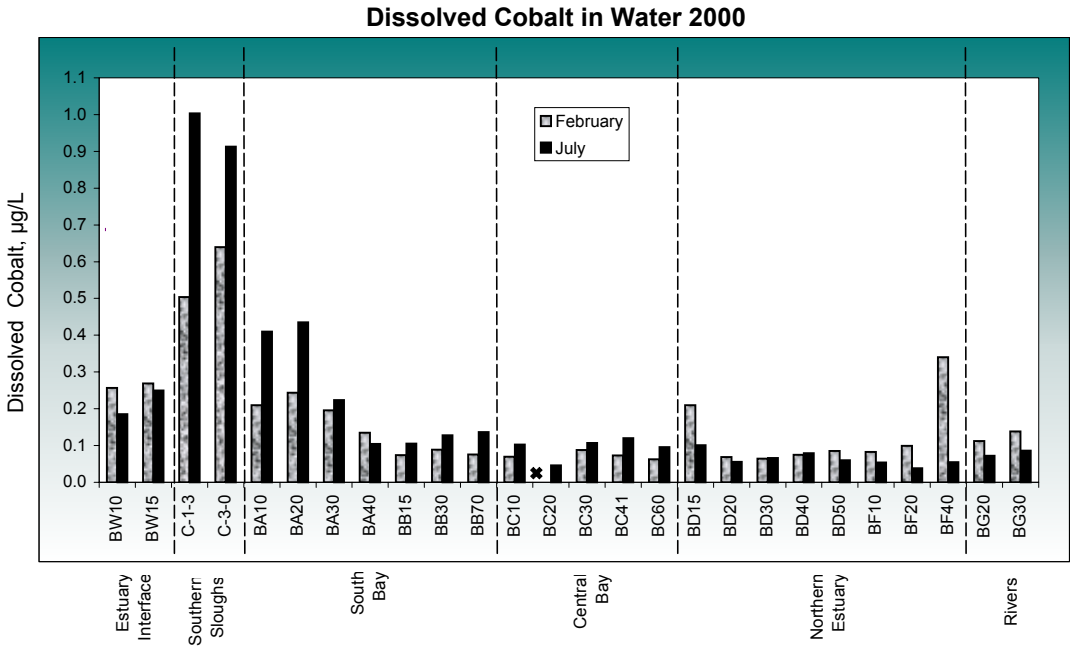


Figure 2.6a. Dissolved cobalt (Co) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.038 to 1.0 ppb. The highest concentration was measured at Sunnyvale (C-1-3) in July and the lowest was measured at Grizzly Bay (BF20) in July. Average concentrations were highest in the Southern Slough (0.96 ppb) in July and lowest in the Central Bay (0.073 ppb) in February.

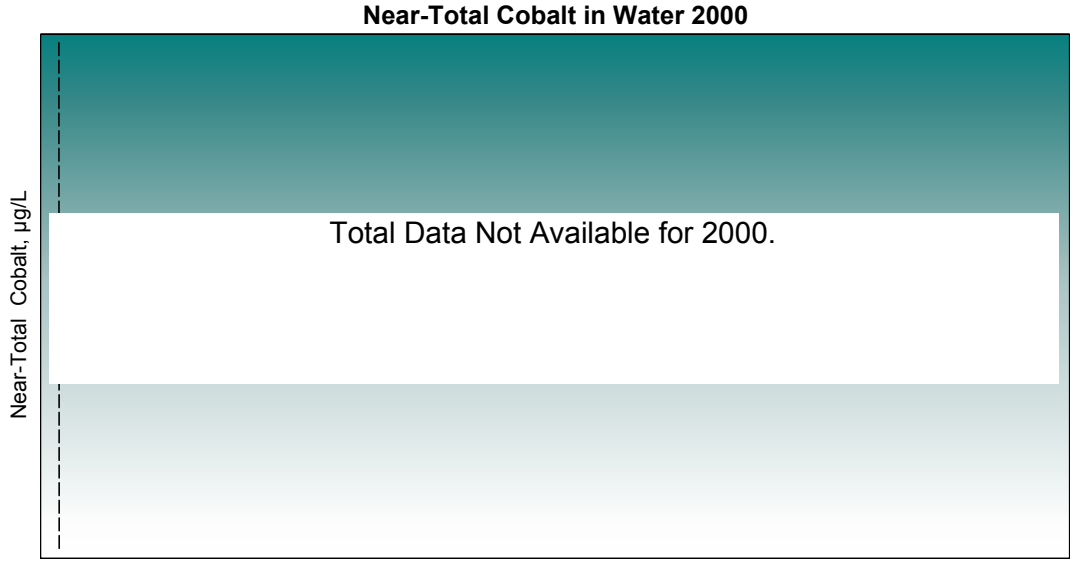


Figure 2.6b. Near-total cobalt (Co) in µg/L (ppb) at each RMP water station in February and July of 2000. Data for 2000 are not available.

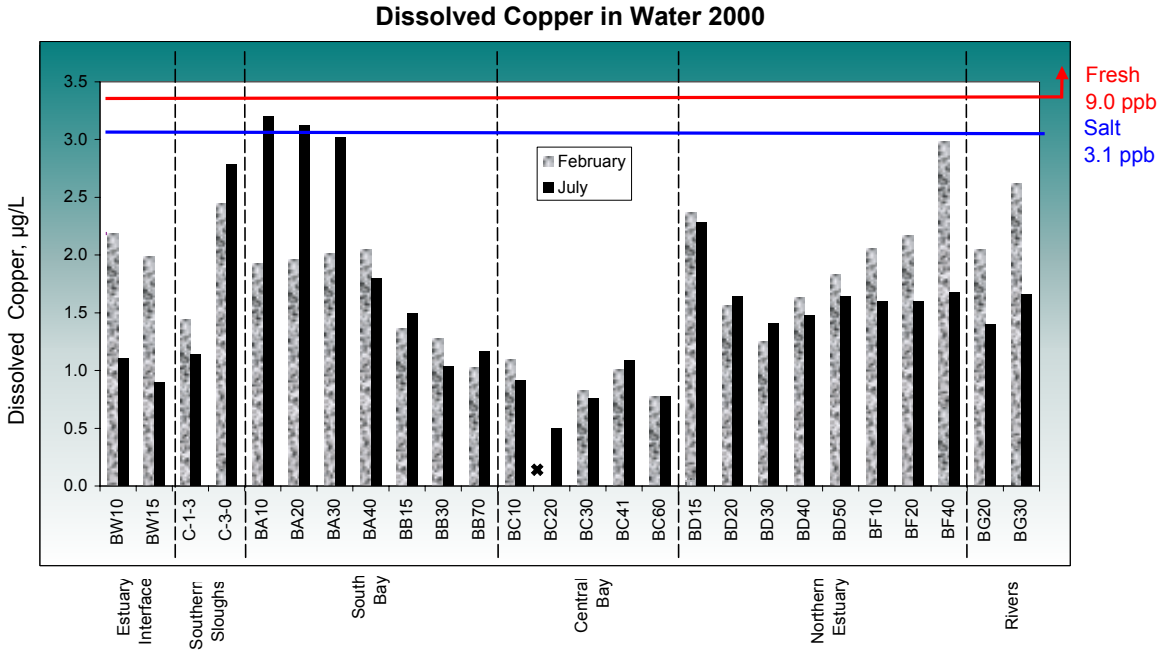


Figure 2.7a. Dissolved copper (Cu) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.50 to 3.2 ppb. The highest concentration was measured at Coyote Creek (BA10) in July and the lowest was measured at Golden Gate (BC20) in July. Average concentrations were highest in the River Stations (2.3 ppb) and lowest in the Central Bay (0.81 ppb) in July. Two samples, Coyote Creek (BA10) and South Bay (BA20), were above the 4-day average WQC for salt water (3.1 ppb).

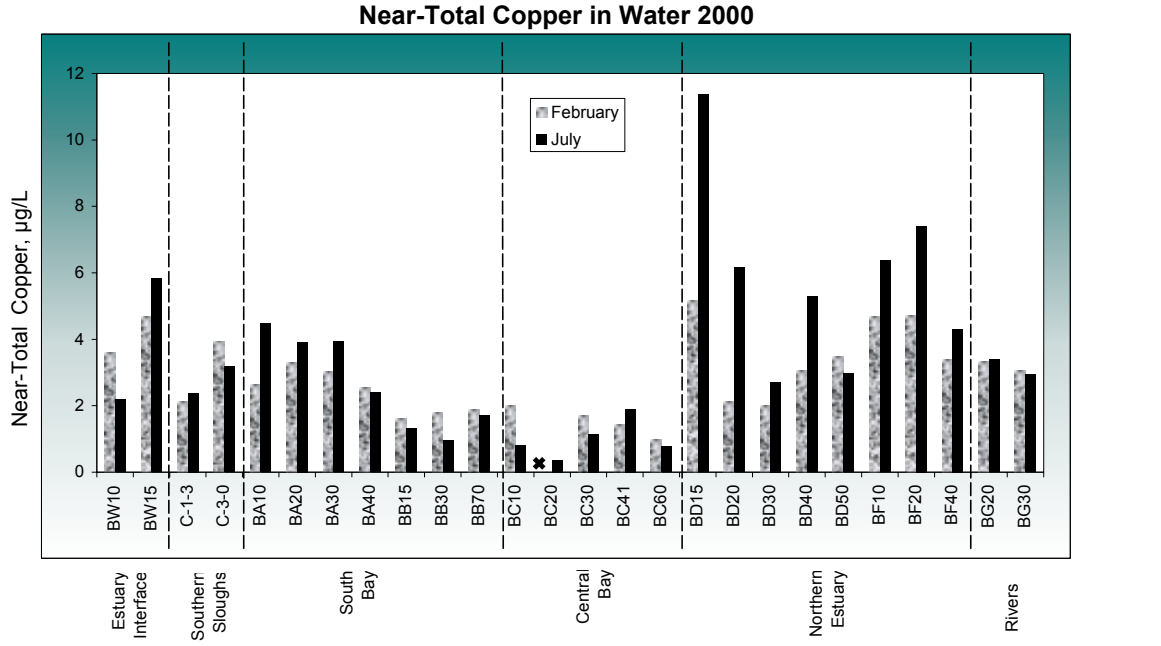


Figure 2.7b. Near-total copper (Cu) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.37 to 11 ppb. The highest concentration was measured at Petaluma River (BD15) in July and the lowest was measured at Golden Gate (BC20) in July. Average concentrations were highest in the Northern Estuary (5.8 ppb) and lowest in the Central Bay (1.0 ppb) in July

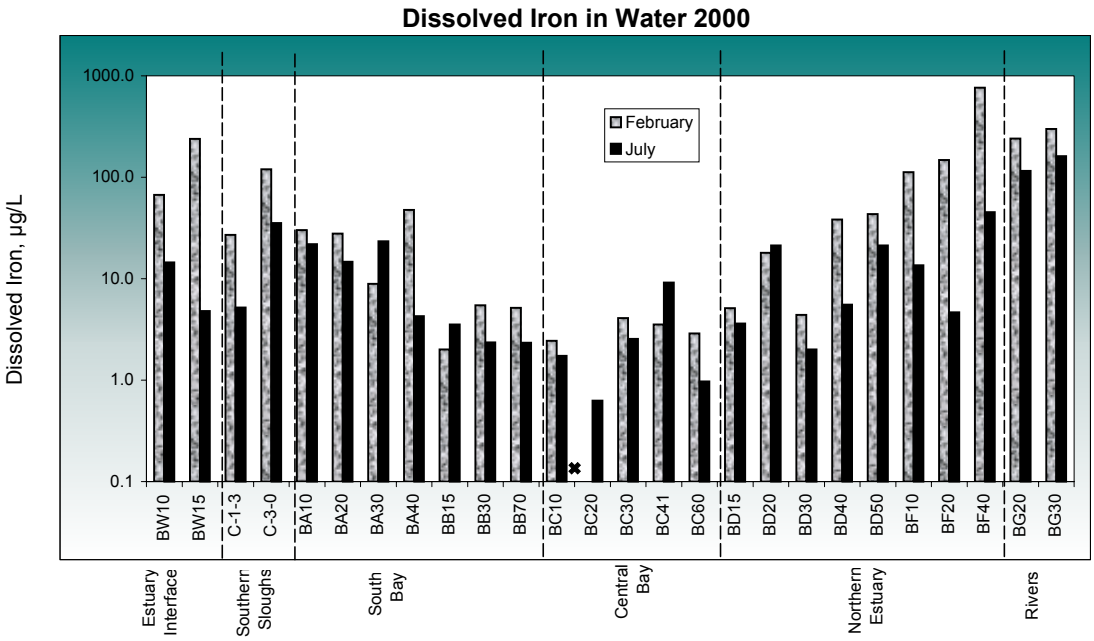


Figure 2.8a. Dissolved iron (Fe) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logarithmic scale. ✖ = not sampled. Concentrations ranged from 0.63 to 760 ppb. The highest concentration was measured at Honker Bay (BF40) in February and the lowest was measured at Golden Gate (BC20) in July. Average concentrations were highest in the River Sites (270 ppb) in February and lowest in the Central Bay (3.0 ppb) in July.

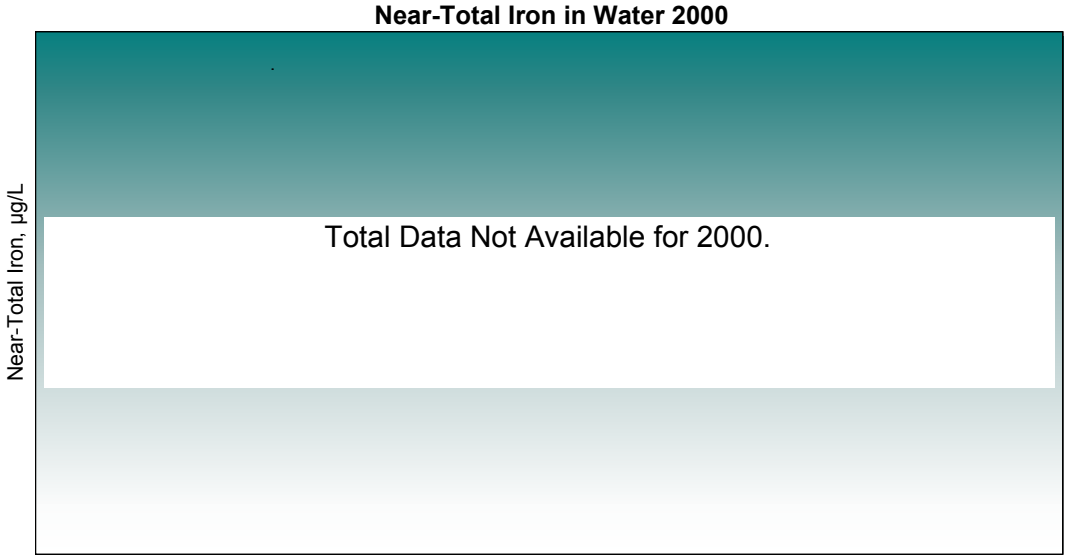


Figure 2.8b. Near-total iron (Fe) in µg/L (ppb) at each RMP water station in February and July of 2000. Data for 2000 are not available.

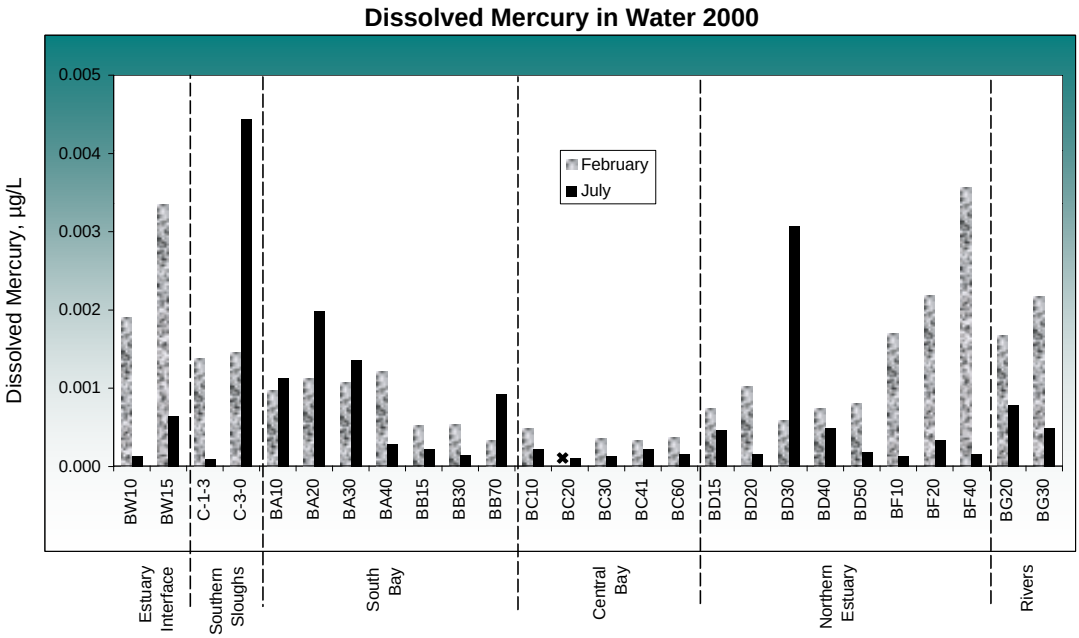


Figure 2.8a. Dissolved mercury (Hg) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.00009 to 0.0044 µg/L. The highest concentration was measured at San Jose (C-3-0) and the lowest was measured at Sunnyvale (C-1-3) in July. Average concentrations were highest in the Estuary Interface (0.0026 µg/L) and lowest in the Central Bay (0.000174 µg/L). Mercury is compared to guidelines only on the basis of total mercury.

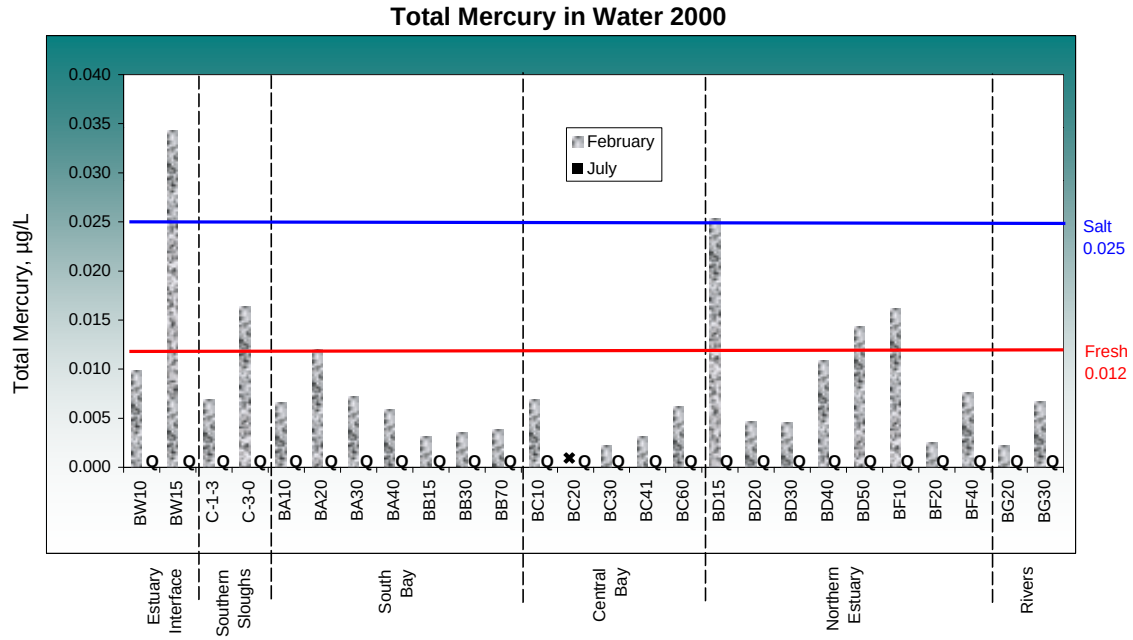


Figure 2.8b. Total mercury (Hg) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled, Q = outside QA limits. July data for total mercury were qualified due to poor precision during analyses. Concentrations in February ranged from 0.0022 to 0.0343 µg/L. The highest concentration was measured at Guadalupe River (BW15) and the lowest concentration was measured at Richardson Bay (BC30). Average concentrations were highest in the Estuary Interface (0.022 µg/L) and lowest in the Rivers (0.0045 µg/L) in February. Five samples were above the Basin Plan guideline for total-recoverable mercury in freshwater (saltwater 0.025 ppb, freshwater 0.012 ppb).

