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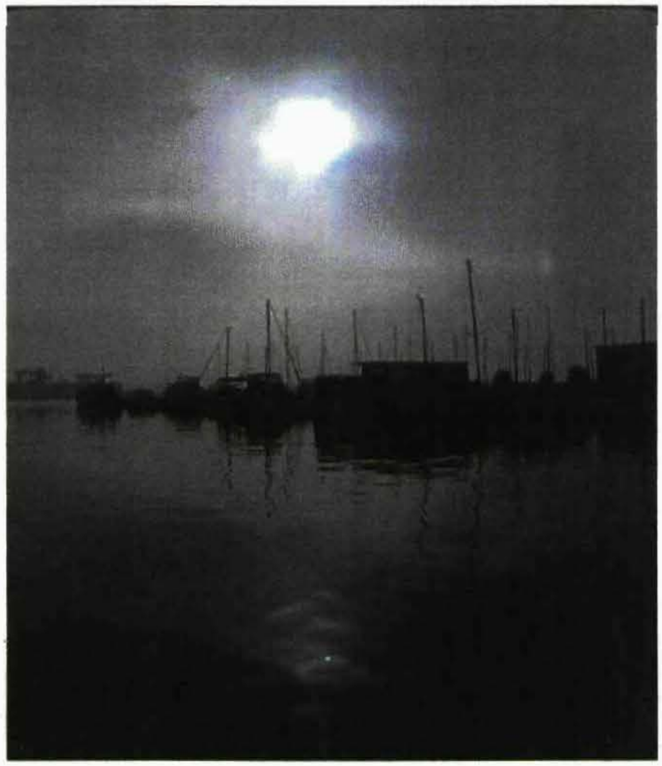
The Marine Environment of Marina del Rey Harbor
July 2001 - June 2002



A Report to the Department of Beaches and Harbors
County of Los Angeles

By

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AQUATIC BIOASSAY & CONSULTING LABORATORIES, INC.

December 23, 2002

Mr. Joe Chesler
County of Los Angeles
Dept. of Beaches and Harbors
13837 Fiji Way
Marina del Rey, CA 90292

Dear Mr. Chesler:

The scientists and staff of Aquatic Bioassay are pleased to present this report of the 2001-2002 marine surveys of Marina del Rey Harbor.

This report contains the results of field and laboratory studies conducted from July 1, 2001 through June 30, 2002. The 2001-2002 monitoring program consisted of monthly water column surveys; semiannual fish surveys and an annual benthic sediment survey.

Please contact me or my staff with any questions or comments you may have regarding this report. We look forward to working closely with the Department of Beaches and Harbors in the coming year.

Yours very truly,

Thomas (Tim) Mikel
Laboratory Director

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Aquatic Bioassay & Consulting

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1. SUMMARY

This report to the County of Los Angeles Department of Beaches and Harbors details the results of the marine monitoring program conducted by Aquatic Bioassay and Consulting Laboratories, Inc. in Marina del Rey Harbor during the period of July 1, 2001 to June 30, 2002. The program included monthly water quality and bacterial sampling; semiannual fish surveys including otter trawl, gill net, ichthyoplankton, beach seine, and diver-biologist transect sampling; and annual benthic sediment collection including physical, chemical, and biological characteristics.

Water Quality. Somewhat cooler water and low rainfall characterized this year's weather. Thus winter and spring rains exerted a smaller influence upon Harbor waters when compared to rainier years. When present, winter and spring precipitation lowered water clarity, salinity, and pH and increased ammonia, bacterial counts, and biochemical oxygen demand (BOD) throughout the Harbor. The influence upon the phytoplankton community was generally limited to the summer. Mild red tides were noticed in July 2001 at Stations 10 and 12 and dark brown discolorations were noticed at Stations 12 and 13 in October, 2002. As expected, seasonal temperature changes in the ocean impacted the Harbor, causing colder water in the winter and warmer water in the summer and fall.

Both the open ocean and Ballona Creek influence water quality at stations near the Harbor entrance. Open ocean influences included lower water temperatures and high dissolved oxygen, salinity and pH. Ballona Creek caused decreased water clarity and increased ammonia, BOD, and bacterial counts especially at Station 1 near the Harbor entrance. Stations in the lower main channel, and even into Basins B and H, were most like the open ocean and were thus the most natural in the Harbor. They were characterized by high dissolved oxygen, salinity, pH and water clarity and low values of BOD. Stations further back in the Marina were warmer, more saline and moderate in dissolved oxygen and clarity.

Flows from Oxford Lagoon affected Basin E and brought reduced water clarity, lower dissolved oxygen, and salinity and elevated levels of BOD and bacteria. Similar to recent surveys, Basin D, which includes Mother's Beach, appeared less affected by surface runoff than in the past perhaps due to low rainfall.

Bacterial measurements were made monthly at 18 stations (648 measurements in the year). Total coliform were above public health standards 33 times, fecal coliform standards 60 times, and enterococcus standards 42 times, an increase over last year. The total excedances (135) were almost double last year's number (84 exceedences). The percentage of exceedences directly related to Ballona Creek or Oxford Lagoon, 109 (81% of the total) did not change much from last year. Enteroccocus exceedences were similar to last year, but the number of fecal coliform exceedences was at least three times higher in each season. Public health standards for total coliforms were exceeded most often in the fall and spring compared to past years.

Physical Characteristics of Benthic Sediments. Physical characteristics (median particle size and sorting) of Harbor sediments from October, 2000 were compared to results from October, 2002 since no samples were analyzed for this survey. Relative percent differences (RPD) were calculated to compare results. Only four stations had RPDs higher than 25%. The differences in median particle size at these stations did not seem to affect chemical contaminant concentrations and biota health. Physical characteristics were

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influenced by energy of water flow that is influenced by Harbor configuration and rainfall intensity. The effect of current and wave action near the entrance and into the upper channel created sediments that were universally coarse and homogenous. A finer, more heterogeneous mix of sediments was found in the back Harbor areas.

Chemical Characteristics of Benthic Sediments. In contrast to last year, Oxford Lagoon and Ballona Creek, appeared to contribute pesticides and organics to stations located nearby. Among chlorinated pesticides, only DDE was found at all stations in the Harbor. Among chlorinated hydrocarbons listed as toxic by NOAA, all 15 Harbor stations had at least one compound that exceeded levels "potentially" toxic to benthic organisms, and 12 out of 15 stations had chlorinated hydrocarbons at levels "probably" toxic to benthic organisms. Many more stations this year were found to have pesticide concentrations that were "probably toxic" compared to last year. However, most chlorinated compounds have continued to remain lower than historical values, are much lower than those of Los Angeles Harbor and are similar to those of reference samples collected offshore. Seven of 15 stations contained PCB concentrations at "potentially" toxic levels but, on average, concentrations were lower than those found in Los Angeles Harbor although higher than concentrations found offshore.

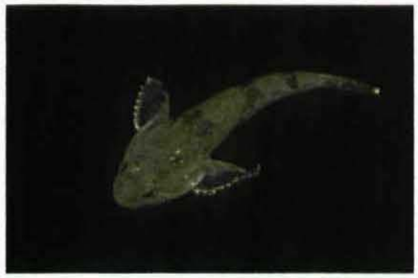
Heavy metals tended to be higher in the main channel and Basins F and E, likely originating from the resident boat population. Station 25 contained the widest variety of contaminants; chlorinated hydrocarbons, pesticides, organics and heavy metals. All stations, except Station 22 in Oxford Lagoon, exceeded at least one metal limit of "possible" toxicity, and 6 out of 15 exceeded at least one metal limit of "probable" toxicity which is improved over last year. Metal concentrations in Marina del Rey sediments do not appear to have greatly increased or decreased since 1989. Concentrations of about half of all comparable metals were approximately two to three times higher than Los Angeles Harbor. Tributyl tin continues to remain low but ubiquitous when compared to past surveys. Nonspecific organic compounds, including nutrients and carbonaceous organics, tended to be higher near the Harbor entrance but were found at several other locations in the marina.

Biological Comparisons of Benthic Sediments. Infaunal index and diversity values were somewhat lower compared to those of Los Angeles Harbor although numbers of individuals and species were higher. Overall, infaunal values were higher than past results.

The total number of infauna species collected this year (211) was slightly lower than last year (248). Nematode and oligocheate worms that are known to be characteristic of highly disturbed benthic sediments were found at several stations, but in relatively low numbers this year. Three commonly occurring polychaetes included *Psuedopolyudora paucibranchiata, Exogone uniformis* and *Mediomastus spp*. The infaunal community was characterized (by cluster analysis) into four station groups located near the harbor entrance, and in the mid and back channels. These groups did not appear to be closely associated with the distribution of either grain size or to any specific chemical compound. Even with various metal contamination, mid-channel stations remained the healthiest in the Harbor.

Fish Populations. Fish enumerations this year included trawl net sampling for bottom fish, gill net sampling for midwater fish, beach seine sampling for inshore fish, plankton net sampling for larval fish and eggs, and diver transect enumeration for reef fish. 29,184 total fish of all age groups, representing 64 different species were recorded. The majority of these were eggs, larvae, or juveniles, which attest to the Harbor's importance as a nursery. In general, abundance was lower and species counts were slightly higher than past years for all strata of fish. Mid water gill nets caught a variety of fish species but the majority of the numbers came from a school of topsmelt in the spring. The Marina continues to sustain an abundant and diverse assemblage of fish fauna and serves as a nursery for many species important to local sport and commercial fisheries, as well as the whole coastal environment.

2. INTRODUCTION



2.1. SCOPE AND PERIOD OF PERFORMANCE

This report covers the period of field and laboratory studies conducted from July 1, 2001 through June 30, 2002, supported by the County of Los Angeles, Department of Beaches and Harbors. The survey program consisted of monthly water column surveys; semiannual fish surveys including trawl, gill net, ichthyoplankton, beach seine, and diver transect enumerations; and annual benthic sediment surveys including the measurement of chemical and physical properties and benthic infaunal organisms.

2.2. HISTORY OF THE SURVEY PROJECT

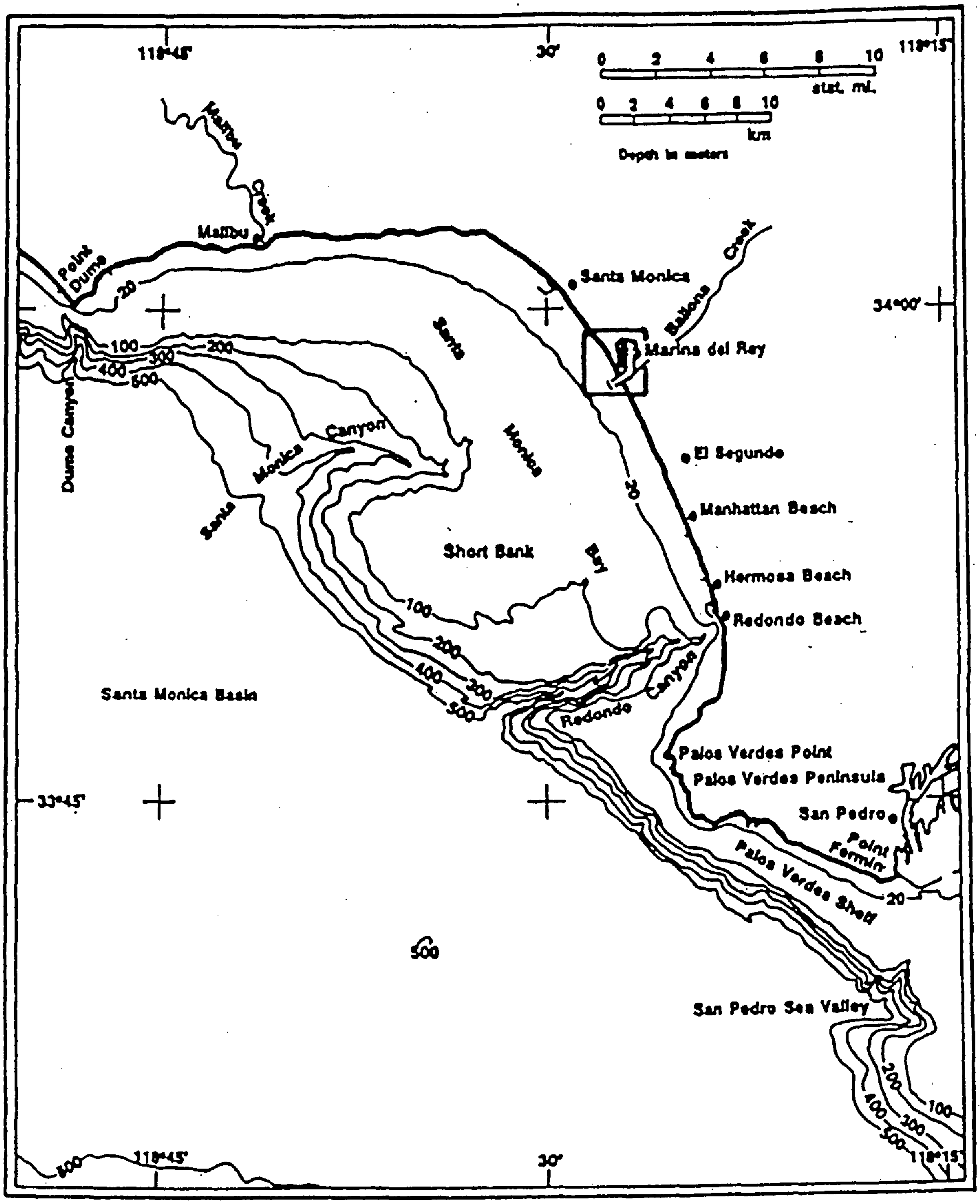
Harbors Environmental Projects of the University of Southern California (HEP, USC) initiated baseline studies in Marina del Rey, the largest manmade marina in the world, in 1976, with partial funding from the Federal Sea Grant Program and the County. Survey techniques were examined and stations established for ecological evaluation of the marina. There was a hiatus until 1984, when surveys were resumed. Although there have been some lapses in periods covered due to funding constraints, the survey constitutes a unique, long term record of the ecology of the area (Soule and Oguri, 1991, 1980, 1985, 1986, 1981, 1988, 1990, 1994; Soule, Oguri and Jones, 1991, 1992a, 1992b, 1993; Soule, Oguri, and Pieper, 1996, 1997; and Aquatic Bioassay and Consulting Laboratories 1997,1998, 1999, 2000, 2001).

2.3. HISTORY OF THE STUDY SITE

Marina del Rey was developed in the early 1960s on degraded wetlands that formed part of the estuary of Ballona Creek Wetlands. The wetlands once extended through the communities of La Ballona, Port Ballona and what is now Venice on the north, to the Baldwin Hills and the San Diego Freeway on the east, and to the Westchester bluffs on the south. Present street drainage extends east to the USC area at Exposition Park, based on early drainage patterns. In earlier years, Ballona Wetlands joined wetlands leading to the Los Angeles River, to the north and east of the Baldwin Hills and Palos Verdes Peninsula. At one time creation of a navigable channel from Ballona Creek to Dominguez Channel and the Los Angeles River was considered. The San Pedro area and the little port of Ballona were competing sites for development of the large port, with railroad magnates engaging in political battles for control. Ultimately San Pedro was selected because it was more sheltered from southwest swells during storms. The history has been reviewed in previous reports, based in part on Bancroft (1884) and Beecher (1915).

Until Ballona Creek was channelized in the 1920s, a number of streams meandered through the wetlands, forming a large pond that drained into what are now Ballona Lagoon and Del Rey Lagoon, behind a barrier beach. The estuary opened into Santa Monica Bay, cutting the submerged Santa Monica Canyon at the margin of the alluvial shelf of the bay (Figure 2-1). In the mud flats, birds, mollusks, and crustaceans abounded, along with mosquitoes and midges in the standing freshwater pools. Urbanization overtook the wetlands, with development of oil and gas fields, truck farms, and industrial sites, which resulted in piecemeal dumping and filling. These activities deprived the wetlands of the normal cycles of renewal, including sedimentation and nutrient flow during heavy winter storms. Channelization occurred to benefit development and to control urban and natural flooding. During World War II, industrial activity increased extensively, with no controls

FIGURE 2-1. LOCATION OF MARINA DEL REY WITHIN SANTA MONICA BAY (FROM SOULE ET AL. 1997).



on fills or dumping of toxic materials, causing contamination problems today when sites are regraded or excavated for new construction. Postwar residential development expanded urbanization to the margins of the reduced wetlands (Figure 2-2). Wartime experience with boats was new to many people and fostered developments in recreational boating, while postwar affluence increased pressure to create marinas to accommodate that interest. The Corps of Engineers designed several configurations and created a physical model for the marina at their laboratory in Vicksburg, Mississippi to test them. Construction began in 1960 with building concrete walls on dry land and then excavating the basins and channels.

The present configuration was believed to be adequate to protect boats without a breakwater, but this was disproved not long after the marina opened, when southwest swells from a winter storm damaged docks and vessels. Thus the present breakwater was added several years later. This protected vessels but also reduced flushing, which in turn reduced ecological conditions within the marina. A rocky reef structure, however, was added as a habitat.

2.4. LONG TERM RESULTS OF STUDIES

Soule et al. (1993) reviewed the reasons for undertaking baseline studies in the marina based on inquiries from the County about the productivity of the waters. Results of monitoring and research studies in Marina del Rey from 1976-1979 and 1984 to 1992 were discussed. Some of the findings are summarized below:

The effects of natural events such as droughts and flooding have an overriding impact on the marina ecology. El Nino episodes characterized by incursion of warmer water from the tropics, and usually linked to increased rainfall, strongly affect the occurrence of fish species and numbers. Sediment distribution is affected by low energy flow in the dry season and low rainfall years, by the intensity and frequency of storms in wet years, and by the extent of sand barriers at the entrance. Fine sediments accumulate in basins and channels under low flow conditions. Dry weather flow and low rainfall runoff conditions may move sediments to the main channel and entrance channel where they accumulate, while heavy runoff will move them seaward. If sandbars are present at the entrance, contaminated fine sediments may accumulate behind them.

Arsenic, copper, lead, mercury, nickel, silver and zinc are present in levels sufficient to inhibit reproductive stages of sensitive species. Lead particularly seems to be associated with runoff. Distribution patterns of chromium, nickel, manganese and iron are associated with, or complexed to, the finest grained sediments and follow their distribution patterns. High concentrations of organotins, which can be toxic in very low concentrations, have been steadily declining. The decline may relate to the fact that organotins have recently been banned from the Harbor.