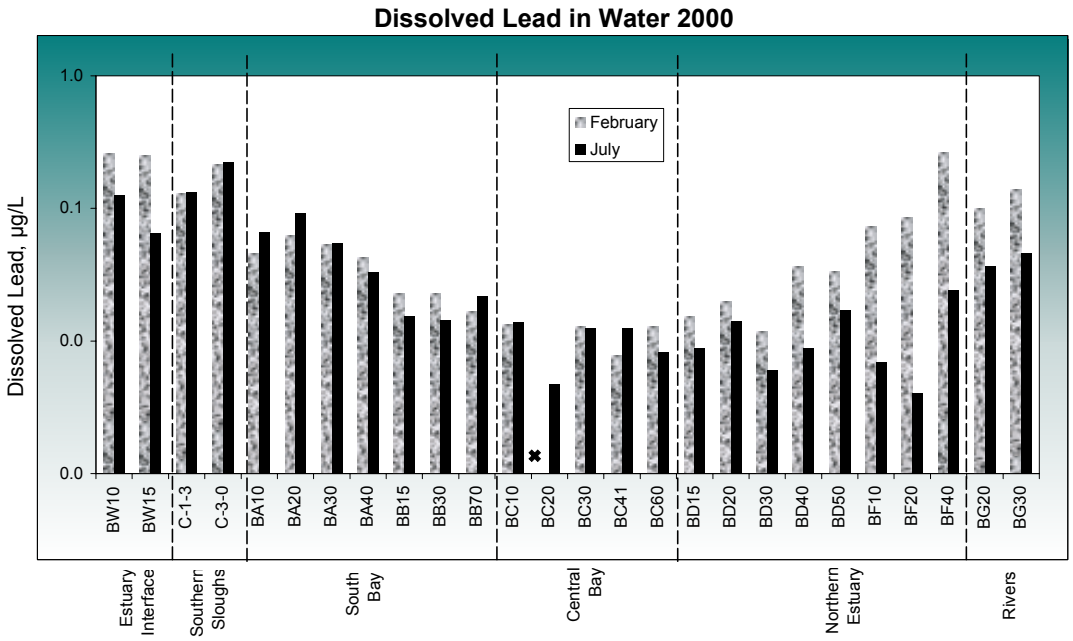


Figure 2.9a. Dissolved lead (Pb) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logaritmic scale. ✖ = not sampled. Concentrations ranged from 0.0041 to 0.26 ppb. The highest concentration was measured at Honker Bay (BF40) in February and the lowest was measured at Grizzly Bay (BF20) in July. Average concentrations were highest in the Estuary Interface (0.26 ppb) in February and lowest in the Central Bay (0.010 ppb) in July.

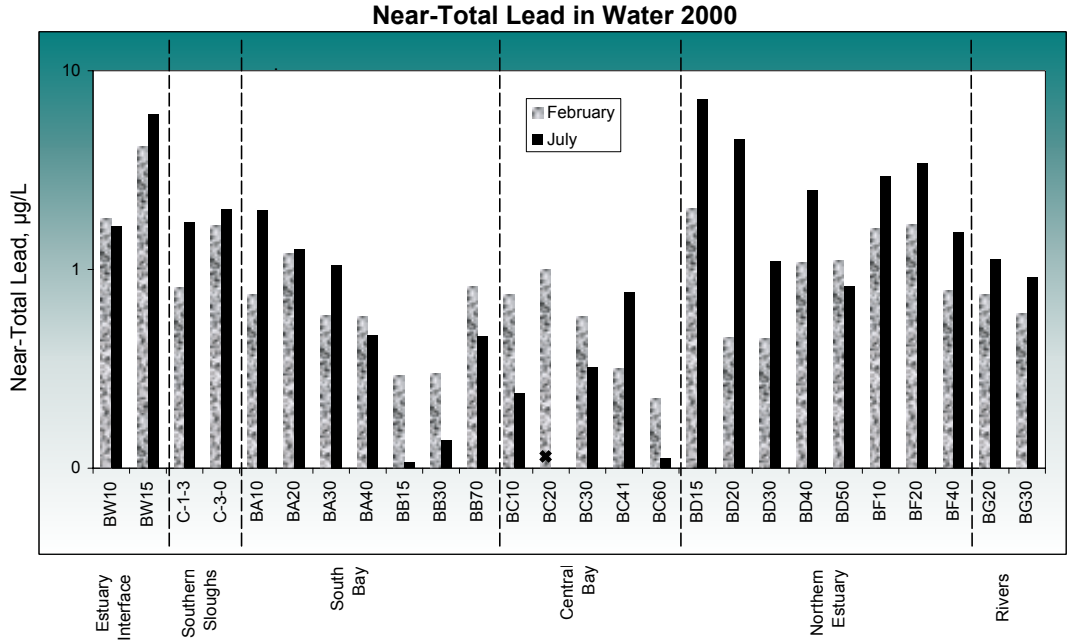


Figure 2.9b. Near-total lead (Pb) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logarithmic scale. ✖ = not sampled. Concentrations ranged from 0.041 to 7.2 ppb. The highest concentration was measured at Petaluma River (BD15) in July and the lowest was measured at Golden Gate (BC20) in July. Average concentrations were highest in the Estuary Interface (3.9 ppb) in July and lowest in the Central Bay (0.30 ppb) in July.

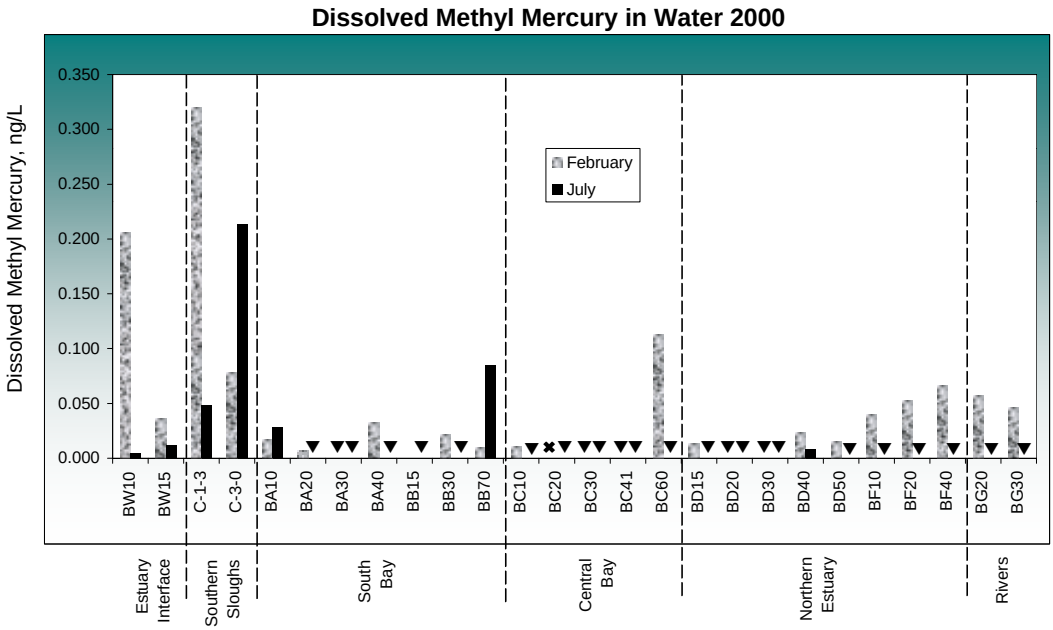


Figure 2.9a. Dissolved methyl mercury (MeHg) in ng/L (ppt) at each RMP water station in February and July of 2000. ▼ = not detected. ✖ = not sampled. Concentrations ranged from below detection to 0.32 ng/L. The highest concentration was measured at Sunnyvale (C-13) in February. Average concentrations were highest in the Southern Sloughs (0.20 ng/L) and lowest in the Central Bay and Rivers in July.

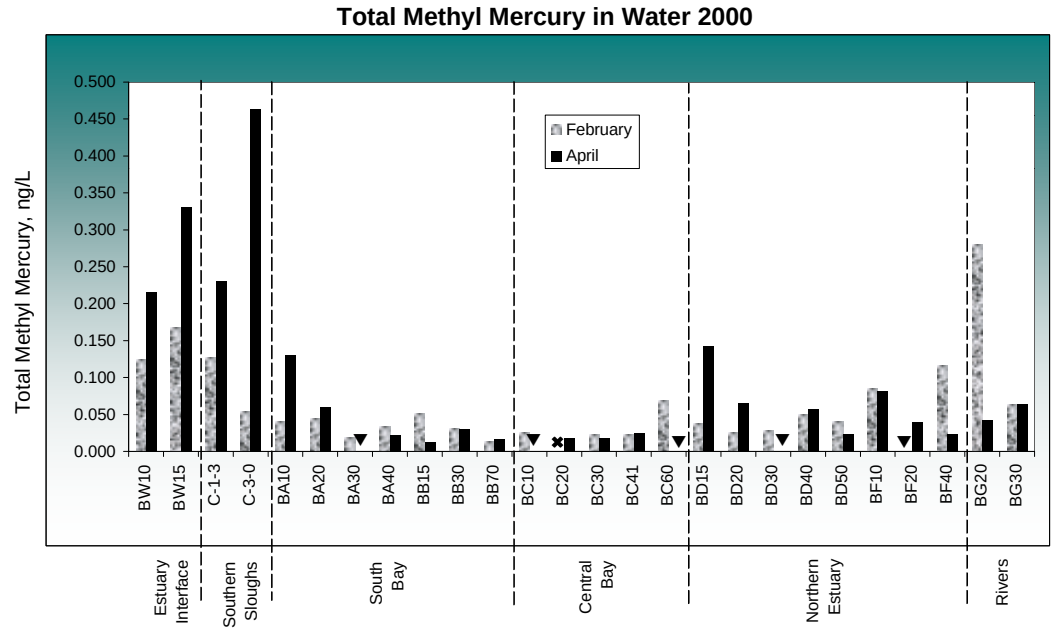


Figure 2.9b. Total methyl mercury (Hg) in ng/L (ppt) at each RMP water station in February and July of 2000. ▼ = not detected. **✖** = not sampled. Concentrationsranged from below detection to 0.463 ng/L. The highest concentration was measured at San Jose (C-3-0). Average concentrations were highest in the Southern Sloughs (0.35 ng/L) and lowest in the Central Bay (0.013), both in July. Water quality criteria do not exist for methyl mercury.

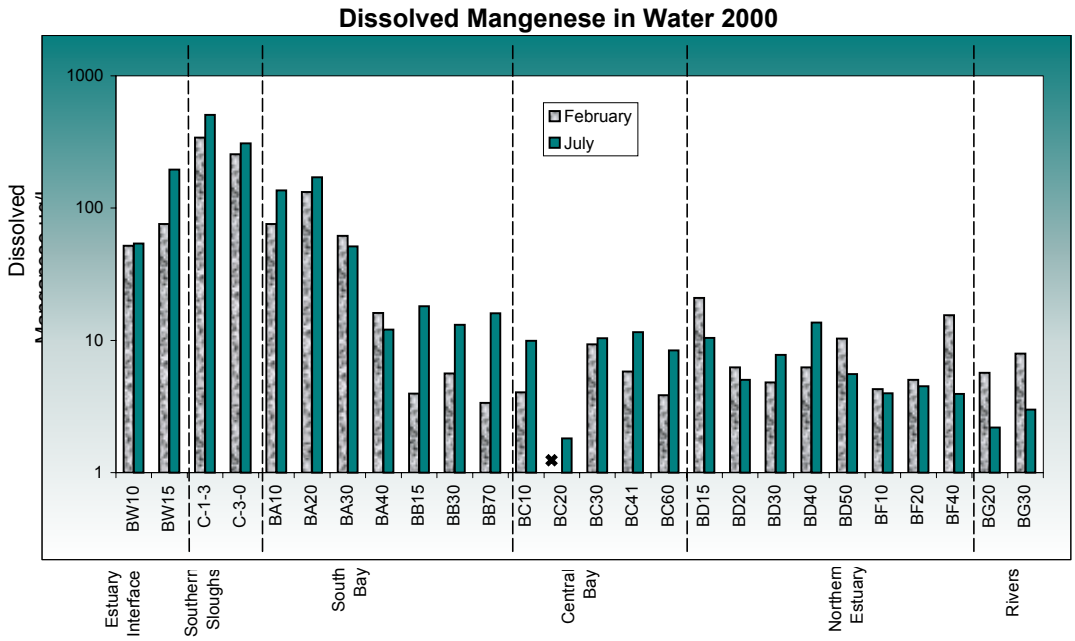


Figure 2.10a. Dissolved manganese (Mn) in µg/L (ppb) at each RMP water station in February and July of 2000. Note the logirithmic scale. ✖ = not sampled. Concentrations ranged from 1.8 to 500 ppb. The highest concentration was measured at Sunnyvale (C-1-3) in July and the lowest concentration was measured at Golden Gate (BC20) in July. Average concentrations were highest in the Southern Slough (400 ppb) and lowest in the River Stations (2.6 ppb) in July.

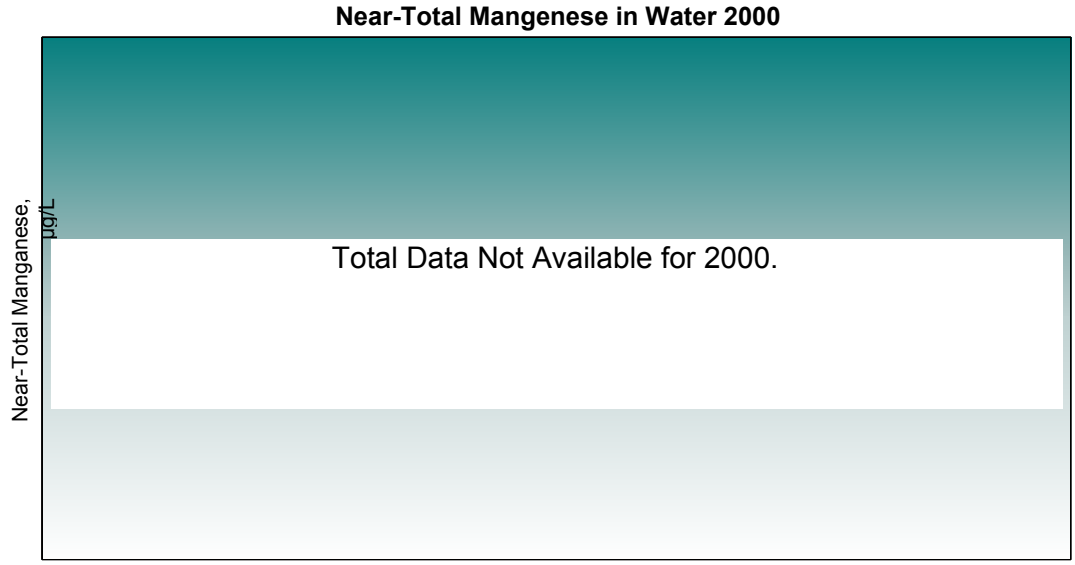


Figure 2.10b. Near-total manganese (Mn) in µg/L (ppb) at each RMP water station in February and July of 2000. Data for 2000 are not available.

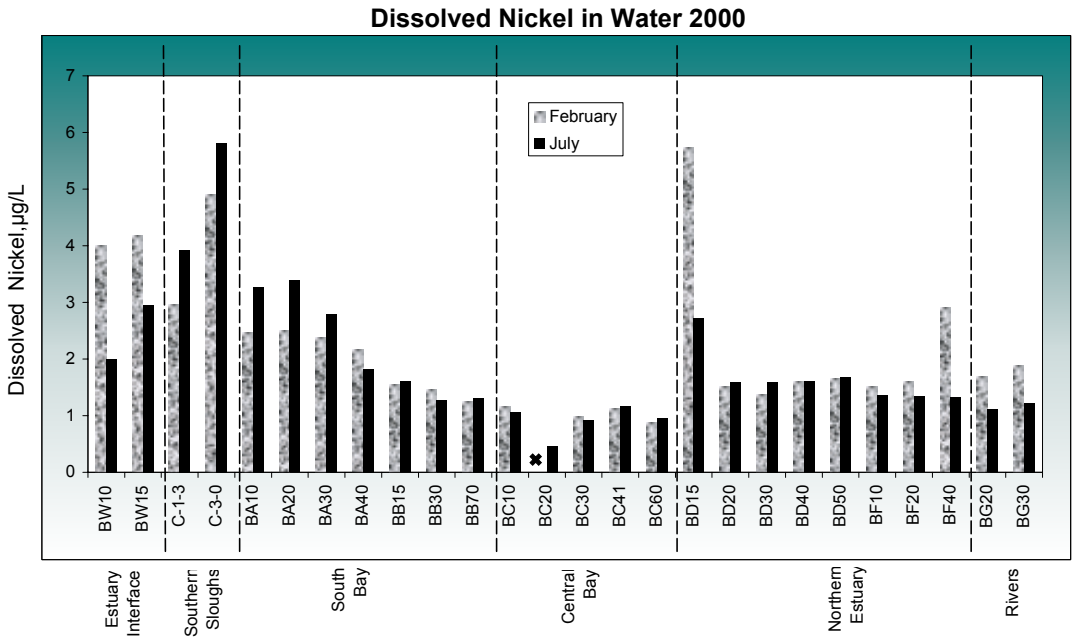


Figure 2.13a. Dissolved nickel (Ni) in µg/L (ppb) at each RMP water station in February and July of 2000. ✖ = not sampled. Concentrations ranged from 0.47 to 5.8 ppb. The highest concentration was measured at San Jose (C-3-0) in July and the lowest concentration was measured at Golden Gate (BC20) in July. Average concentrations were highest in the Southern Slough (4.9 ppb) and lowest in the Central Bay (0.92 ppb) in July.

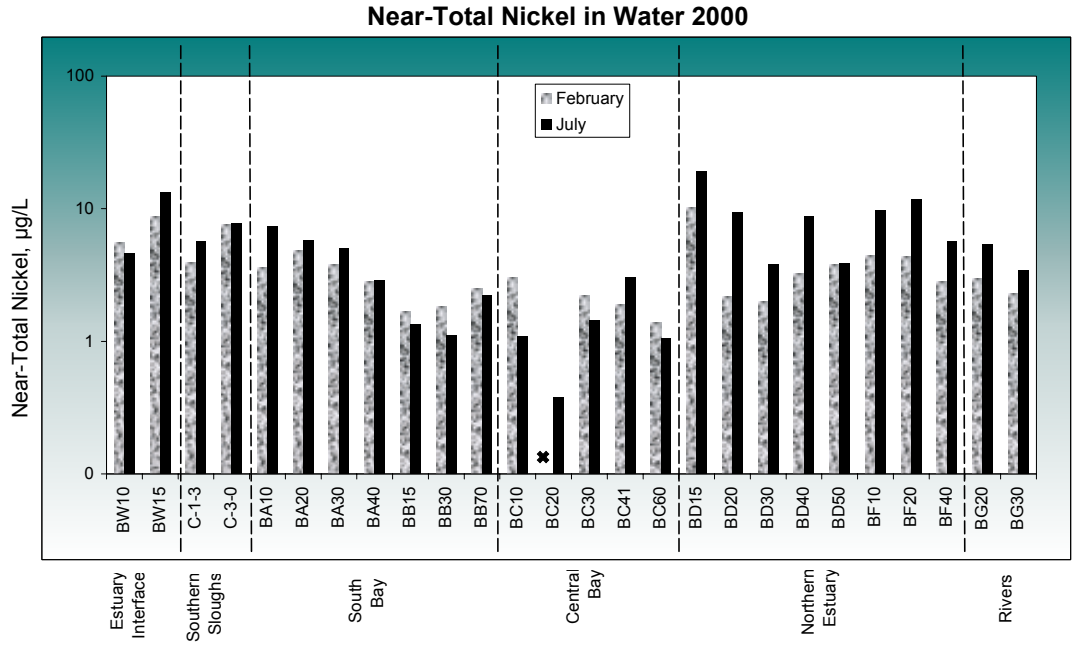


Figure 2.13b. Near-total nickel (Ni) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logarithmic scale. ✖ = not sampled. Concentrations ranged from 0.38 to 19 ppb. The highest concentration was measured at Petaluma River (BD15) in July and the lowest concentration was measured at Golden Gate (BC20) in July. Average concentrations were highest in the Northern Estuary (9.0 ppb) and lowest in the Central Bay (1.4 ppb) in July.

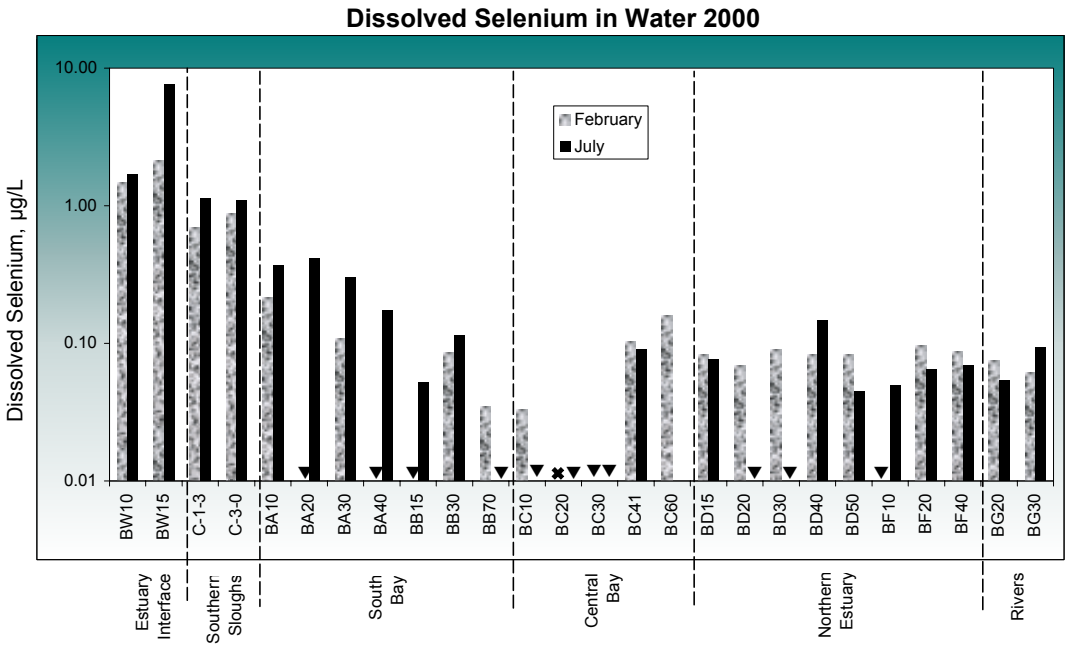


Figure 2.14a. Dissolved selenium (Se) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logarithmic scale. ▼ = not detected. ✖ = not sampled. Concentrations ranged from below detection to 7.7 ppb. The highest concentration was measured at Guadalupe River (BW15) in July. Average concentrations were highest in the Estuary Interface (4.7 ppb) and lowest in the Central Bay (0.02 ppb) in July. Selenium is compared to guidelines only on the basis of total selenium.