Pesticides occur in concentrations that are inhibitory to some organisms, especially reproductive stages. The levels of pesticides have been declining, however. Polychlorinated biphenyls (PCBs) have appeared episodically and have reappeared this year. Some terrestrial soils in areas to the north of the marina are known to contain high levels of PCBs that can enter drainage channels during grading or excavation. Pilot analyses of terrestrial soils surrounding Oxford Basin indicate that most areas are heavily contaminated with heavy metals, chlorinated pesticides, and polynuclear aromatic hydrocarbons.

FIGURE 2-2. STUDY SITE MARINA DEL REY HARBOR (FROM SOULE ET AL. 1997).

When excessive coliform and enterococcus bacterial contamination is found throughout the marina, it is largely due to runoff as evidenced by the high levels that occur at Ballona Creek and Oxford Basin immediately after storms in the winter. However, prolonged rainfall periods tend to reduce bacterial counts. Lower levels were usually found during the summer, when marina usage is at its highest but runoff the lowest. High coliform counts at Mother's Beach in Basin D in past years were largely due to birds resting on the sand, this was controlled by stringing monofilament or polypropylene lines across flight patterns. High counts in the water at the docks where the Life Guard, Sheriff's Patrol and Coast Guard vessels tie up are probably due to seagulls and pelicans resting, and to the practice of hosing bird guano off the docks each morning, before samples were taken.

Benthic organisms are disrupted physically by natural events such as flooding, or manmade events such as dredging or pollution. Opportunistic species, particularly nematodes, which tolerate lower salinities, reproduce more rapidly with very large numbers and often recolonize disturbed areas. Areas influenced by Ballona Creek are often dominated by nematodes and oligocheate worms. More normal fauna through succession replace them if conditions stabilize. The soft, unconsolidated sediments and sometimes inhibitory levels of contamination favor populations of tolerant polychaete worms. They provide an important food for bottom feeding fish, but tend to select against molluscan and macrocrustacean species. Microcrustaceans are less nutritious by weight than polychaetes because of their indigestible exoskeletons.

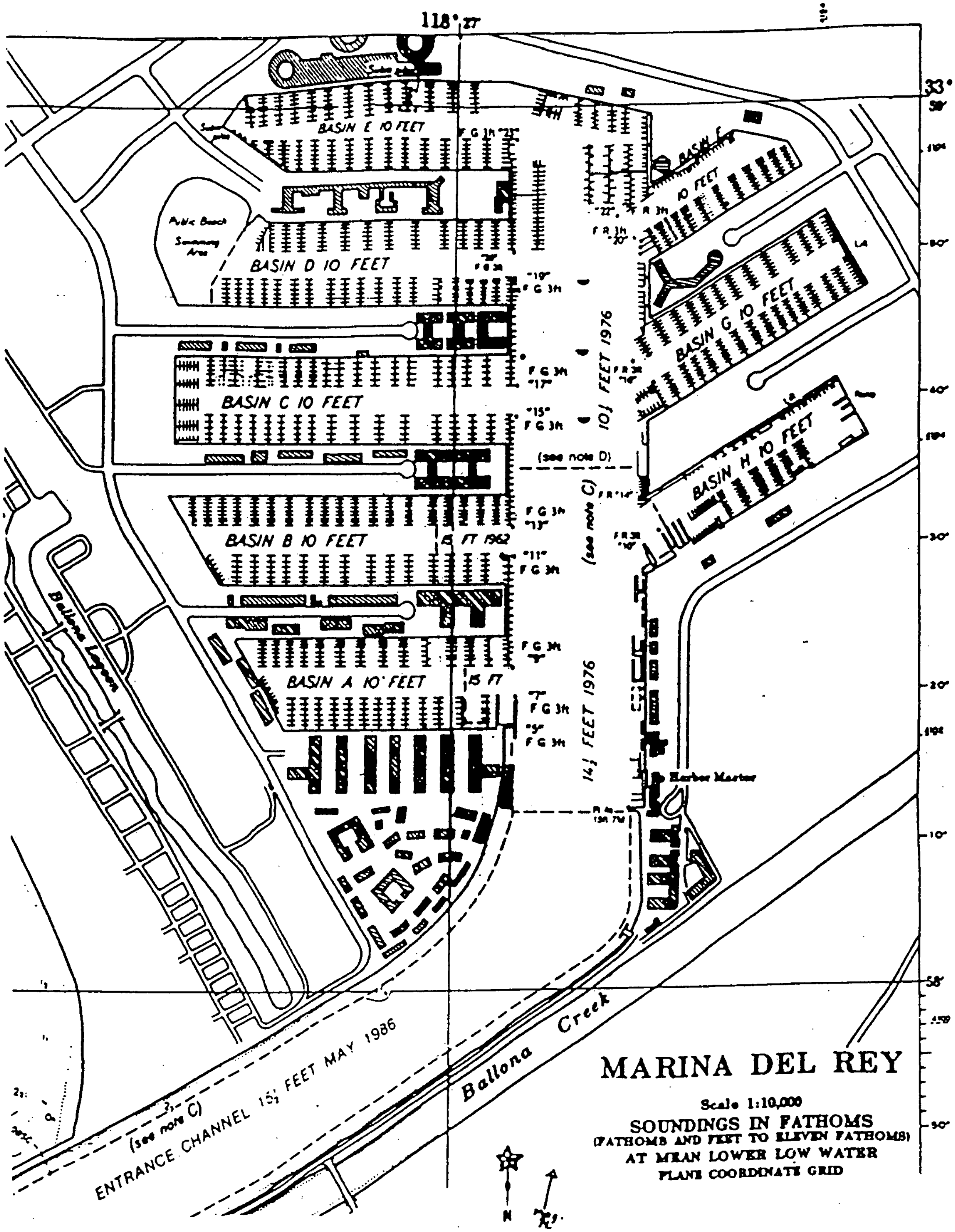
About 115 species or larval taxa of fishes have been reported in the marina, more than for any other wetlands in the area. The fish species represent the remains of the wetlands fauna that has been largely shut off from the wetlands south of Ballona Creek. The rocky breakwater and jetties are important to species that would otherwise not find a habitat in the marina. The seagrass beds in sandy Basin D are very important to development of larval and juvenile fish, which also provide forage for larger fish.

Oxford Basin drainage is a significant source of pollutants in spite of the relatively low volume of runoff into the basin, as evidenced by the relatively high levels of coliforms, organic nitrogen and lead, for example. Ballona Creek is a significant source of contaminants, as indicated by levels of coliforms, volatile solids, chemical oxygen demand, oil and grease, sulfide, organic nitrogen, lead and silver. Levels of non-metals have been reduced, some by orders of magnitude, during the period of the surveys. Floating trash flushed from storm drains accumulates at the breakwater and south jetty after rains and often mark its flow pattern. Debris such as grass clippings and plastic food containers may move up into the main channel on the tides. The screen in Ballona Creek is not very effective at catching debris, it becomes filled and overflows, and is not deployed during rainstorms.

Adding slips and vessels acts to damp the limited circulation. As slips were added it became more critical to guard against pollution to preserve esthetic and marine environmental quality. Addition of vessels at the inner end of the main channel strongly affected the area. The present configuration of slips is illustrated in Figure 2-3.

Monthly survey data do not indicate a serious or widespread problem with sewage release from vessels. However, the increase in the number of persons living aboard vessels which are not equipped with adequate holding tanks or capable of going to sea increases the possibility of contamination of persons exposed to waters in the marina while doing routine maintenance.

FIGURE 2-3. CHART OF SLIPS IN MARINA DEL REY HARBOR (FROM SOULE ET AL. 1997).



2.5. STATION LOCATIONS AND DESCRIPTIONS

Figure 2-4 illustrates the survey stations for the Harbor, Ballona Creek, and Oxford Basin. Stations were numbered 1 to 13 for the original studies. A number of others were added for special studies, but not all of those were retained for routine monitoring, resulting in numbers out of sequence with the original stations. Stations MDR 1 through MDR 13 were designated in 1976. Stations MDR 18 through MDR 20 were added in 1988 for water quality and bacteriology.

MDR 1 is located midway between the breakwall and the southern jetty at the mouth of Ballona Creek Flood Control Channel. The area is subjected to discharges from the creek to severe impacts from storm water flow and deposition or erosion from storm wave action. The depth is irregular (2-6 meters). Depth during 2000 increased to about 7 meters due to dredging early in the year.

MDR 2 is located at the entrance to the Marina, midway between the two Marina jetties. The area is protected from most storm waves and swells. Tidal action, winds, and weak longshore currents influence it. The tides carry sediment and debris into the marina from Ballona creek, and sand from the northern beach blows into the channel, covering jetty rocks, creating sandbars which reduce navigable areas. Dredging of nearby areas occurred in February 1987, October 1992 and in October-November, 1994. Similar to MDR 1, dredging early in 2000 increased the depth to about 7 meters.

MDR 3 lies on the northwest side of the entrance channel, in front of the tide gate to the Venice Canal system. It is protected from all but severe storm waves but subjected to sediment and contaminated drainage from the lagoon. In the 1970s, mussel mounds were present intermittently in this area.

MDR 4 is seaward of the Administration docks, where there is heavy vessel use. It is sometimes a depositional area, since it is at the junction of the entrance channel with the main channel. The depth is 3-6 meters.

MDR 5 is in the center of the main channel opposite Burton Chace Park. Sediment accumulates there when it is flushed from the basins. It marks the end of the area originally dredged to greater depth in the outer marina. The depth is 4-5 meters.

MDR 6 is at the innermost end of Basin B and is protected from westerly winds by the seawall. Circulation is reduced, and pollution levels are usually medium low to moderate. The depth is 3-4 meters.

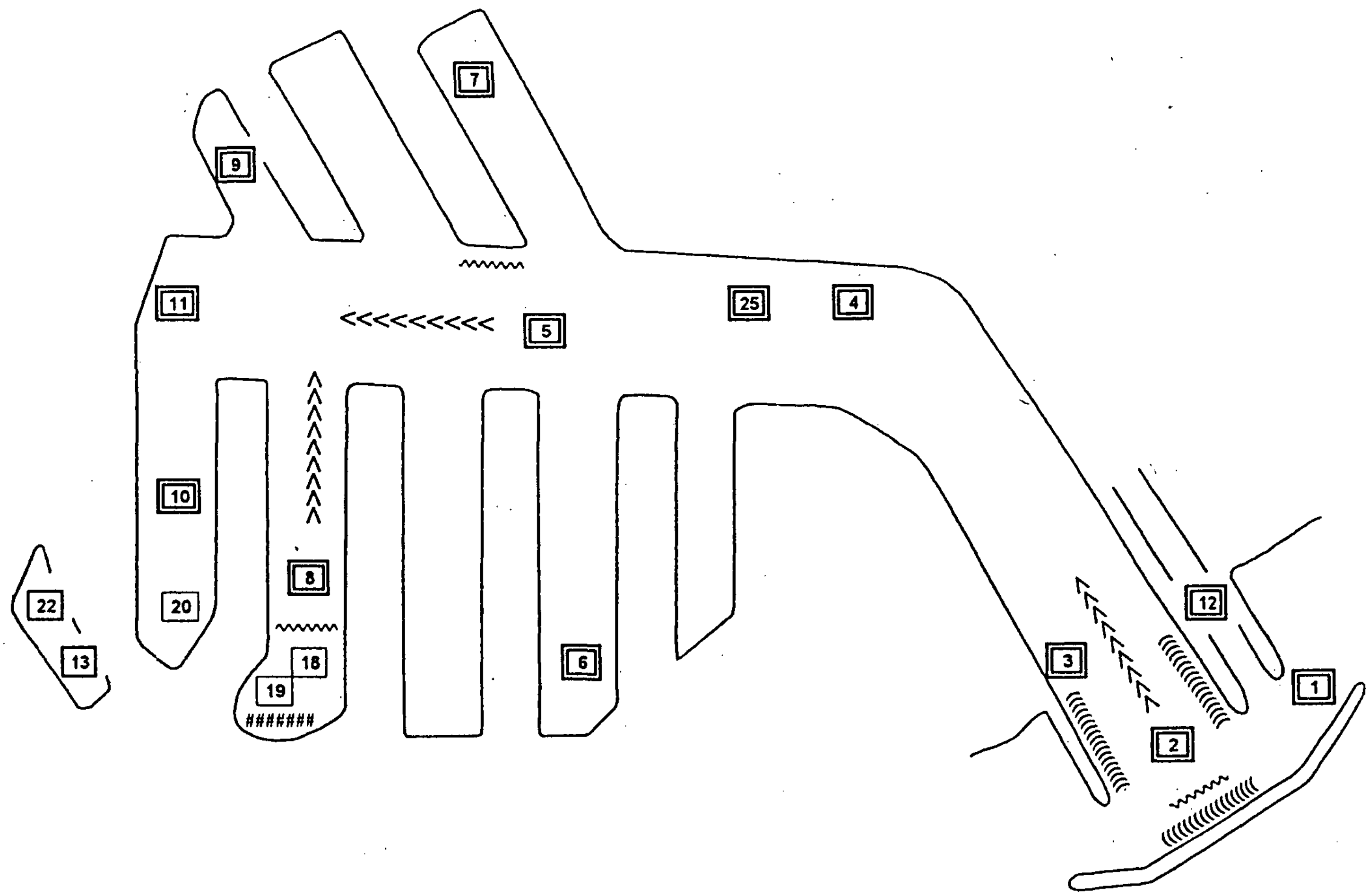
MDR 7 is at the end of Basin H near the work yard dock. It is exposed to westerly winds. The depth is 3-4 meters.

MDR 8 is off the swimming beach (Mother's Beach) in Basin D near the first slips outside of the floats. The depth is 3-4 meters.

MDR 9 is at the innermost end of Basin F where circulation is low. The depth is 2-3 meters. There is a boat launch ramp located here.

MDR 10 is at the innermost end of Basin E and is subjected to flow from Oxford Flood Control Basin and major street drainage. Highly contaminated sediments have been deposited beneath the docks, which broke up due to accretion. In 1995, the docks were removed and sediment was taken by clamshell for land disposal. The area was dragged to level, and larger slips were constructed. The depth is 4 meters.

FIGURE 2-4. LOCATION OF MARINA DEL REY HARBOR SAMPLING STATIONS.



Water Quality Stations only

Water Quality and Sediment Chemistry Stations

Water Quality, Sediment Chemistry, and Benthic Infauna Stations

>>>>>>>>>>>>>> Bottom Fish by Otter Trawl and Ichthyoplankton by Plankton Net

Midwater Fish by Gill Net

Reef Fish by Diver Transect

######################## Inshore Fish by Beach Seine

MDR 11 is at the end of the main channel and is subjected to storm drain flow and influx from Station 10. It is impacted by reduced circulation. Pollution levels increased when slips were built for larger boats. The depth is 2-3 meters.

MDR 12 is in Ballona Creek at the Pacific Avenue footbridge. It is subject to tidal flushing, freshwater discharge year-round, and heavy rainfall from storm drains. It is also subjected to illegal dumping of trash upstream and formerly to sewage overflows. The depth is 1-4 meters.

MDR 13 is inside the tidegate in Oxford Basin and is subjected to reduced tidal flushing, stormwater runoff, and street drainage. Only the surface is sampled, and it is accessible only through a locked gate.

MDR 18 is twenty meters off the wheelchair ramp in Basin D at the perimeter of the swimming rope. The depth is 1-2 meters.

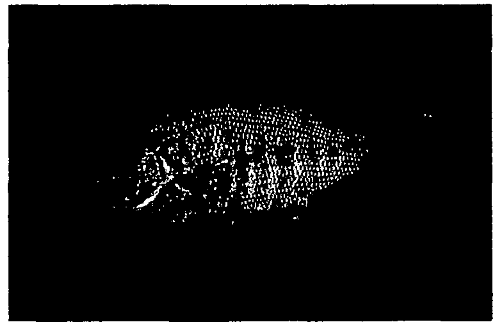
MDR 19 is at the end of wheel chair ramp and is accessible only from shore on foot. Only the surface is sampled.

MDR 20 is at the innermost end of Basin E where Oxford Basin flows through a tidegate into the marina. Large vessels there obstruct the flow. The depth is 2-3 meters.

MDR 22 is at the inner Oxford Basin at a bend where the Washington Boulevard culvert empties into the basin. It is only a mudflat at very low tides and is accessible only by foot.

MDR 25 is between the Administration docks and the public fishing docks. The area is subjected to intensive vessel use by lifeguards, Sheriff's patrol, and Coast Guard and is a popular bird roost, as well. The fishing docks attract birds to the fishermen's catch and offal, and dogs are frequently on the docks. A storm surge heavily damaged the administration docks in 1983, and they were rebuilt in 1985. The depth is 3-6 m.

3. WATER QUALITY



3.1. BACKGROUND

3.1.1. General Weather and Oceanography

With the exception of somewhat continuous freshwater runoff from storm drains and periodic rainstorm events, the aquatic conditions in Marina del Rey Harbor are mostly dominated by the oceanographic conditions in the Southern California Bight. The mean circulation in the Southern California Bight is controlled by the northward-flowing Southern California Countercurrent, which may be considered as an eddy of the offshore, southward-flowing California Current (Daily, et. al. 1993). The California Countercurrent is seasonal in nature and is usually well developed in the summer and fall and weak (or absent) in winter and spring (SCCWRP 1973). This causes relatively nutrient-poor waters to predominate in the warmer water months and nutrient rich waters to predominate in the colder water months (Soule, et. al. 1997).

Superimposed upon annual trends are the sporadic occurrences of the El Nino Southern Oscillation (ENSO), an oceanographic anomaly whereby particularly warm, nutrient-poor water moves northward from the tropics and overwhelms the typical upwelling of colder nutrient-rich water. The El Nino Watch (Coast Watch, NMFS, and NOAA) program monitors sea surface temperatures off the West Coast of the United States and then compares them to long-term means. Coastal Watch data shows temperatures during 2001-2002 were below normal all year, with the least normal temperature occurring in August and December, 2001, 1.5 °C below normal. All other temperatures ranged from 0 to 1.0°C below normal. In 1995-96, water temperatures were slightly higher with temperatures 2 to 3° C above normal especially during February through May (Soule et. al. 1997). During 1996, temperatures remained high in the Southern California Bight (1° to 4° C above normal) from July through October but climbed again in 1997 with temperatures averaging 5° C above normal in June. A strong ENSO anomaly characterized the 1997-98 survey. Surface water temperatures averaged from 2° (April, 1998) to 5° C (August to December, 1997) above normal. During 1998-99, surface water temperatures were from 2° to 4° C above normal July to September but were from 0° to 3° C *below* normal for the remainder of the year (November to June). This trend continued through 1999-2000, average temperatures ranged from 2.5° below to 1.5°C above normal. During 2000-2001, surface temperatures ranged from 2.0 (April, 2001) to 0.5 °C above normal in June of 2001.