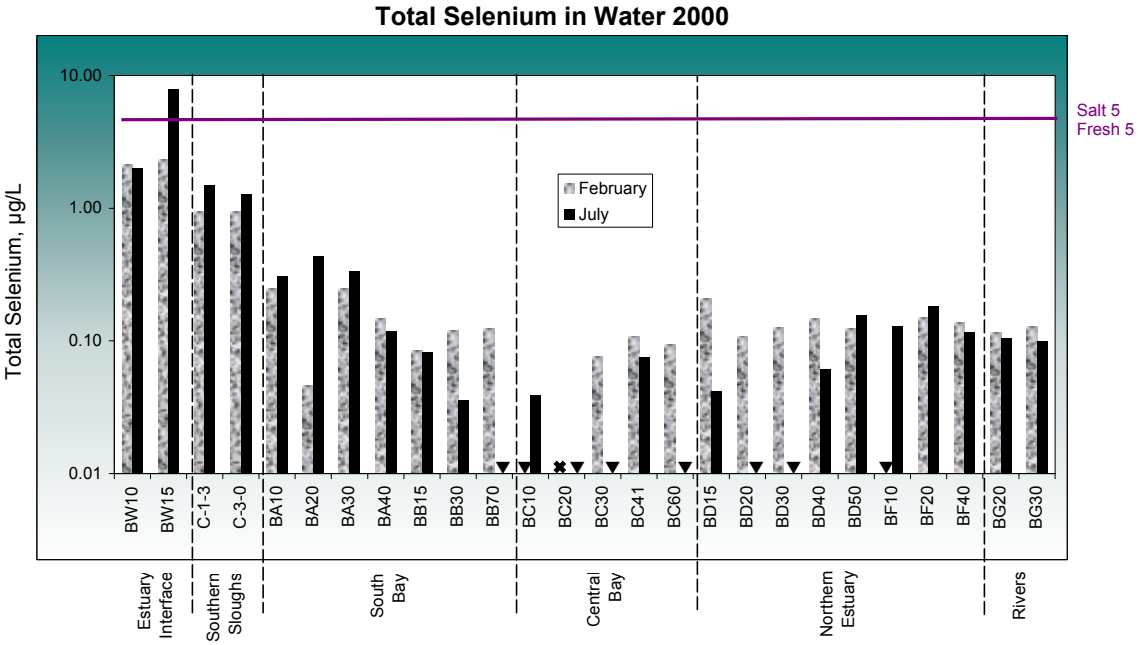


Figure 2.14b. Total selenium (Se) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logarithmic scale. ▼ = not detected. ✖ = not sampled. Concentrations ranged from below detection to 7.96 ppb. The highest concentration was measured at Guadalupe River (BW15) in July. Average concentrations were highest in the Estuary Interface (5.0 ppb) and lowest in the Central Bay (0.02 ppb) in July. One sample from Guadalupe River (BW15) was above the 4-day average WQC for total selenium (5 ppb).

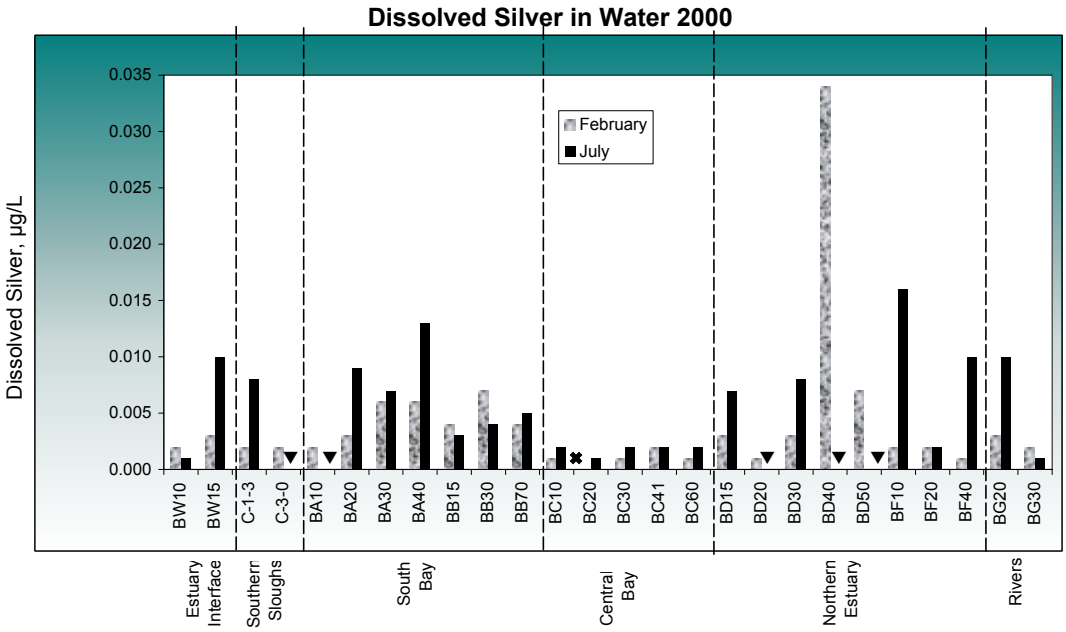


Figure 2.15a. Dissolved silver (Ag) in µg/L (ppb) at each RMP water station in February and July of 2000. ▼ = not detected. ✖ = not sampled. Concentrations ranged from below detection to 0.034 ppb. The highest concentration was measured at Davis Point (BD40) in February. Average concentrations were highest in the Northern Estuary (0.0066 ppb) and lowest in the Central Bay (0.0012 ppb) in February.

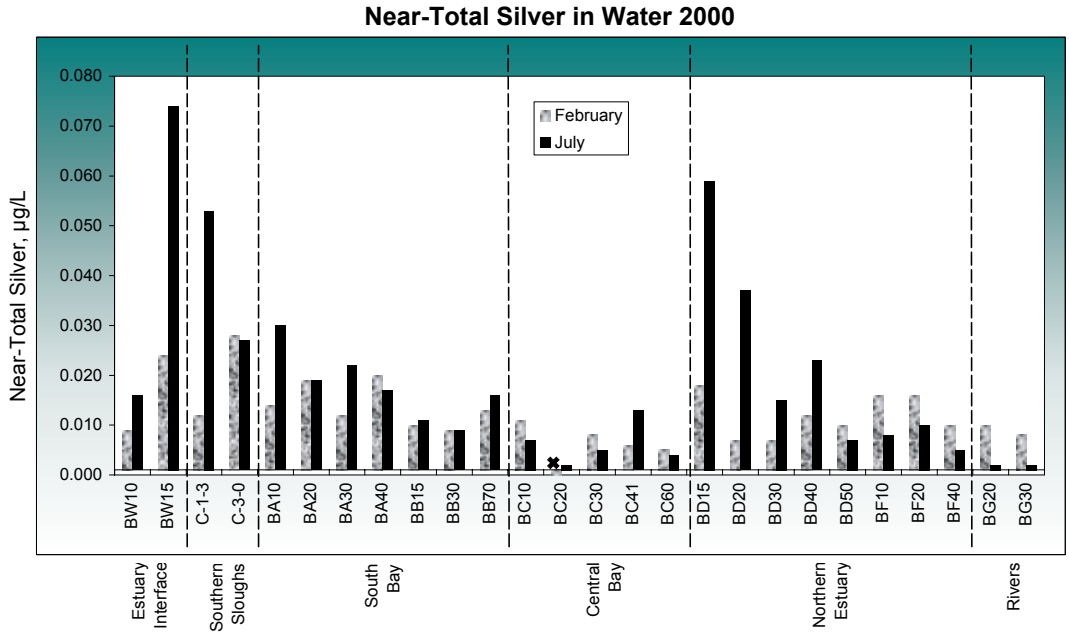


Figure 2.15b. Total silver (Ag) in µg/L (ppb) at each RMP water station in February and July of 2000.✖ = not sampled. Concentrations ranged from 0.002 to 0.074 ppb. The highest concentration was measured at Guadalupe River (BW15) in July and the lowest concentration was measured at Golden Gate (BC20), Sacramento River (BG20) and San Joaquin River (BG30) in July. Average concentrations were highest in the Estuary Interface (0.045 ppb) in July and lowest in the River Stations (0.0020 ppb) in July.

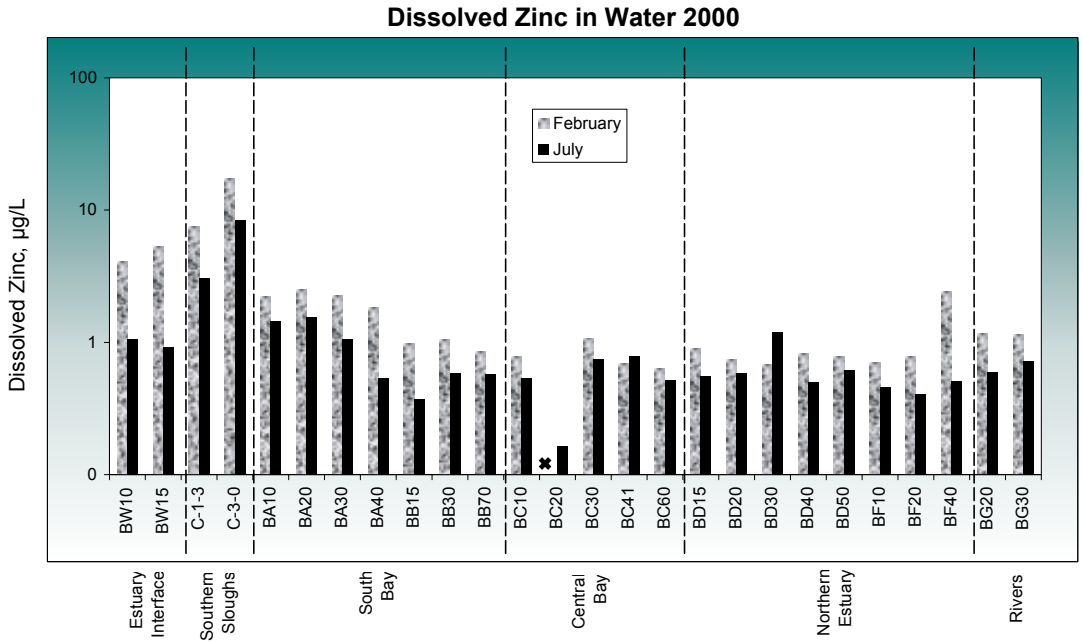


Figure 2.16a. Dissolved zinc (Zn) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logarithmic scale. ✖ = not sampled. Concentrations ranged from 0.17 to 17 ppb. The highest concentration was measured at San Jose (C-3-0) in February and the lowest concentration was measured at Golden Gate (BC20) in July. Average concentrations were highest in the Southern Slough (12 ppb) in February and lowest in the Central Bay (0.55 ppb) in July.

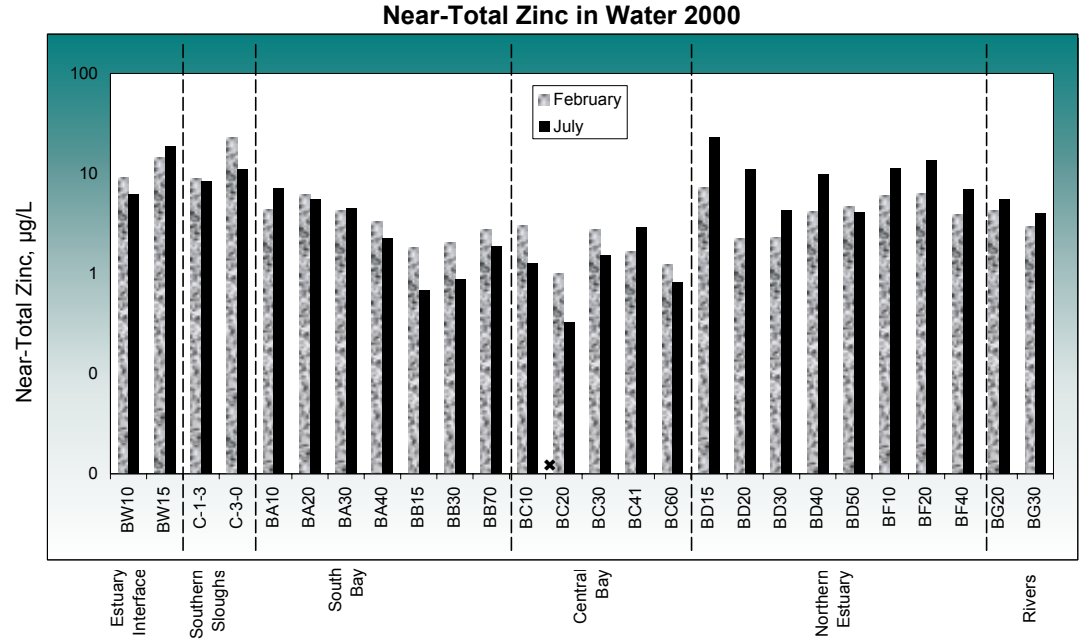
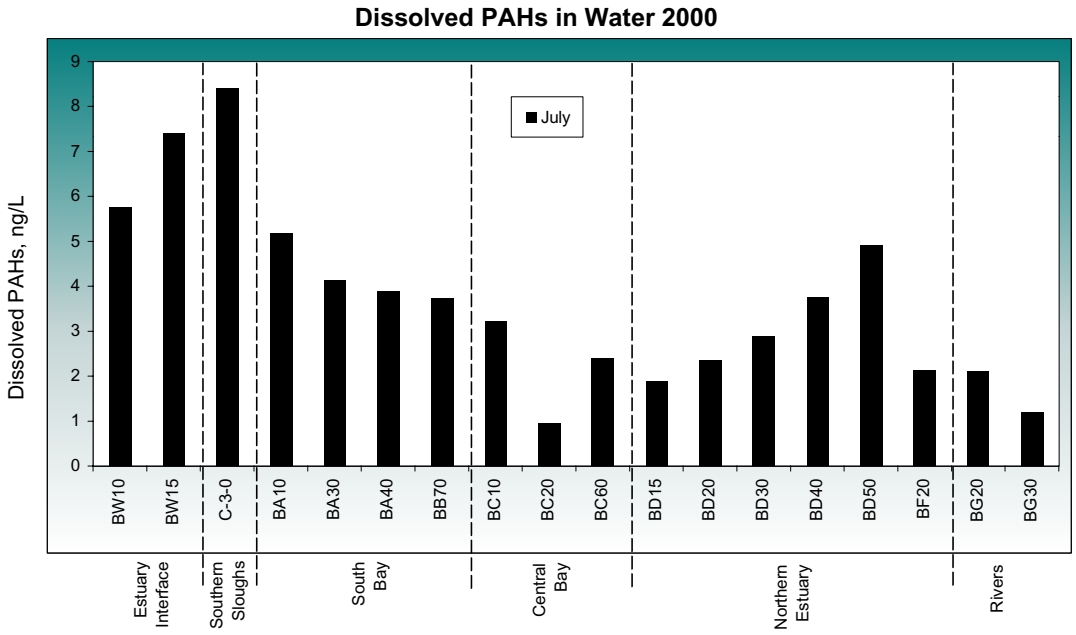
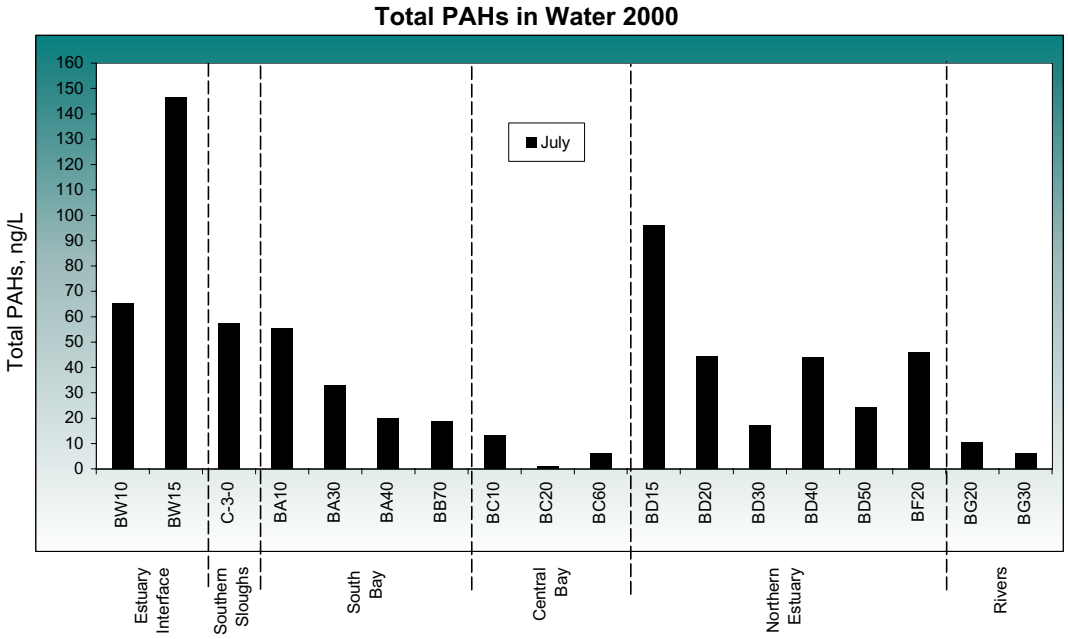


Figure 2.16b. Near-total zinc (Zn) in µg/L (ppb) at each RMP water station in February and July of 2000. Note logaritmic scale. ✖ = not sampled. Concentrations ranged from 0.33 to 23 ppb. The highest concentration was measured at Petaluma River (BD15) in July and the lowest concentration was measured at Golden Gate (BC20) in July. Average concentrations were highest in the Southern Slough (15 ppb) in February and lowest in the Central Bay (1.4 ppb) in July.



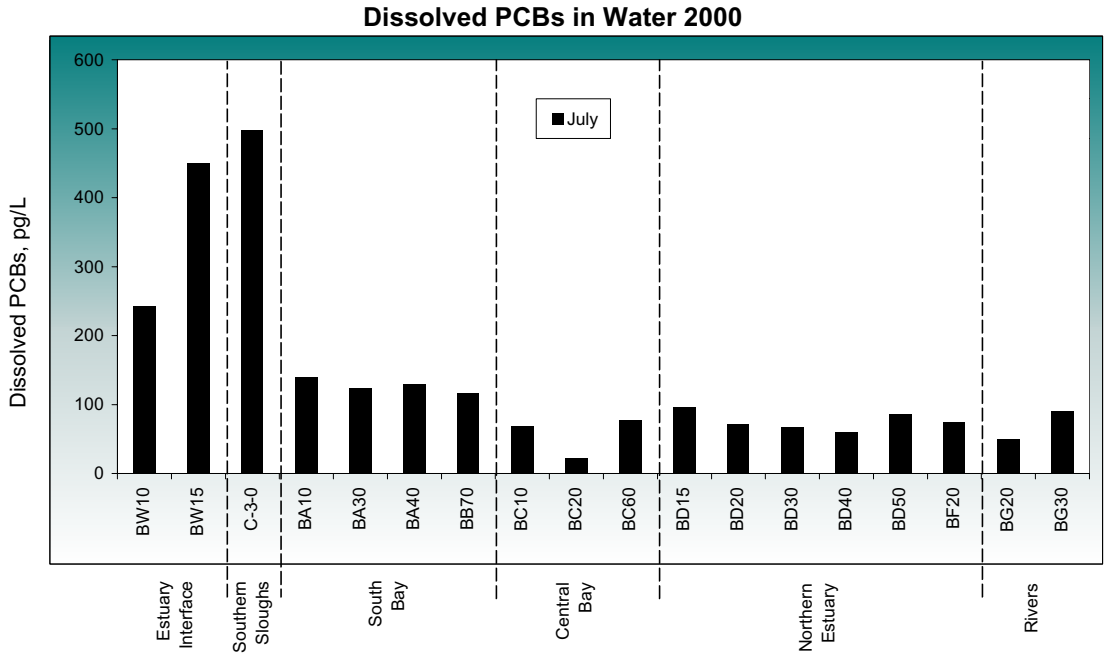
Source Data: See Data Table 4

Figure 2.14a. Dissolved PAHs in ng/L (ppt) at each RMP water station in July of 2000. Concentrations ranged from 0.94 to 8.4 ng/L. The highest concentration was measured at San Jose (C-3-0) and the lowest concentration was measured at Golden Gate (BC20). On average, concentrations were highest at the Southern Sloughs station, San Jose (C-3-0, 8.4 ng/L) and lowest in the Rivers (1.6 ng/L).



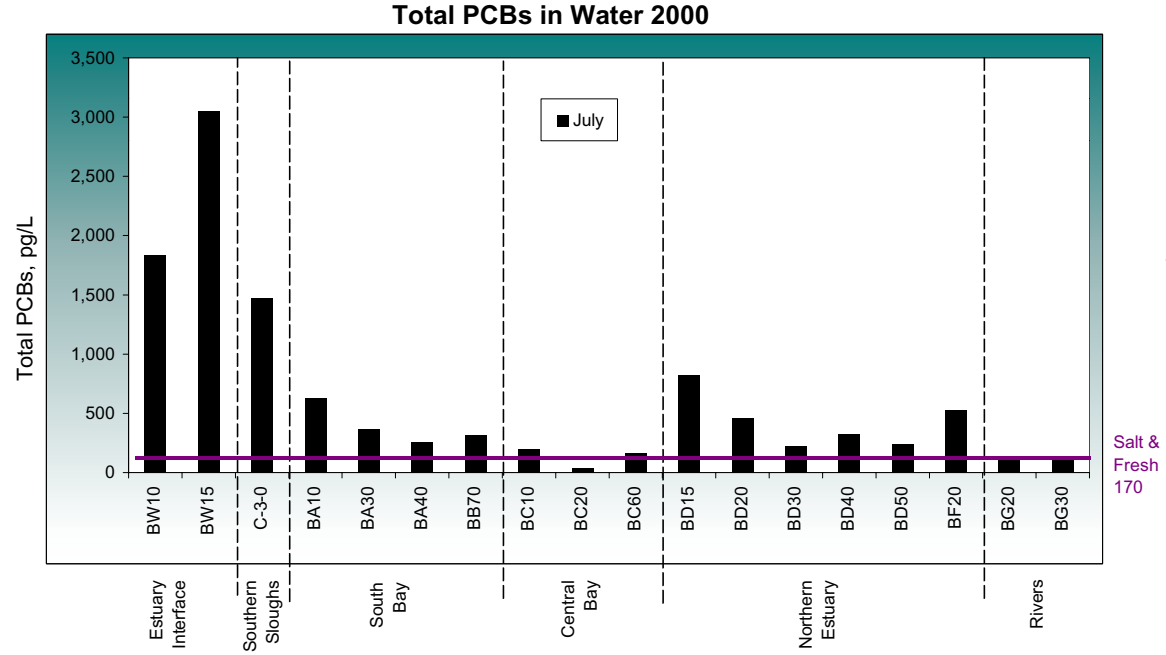
Source Data: See Data Table 5

Figure 2.14b. Total PAHs in ng/L (ppt) at each RMP water station in July 2000. Concentrations ranged from 0.94 to 147 ng/L. The highest concentration was measured at Guadalupe River (BW15) and the lowest concentration was measured at Golden Gate (BC20). Average concentrations were highest in the Estuary Interface (106 ng/L) and lowest in the Central Bay (6.7 ng/L). Water quality criteria exist only for individual PAH congeners, none of which were exceeded in July 2000.



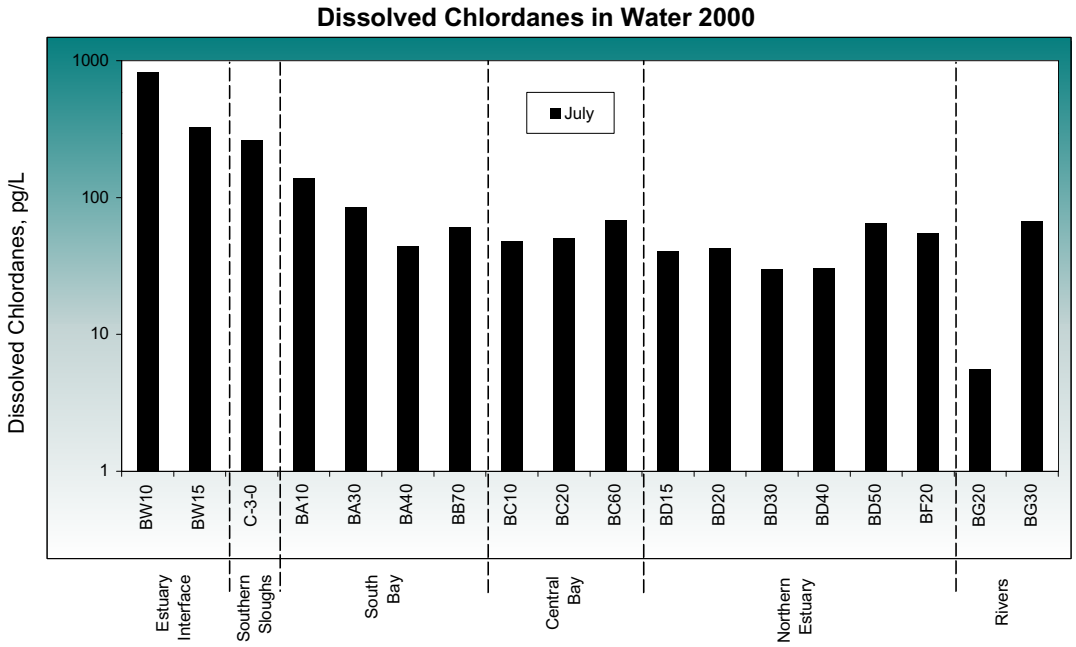
Source Data: See Data Table 6

Figure 2.15a. Dissolved PCBs in pg/L (ppq) at each RMP water station in July 2000. Concentrations ranged from 22 to 498 pg/L. The highest concentration was measured at San Jose (C-3-0) and the lowest at Golden Gate (BC20). On average, concentrations were highest at the Southern Sloughs station, San Jose (C-3-0) (498 pg/L) and lowest in the Central Bay (56 pg/L). PCBs are compared to guidelines only on the basis of total PCBs.



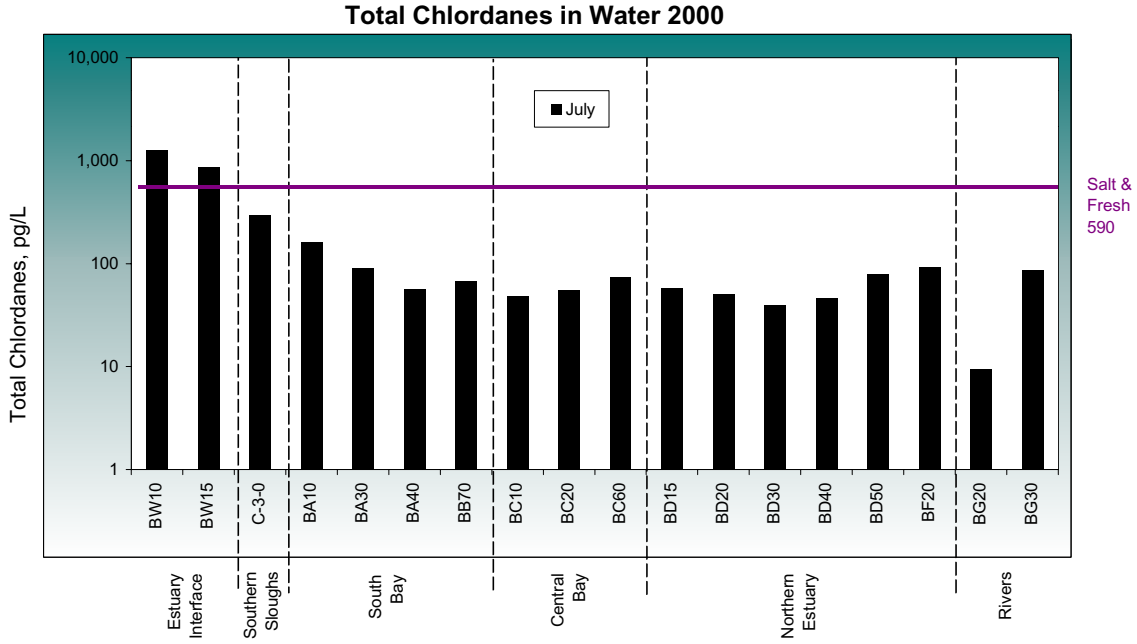
Source Data: See Data Table 7

Figure 2.15b. Total PCBs in pg/L (ppq) at each RMP water station in July 2000. Concentrations ranged from 37 ppq to 3,050 pg/L. The highest concentration was measured at Guadalupe River (BW15) and the lowest concentration was measured at Golden Gate (BC20). Average concentrations were highest in the Estuary Interface (2,450 pg/L) and lowest in the Rivers (123 pg/L). Fourteen samples had PCB concentrations above the human health criterion for total PCBs (organisms only criterion, 0.00017 µg/L).



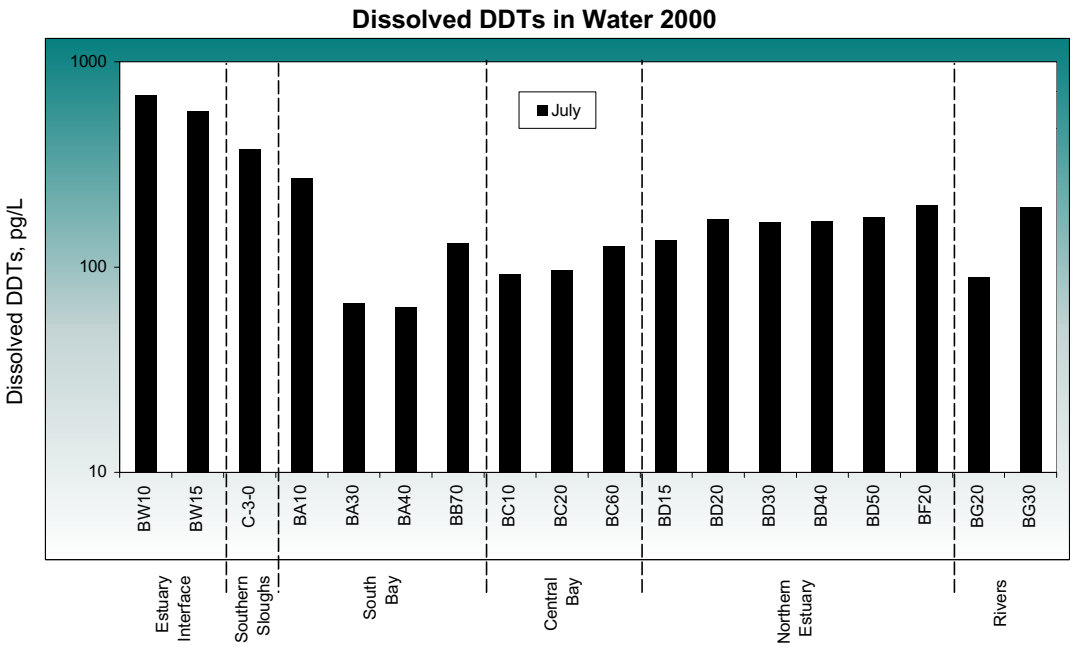
Source Data: See Data Table 8

Figure 2.16a. Dissolved Chlordanes in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. Concentrations ranged from 5.6 to 826 pg/L. The highest concentration was measured at Standish Dam (BW10) and the lowest concentration was meaured at Sacramento River (BG20). Average concentrations were highest in the Esuary Interface (577 pg/L) and lowest in the Rivers (36 pg/L). Chlordanes are compared to guidelines only on the basis of total chlordanes.



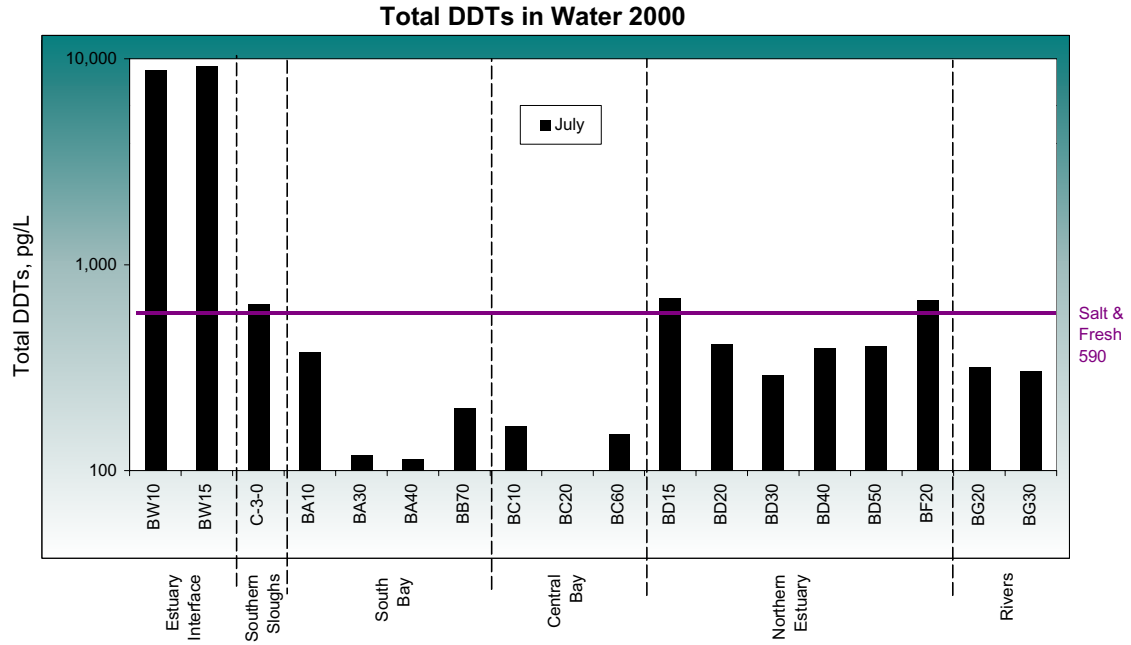
Source Data: See Data Table 9

Figure 2.16b. Total Chlordanes in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. Concentrations ranged from 10 to 1,290 pg/L. The highest concentration was measured at Standish Dam (BW10) and the lowest concentration was measured in the Sacramento River (BG20). Average concentrations were highest in the Estuary Interface (1,070 pg/L) and lowest in the Rivers (48 pg/L). Two samples collected from the Estuary Interface stations had concentrations above the human health criterion for total chlordanes (organisms only criterion, 0.00059 µg/L).



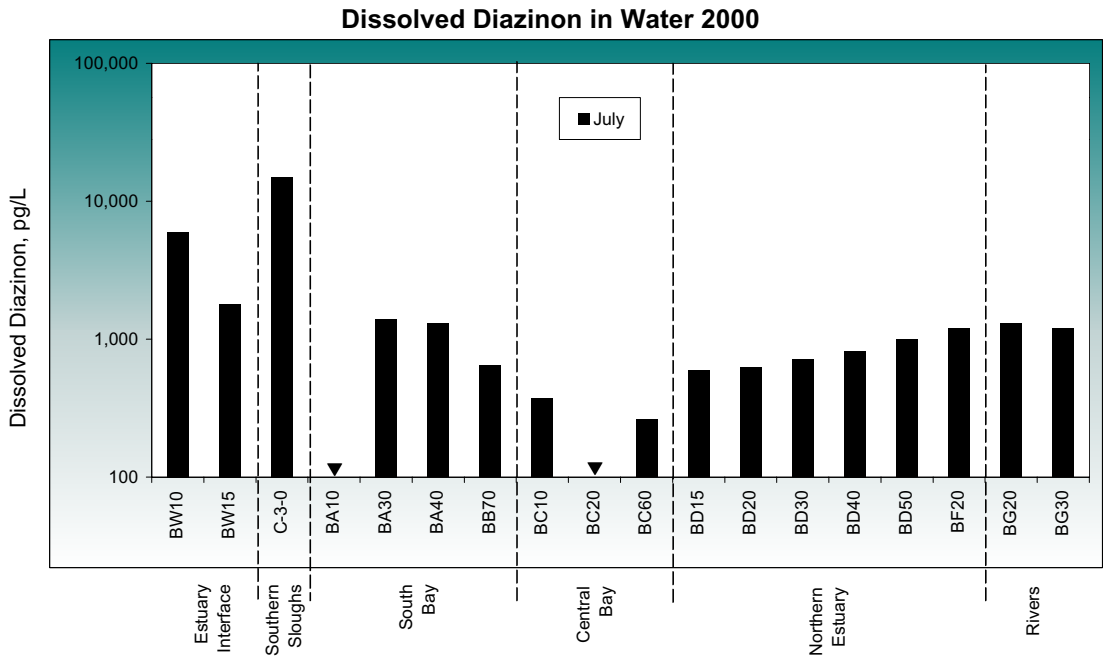
Source Data: See Data Table 8

Figure 2.17a. Dissolved DDTs in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. Concentrations ranged from 64 to 685 pg/L. The highest concentration was measured at Standish Dam (BW10) and the lowest concentration was measured at Redwood Creek (BA40). Average concentrations were highest in the Estuary Interface (630 pg/L) and lowest in the Central Bay (106 pg/L). DDTs are compared to guidelines only on the basis of total DDTs.



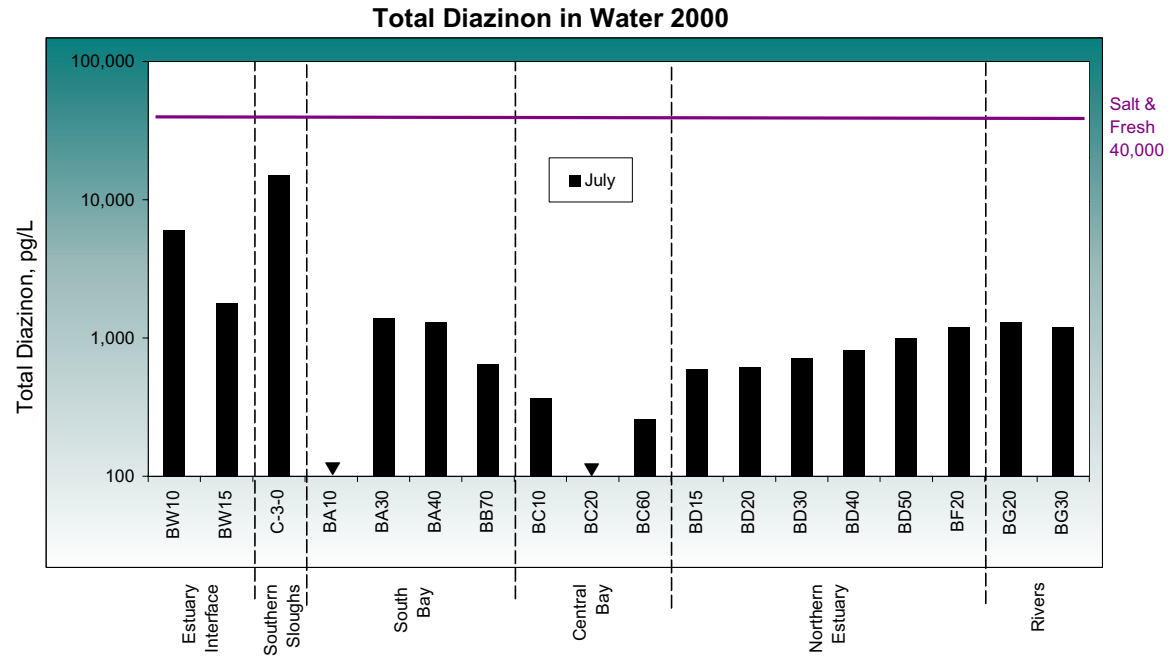
Source Data: See Data Table 9

Figure 2.17b. Total DDTs in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. Concentrations ranged from 104 to 9,270 pg/L. The highest concentration was measured at Guadalupe River (BW15) and the lowest concentration was measured at Golden Gate (BC20). Average concentrations were highest in the Estuary Interface (8,990 pg/L) and lowest in the Central Bay (137 pg/L). Five samples had concentrations of DDTS above the human health criterion for total DDTs (organisms only criterion, 0.00059 µg/L).