Seasonal variability can include changes in air and water temperature, waves, winds, rainfall, and length and intensity of solar radiation. Periodic offshore storms can affect all of these patterns, as well. Shorter-term variability can include the above variables and tidal influences that, along with rainfall, can greatly affect water quality in Marina del Rey Harbor. Periodic phytoplankton blooms, including red tides, may be influenced by the above physical patterns, and can be exacerbated by anthropogenic inputs such as contaminated runoff and sewage effluents. In turn, blooms of red tide within enclosed bays and harbors can negatively impact resident fish and invertebrates (Daily, et. al. 1993).

3.1.2. Anthropogenic Inputs

Major modifications to Marina del Rey waters occur largely through wet and dry weather flow through the Ballona Creek Flood Control Channel, through run-off into Basin E from both the Oxford Flood Control Basin and local flood-control pumping, and through numerous storm drains and other channels that drain into the marina basins themselves. By far, the largest in volume flow and potential impact is the runoff from Ballona Creek, a major drainage area for much of metropolitan Los Angeles. While the Ballona Creek runoff may have a major influence particularly on surface waters near the marina entrance, only a portion of the Ballona Creek water enters the marina. The effect of this runoff is easily seen after a storm, however, by observing the accumulation of trash (Styrofoam cups, plastic bottles, plastic bags, tennis balls, etc.) at the outer breakwater and the outer channel jetties. Conversely, the runoff that flows or is pumped into Oxford Basin, enters the marina at Basin E, and has no other outlet. Changing the prevailing northwest winds to Santa Ana conditions (northeast winds) may bring cooler sub-surface waters into the coastal waters and, therefore, into the marina. This water could potentially contain treated effluent from the Hyperion sewage treatment outfall (Soule, et. al. 1997).

3.1.3. Rainfall

The mild "Mediterranean" climate of the southern California coastal basin is one of its greatest attractions. Summers are warm and almost rainless; winters are pleasant with occasional mild storms, although heavy rains and rapid runoff from the mountains and coastal slopes can sometimes cause serious flooding. Annual precipitation in the southern California coastal basin strongly depends upon distance from the coast, elevation, and topography. Precipitation in the coastal basin occurs as rainfall on the coastal lowlands and as snow and rainfall in the mountains (SCCWRP 1973). Southern California rainfall is characterized by large variations on an annual basis (Figure 3-1).

Total rainfall is not as important in terms of impacting the marina as the timing of the rainfall, the amount in a given storm, and the duration of a storm (or consecutive storms). Relative to timing, the first major storm of the season will wash off the majority of the pollutants and nutrients accumulated on the land over the preceding dry period. An early, large, long duration storm would have the greatest impact on the waters of the marina. In addition, determining the impact of the rainfall and runoff is also a function of the timing of the monthly surveys (monitoring and sampling). With a greater lag between runoff and survey sampling, mixing with oceanic waters would reduce observable impacts (Soule, et. al. 1996).

The rainfall reported in this document is for the Los Angeles Airport obtained from the Western Regional Climate Center in Reno, Nevada. Data is summarized in Table 3-1, and precipitation and water column survey days are highlighted. Very little rainfall was recorded from July to November 9 (0.07 inches). The first relatively serious rainfall of the season occurred between November 10 through 12 (0.41 inches) followed by more rain November 24 and 29 (0.90 inches between them). Small storms occurred intermittently throughout the year. On December 2 through 3, 0.23 inches fell, on December 14, 0.23 inches fell, during December 20 through 21, 0.37 inches fell and on the 28 through 30, 0.42 inches fell. Two small storm events occurred January 2 through 3 (0.15 inches) and on the 27 to the 28 (0.58 inches). February saw one storm event on the 17th (0.35 inches) and March had four days of recordable rainfall, March 7 and 17 (0.11 inches, each), March 22 through 23 (0.04 inches) and March 28 (0.01 inches). Rainfall from April to June totaled 0.18 inches. Individual precipitation at each event equaled no more than one inch.

Rainfall during this sampling period (4.2 inches) was much lower than the previous year (16 inches Figure 3-1). The wettest month of the sampling season was November (1.34

FIGURE 3-1. MONTHLY (LINES) AND ANNUAL (BARS) LOS ANGELES RAINFALL (INCHES).

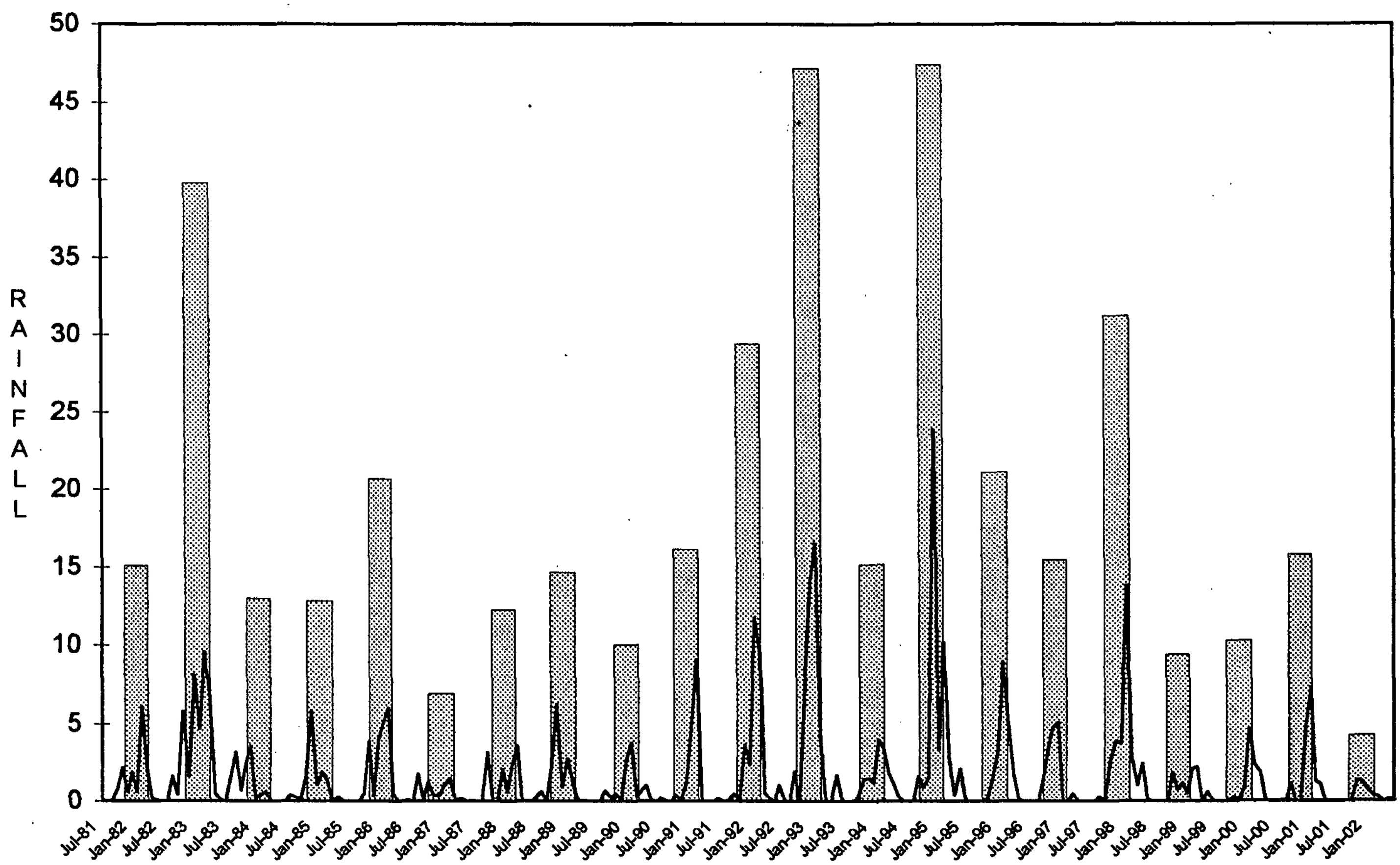


FIGURE 3-2. LOS ANGELES AIRPORT RAINFALL (INCHES).

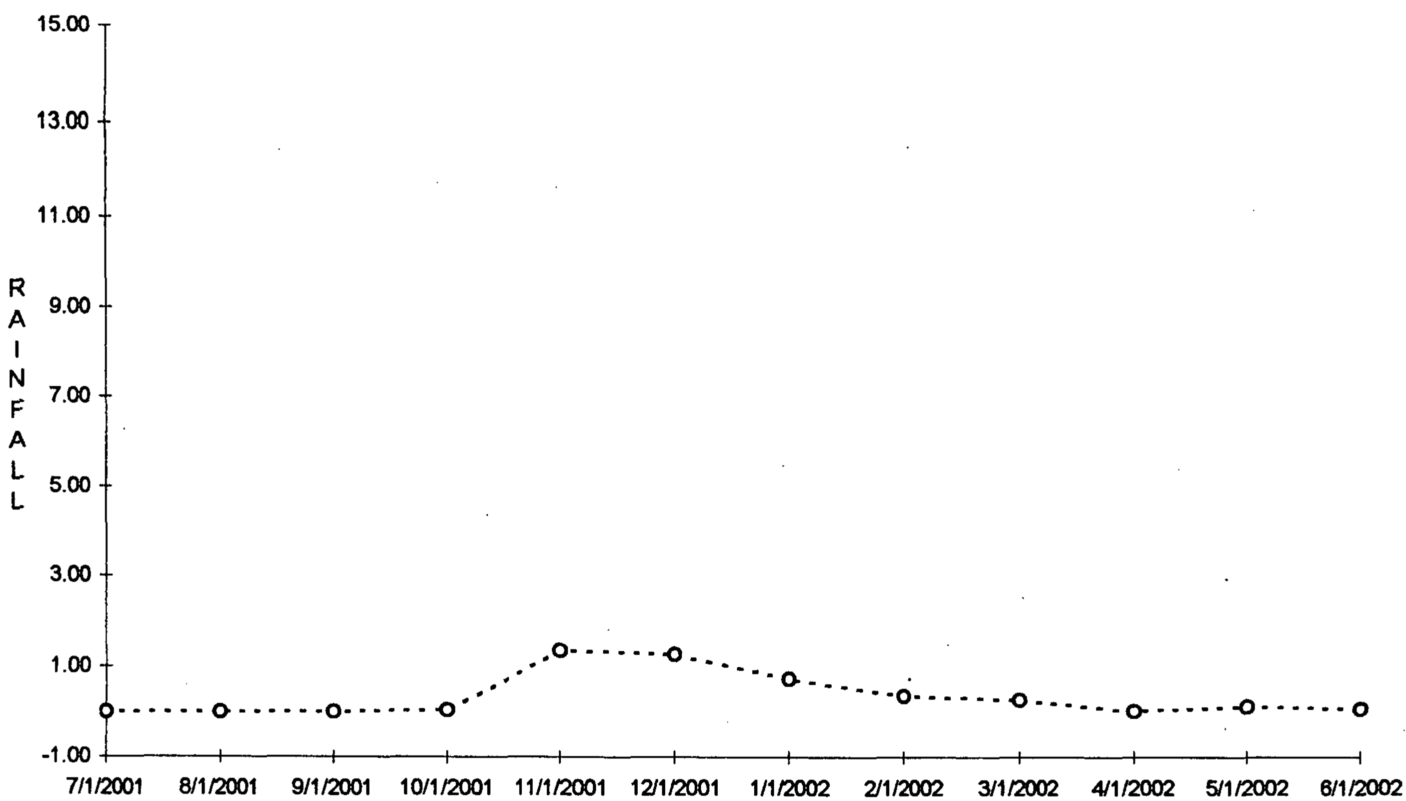


TABLE 3-1. DAILY LOS ANGELES AIRPORT RAINFALL (INCHES) WITH DATES OF WATER COLUMN SURVEYS.

DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.
7/1/2001	0.00	9/1/2001	0.00	11/1/2001	0.00	1/1/2002	0.00	3/1/2002	0.00	5/1/2002	0.00
7/2/2001	0.00	9/2/2001	0.00	11/2/2001	0.00	1/2/2002	0.10	3/2/2002	0.00	5/2/2002	0.00
7/3/2001	Trace	9/3/2001	0.00	11/3/2001	0.00	1/3/2002	0.05	3/3/2002	0.00	5/3/2002	0.00
7/4/2001	Trace	9/4/2001	0.00	11/4/2001	0.03	1/4/2002	0.00	3/4/2002	0.00	5/4/2002	0.00
7/5/2001	Trace	9/5/2001	0.00	11/5/2001	0.00	1/5/2002	0.00	3/5/2002	0.00	5/5/2002	0.00
7/6/2001	Trace	9/6/2001	0.00	11/6/2001	0.00	1/6/2002	0.00	3/6/2002	Trace	5/6/2002	0.00
7/7/2001	0.00	9/7/2001	0.00	11/7/2001	0.00	1/7/2002	0.00	3/7/2002	0.11	5/7/2002	0.00
7/8/2001	0.00	9/8/2001	0.00	11/8/2001	0.00	1/8/2002	0.00	3/8/2002	0.00	5/8/2002	0.00
7/9/2001	0.00	9/9/2001	0.00	11/9/2001	0.00	1/9/2002	0.00	*3/8/2002*	*Survey*	5/9/2002	0.00
7/10/2001	0.00	9/10/2001	0.00	11/10/2001	0.02	1/10/2002	0.00	3/9/2002	0.00	5/10/2002	0.00
7/11/2001	0.00	9/11/2001	0.00	11/11/2001	0.04	1/11/2002	0.00	3/10/2002	0.00	5/11/2002	0.00
7/12/2001	0.00	9/12/2001	0.00	11/12/2001	0.35	1/12/2002	0.00	3/11/2002	0.00	5/12/2002	0.00
7/13/2001	0.00	9/13/2001	0.00	11/13/2001	0.00	1/13/2002	0.00	3/12/2002	0.00	5/13/2002	0.00
7/14/2001	0.00	*9/13/2001*	*Survey*	11/14/2001	0.00	1/14/2002	0.00	3/13/2002	0.00	5/14/2002	0.00
7/15/2001	0.00	9/14/2001	0.00	11/15/2001	0.00	1/15/2002	0.00	3/14/2002	0.00	5/15/2002	0.00
7/16/2001	0.00	9/15/2001	0.00	11/16/2001	0.00	1/16/2002	Trace	3/15/2002	0.00	5/16/2002	0.00
7/17/2001	0.00	9/16/2001	0.00	11/17/2001	0.00	1/17/2002	0.00	3/16/2002	0.00	5/17/2002	0.00
7/18/2001	0.00	9/17/2001	0.00	11/18/2001	0.00	1/18/2002	0.00	3/17/2002	0.11	5/18/2002	Trace
7/18/2001	*Survey*	9/18/2001	0.00	11/19/2001	0.00	1/19/2002	0.00	3/18/2002	0.00	5/19/2002	Trace
7/19/2001	0.00	9/19/2001	0.00	11/20/2001	0.00	1/20/2002	0.00	3/19/2002	0.00	5/20/2002	0.11
7/20/2001	0.00	9/20/2001	0.00	11/21/2001	0.00	1/21/2002	0.00	3/20/2002	0.00	5/21/2002	0.00
7/21/2001	0.00	9/21/2001	0.00	11/22/2001	0.00	1/22/2002	0.00	3/21/2002	0.00	5/22/2002	0.00
7/22/2001	0.00	9/22/2001	0.00	11/23/2001	0.00	1/23/2002	0.00	3/22/2002	0.01	5/23/2002	0.00
7/23/2001	0.00	9/23/2001	0.00	11/24/2001	0.60	1/24/2002	0.00	3/23/2002	0.03	*5/23/2002*	*Survey*
7/24/2001	0.00	9/24/2001	0.00	11/25/2001	0.00	*1/24/2002*	*Survey*	3/24/2002	0.00	5/24/2002	0.00
7/25/2001	0.00	9/25/2001	0.00	11/25/2001	0.00	1/25/2002	0.00	3/25/2002	0.00	5/25/2002	0.00
7/26/2001	0.00	9/26/2001	0.00	11/26/2001	0.00	1/26/2002	0.00	3/26/2002	0.00	5/26/2002	0.00
7/27/2001	0.00	9/27/2001	0.00	11/27/2001	0.00	1/27/2002	0.49	3/27/2002	0.00	5/27/2002	0.00
7/28/2001	0.00	9/28/2001	0.00	11/28/2001	0.00	1/28/2002	0.09	3/28/2002	0.01	5/28/2002	0.00
7/29/2001	0.00	9/29/2001	0.00	11/29/2001	0.30	1/29/2002	0.00	3/29/2002	0.00	5/29/2002	0.00
7/30/2001	0.00	9/30/2001	0.00	11/30/2001	0.00	1/30/2002	0.00	3/30/2002	0.00	5/30/2002	0.00
7/31/2001	0.00					1/31/2002	0.00	3/31/2002	0.00	5/31/2002	0.00
Sum =	**0.00**	**Sum =**	**0.00**	**Sum =**	**1.34**	**Sum =**	**0.73**	**Sum =**	**0.27**	**Sum =**	**0.11**

DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.	DATE	PRECIP.
8/1/2001	0.00	10/1/2001	0.00	12/1/2001	0.00	2/1/2002	0.00	4/1/2002	0.00	6/1/2002	0.00
8/2/2001	0.00	10/2/2001	0.00	12/2/2001	0.10	2/2/2002	0.00	4/2/2002	0.00	6/2/2002	0.00
8/3/2001	0.00	10/3/2001	0.00	12/3/2001	0.13	2/3/2002	0.00	4/3/2002	0.00	6/3/2002	0.00
8/4/2001	0.00	10/4/2001	0.00	12/4/2001	0.00	2/4/2002	0.00	4/4/2002	0.00	6/4/2002	0.00
8/5/2001	0.00	10/5/2001	0.00	12/5/2001	0.00	2/5/2002	0.00	4/5/2002	0.00	6/5/2002	0.00
8/6/2001	0.00	10/6/2001	0.00	12/6/2001	0.00	2/6/2002	0.00	4/6/2002	Trace	6/6/2002	0.00
8/7/2001	0.00	10/7/2001	0.00	12/7/2001	0.00	2/7/2002	0.00	4/7/2002	0.00	6/7/2002	0.00
8/8/2001	0.00	10/8/2001	0.00	12/8/2001	0.00	2/8/2002	0.00	4/8/2002	Trace	6/8/2002	0.00
8/9/2001	0.00	10/9/2001	0.00	12/9/2001	Trace	2/9/2002	0.00	4/9/2002	0.00	6/9/2002	0.00
8/10/2001	0.00	10/10/2001	0.00	12/10/2001	0.00	2/10/2002	0.00	4/10/2002	0.00	6/10/2002	0.00
8/11/2001	0.00	10/11/2001	0.00	12/11/2001	0.00	2/11/2002	0.00	4/11/2002	0.00	6/11/2002	0.00
8/12/2001	0.00	10/12/2001	0.00	12/12/2001	0.00	2/12/2002	0.00	4/12/2002	0.00	6/12/2002	0.00
8/13/2001	0.00	10/13/2001	0.00	*12/12/2001*	*Survey*	2/13/2002	0.00	4/13/2002	0.00	6/13/2002	0.00
8/14/2001	0.00	10/14/2001	0.00	12/13/2001	0.00	2/14/2002	0.00	4/14/2002	0.00	6/14/2002	0.00
8/15/2001	0.00	10/15/2001	0.00	12/14/2001	0.23	2/15/2002	0.00	4/15/2002	0.02	6/15/2002	0.00
8/16/2001	0.00	10/16/2001	0.00	12/15/2001	0.00	2/16/2002	0.00	4/16/2002	0.00	6/16/2002	0.00
8/17/2001	0.00	10/17/2001	0.00	12/16/2001	0.00	2/17/2002	0.35	4/17/2002	0.00	6/17/2002	0.00
8/18/2001	0.00	10/18/2001	0.00	12/17/2001	0.00	2/18/2002	0.00	4/18/2002	0.00	6/18/2002	0.00
8/19/2001	0.00	10/19/2001	0.00	12/18/2001	0.00	2/19/2002	0.00	4/19/2002	0.00	6/19/2002	0.00
8/20/2001	0.00	10/20/2001	0.00	12/19/2001	0.00	2/20/2002	0.00	4/20/2002	0.00	6/20/2002	0.00
8/21/2001	0.00	10/21/2001	0.00	12/20/2001	0.16	2/21/2002	0.00	4/21/2002	0.00	*6/20/2002*	*Survey*
8/22/2001	0.00	10/22/2001	0.00	12/21/2001	0.21	2/22/2002	0.00	4/22/2002	0.00	6/21/2002	0.05
8/23/2001	0.00	10/23/2001	0.00	12/22/2001	0.00	*2/22/2002*	*Survey*	*4/22/2002*	*Survey*	6/22/2002	0.00
8/24/2001	0.00	10/24/2001	0.00	12/23/2001	0.00	2/23/2002	0.00	4/23/2002	0.00	6/23/2002	0.00
8/25/2001	0.00	10/25/2001	0.00	12/24/2001	0.00	2/24/2002	0.00	4/24/2002	Trace	6/24/2002	0.00
8/26/2001	0.00	10/26/2001	0.00	12/25/2001	0.00	2/25/2002	0.00	4/25/2002	Trace	6/25/2002	0.00
8/27/2001	0.00	10/27/2001	0.00	12/26/2001	0.00	2/26/2002	0.00	4/26/2002	Trace	6/26/2002	0.00
8/28/2001	0.00	10/28/2001	0.00	12/27/2001	0.00	2/27/2002	0.00	4/27/2002	0.00	6/27/2002	0.00
8/29/2001	0.00	10/29/2001	0.00	12/28/2001	Trace	2/28/2002	0.00	4/28/2002	0.00	6/28/2002	0.00
8/29/2001	*Survey*	10/30/2001	0.04	12/29/2001	0.32	2/29/2002	0.00	4/29/2002	0.00	6/29/2002	0.00
8/30/2001	0.00	10/31/2001	0.00	12/30/2001	0.10			4/30/2002	0.00	6/30/2002	0.00
8/31/2001	0.00	*10/31/2001*	*Survey*	12/31/2001	0.00						
Sum =	**0.00**	**Sum =**	**0.04**	**Sum =**	**1.25**	**Sum =**	**0.35**	**Sum =**	**0.02**	**Sum =**	**0.05**

inches), followed by December (1.25 inches), January (0.73 inches) and February (0.35 inches). Small amounts of rain were recorded in October (0.04 inches), April (0.02 inches), May (0.11 inches) and June (0.05 inches) (see Figure 3-2). No water quality surveys occurred immediately after a storm event.

3.1.4. Bacterial Water Quality

Maintaining public health standards is a major concern for the marina. Although most of the marina is not used for body contact sports, boaters are in contact with the water during boat maintenance and youngsters learning to sail frequently end up spilled into the water. Extra protection is provided to the Mother's Beach area since children and adults paddle and swim in the shallow waters. Fecal contamination may enter the marina from a variety of sources: illegal dumping or leakage of human sewage from vessels, tidal flushing or rainfall runoff of fecal material from animal and/or humans from jetties, beaches and docks; hosing off vessels used as bird roosts; and runoff from storm drain channels. During heavy rainfall, percolating water can overwhelm sewage treatment plants, and cause overflow into storm drain channels. Recreational vessels in the marina do not seem to be a continuing source of coliform contamination, based on historic data, since there are few dry weather violations. The Los Angeles County Department of Health Services monitors four sites in the marina on a weekly basis although budget problems may end this activity. The County is also responsible for monitoring sewer line breaks or overflows.

This study samples 14 marina sites. Additionally, four stations in the adjacent stormwater channels, Ballona Creek and Oxford Lagoon are monitored monthly, to provide independent documentation of bacterial contamination in the marina. Total coliforms, fecal coliforms and enterococcus measurements, are believed by health authorities to present a reasonably good picture of conditions in the environment (R. Kababjian, Los Angeles County Department of Health Services, pers. comm.). The principle problem is that at least 72 hours are needed for incubation to determine the extent of contamination present, slowing the response to potentially hazardous conditions. Research has been underway to develop cost effective, rapid tests. Currently, it is more prudent to post areas of potential or known contamination episodes immediately, such as beaches during rainstorms, than to wait for confirmation (Soule et. al. 1996, 1997). Rainfall episodes have been closely associated with violations of all three bacterial standards, especially at areas of the stormwater channels, Ballona Creek, Oxford Basin, and adjacent to the latter in Basin E. Because bacteria reproduce geometrically, normal parametric measures of bacterial density are not adequate to characterize bacterial counts. Therefore, note that all bacterial graphs are scaled logarithmically and all averages are calculated using geometric means.

3.2. MATERIALS AND METHODS

Sampling and data collection for water quality assessment was conducted monthly at the 18 stations described above. The monthly survey dates were selected so that sampling could begin at high tide, with succeeding stations sampled on the falling tide. Except for the one walk-in station at Mothers' Beach (19) and two in Oxford Lagoon (13 and 22), all water quality sampling was performed from Aquatic Bioassay's inflatable boat.

Temperature, conductivity (later converted to salinity), dissolved oxygen, pH, and light transmissance were measured continuously through the water column using a SeaBird Water Quality Analyzer and associated Chelsea 25-cm Transmissometer. All probes were calibrated immediately prior to each field excursion and, if any data were questionable, immediately after the instruments were returned to the laboratory. Measurements of light penetration were assessed using a Secchi disk, and water color was measured by comparing the Forel-Ule scale vials against the Secchi disk. At all stations, water samples were collected at the surface, middle and bottom using a Nauman sampler.

Water was distributed into sterile 125-ml polypropylene bottles for bacterial analysis, 250-ml polypropylene bottles containing sulfuric acid for ammonia analysis, and 300-ml glass, dark BOD bottles for biochemical oxygen demand analysis.

At stations 1, 2, 5, 10, 12, 13, 19, 20, and 22; temperature and pH were measured directly at the surface using an NBS traceable standard mercury thermometer and hand-held, buffer-calibrated pH meter (respectively). Extra water samples were also collected at these stations and set for dissolved oxygen and chloride titration. These extra samples and their associated measurements for dissolved oxygen and salinity were used to calibrate the water quality analyzer.

All samples from all stations were placed in coolers containing blue ice and were returned to the Ventura laboratory the same day. Immediately upon return, the bacterial samples were set for total and fecal coliform and enterococcus bacteria via multiple-tube fermentation methods. Check samples were titrated for dissolved oxygen by Winkler titration and chloride (later converted to salinity) by the argentometric titration. Biochemical oxygen demand samples were immediately set and stored in a 20 °C incubator. Ammonia samples were placed in a laboratory refrigerator at 4 °C until analyzed. Ammonia was analyzed by ion-selective electrode calibrated against known standards. All water analyses were performed in accordance with either *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, 20th Edition) or *Methods for the Chemical Analysis of Water and Wastes* (US EPA, revised March 1983, EPA/600/4-79/020) modified to accommodate the analysis of seawater. Aquatic Bioassay is certified by both the State of California and the US EPA to perform these analyses.

After all analyses were completed, the five water quality analyzer variables were correlated against the check samples measured or collected in the field: thermistor probe versus mercury thermometer, conductivity probe versus chloride titration, dissolved oxygen probe versus Winkler titration, field pH probe versus hand-held pH meter, and transmissometer versus Secchi disk. The Seabird Water Quality Analyzer data were downloaded, processed and water column graphs were generated. Two tables were also prepared containing the results of the physical, chemical, bacterial, and observational water measurements. Check sample correlations, water column graphs, and data tables were joined with a short narrative report and were presented to the Department of Beaches and Harbors monthly. The results and conclusions of all water column measurements and analyses are presented and summarized in Section 3.3 below. Appendix 9.2 contains all data and survey logs for the year.

3.3. RESULTS

3.3.1. Temperature

Coastal water temperatures vary considerably more than those of the open ocean due to the relative shallowness of the water, inflow of freshwaters from the land, and upwelling. Density is important in that it is a major factor in the stratification of waters. The transition between two layers of varying density is often distinct; the upper layer, in which most wind-induced mixing takes place, extends to a depth of 10 to 50 m in southern California. In the winter, there is little difference in temperature between surface and deeper waters. In the summer, a relatively strong stratification (i.e. thermocline) is evident because the upper layers become more heated than those near the bottom. Thus, despite little difference in salinity between surface and bottom, changes in temperature during the summer result in a large reduction of density at the surface (SCCWRP 1973). Stratified water allows for less vertical mixing. This is important in Marina del Rey Harbor because bottom waters may become oxygen-depleted without significant replenishment from the surface (Soule et. al. 1997).

Vertical temperature patterns. Figure 3-3 depicts the minimum, average, and maximum temperatures for each station plotted against depth for 2001-2002. At most stations, temperatures were constant with depth throughout the year. At stations 2, 8, 9, 12 and 18, temperatures decreased very slightly with depth as expected. However, stations 1 and 7 showed a slight increase in temperature with depth.

Temperature patterns over the year. Figure 3-4 demonstrates the maximum, average, and minimum temperatures for the 18 water column stations over the sampling season in Marina del Rey Harbor. For the most part, seasonal patterns were similar among stations indicating the strong influence of the oceanographic conditions on the Harbor waters. Average temperature during the beginning of the sampling season (July) was 21 °C at most stations. The average temperature in August increased slightly to 22 °C, the highest temperature during this sampling period. Beginning in September (21 °C), average temperatures steadily declined until January (13 °C) which was the lowest temperature for this sampling period. Temperatures then gradually climbed again through June (15 to 21 °C). Although slightly colder this year than last, temperatures were consistent with seasonal variability without radical fluctuations.

Spatial temperature patterns. The horizontal spatial pattern of temperatures averaged over the year is presented as a three-dimensional graph in Figure 3-5. The spatial pattern of temperature was similar to those of past reports. Warmest stations (averages 18.0 to 18.4 °C) tended to be those further back in the Harbor (Stations 7, 8, 9, 10, 11, and 20). Stations near the entrance (Stations 1, 2, 3 and 12) averaged coldest (16.6 to 17.2 °C). Average temperatures at other stations were moderate (17.3 to 17.9 °C). Station 19 at Mothers Beach averaged somewhat colder than other back-bay stations since it is very shallow, and the measurements are usually made early in the morning. Otherwise, the overall pattern strongly indicates cooler water occurs near the Harbor entrance and warmer temperatures in the back basins.

Temperature ranges compared with past years. Table 3-2 lists: 1) the individual seasonal temperature ranges from fall 1991 through summer 2001, 2) the overall seasonal ranges for the ten year period, and 3) the temperature values collected during 2001-2002. All 2001-2002 temperatures were within the overall seasonal ranges for the preceding ten years. Overall, this year's averages were similar to last years.

3.3.2. Salinity

Salinity (a measure of the concentration of dissolved salts in seawater) is relatively constant throughout the open ocean. However, it can vary in coastal waters primarily because of the inputs of freshwater from the land or because of upwelling. Long-term salinity variations have not been documented to the same extent as temperature phenomena. In a five-year study conducted by the U.S. Navy Research and Development Center, more than 1000 samples were analyzed for salinity. The mean salinity was 33.75

FIGURE 3-3. MIN., AVERAGE, AND MAX. TEMPERATURE (DEG C) VS. DEPTH (M) AT 18 WATER COLUMN STATIONS.

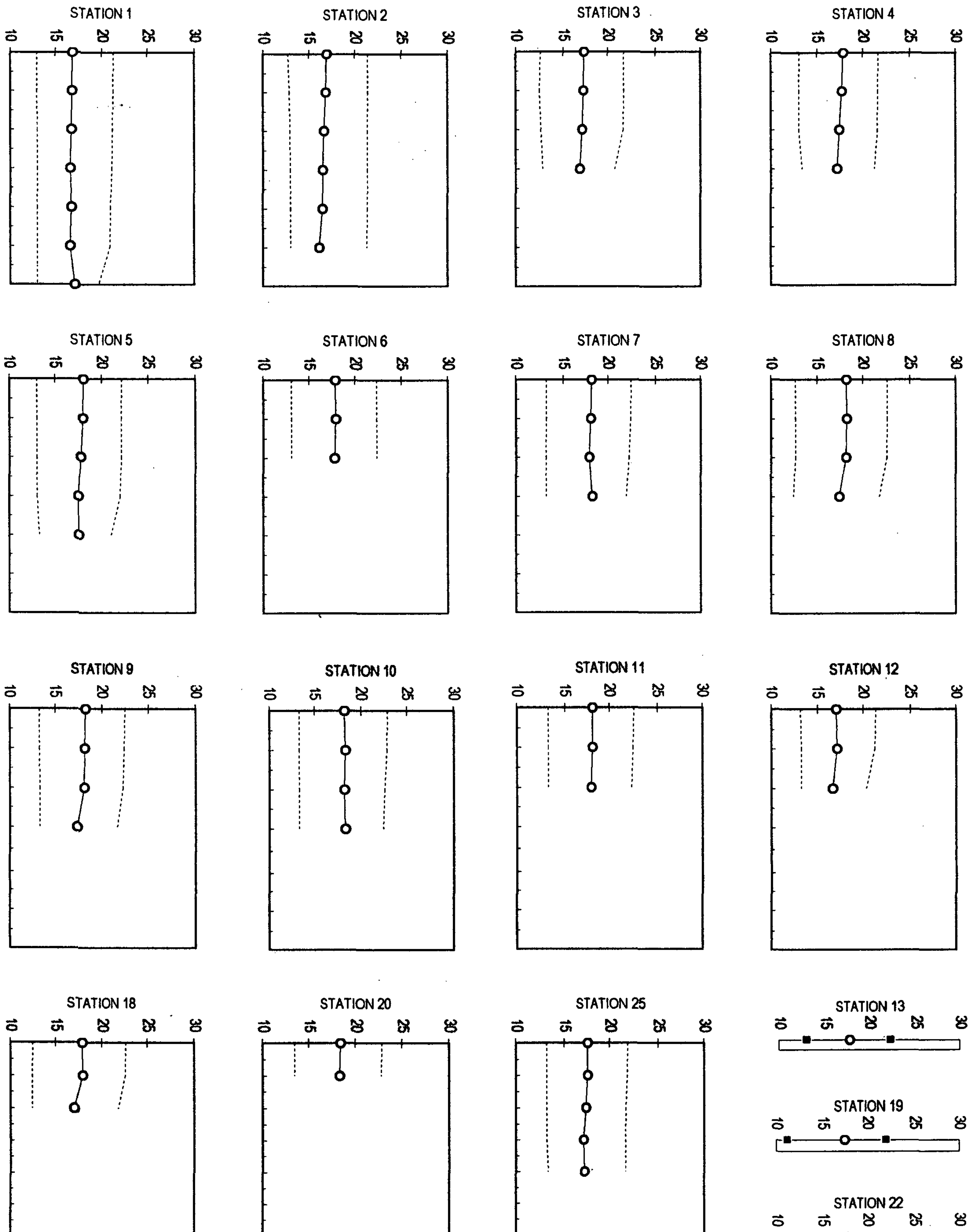


FIGURE 3-4. MINIMUM, AVERAGE, AND MAXIMUM TEMPERATURE (DEG C) VS. MONTH AT 18 WATER COLUMN STATIONS.

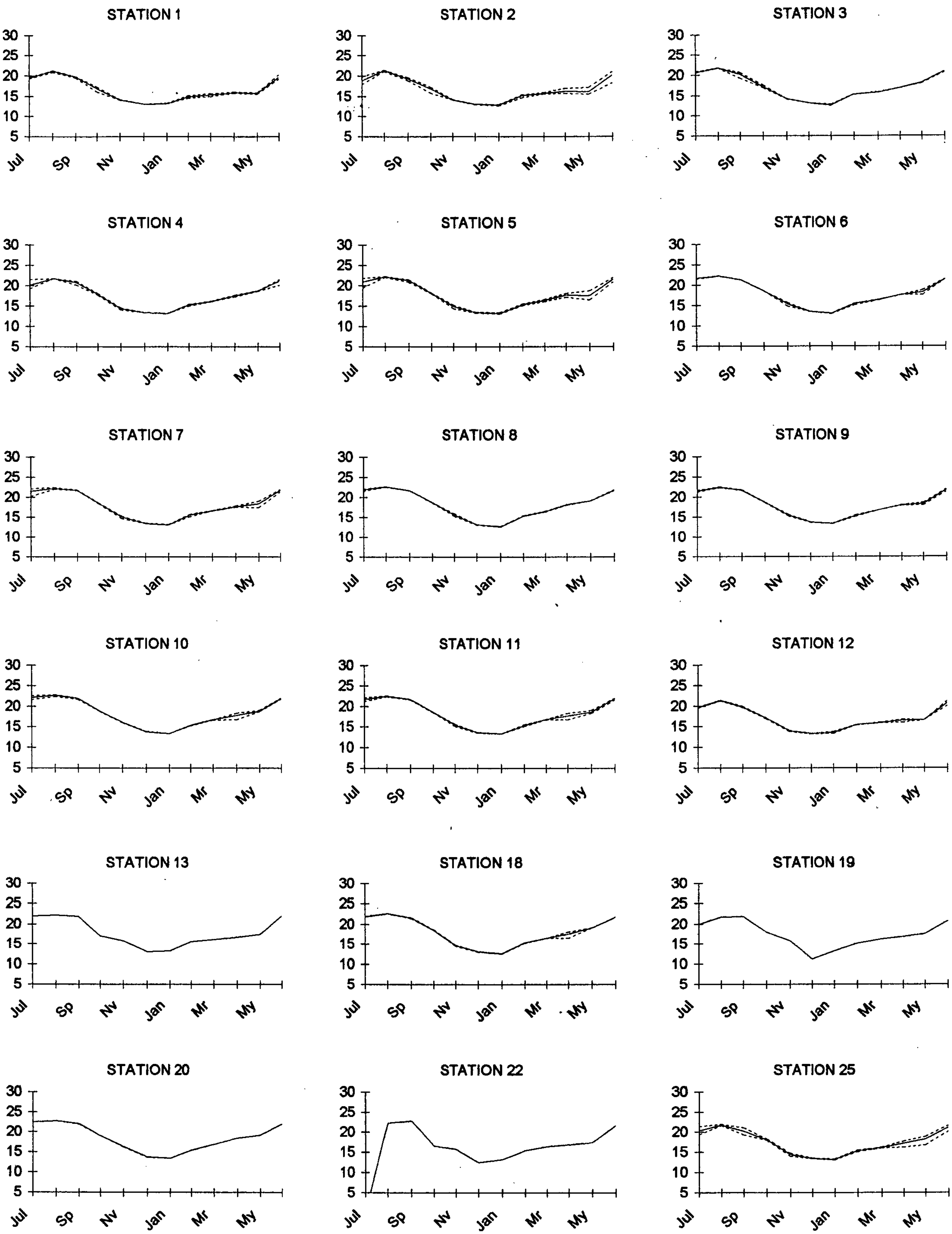


FIGURE 3-5. AVERAGE ANNUAL TEMPERATURE (DEG C) AT 18 WATER COLUMN STATIONS.