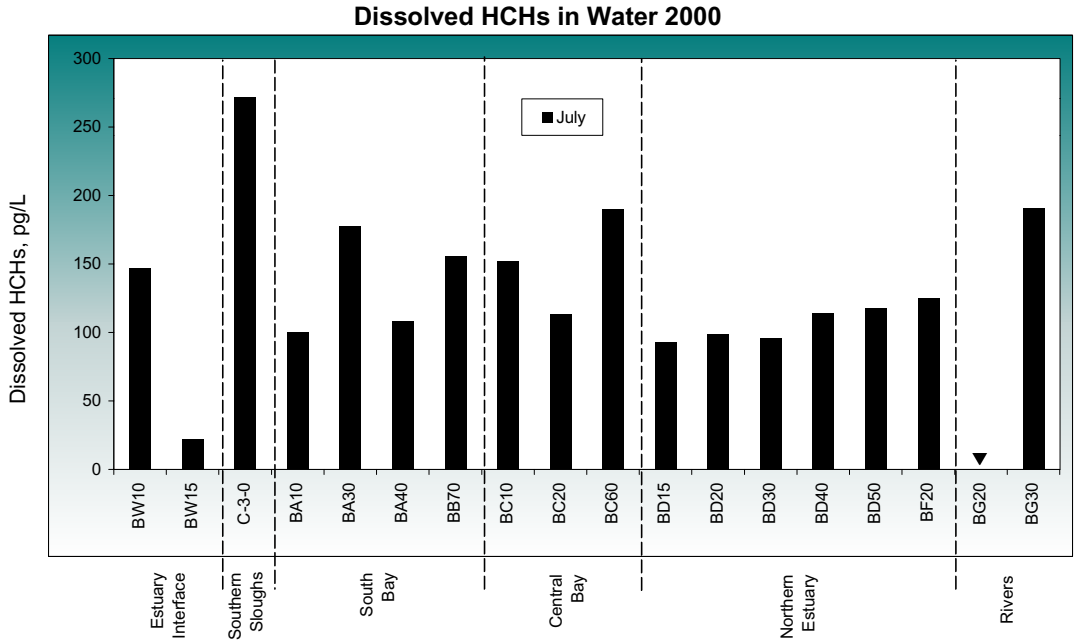
Source Data: See Data Table 8

Figure 2.18a. Dissolved diazinon in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. ▼ = not detected. Concentrations ranged from below detection to 15,000 pg/L. The highest concentration was measured at San Jose (C-3-0). On average, concentrations were highest at the Southern Sloughs station, San Jose (C-3-0) (24,000 pg/L) and lowest in the Central Bay (210 pg/L). Diazinon is compared to guidelines only on the basis of total diazinon.



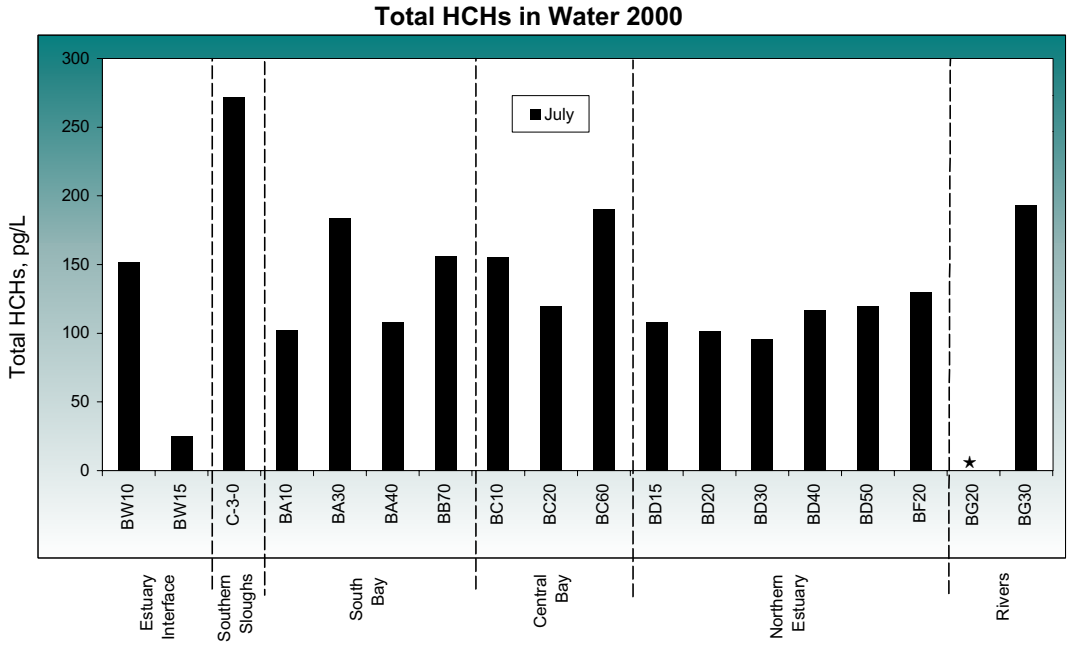
Source Data: See Data Table 9

Figure 2.18b. Total diazinon in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. ▼ = not detected. Concentrations ranged from below detection to 15,000 pg/L. The highest concentration was measured at San Jose (C-3-0). On average, concentrations were highest at the Southern Sloughs station, San Jose (C-3-0) (25,000 pg/L) and lowest in the Central Bay (210 pg/Lq). All of the samples were below the EPA water quality criterion for total diazinon (40,000 pg/L).



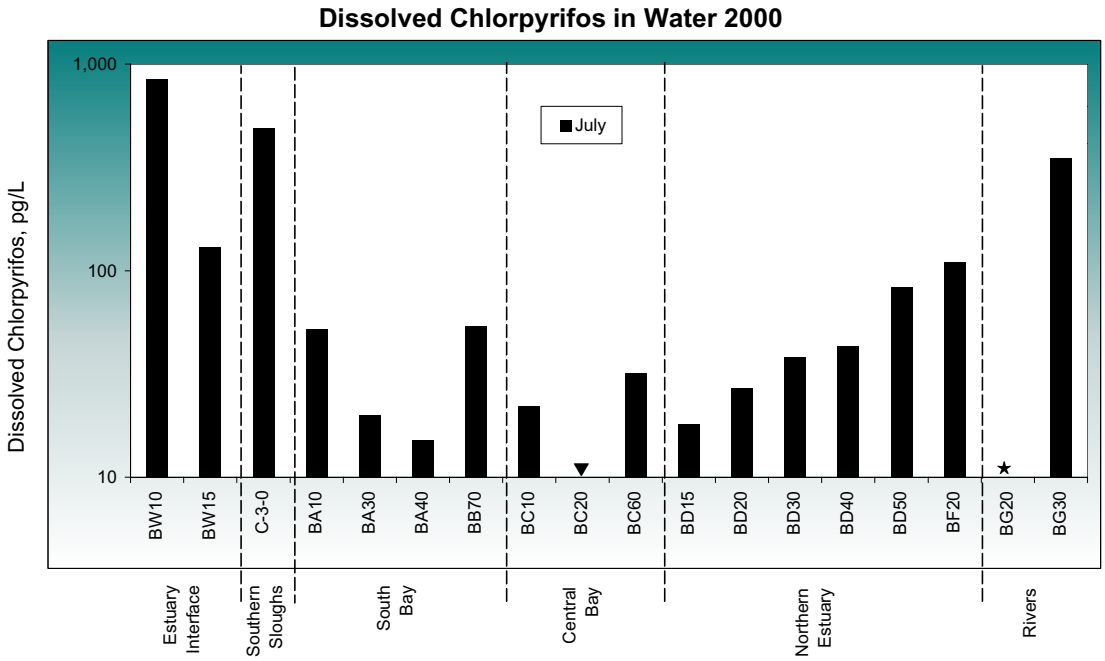
Source Data: See Data Table 8

Figure 2.19a. Dissolved HCHs in pg/L (ppq) at each RMP water station in July 2000. ▼ = not detected. Concentrations ranged from below detection to 272 pg/L. The highest concentration was measured at San Jose (C-3-0) and the lowest concentration was measured at Sacramento River (BG20). On average, concentrations were highest in the Southern Sloughs station, San Jose (C-3-0) (272 pg/L) and lowest in the Estuary Interface (85 pg/L). There are no water quality criteria for dissolved HCHs.



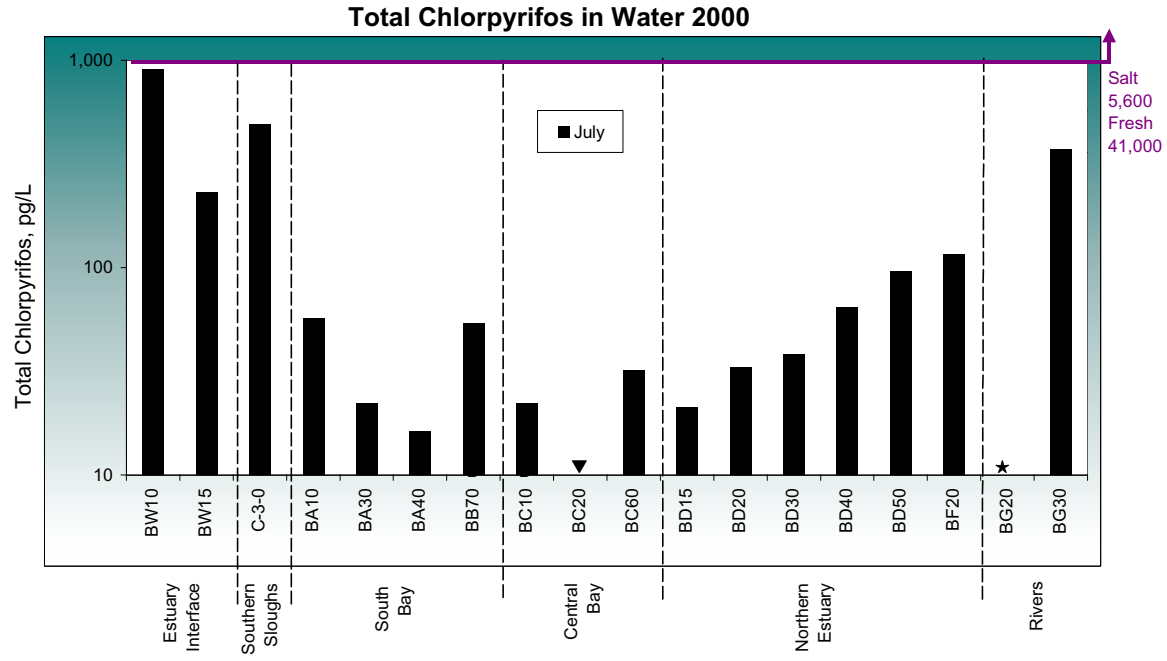
Source Data: See Data Table 9

Figure 2.19b. Total HCHs in pg/L (ppq) at each RMP water station in July 2000. ★ = not available. Concentrations ranged from below detection to 272 pg/L. The highest concentration was measured at San Jose (C-3-0). On average, concentrations were highest at the Southern Sloughs station, San Jose (C-3-0) (272 pg/L) and lowest in the Estuary Interface (89 pg/L). Water quality criteria exist only for individual HCH compounds, none of which were exceeded in 2000.



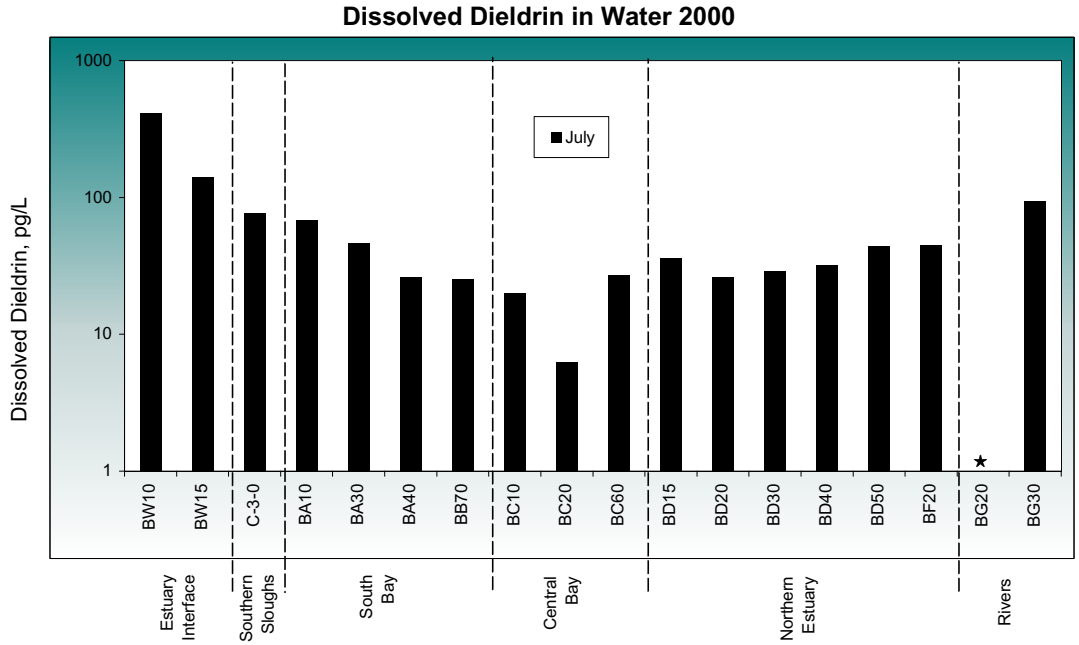
Source Data: See Data Table 8

Figure 2.20a. Dissolved chlorpyrifos in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. ▼ = not detected. ★ = data not available. Concentrations ranged from below detection to 850 pg/L. The highest concentration was measured at Standish Dam (BW10). On average, concentrations were highest at both the Southern Sloughs station San Jose (C-3-0) (490 pg/L) and the Estuary Interface stations (490 pg/L) and lowest in the Central Bay (18 pg/L). Chlorpyrifos is compared to guidelines only on the basis of total chlorpyrifos.



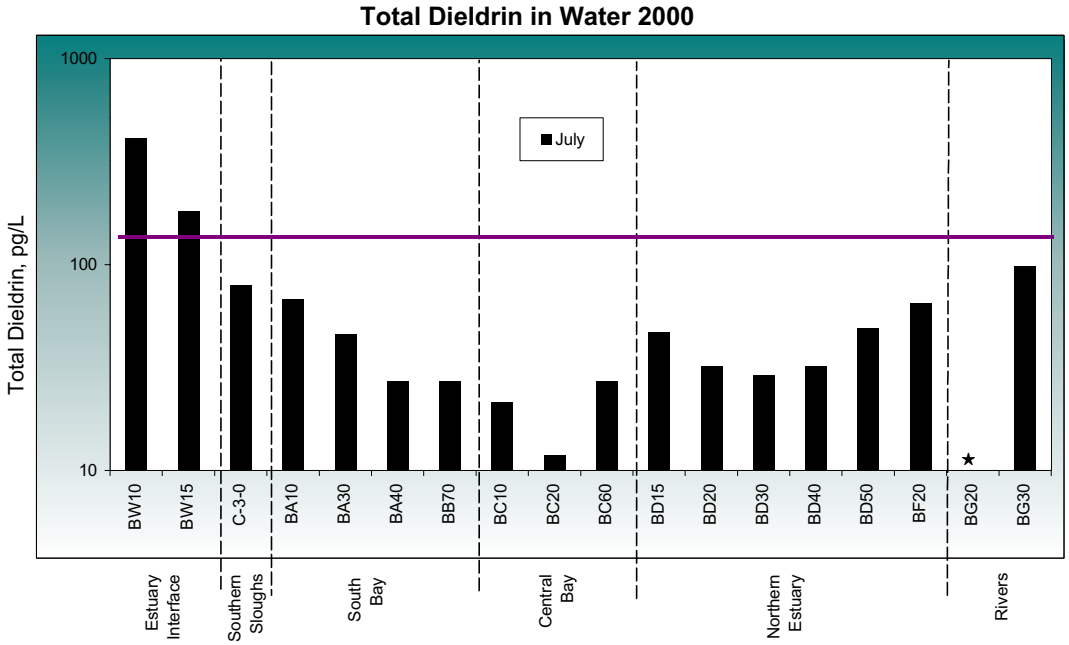
Source Data: See Data Table 9

Figure 2.20b. Total Chlorpyrifos in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. ▼ = not detected. ★ = data not available. Concentrations ranged from below detection to 898 pg/L. The highest concentration was measured at Standish Dam (BW10). Average concentrations were highest in the Estuary Interface (564 pg/L) and lowest in the Central Bay (18 pg/L). No samples were above the 4-day WQO for total chlorpyrifos (saltwater 0.0056 µg/L, freshwater 0.041 µg/L)



Source Data: See Data Table 8

Figure 2.21a. Dissolved dieldrin in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. ★ = data not available. Concentrations ranged from 6.2 to 410 pg/L. The highest concentration was measured at Standish Dam (BW10) and the lowest concentration was measured at Golden Gate (BC20). Average concentrations were highest in the Estuary Interface (275 pg/L) and lowest in the Central Bay (18 pg/L). Dieldrin is compared to guidelines only on the basis of total dieldrin.



Source Data: See Data Table 9

Figure 2.21b. Total Dieldrin in pg/L (ppq) at each RMP water station in July 2000. Note logarithmic scale. ★ = data not available. Concentrations ranged from 12 to 413 pg/L. The highest concentration was measured at Standish Dam (BW10) and the lowest concentration was measured at Golden Gate (BC20). Average concentrations were highest in the Estuary Interface (298 pg/L) and lowest in the Central Bay (20 pg/L). The two samples collected at the Estuary Interface stations were above the human health criterion for total dieldrin (organisms only criterion, 0.00014 µg/L).

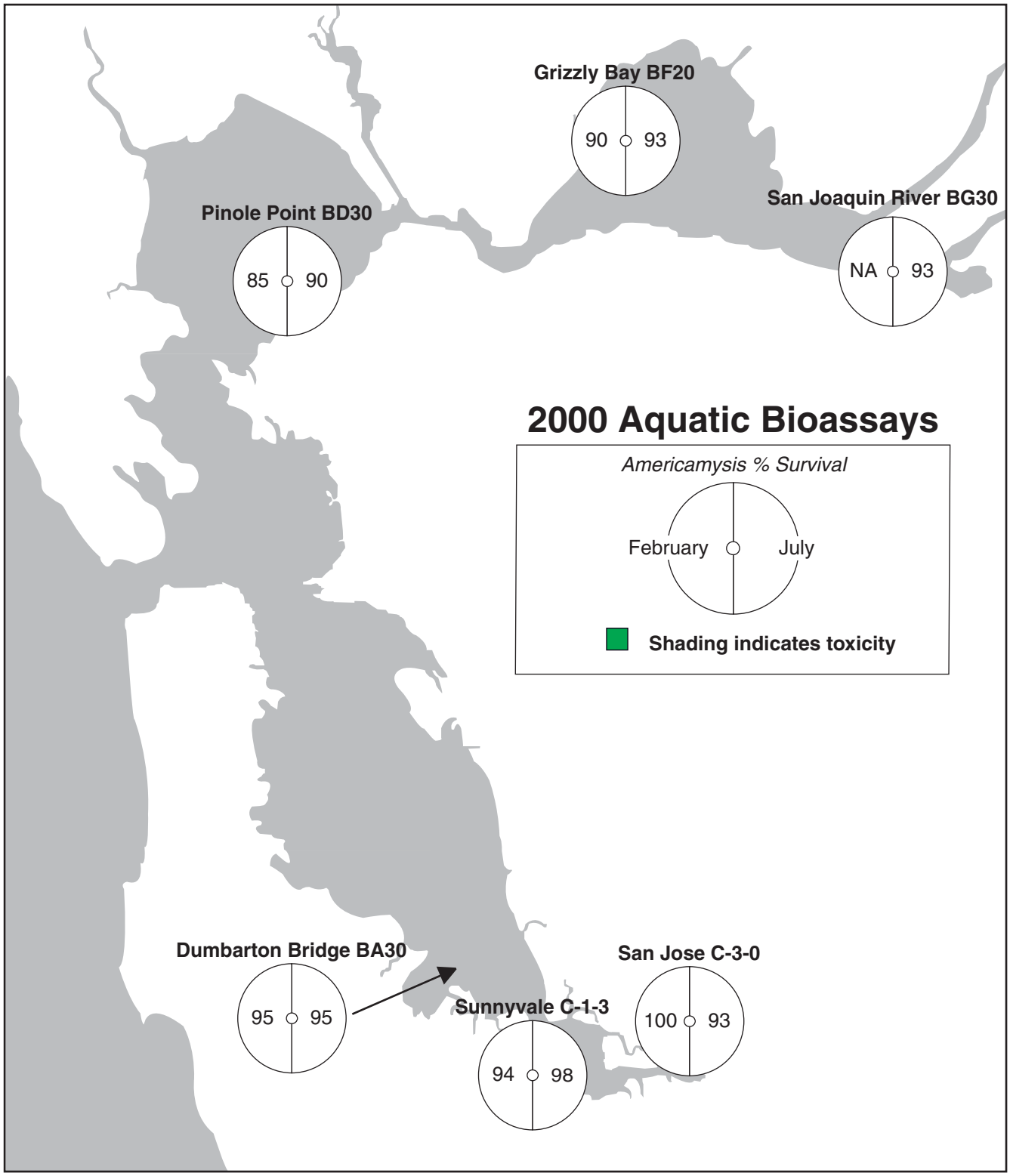


Figure 2.22. Aquatic bioassay results for 2000. NA = not available. Clean artificial seawater was used for control samples. Significant toxicity in a seven-day *Americamysis bahia* test was not observed in any of the tested samples from RMP stations. Toxicity was determined by statistical comparison to controls.

Source Data: See Data Table 10

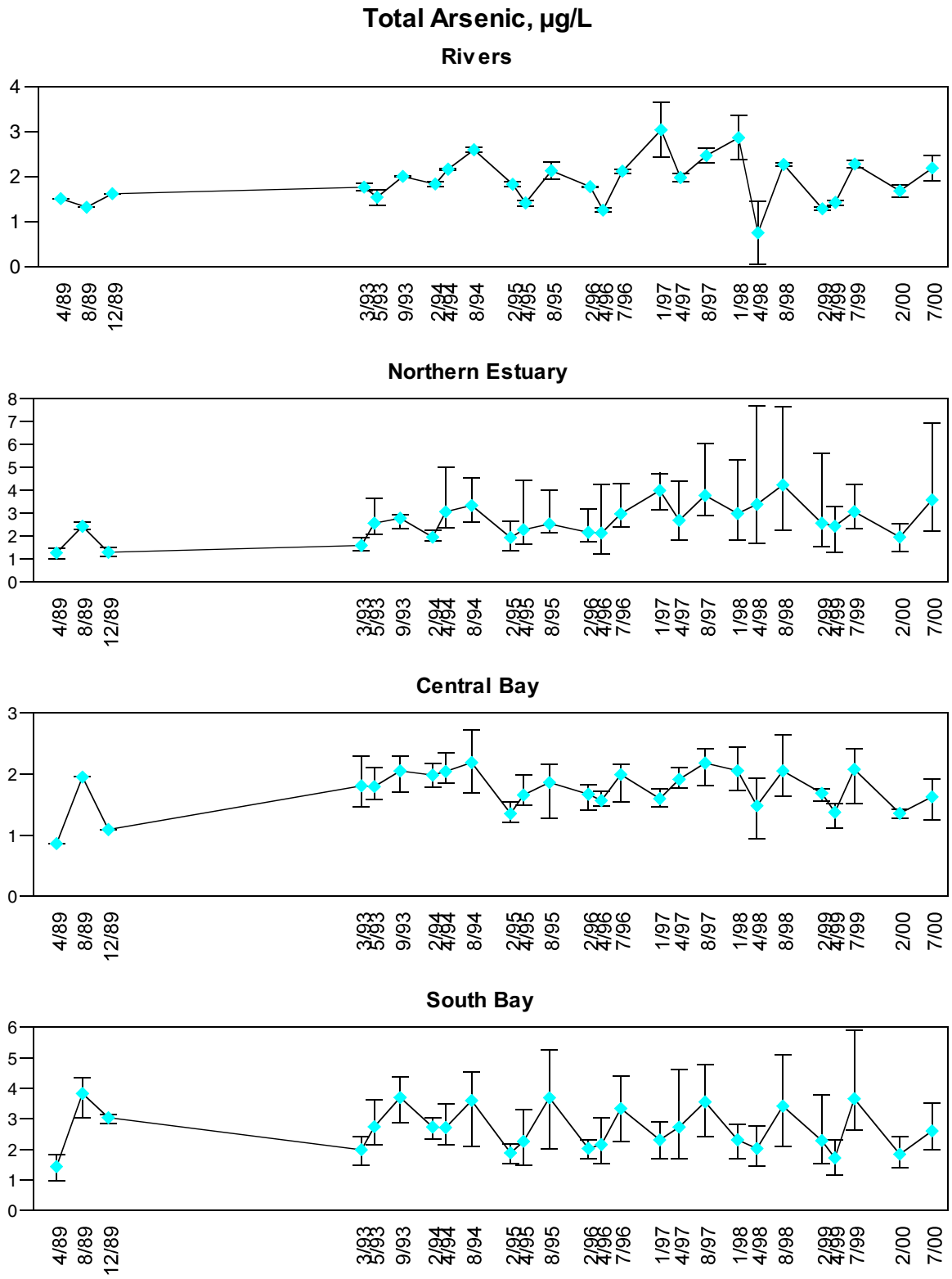


Figure 2.23. Average total arsenic concentrations in water (µg/L) in each Estuary reach from 1989–2000. Note different y-axis scales. The vertical bars represent range of values. The sample size varies between sites and between seasons.

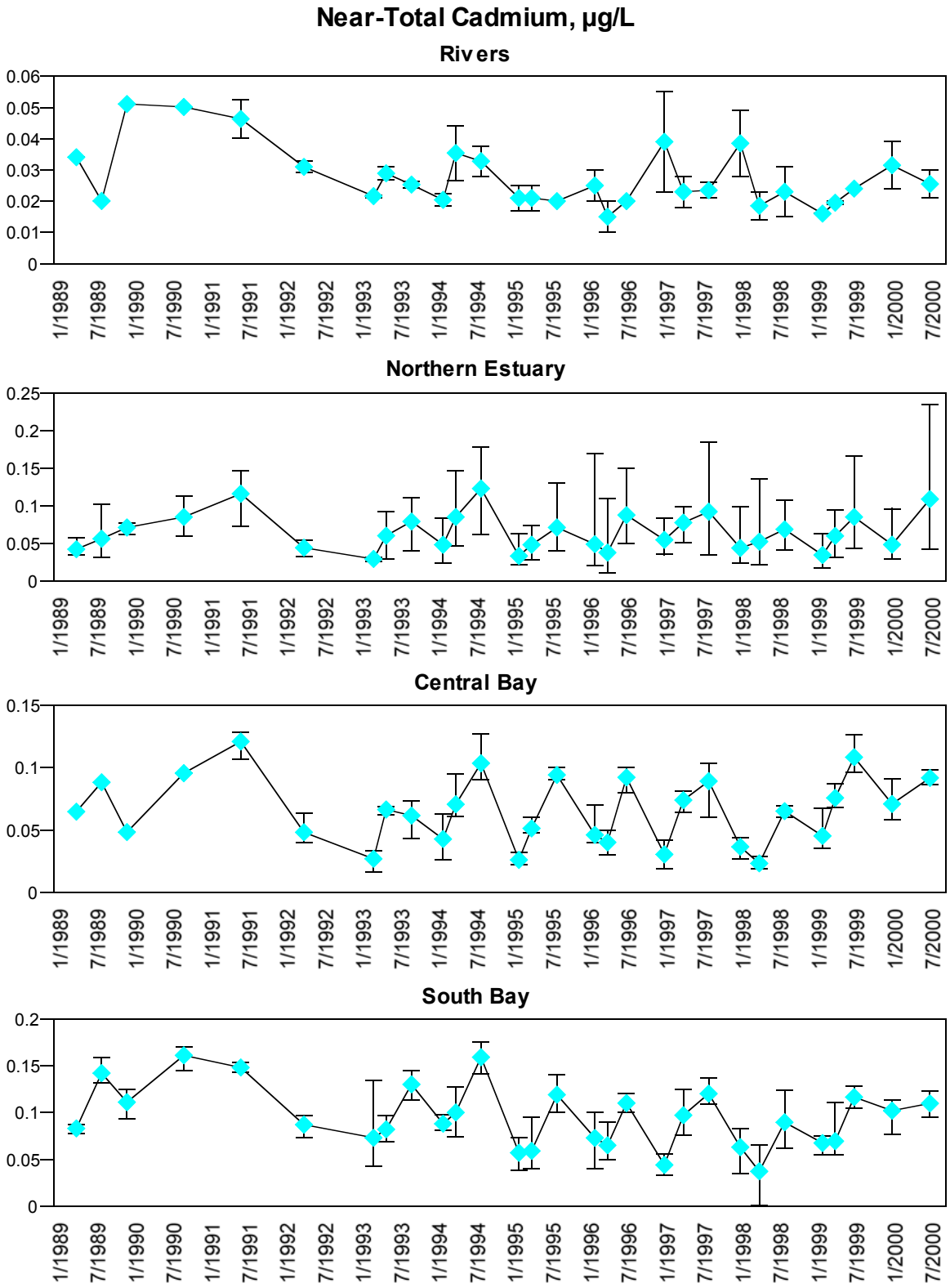


Figure 2.28b. Average near-total cadmium concentrations in water (µg/L) in each Estuary reach from 1998-2000. Note different y-axis scales. The vertical bars represent range of values. The sample size varies between sites and between seasons.

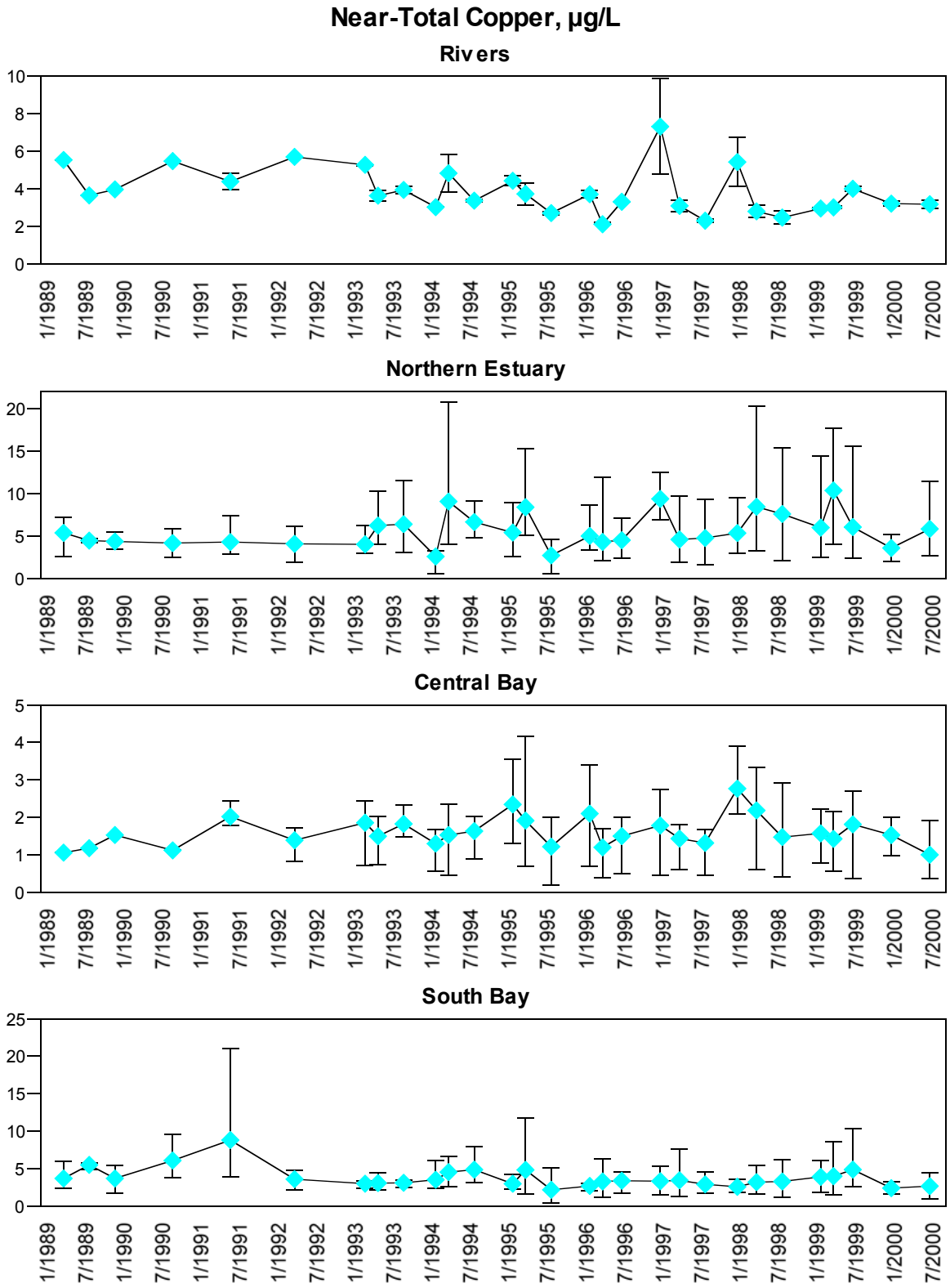


Figure 2.29b. Average near-total copper concentrations in water (µg/L) in each Estuary reach from 1989–2000. Note different y-axis scales. The vertical bars represent range of values.

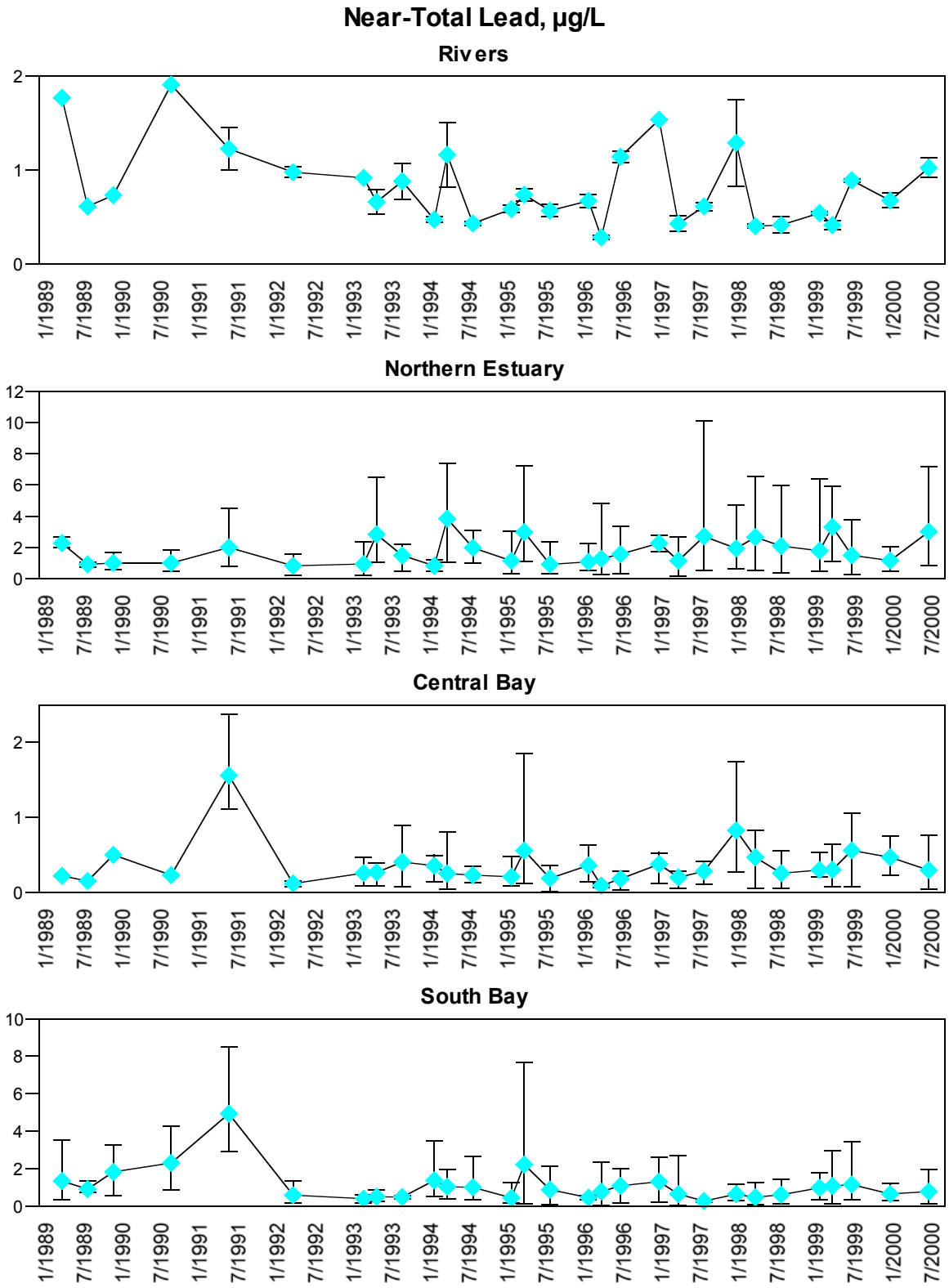


Figure 2.30b. Average near-total lead concentrations in water (µg/L) in each Estuary reach from 1989–2000. Note different y-axis scales. The vertical bars represent range of values.

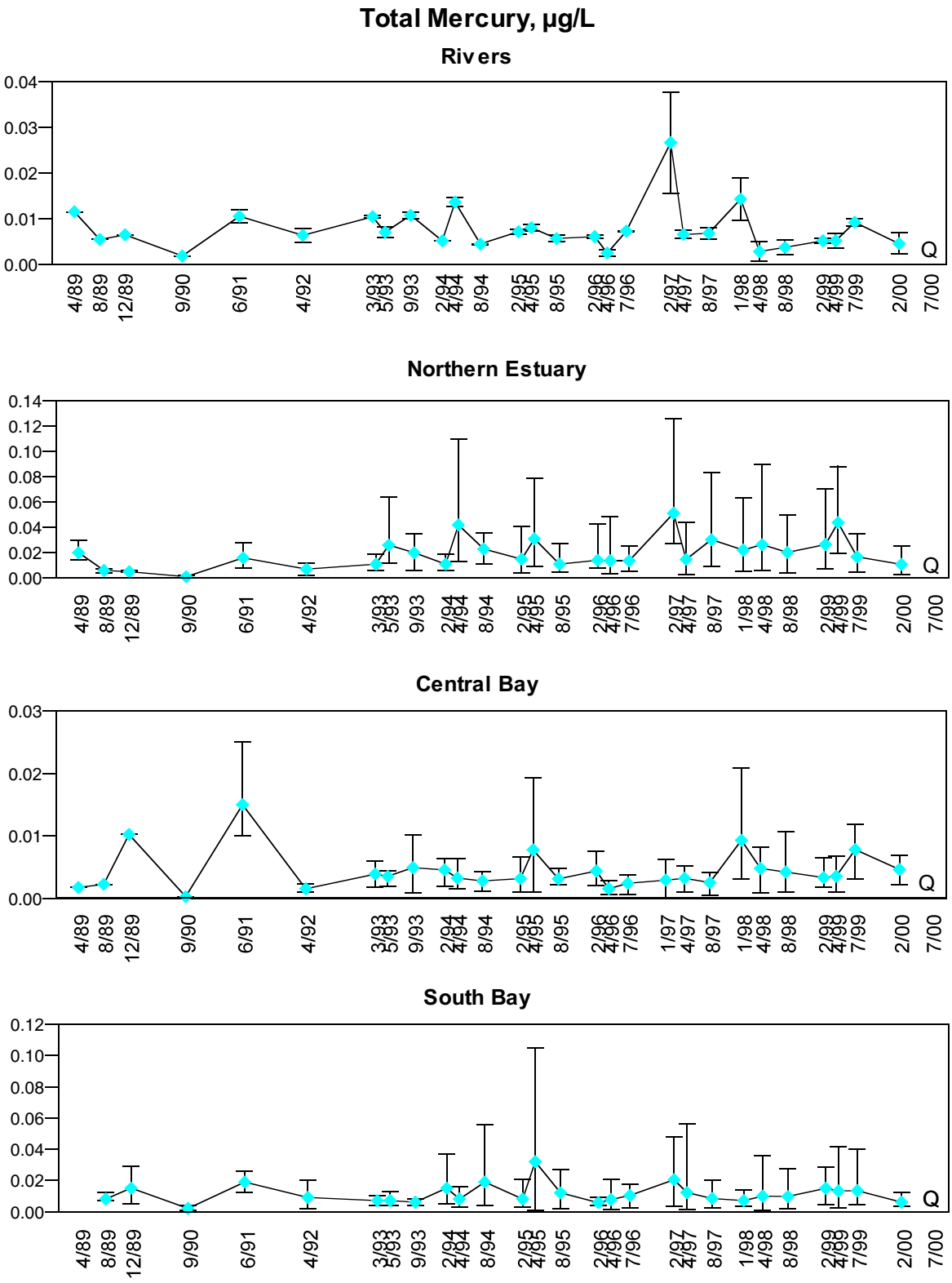


Figure 2.27. Average total mercury concentrations in water (µg/L) in each Estuary reach from 1989–2000. Note different y-axis scales. The vertical bars represent range of values. Q = outside QA limits, poor precision between analyses.