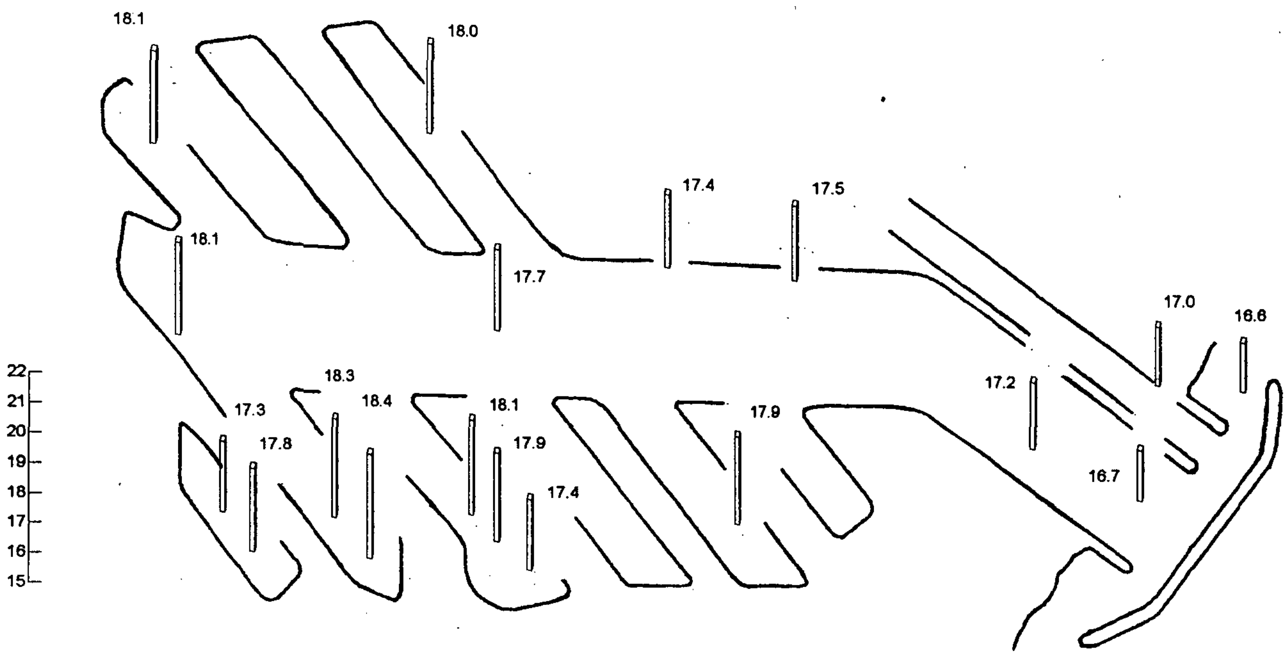


TABLE 3-2. SEASONAL TEMPERATURE RANGES (DEG C) FOR ALL DEPTHS AND STATIONS.

Survey	Fall	Winter	Spring	Summer
1991-92	16.5 - 22.3	11.0 - 14.8	15.9 - 22.7	16.8 - 26.0
1992-93	17.0 - 22.8	13.5 - 15.8	15.2 - 22.6	17.8 - 28.2
1993-94[1]	18.4 - 26.6	13.1 - 15.3	14.8 - 21.2	18.0 - 24.6
1994-95	13.6 - 23.4	12.8 - 17.0	15.0 - 20.1	17.3 - 23.7
1995-96	17.3 - 24.7	13.8 - 17.3	13.9 - 22.6	18.0 - 26.9
1996-97	16.0 - 23.5	12.4 - 15.7	16.5 - 20.1	19.9 - 24.8
1997-98	15.0 - 24.9	11.1 - 17.4	14.5 - 20.7	17.7 - 28.8
1998-99	12.9 - 23.5	12.6 - 16.2	13.5 - 19.8	18.3 - 23.5
1999-00	15.9 - 20.2	11.9 - 15.6	12.8 - 19.8	18.3 - 24.5
2000-01	16.5 - 24.8	8.0 - 15.2	13.5 - 19.9	17.0 - 23.0
Overall range	**12.9 - 26.6**	**8.0 - 17.4**	**12.8 - 22.7**	**16.8 - 28.8**
2001-02[2]	13.8 - 22.8	11.1 - 15.7	14.9 - 19.2	18.3 - 22.1

[1] Two months only in the fall, winter, and summer.

[2] One month only in the summer. No July data reported for Station 22.

parts per thousand (ppt), and the range of 90% of the samples in southern California fell between 33.57 and 33.92 ppt (SCCWRP 1973).

The general lack of variability in salinity concentrations can be affected by a number of oceanographic factors. During spring and early summer months, northwest winds are strongest and drive surface waters offshore. Deeper waters, which are colder, more nutrient-rich, and more saline, are brought to the surface to replace water driven offshore (Emery 1960). El Nino (ENSO) events can also affect coastal salinities. During these events northern flowing tropical waters move into the Bight with waters that are also more saline, but are warmer and lower in nutrients than ambient water. Major seasonal currents (i.e. California current, countercurrent, or undercurrent) can also affect ambient salinity to some degree (Soule et. al. 1997).

Vertical salinity patterns. Very little difference among surface to bottom averages reflect the relatively low rainfall recorded for this year (Figure 3-6). The greatest variability in salinity occurred at Stations 13 and 22 in Oxford Lagoon with the lowest salinity recorded at 4.2 parts per thousand (ppt) in April 2002. Other stations with high variability were Stations 5 in mid channel, Station 9 in Basin F and Station 12 in Ballona Creek. Most of the variability at Stations 5 and 9 occurred at, or below, a depth of 4 meters with the salinity dropping a few parts per thousand. Station 12 showed minimum salinity concentrations at the surface. This was probably due to the input of urban runoff into Ballona Creek.

Salinity patterns over the year. Figure 3-7 depicts the salinity measurement at each station by month over the period of the sampling year. Salinity remained constant at most stations over the year relating to the overall lack of rain and large storm events (29.9 to 34.3 ppt). Stations 13 and 22 in Oxford Lagoon showed marked declines in salinity in April, 2002 and salinity at Station 22 also decreased in October. These declines were likely due to small rainfall events during those months (0.02 inches and 0.04 inches, respectively). Station 5 in mid channel showed a slight drop in salinity in May of 2002 with rainfall for that month at 0.11 inches. Station 9 in Basin F was slightly variable in February, 2002, unrelated to a storm event.

Spatial salinity patterns. With the exception of those stations in Oxford Lagoon (13 and 22), all stations sampled within Marina del Rey Harbor had average year-long salinities of between 33.0 and 33.4 parts per thousand (ppt) (Figure 3-8). Stations 13 and 22 in Oxford Lagoon (30.8 and 29.3 ppt, respectively) were lower most likely due to municipal freshwater discharges as well as some minor storm events.

Salinity ranges compared with past years. Table 3-3 lists: 1) the individual seasonal salinity ranges from fall 1993 through summer 2001, 2) the overall seasonal ranges for the eight year period, and 3) the temperatures collected during 2001-2002. All 2001-2002 salinities were well within, or close to, the overall seasonal ranges for the preceding eight years.

3.3.3. **Dissolved Oxygen**

The most abundant gases in the ocean are oxygen, nitrogen, and carbon dioxide. These gases are dissolved in seawater and are not in chemical combination with any of the materials composing seawater. Gases are dissolved from the atmosphere by exchange across the sea surface. The gases dissolved at the sea surface are distributed by mixing, advection (i.e. from currents), and diffusion. Concentrations are modified further by biological activity, particularly by plants and certain bacteria. In nature, gases dissolve in

FIGURE 3-6. MIN., AVERAGE, AND MAX. SALINITY (PPT) VERSUS DEPTH (M) AT 18 WATER COLUMN STATIONS.

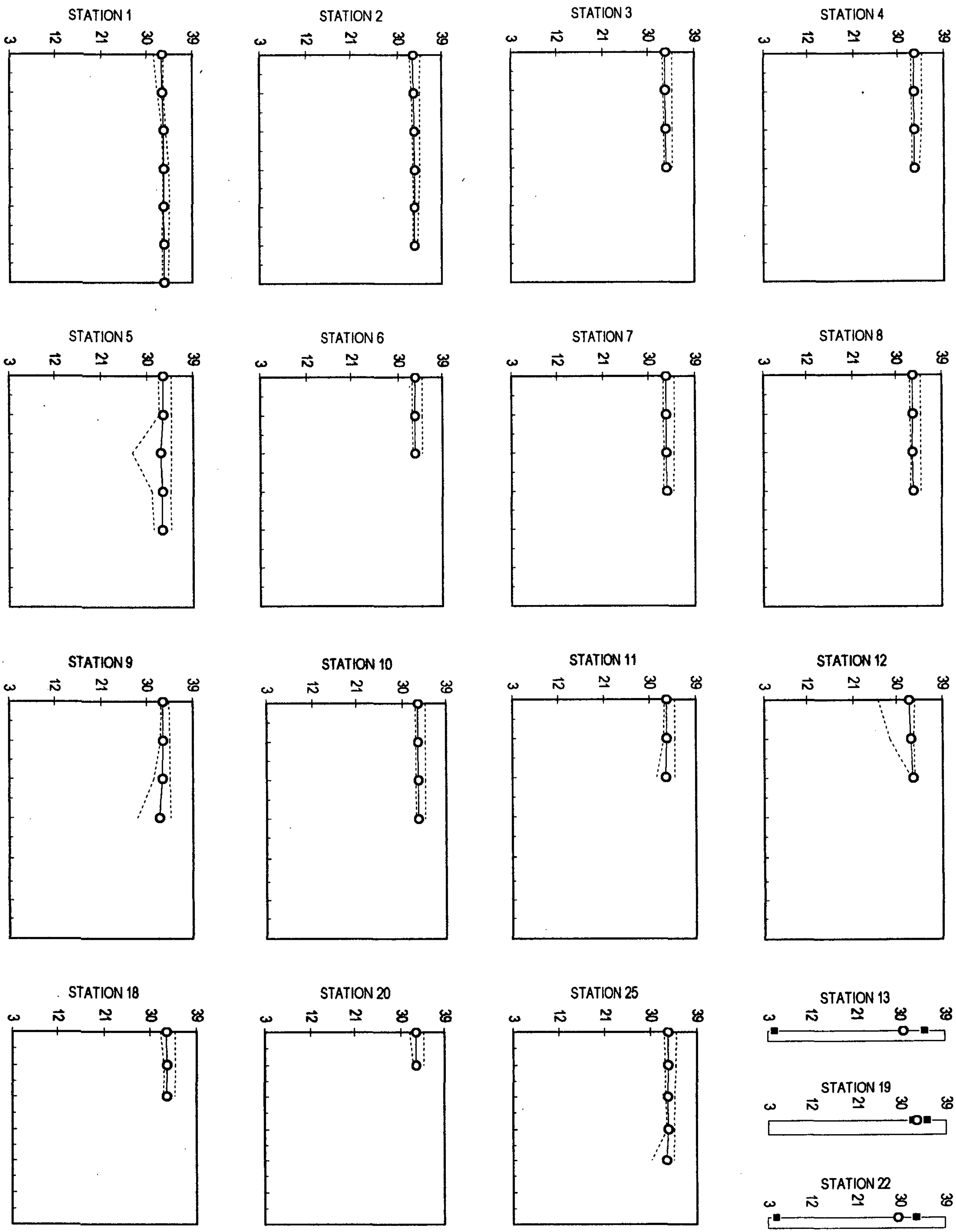


FIGURE 3-7. MINIMUM, AVERAGE, AND MAXIMUM SALINITY (PPT) VS. MONTH AT 18 WATER COLUMN STATIONS.

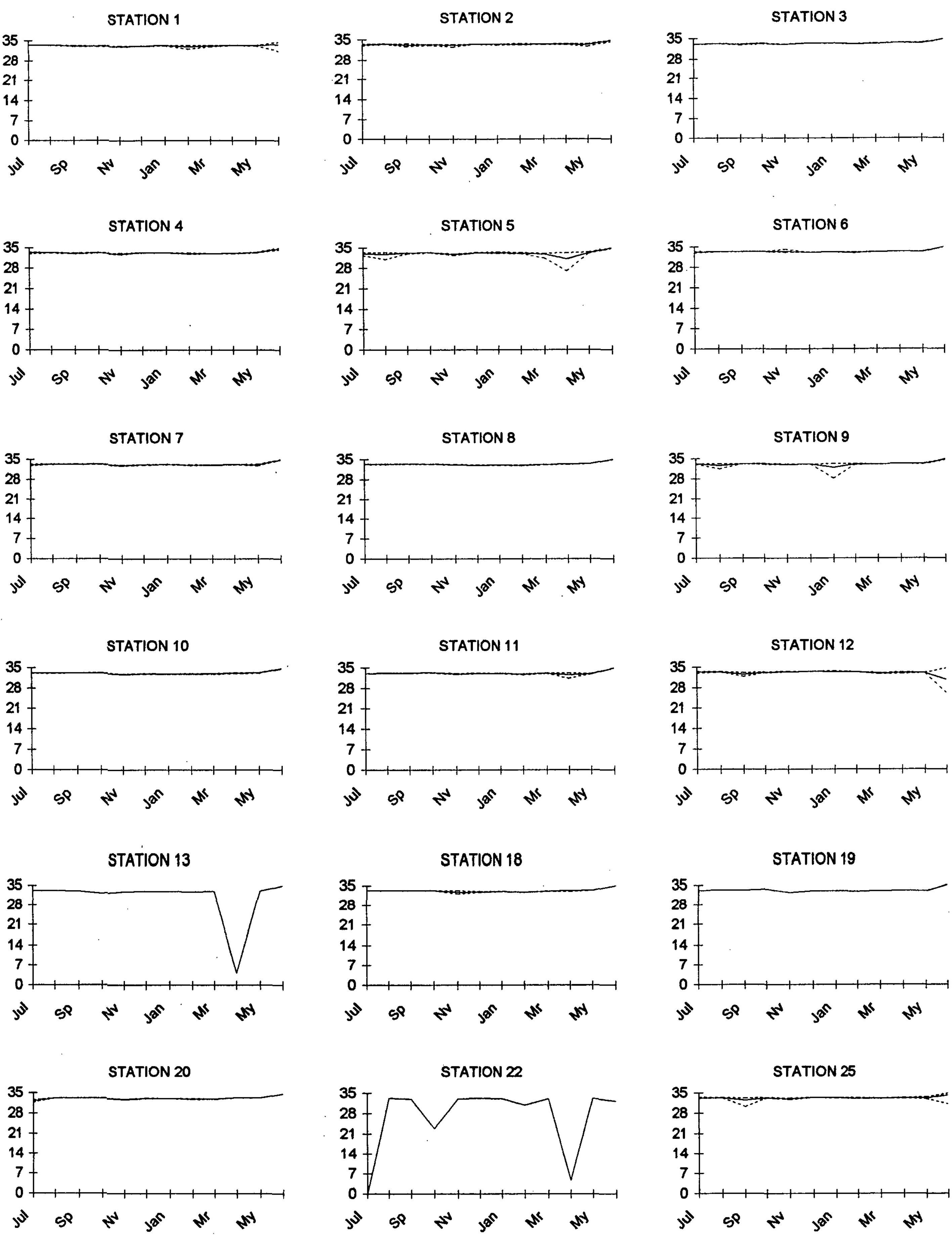


FIGURE 3-8. AVERAGE ANNUAL SALINITY (PPT) AT 18 WATER COLUMN STATIONS.

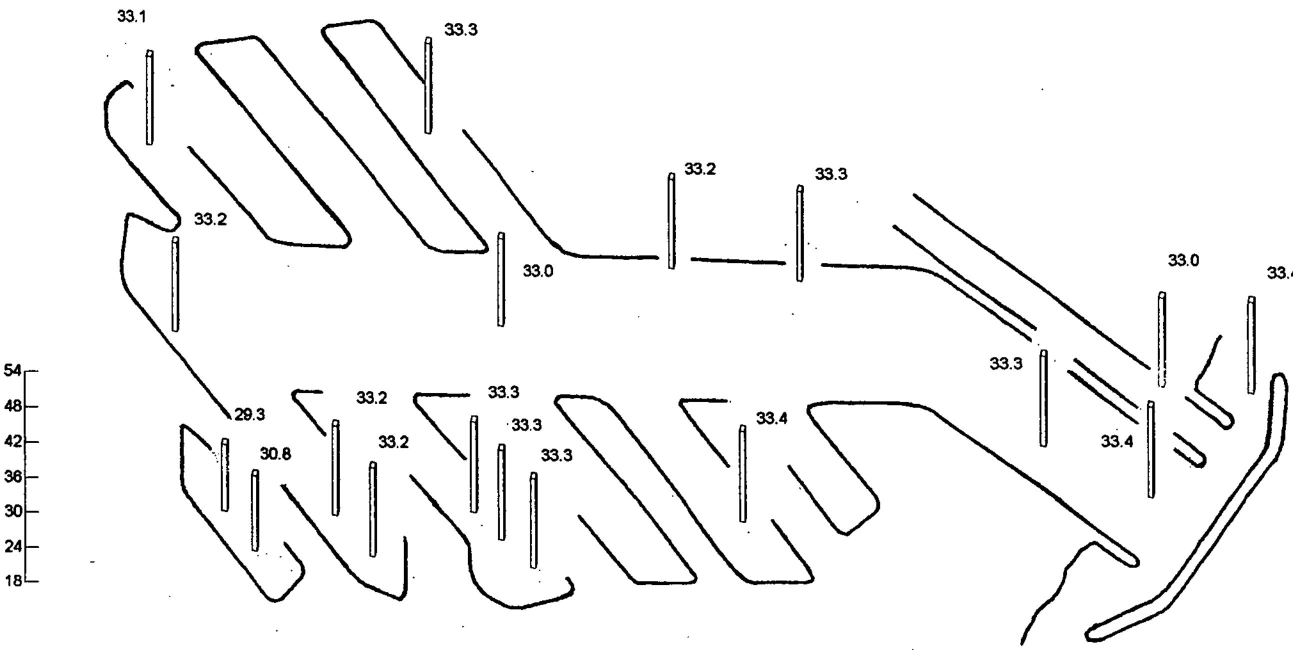


TABLE 3-3. SEASONAL SALINITY RANGES (PPT) FOR ALL DEPTHS AND STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1]	28.1 - 34.5	16.4 - 33.9	19.1 - 34.5	33.1 - 34.6
1994-95	30.1 - 34.8	0.2 - 34.2	26.5 - 34.5	20.7 - 34.8
1995-96	21.1 - 34.8	1.4 - 34.4	11.1 - 34.5	18.7 - 34.0
1996-97	24.7 - 34.1	21.6 - 33.7	21.1 - 33.9	27.6 - 33.9
1997-98	5.0 - 33.8	1.2 - 33.4	11.6 - 33.5	19.4 - 33.8
1998-99	10.3 - 34.4	10.3 - 33.9	1.2 - 34.2	20.3 - 34.0
1999-00	20.3 - 33.9	25.9 - 33.5	19.9 - 34.1	19.0 - 35.2
2000-01[2]	24.6 - 33.8	19.1 - 33.5	16.6 - 33.8	20.7 - 33.9
Overall range	**5.0 - 34.8**	**0.2 - 34.4**	**1.2 - 34.5**	**18.7 - 35.2**
2001-02[3]	22.9 - 34.0	28.1 - 33.7	4.2 - 33.6	26.1 - 35.2

[1] Two months only in the fall.

[2] Two months only in winter and summer. One month in fall.

[3] One month only in the summer. No July data reported for Station 22.

water until saturation is reached given sufficient time and mixing. The volume of gas that saturates a given volume of seawater is different for each gas and depends upon temperature, pressure, and salinity. An increase in pressure, or a decrease in salinity or temperature, causes an increase in gas solubility. Perhaps the most important dissolved gas in seawater is oxygen. Animals require oxygen for respiration. Plants release oxygen as a by-product of photosynthesis and utilize it during respiration. The decomposition of organic matter in the ocean is dependent upon oxygen concentration. Consequently, the amount of oxygen dissolved in seawater depends not only on mixing but also upon the type and degree of biological activity. The amount of oxygen dissolved in the sea varies from zero to about 11 milligrams per liter. At the surface of the sea, the water is more or less saturated with oxygen because of the exchange across the surface and plant activity. In fact, when photosynthesis maximizes during phytoplankton blooms as in red tide events (see Section 3.1.1), it can become supersaturated (Anikouchine and Sternberg 1973). When these blooms die off, bacterial aerobic respiration during decomposition of these phytoplankton cells can rapidly deplete dissolved oxygen in the water.

During conditions where mixing is minimal, oxygen can go to zero and result in the emission of hydrogen sulfide due to anaerobic respiration in the water column or benthic sediments. Rainfall runoff also brings organic detritus and organics into the marina, which may result in significant oxygen utilization. This could include bacterial breakdown of the organics as well as the oxidation of chemicals in the runoff (Soule et. al. 1997). For enclosed marine areas, such as Marina del Rey Harbor, dissolved oxygen is replenished to a great deal by the flow of seawater from incoming tides. The amount of replenishment is related to the height and duration of the tide and the distance from the source of the tide. Thus, areas further from the entrance of Marina del Rey Harbor will have a smaller degree of oxygen exchange than those closer to the entrance.

Vertical dissolved oxygen patterns. Figure 3-9 depicts the minimum, average, and maximum dissolved oxygen values for each station plotted against depth for 2001-2002. From surface to bottom, ranges were widest with the lowest and highest values in Ballona Creek (Station 12), Oxford Lagoon (Stations 13) and Basin E and D (Stations 10 and 18 respectively). Average dissolved oxygen concentrations remained relatively constant through the water column at all Stations.

Dissolved oxygen patterns over the year. Dissolved oxygen values varied among stations in similar patterns with lowest values usually recorded in the fall (Figure 3-10). Highest values were recorded in late winter through spring. Station 13 in Oxford Lagoon experienced the highest concentration of dissolved oxygen (13.5 mg/L) in April, 2002, due likely to a phytoplankton bloom. Interestingly the lowest dissolved oxygen value was reported at Station 22 (1.2 mg/L) in April, 2002, also in Oxford Lagoon. Regulatory agencies consider dissolved oxygen values less than 5.0 mg/l as not acceptable for marine life. Actually, the 5.0 mg/l minimum is based on fish survival, while invertebrates can survive on much lower levels (Soule et. al. 1997). Values below 5.0 mg/l were most frequent at Oxford Lagoon (Stations 13 and 22 - 6 and 7 times, respectively) and Basin E (Stations 10 and 20 – 3 times, each). Values at Stations 7, 8, 9, 11 and 25 were below 5.0 mg/l twice, and all other stations were below once (all these in October). Most stations showed a slight decrease in January, 2002 and April, 2002, which may be rainfall related. Oxygen concentrations varied greatest in Ballona Creek (Station 12) and Oxford Lagoon (Stations 13 and 22). A dissolved oxygen sample could not be completed for Station 22 in July.

GURE 3-9. MIN., AVERAGE, AND MAX. DIS. OXYGEN (MG/L) VERSUS DPTH.(M) AT 18 WATER COLUMN STATIONS.

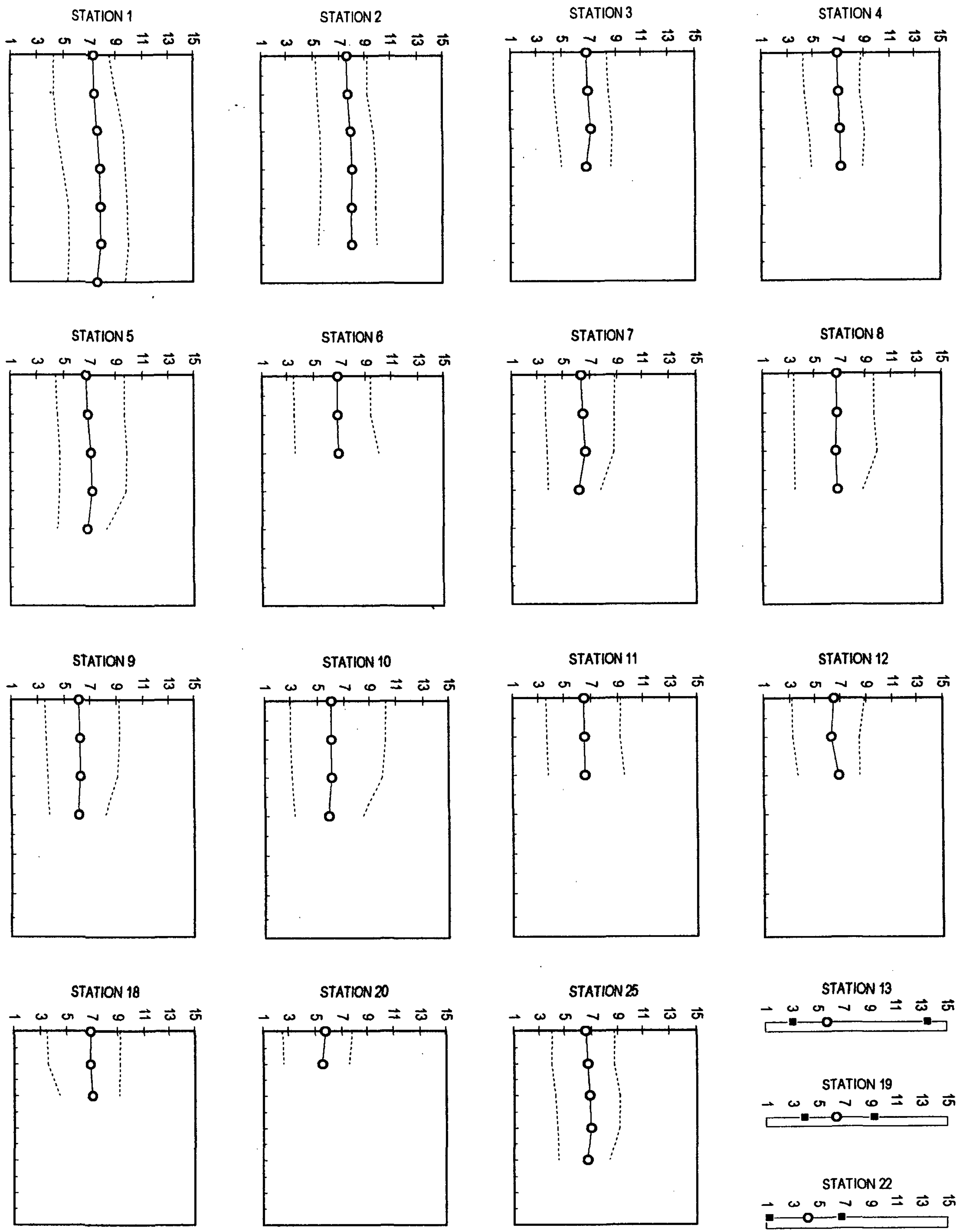


FIGURE 3-10. MINIMUM, AVERAGE, AND MAXIMUM DIS. OXYGEN (MG/L) VS. MONTH AT 18 WATER COLUMN STATIONS.

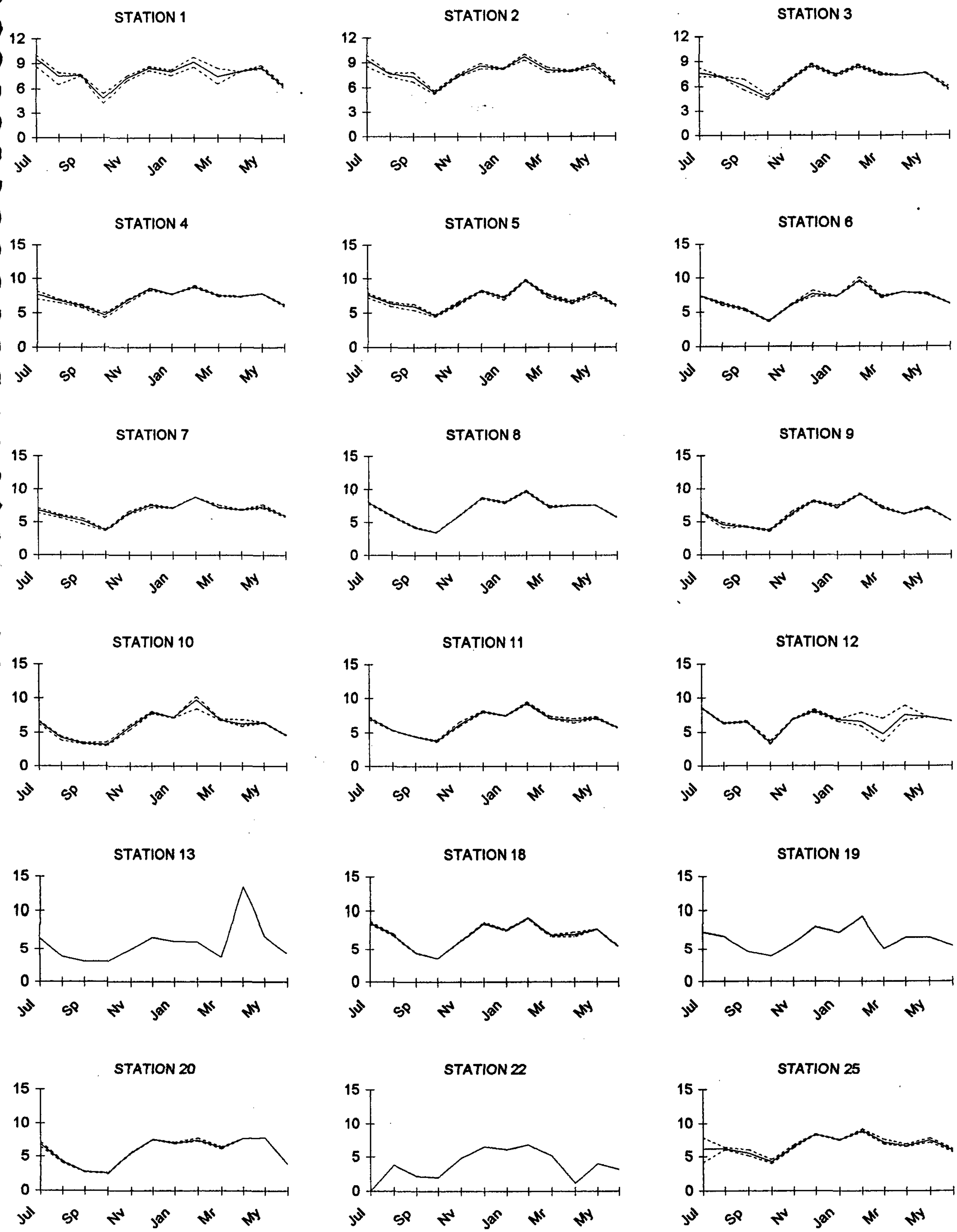


FIGURE 3-11. AVERAGE ANNUAL DISSOLVED OXYGEN (MG/L) AT 18 WATER COLUMN STATIONS.

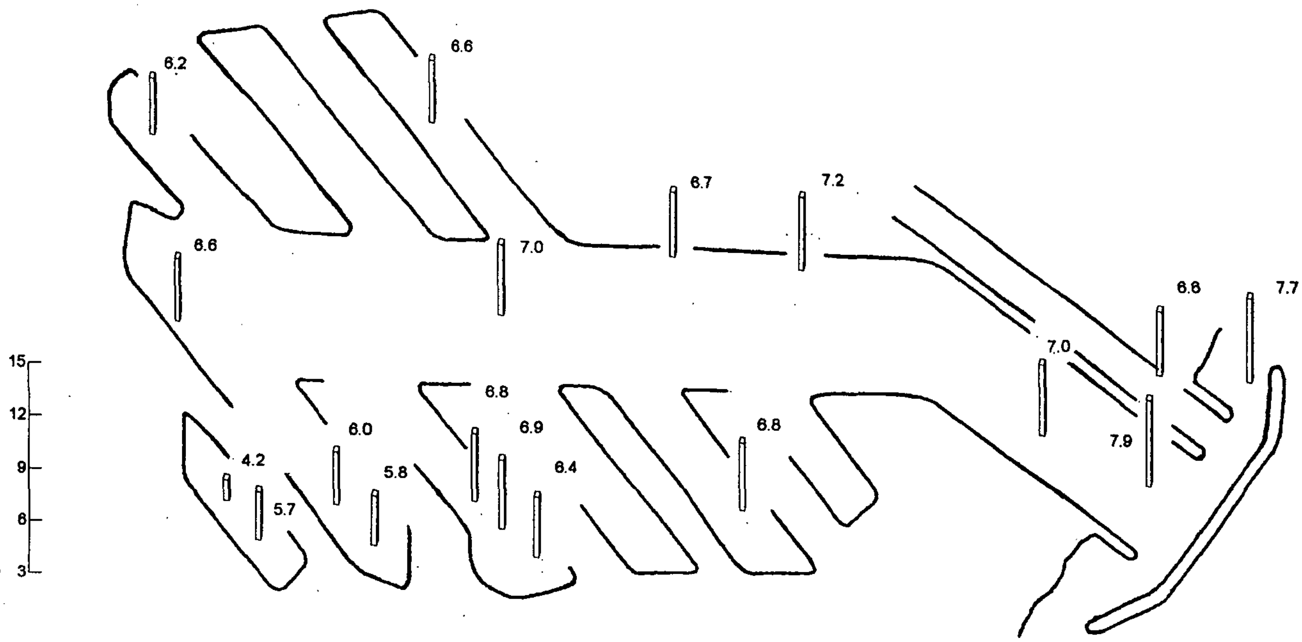


TABLE 3-4. SEASONAL DISSOLVED OXYGEN RANGES (MG/L) FOR ALL DEPTHS AND STATIONS.

Survey	Fall	Winter	Spring	Summer
1991-92	4.7 - 10.2	5.5 - 10.1	2.0 - 8.8	2.0 - 8.8
1992-93	2.5 - 8.2	2.0 - 8.9	3.3 - 11.1	4.0 - 9.2
1993-94[1]	-----	-----	-----	2.5 - 8.1
1994-95	3.3 - 9.4	2.7 - 9.7	4.4 - 10.2	1.0 - 8.3
1995-96	1.9 - 8.1	4.6 - 12.1	4.6 - 9.2	2.2 - 9.1
1996-97	2.6 - 10.1	4.4 - 8.6	3.8 - 13.9	2.4 - 8.1
1997-98	3.0 - 7.2	3.8 - 10.0	5.2 - 10.6	1.2 - 9.6
1998-99	2.8 - 9.6	4.0 - 11.4	4.2 - 8.6	2.7 - 8.3
1999-00	2.7 - 8.3	4.3 - 9.1	2.0 - 7.7	1.0 - 8.1
2000-01	3.1 - 8.6	5.0 - 9.0	4.0 - 10.3	3.8 - 10.0
Overall range	**1.9 - 12.0**	**2.0 - 12.1**	**2.0 - 13.9**	**1.0 - 10.0**
2001-02[2]	2.1 - 7.8	6.0 - 10.3	1.2 - 13.5	3.2 - 6.7

[1] Two months only in the fall, winter, and summer.

[2] One month only in the summer. No July data reported for Station 22

Spatial dissolved oxygen patterns. In general, dissolved oxygen tended to decline with distance from Harbor entrance, reflecting the reduced horizontal mixing with oceanic water within the interior basins (Figure 3-11). Lowest average values were in Oxford Lagoon (Stations 13 and 22 - 5.7 and 4.2 mg/l, respectively) and Basin E (Stations 10 and 20 - 6.0 and 5.8 mg/l, respectively). The highest oxygen averages in the Harbor were those nearest the entrance and in mid channel (Stations 1, 2, 3, 4 and 5 - 7.0 to 7.9 mg/l). Remaining stations were moderate, averaging from 6.2 to 6.9 mg/l.