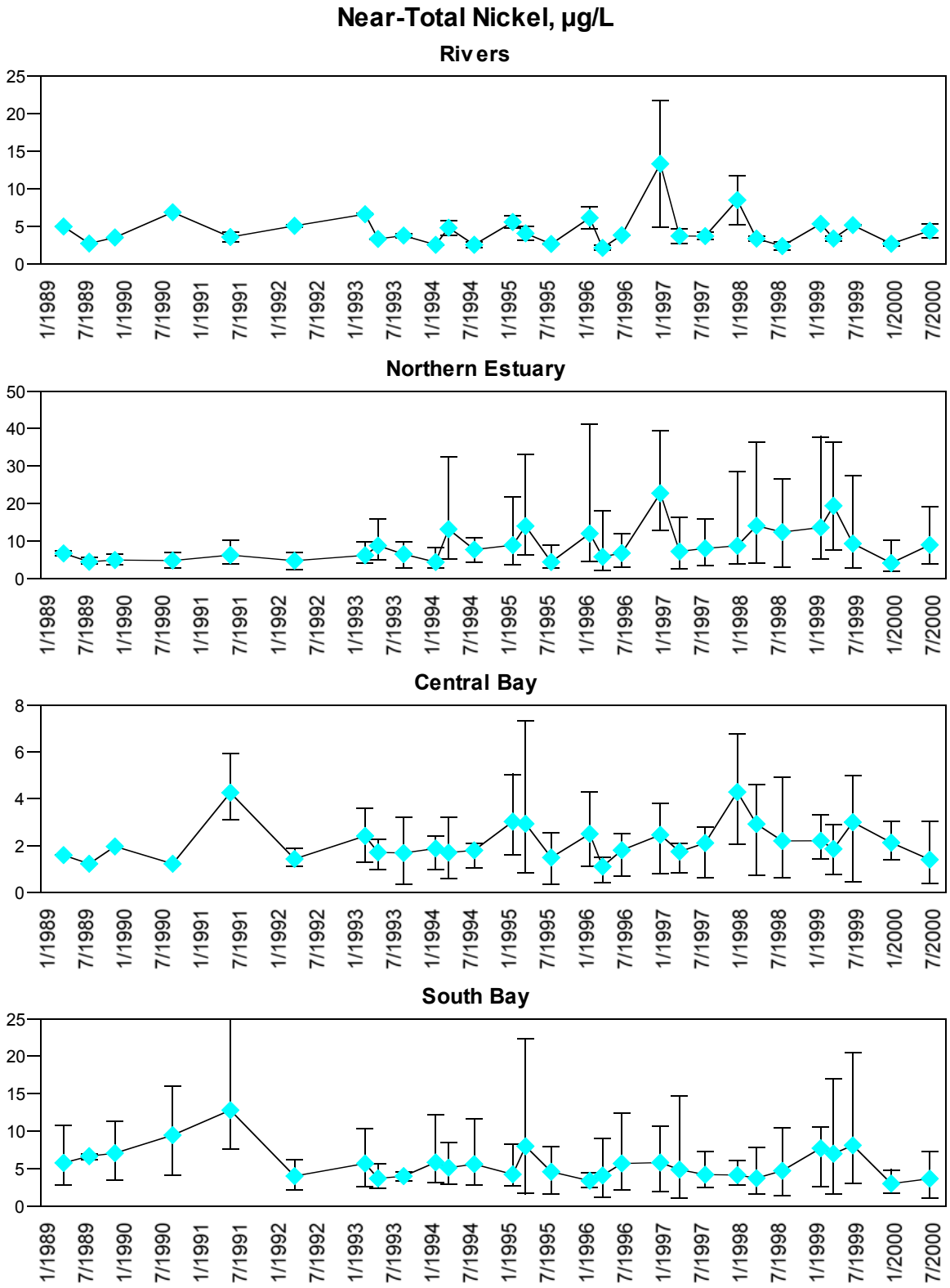


Figure 2.32b. Average near-total nickel concentrations in water (µg/L) in each Estuary reach from 1989–2000. Note different y-axis scales. The vertical bars represent range of values.

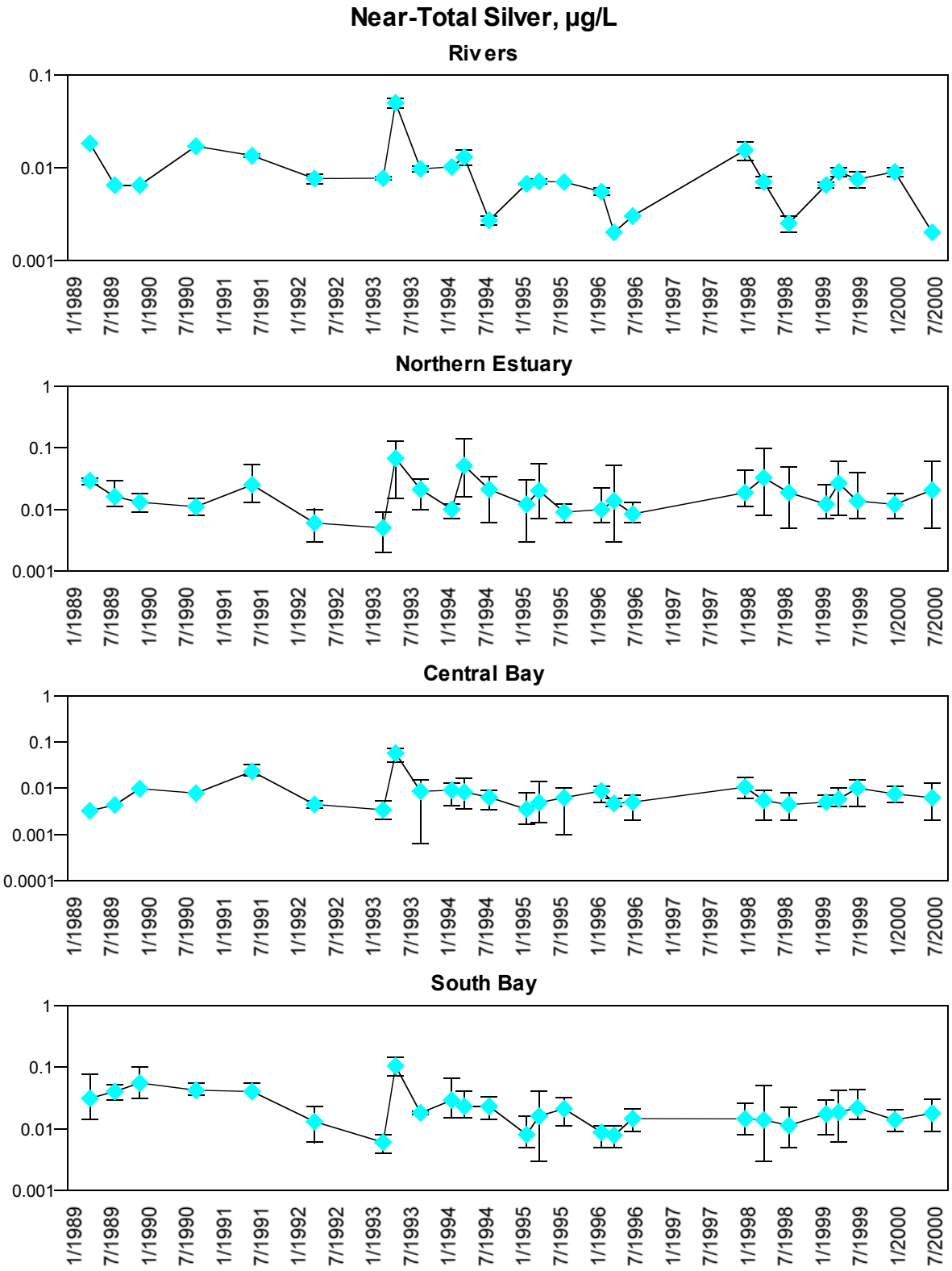


Figure 2.34b. Average near-total silver concentrations in water (µg/L) in each Estuary reach from 1989–2000. Note different y-axis logarithmic scales. The vertical bars represent range of values. All 1997 samples were lost due to methodological problems.

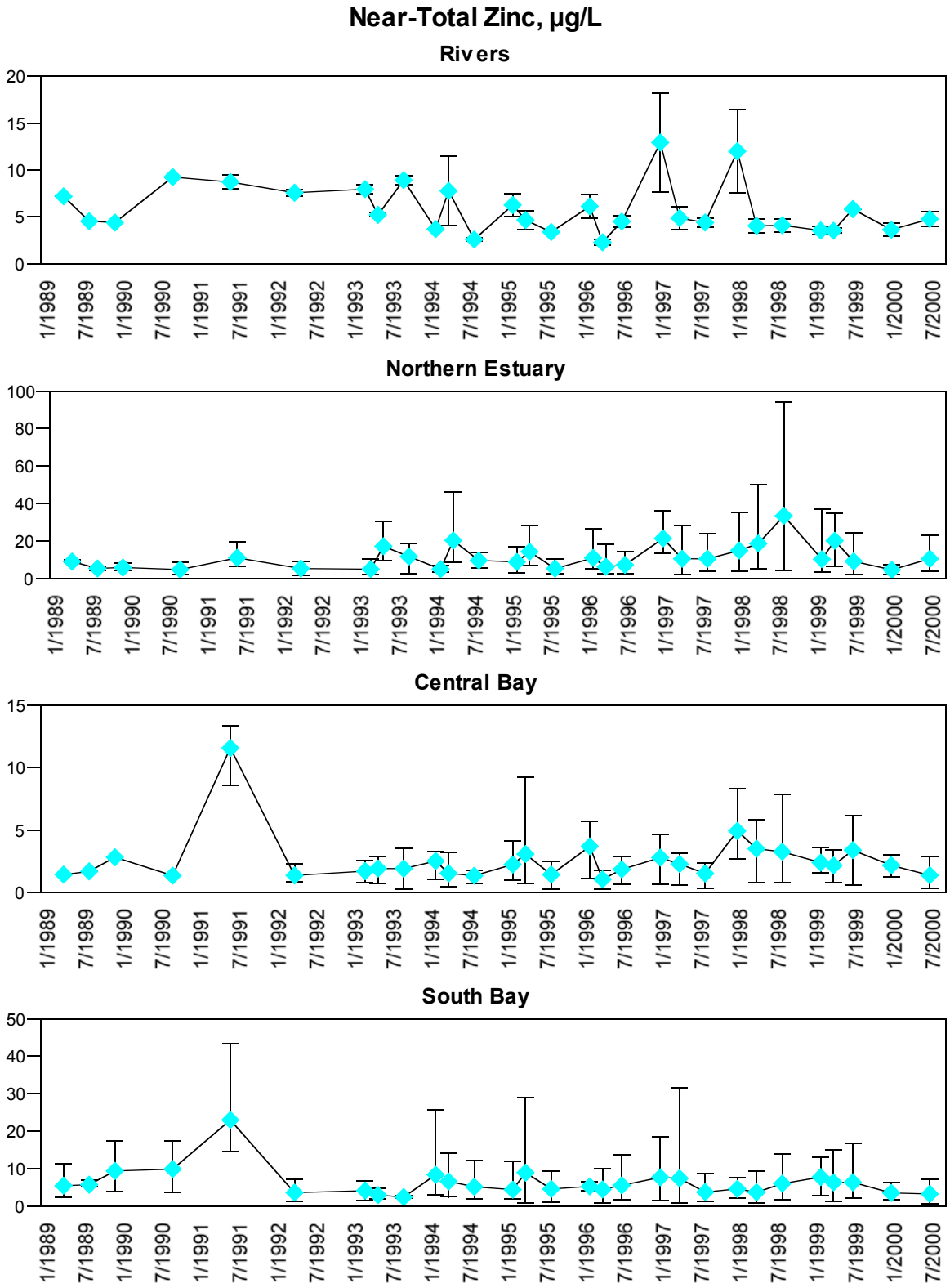


Figure 2.35b. Average near-total zinc concentrations in water (µg/L) in each Estuary reach from 1989–2000. Note different y-axis scales. The vertical bars represent range of values.

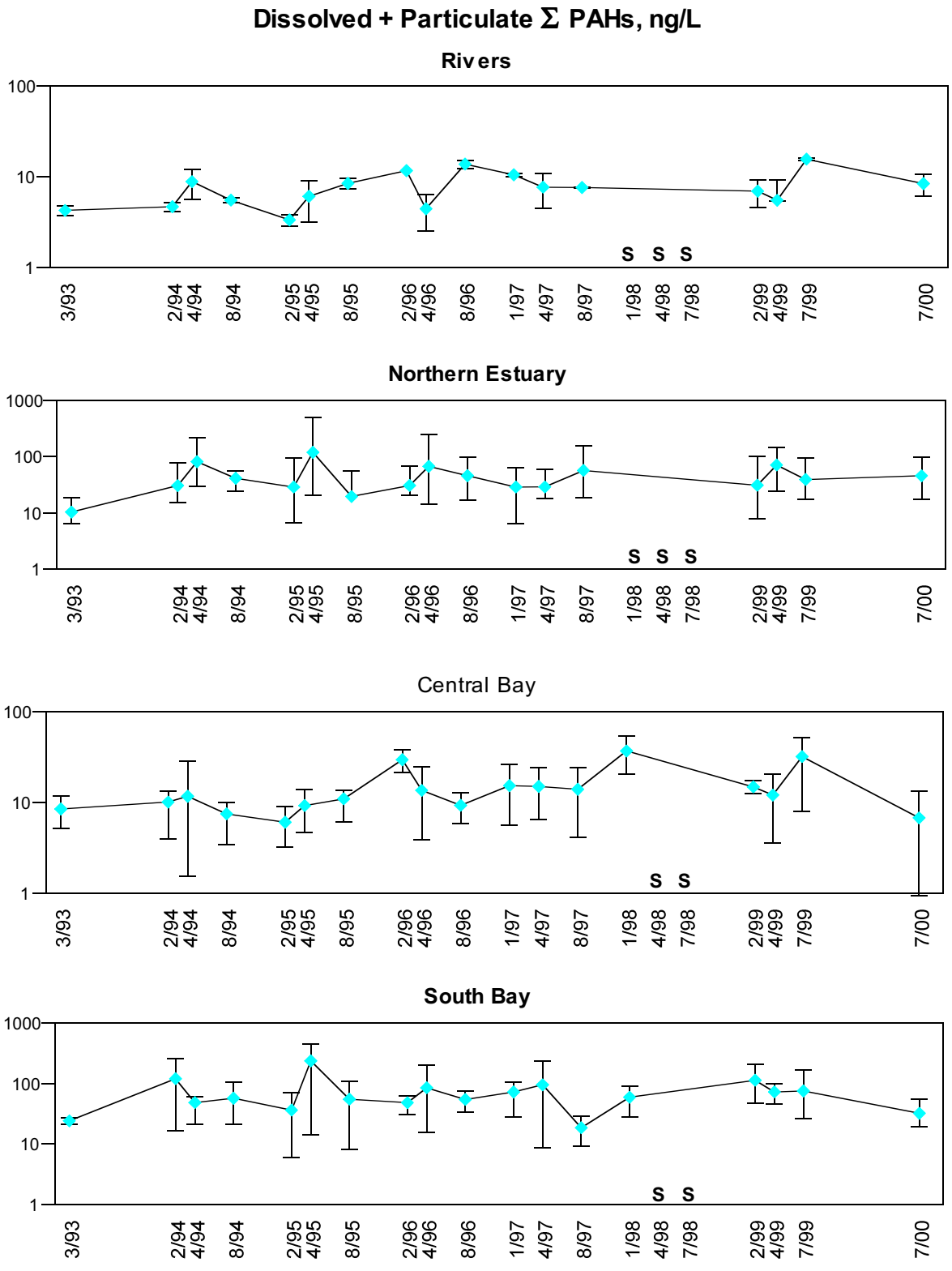


Figure 2.32. Average total (dissolved + particulate) PAH concentrations (ng/L) in water for each Estuary reach from 1993–2000. Note different y-axis logarithmic scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = qualified values represent significant portion of the sum.

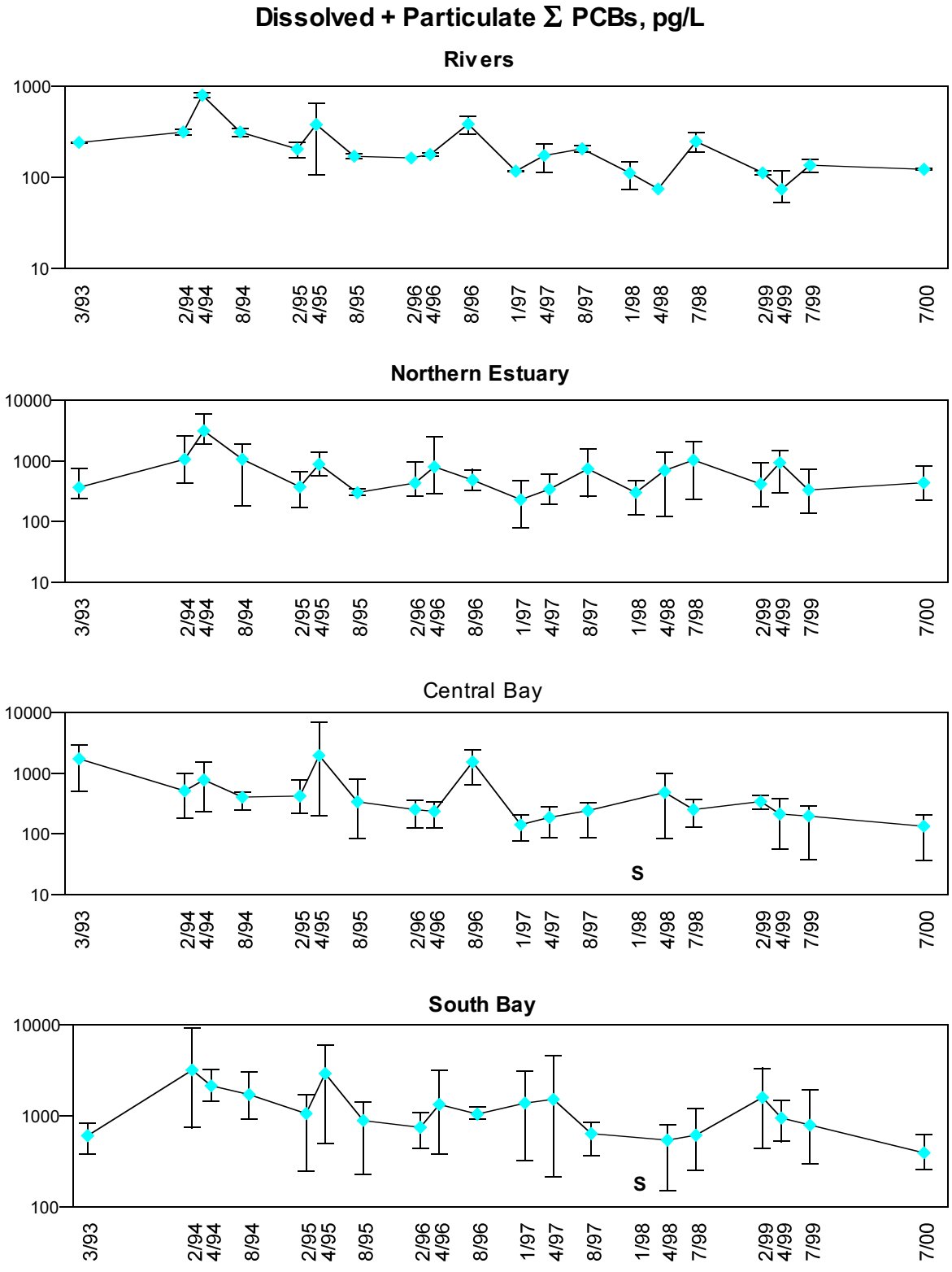


Figure 2.33. Average total (dissolved + particulate) PCB concentrations (pg/L) in water for each Estuary reach from 1993–2000. Note different y-axis logarithmic scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = qualified values represent significant portion of the sum.

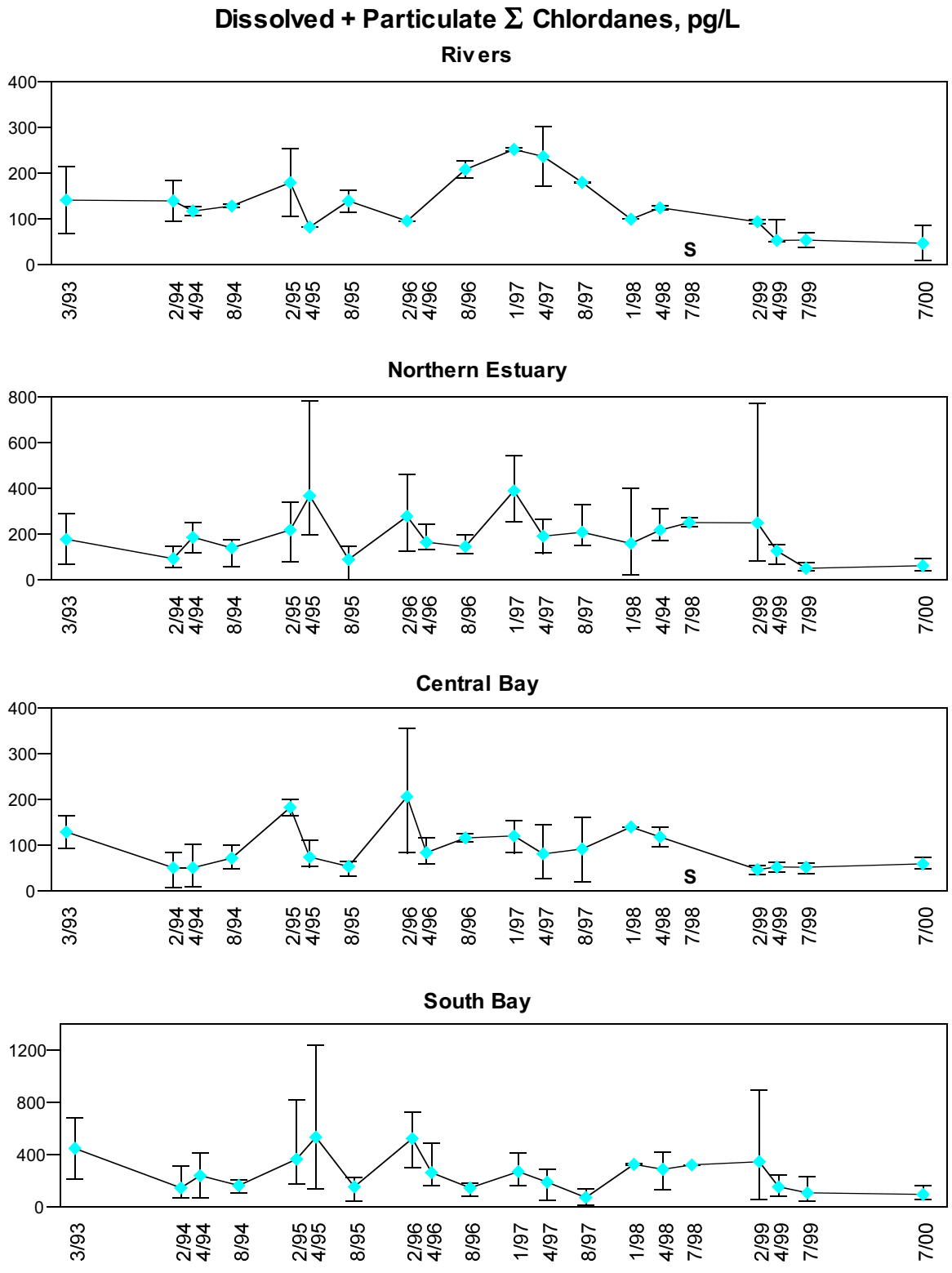


Figure 2.34. Average total (dissolved + particulate) Chlordane concentrations (pg/L) in water for each Estuary reach from 1993–2000. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = qualified values represent significant portion of the sum.