Dissolved oxygen ranges compared with past years. With the exception of Spring, 2002, when the lowest dissolved oxygen value was 1.2 mg/L (compared to an historical range: 2.0 - 13.9 mg/L), 2001-2002 dissolved oxygen values were within the overall seasonal ranges for the preceding ten years (Table 3-4).

3.3.4. Hydrogen Ion Concentration (pH)

pH is defined as the negative logarithm of the hydrogen ion concentration. A pH of 7.0 is neutral, values below 7.0 are acidic, and those above 7.0 are basic (Horne 1969). Seawater in southern California is slightly basic, ranging between 7.5 and 8.6, although values in shallow open-ocean water are usually between 8.0 and 8.2 (SWQCB 1965). These narrow ranges are due to the strong buffering capacity of seawater, which rarely allows for extremes in pH.

Factors, which can influence pH in semi-enclosed eutrophic estuaries, such as Marina del Rey Harbor, are freshwater inputs and biological activity. Since freshwater pH values tend to be about 0.5 pH units less than seawater, any inflow from a freshwater source will tend to lower the pH slightly. When photosynthesis is greater than respiration, more carbon dioxide is taken up than used, and pH may increase to higher values in the euphotic (i.e. light penetrating) zone. When respiration is greater than photosynthesis, more carbon dioxide is released than used and pH may decrease, especially when mixing is minimal such as in the oxygen minimum zone and towards the bottom (Soule et. al. 1997).

Vertical pH patterns. Surface to bottom pH profiles (Figure 3-12) indicated that there was very little change with depth, and at nearly all stations, minimum-maximum ranges were narrow. Contrary to last year, Stations 22 in Oxford Lagoon and Station 12 in Ballona Creek did not experience wide variability in pH values. However, Station 9 in Basin F showed a drastic September decline in pH at a depth of 2 to 6 meters (4.2 - 4.4 units). This station is generally very shallow and acidic freshwater inputs may be causing this reduction in pH.

pH patterns over the year. Overall, averages varied little at nearly all stations (Figure 3-13) with a slight decline in pH during August and again in December occurring at all stations. Both these months did not have much rainfall, this drop could be related to the relationship between photosynthesis and respiration where carbon dioxide decreases which raises pH. Contrary to past years, Oxford Lagoon and Ballona Creek did not have the greatest variability in pH. Station 9 in Basin F experienced a large decline in pH in September. Station 19 at Mother's Beach saw a large decrease in pH in March. Neither month had significant rainfall, so the sources of these decreases remain unclear. A pH sample was not completed for Station 22 in July.

Spatial pH patterns. When averaged over the 12-month sampling period, pH values were very similar among stations (Figure 3-14). The lowest average (7.5, Station 9) was in Basin F. No average pH value exceeded 8.0 and the other stations averaged between 7.6 and 7.9 units.

FIGURE 3-12. MIN, AVERAGE, AND MAX PH (UNITS) VERSUS DEPTH (M) AT 18 WATER COLUMN STATIONS.

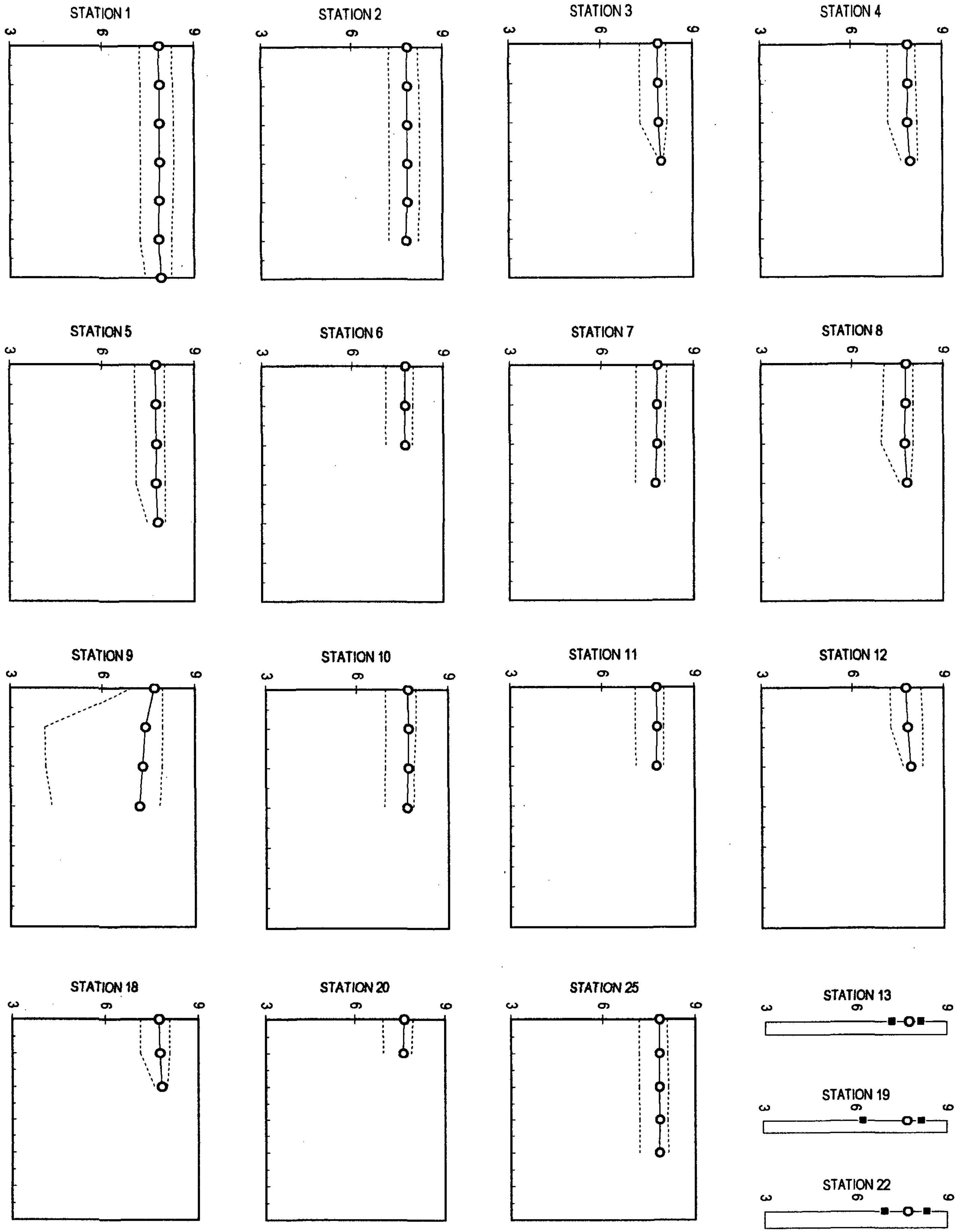


FIGURE 3-13. MINIMUM, AVERAGE, AND MAXIMUM PH (UNITS) VS. MONTH AT 18 WATER COLUMN STATIONS.

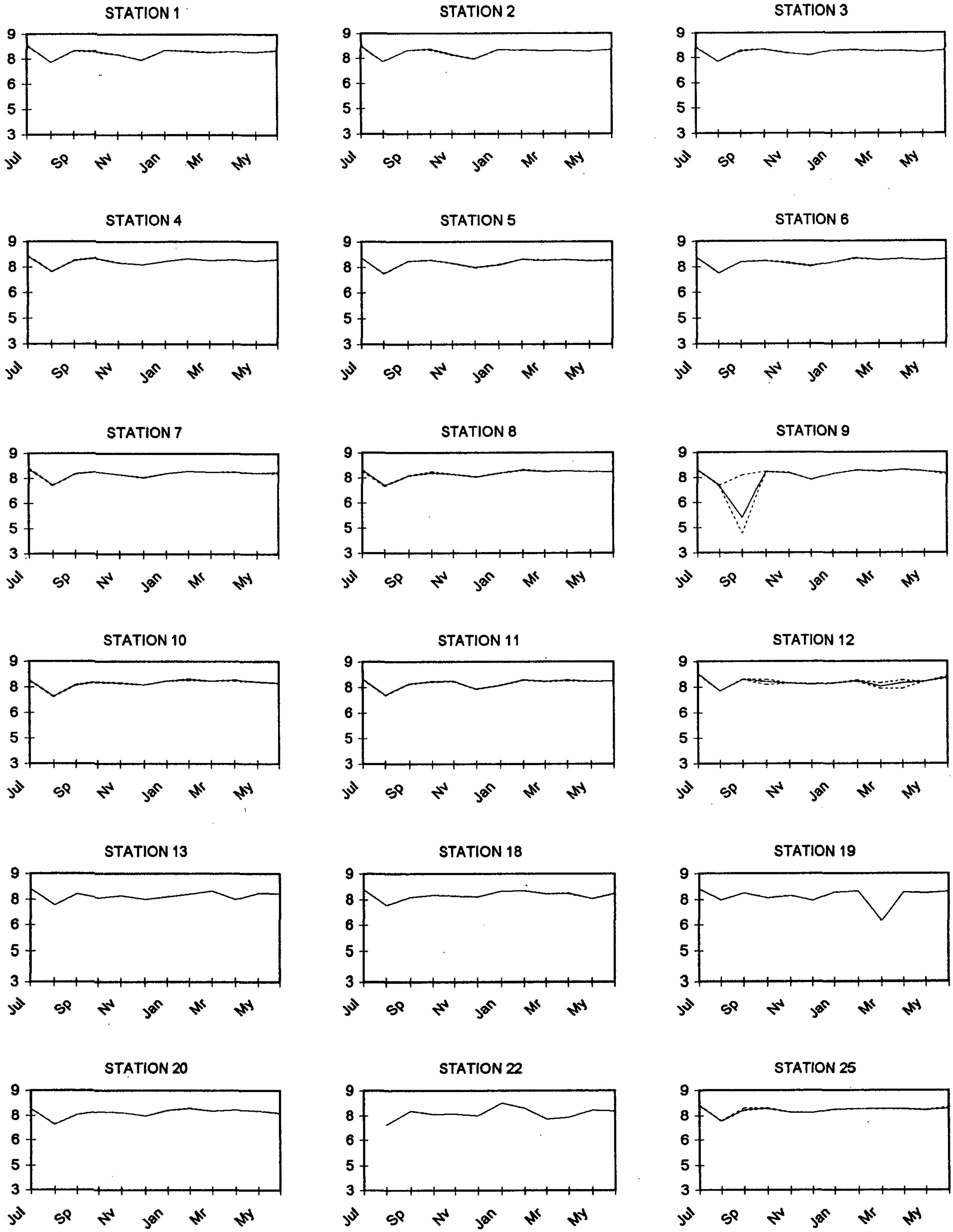


FIGURE 3-14. AVERAGE ANNUAL PH (UNITS) AT 18 WATER COLUMN STATIONS.

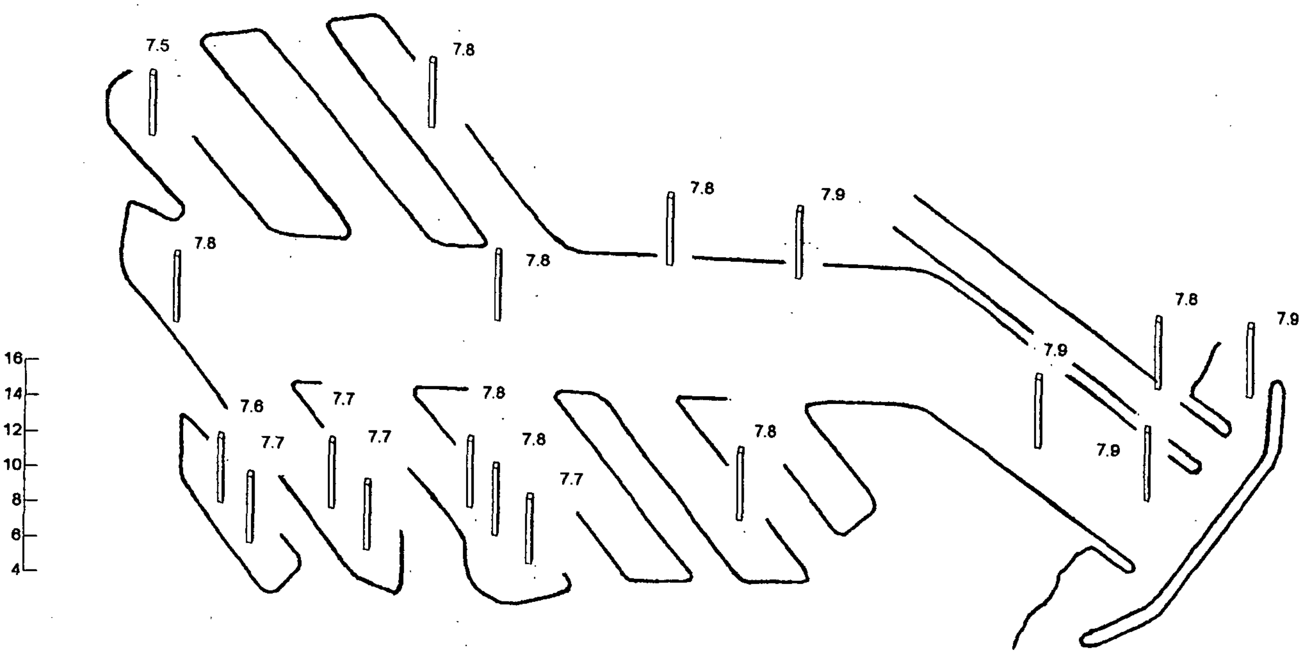


TABLE 3-5. SEASONAL PH RANGES (UNITS) FOR ALL DEPTHS AND STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1.]	7.9 - 8.6	7.2 - 8.1	7.8 - 8.7	7.3 - 8.7
1994-95	7.5 - 8.2	7.1 - 8.3	7.5 - 8.5	7.8 - 8.3
1995-96	7.5 - 8.3	7.2 - 8.2	7.4 - 8.3	7.3 - 8.4
1996-97	7.5 - 8.3	7.5 - 8.3	7.8 - 8.5	7.5 - 8.2
1997-98	7.7 - 8.3	6.8 - 8.2	7.7 - 8.6	7.1 - 8.7
1998-99	7.7 - 8.4	7.3 - 8.4	7.0 - 8.1	7.5 - 8.5
1999-00	7.8 - 8.4	7.6 - 8.0	7.6 - 8.3	7.6 - 8.3
2000-01	7.8 - 8.2	7.7 - 8.2	7.7 - 8.4	6.9 - 8.3
Overall range	**7.5 - 8.6**	**6.8 - 8.4**	**7.0 - 8.7**	**6.9 - 8.7**
2001-02[2.]	4.2 - 8.1	7.4 - 8.3	6.3 - 8.0	7.7 - 8.1

[1.] Two months only in winter and summer. One month in fall.

[2.] One month only in the summer. No July data reported for Station 22.

pH ranges compared with past years. Fall (2001) and Spring (2002) minimum pH values were below the overall seasonal ranges for the preceding eight years (Table 3-5). All other pH values were within range.

3.3.5. Ammonia

The common inorganic nitrogenous nutrients are nitrate, nitrite, and ammonia. In natural seawater, nitrate is the dominant of these three forms. Nitrite is usually an intermediate form appearing either when nitrate is reduced to ammonia or in the reverse process, as ammonia is oxidized to nitrate. Ammonia is normally present only in small concentrations in natural waters, although in oxygen-deficient waters, it may be the dominant form of nitrogenous nutrients. Ammonia concentrations in the ocean are usually formed by the breakdown of organic material and recycling into inorganic nitrogen. The Hancock Foundation surveys found nitrate concentrations in surface waters ranging from 0.01 to 0.04 mg/l over their study area. Surface concentrations in spring months were somewhat higher than those found during fall and winter months (SCCWRP 1973). These figures are mirrored by our own studies in Ventura County (Aquatic Bioassay 1996).

Ammonia concentration in the ocean is important for three reasons. First, since nitrogen is usually limiting in marine waters, its presence or absence can have a profound affect upon the primary producers in the ocean (i.e. usually phytoplankton) and thus the subsequent trophic levels that depend upon them (i.e. nearly all other living organisms in the sea). Secondly, too much ammonia can cause algal blooms that can be detrimental to other organisms, particularly in enclosed bays and estuaries such as Marina del Rey Harbor (see Section 3.3.1.3 for a discussion of the impacts of red tide algal blooms). Thirdly, ammonia is a by-product of the degradation of most forms of organic waste in the marine environment and can thus be used as a rough indicator of organic pollution. Surface runoff and drainage of nitrogen, including ammonia, is governed by the frequency, intensity, and duration of precipitation in the drainage basins. As a result, there can be relatively large fluctuations in these inputs from year to year, and lengthy periods within a year when they are absent (SCCWRP 1973). Marina del Rey is an estuary, which is a partially enclosed coastal ecosystem where seawater mixes with nutrient-rich freshwater that has drained from the land. The confined conditions tend to trap the nutrients, resulting in an extremely productive and important ecosystem, which is an important nursery area for many species of fish and invertebrates. In estuarine and coastal systems, ammonia input from natural recycling (breakdown of organic material) is often significantly increased by input from anthropogenic sources. These anthropogenic sources include ocean outfalls for treated sewage, rainwater runoff, and input from boats. Direct rainwater runoff into Marina del Rey is significantly augmented by runoff from the major flood control facilities, Oxford Basin and Ballona Creek. The ammonia concentrations in the marina are likely to be indicative of the breakdown of organic debris and/or waste, and terrestrial fertilizers, whether of human or animal origin. Localized events in the marina may add to the ammonia concentrations. These include the discharge of human wastes, bird droppings and wash-down products from nearby docks and walkways (Soule et. al. 1997).

Vertical ammonia patterns. No unifying vertical patterns of ammonia concentration were evident in Marina del Rey Harbor (Figure 3-15). Although some station averages increased slightly with depth, others decreased, while still others were relatively unchanged. For all stations and all depths, ammonia minima were at or near the detection limit (<0.01 mg/L) during at least one monthly survey. Maximum values ranged fairly widely at Stations 2, 6, 11, 12 and 18 with no apparent unifying pattern.

FIGURE 3-15. MIN, AVERAGE, AND MAX AMMONIA (MG/L) VERSUS DPTH.(M) AT 18 WATER COLUMN STATIONS.