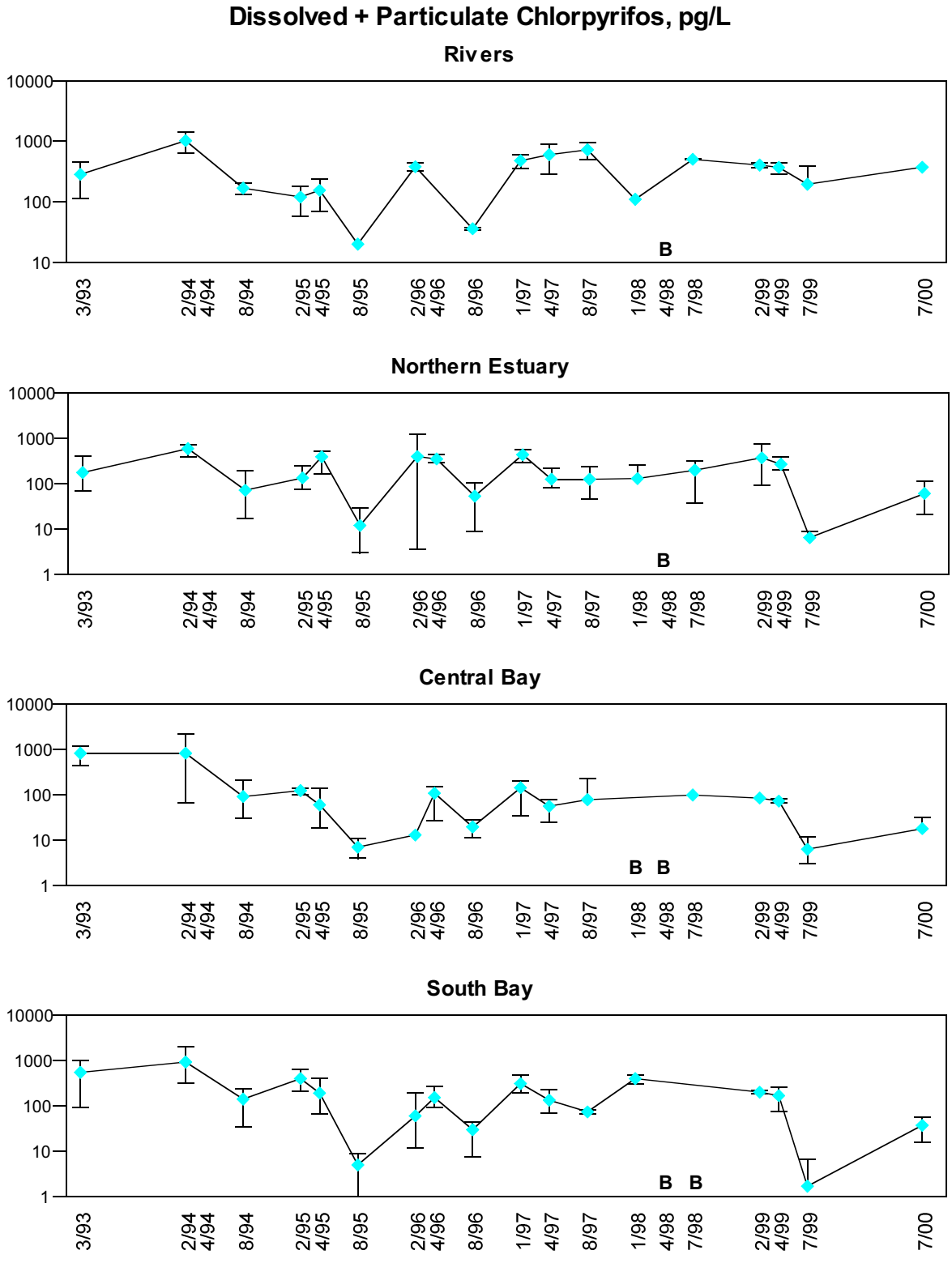


Figure 2.35. Average total (dissolved + particulate) Chlorpyrifos concentrations (pg/L) in water for each Estuary reach from 1993–2000. Note different y-axis logarithmic scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. B = significant portion of the samples suffered from blank contamination.

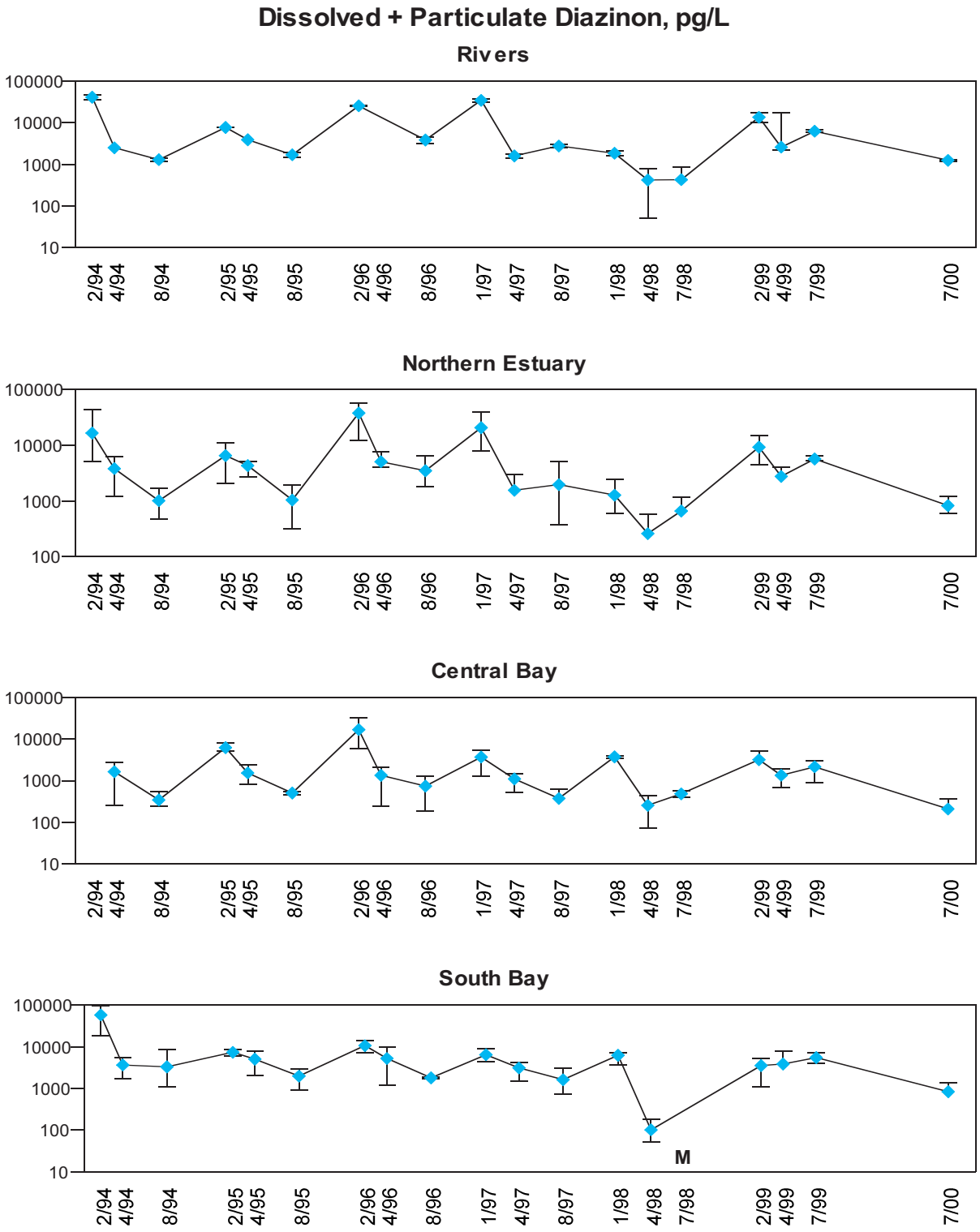


Figure 2.36. Average total (dissolved + particulate) Diazinon concentrations (pg/L) in water for each Estuary reach from 1993–2000. Note logarithmic scale. Sample size varies between reaches and seasons. The vertical bars represent the range of vaues. M = matrix interference.

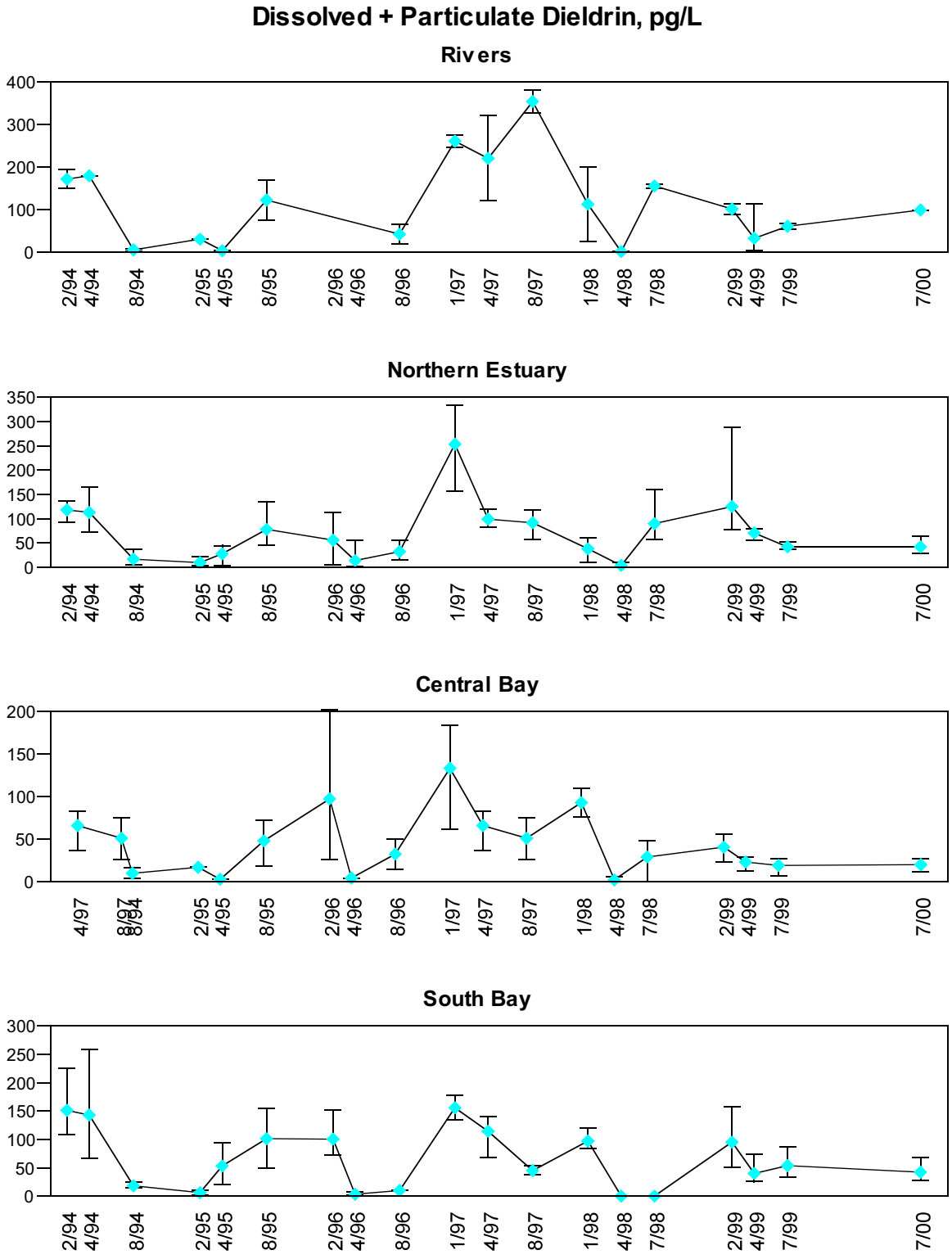


Figure 2.37. Average total (dissolved + particulate) Dieldrin concentrations (pg/L) in water for each Estuary reach from 1993–2000. Note different y-axis scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons.

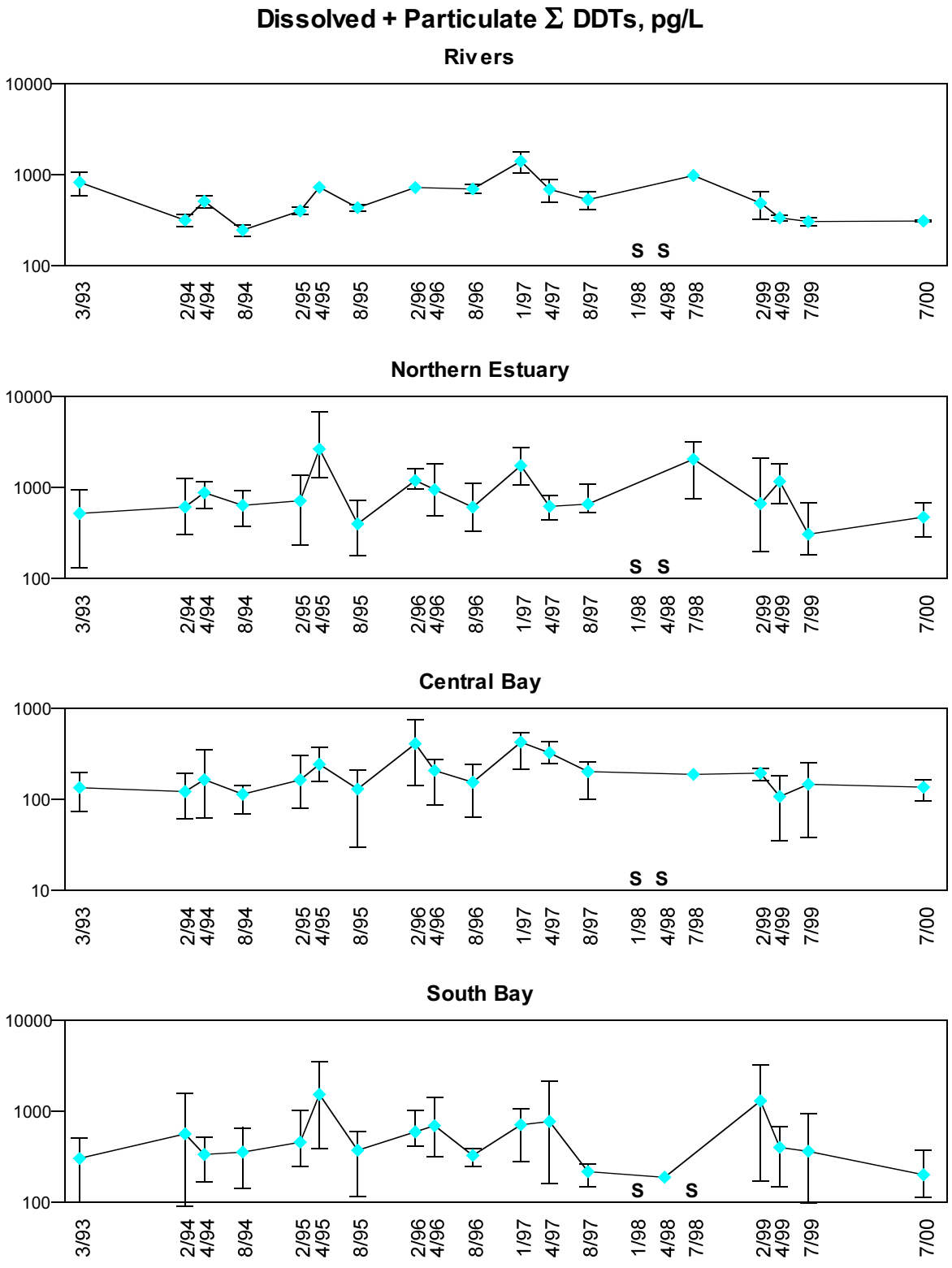


Figure 2.38. Average total (dissolved + particulate) DDT concentrations (pg/L) in water for each Estuary reach from 1993–2000. Note different y-axis logarithmic scales. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = qualified values represent significant portion of the sum.

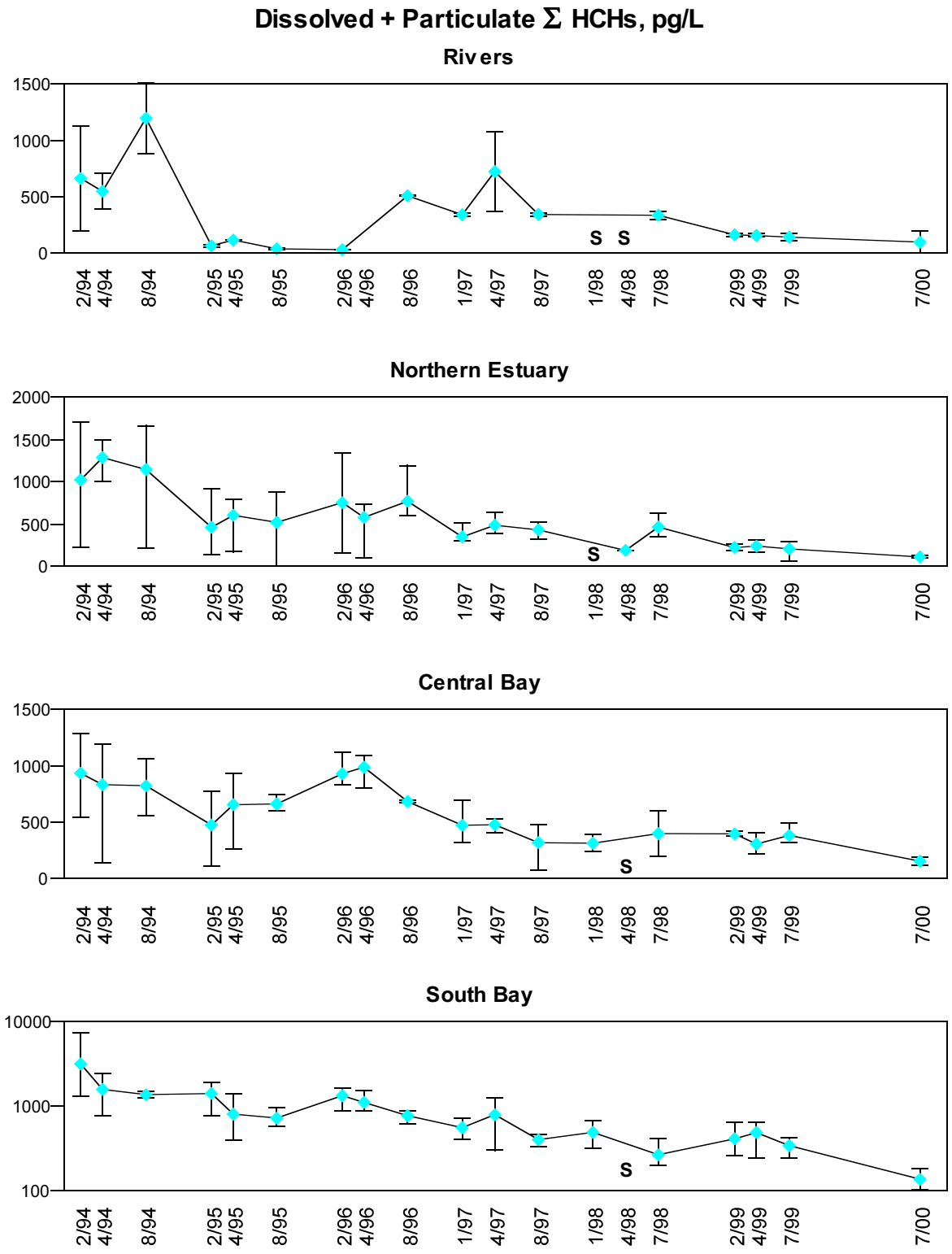


Figure 2.39. Average total (dissolved + particulate) HCH concentrations (pg/L) in water for each Estuary reach from 1993–2000. Note different y-axis scales and logarithmic scale for concentrations in the South Bay. The vertical bars represent the range of values. Sample size varies between reaches and seasons. S = qualified values represent significant portion of the sum.