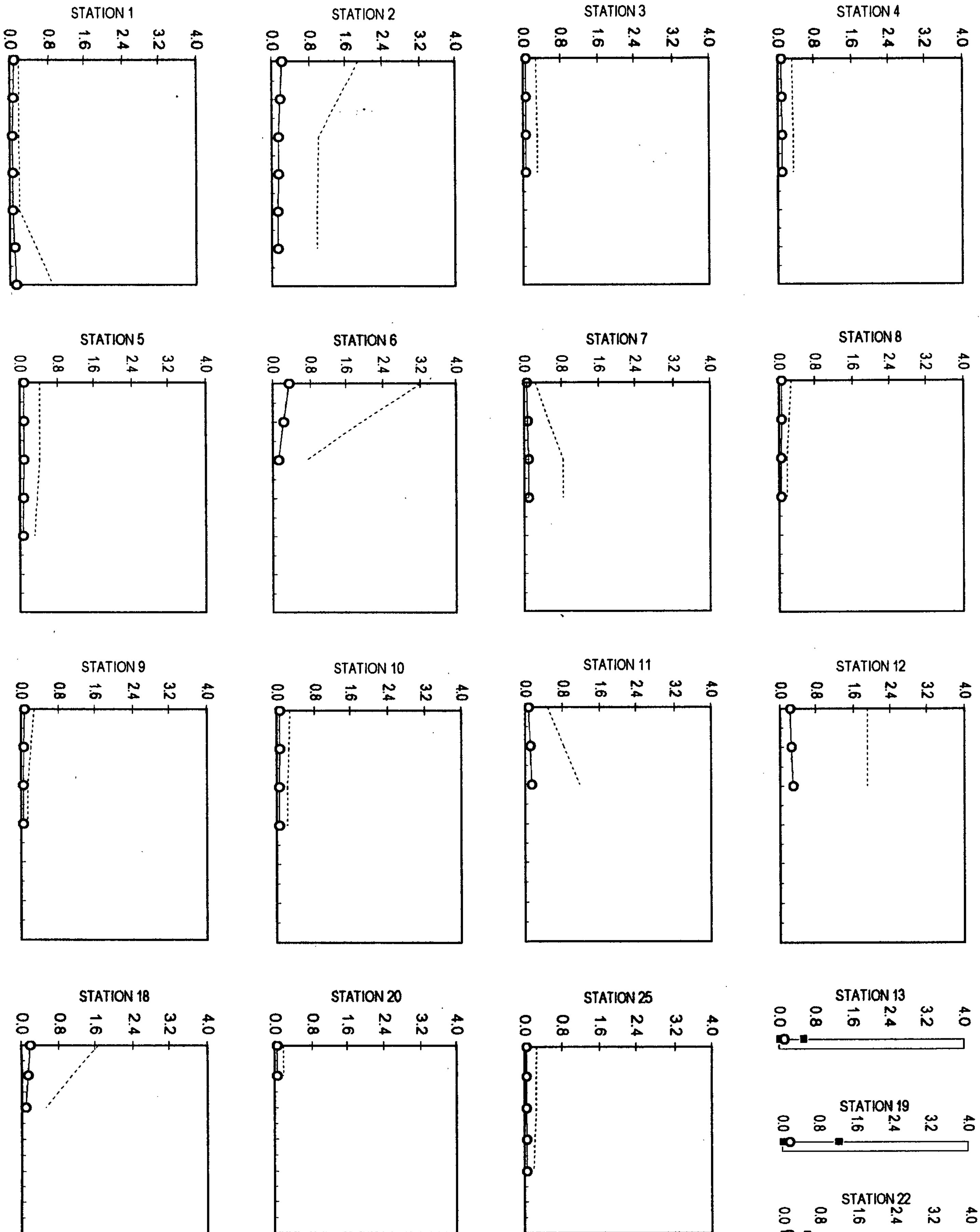
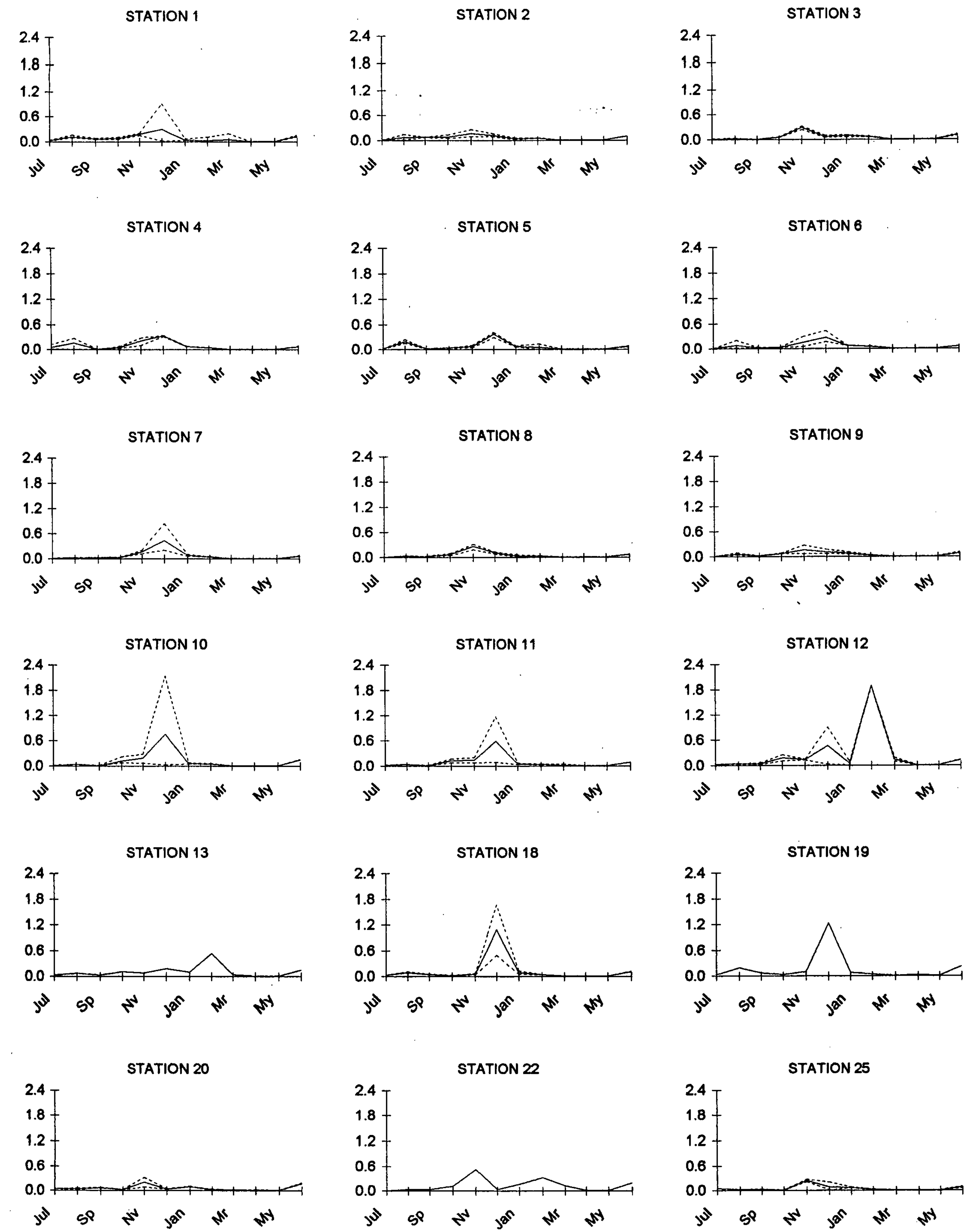


FIGURE 3-16. MINIMUM, AVERAGE, AND MAXIMUM AMMONIA (MG/L) VS. MONTH AT 18 WATER COLUMN STATIONS.



Ammonia patterns over the year. For most stations, averages did not vary widely over the year (Figure 3-16), with peaks appearing most commonly in November through February coinciding with the majority of rainfall. Stations 4 and 5 showed slight ammonia peaks in August likely not related to rainfall. Additionally, all samples showed a slight increase in ammonia levels in June although no rain was recorded in June. Station 12 in Ballona Creek showed a relatively large increase in ammonia values in February likely due to municipal drainage. Patterns in Oxford Lagoon (Stations 13 and 22) did not strongly influence ammonia values in Basin E (Stations 10 and 20) this year.

Spatial ammonia patterns. Highest ammonia averages over the year were at Station 12 in Ballona Creek (0.26 mg/L) (Figure 3-17). Moderate ammonia concentrations were found at Stations 19 and 18 in Basin D (0.17 and 0.13 mg/L, respectively), Stations 22 and 13 (0.14 and 0.11, respectively), Station 11 in the back harbor (0.10 mg/L) and at Station 10 in Basin E (0.12 mg/L). All other stations had ammonia values of 0.05 to 0.09 mg/l.

Ammonia ranges compared with past years. All 2001-2002 ammonia values were well below average values of the recent past (Table 3-6) but higher than last year in the Fall and Winter.

3.3.6. **Biochemical Oxygen Demand (BOD)**

In the standardized biochemical oxygen demand (BOD) test, the oxygen concentration of the water sample is measured, and a portion of that water is sealed in a specially designed airtight container (i.e. BOD bottle). The sample incubates for five days at 20 °C, and the dissolved oxygen is re-measured (APHA 1995). During the five-day period, naturally occurring bacteria reproduce and respire and consume whatever organic material is available. In the process, they utilize the accessible oxygen in the sealed container. Thus, the BOD is a measure of the amount of oxygen consumed by bacterial respiration over the period of five days. Although the BOD test utilizes bacteria, it is not a measure of bacterial density but rather an indirect measure of organic material in the water. The source of organic material may be natural, such as plankton or organic detritus from upwelled waters, or anthropogenic, such as wastewater effluents, stormwater drainage, or non-point runoff.

Vertical BOD patterns. Vertical BOD profiles (Figure 3-18) suggest that the BOD ranges tended to remain relatively constant with depth at all stations. Stations 1, 10, 12, 20, 25, 13 and had high surface BOD values. BOD values were much higher this year compared to last. The source of the high BOD values is likely municipal, freshwater runoff.

BOD patterns over the year. Station 13 in Oxford Lagoon showed the largest variability in BOD values among months with a high of 22 mg/L in September and spikes in January (12 mg/L), March (13.4 mg/L) and April (15.2 mg/L). Station 22 in Oxford Lagoon exhibited spikes in BOD during September (13.9 mg/l), October (15.0 mg/L) and March (11.6 mg/L). For most stations, BOD values were relatively low (below 5.0 mg/l) throughout this year (Figure 3-19). A brown water discoloration, noted at Station 12 in Ballona Creek and Station 13 in Oxford Lagoon, may have been red tide activity which may account for the surge in BOD in October, 2001. Stations 1, 2 and 3 at the harbor entrance also exhibited small increases in BOD in October, likely from Station 12 influences.

FIGURE 3-17. AVERAGE ANNUAL AMMONIA (MG/L) AT 18 WATER COLUMN STATIONS.

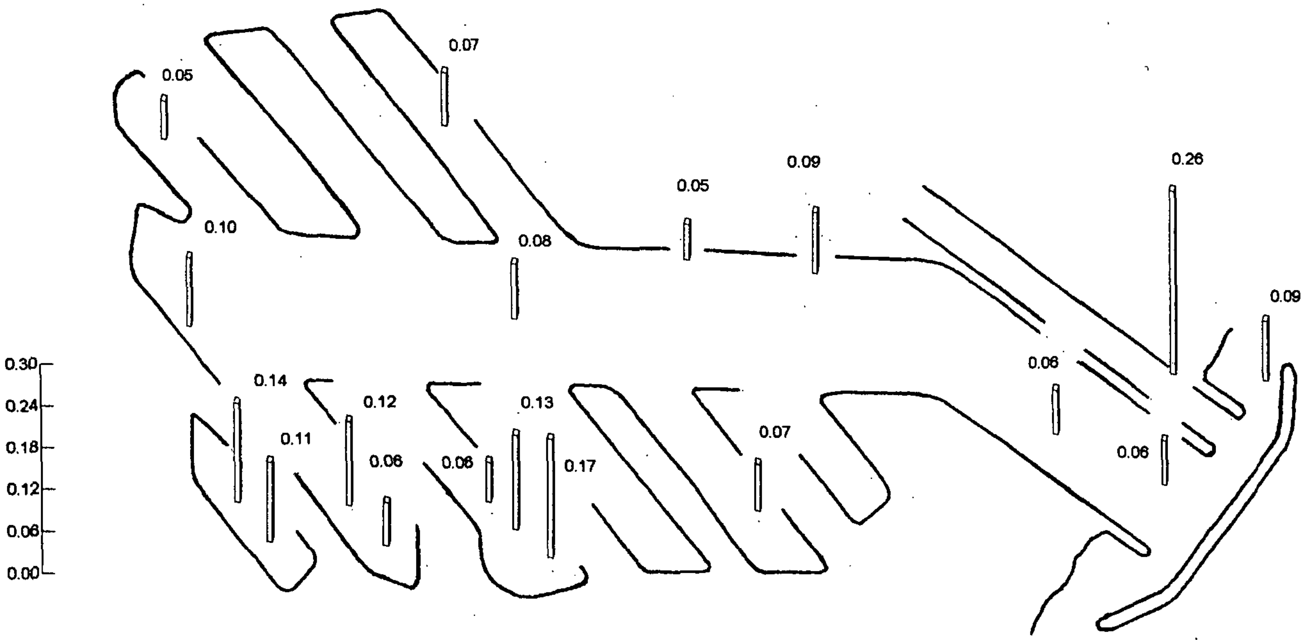


TABLE 3-6. SEASONAL AMMONIA RANGES (MG/L) FOR ALL DEPTHS AND STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1]	-----	2.6 - 30.6	2.3 - 10.0	1.5 - 4.5
1994-95	1.5 - 6.0	0.2 - 5.0	0.9 - 4.1	1.0 - 12.7
1995-96	2.2 - 15.0	3.2 - 47.4	2.5 - 12.0	0.3 - 18.9
1996-97	0.3 - 18.2	0.3 - 27.7	0.3 - 22.6	0.3 - 105.8
1997-98	0.3 - 52.3	0.4 - 37.1	0.4 - 18.1	0.4 - 28.3
1998-99	0.4 - 45.5	0.4 - 43.6	0.4 - 22.9	0.01 - 3.5
1999-00	0.01 - 0.85	0.00 - 0.72	0.01 - 0.96	0.01 - 0.22
2000-01	0.01 - 0.42	0.00 - 0.26	0.01 - 0.21	0.01 - 0.27
Overall range	**0.01 - 52.3**	**0.00 - 47.4**	**0.01 - 22.9**	**0.01 - 105.8**
2001-02[2]	0.01 - 0.53	0.01 - 2.15	0.01 - 0.19	0.05 - 0.22

[1] Two months only in the winter and summer.

[2] One month only in the summer. No July data reported for Station 22.

FIGURE 3-18. MIN, AVERAGE, AND MAX BOD (MG/L) VERSUS DEPTH (M) AT 18 WATER COLUMN STATIONS.

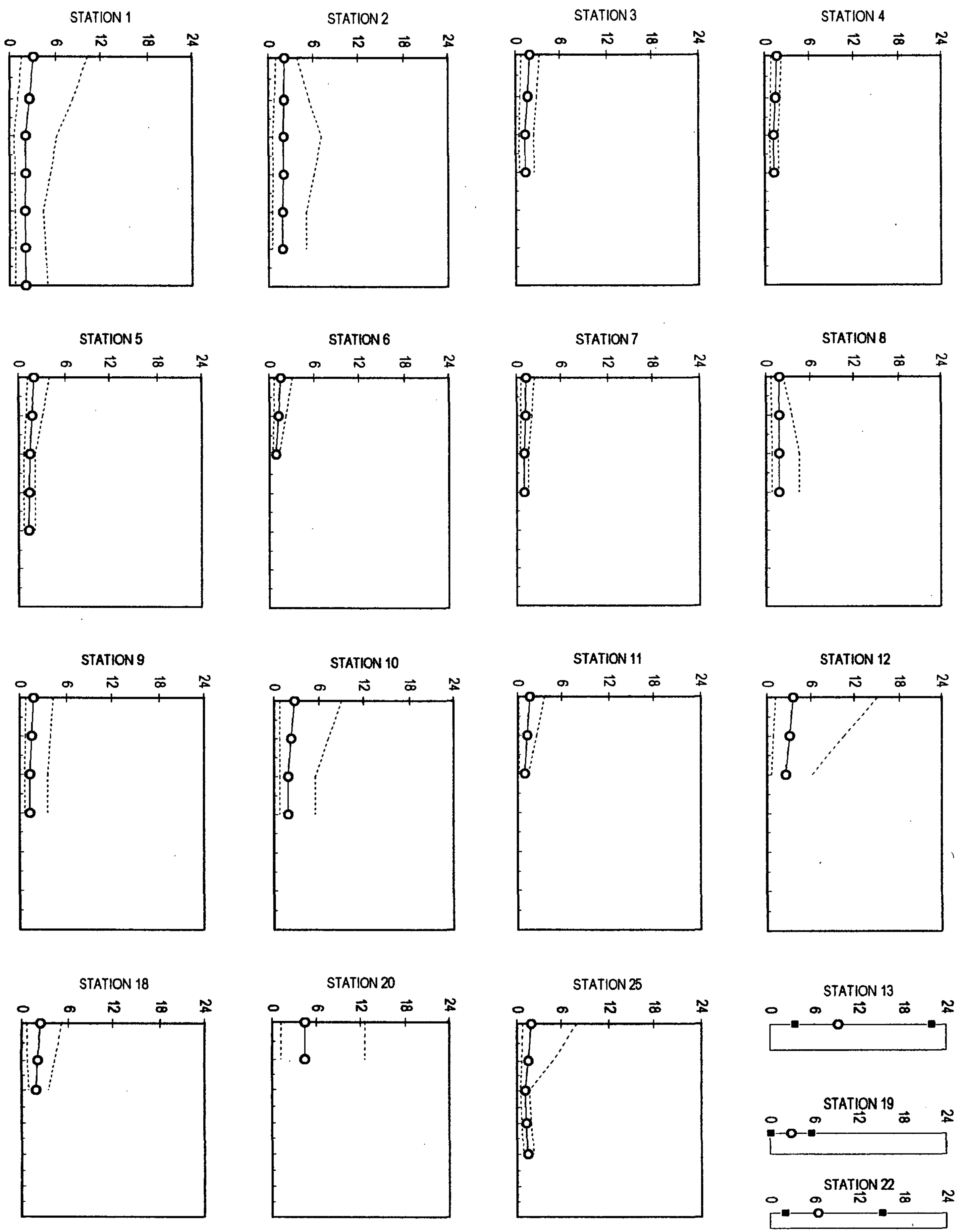
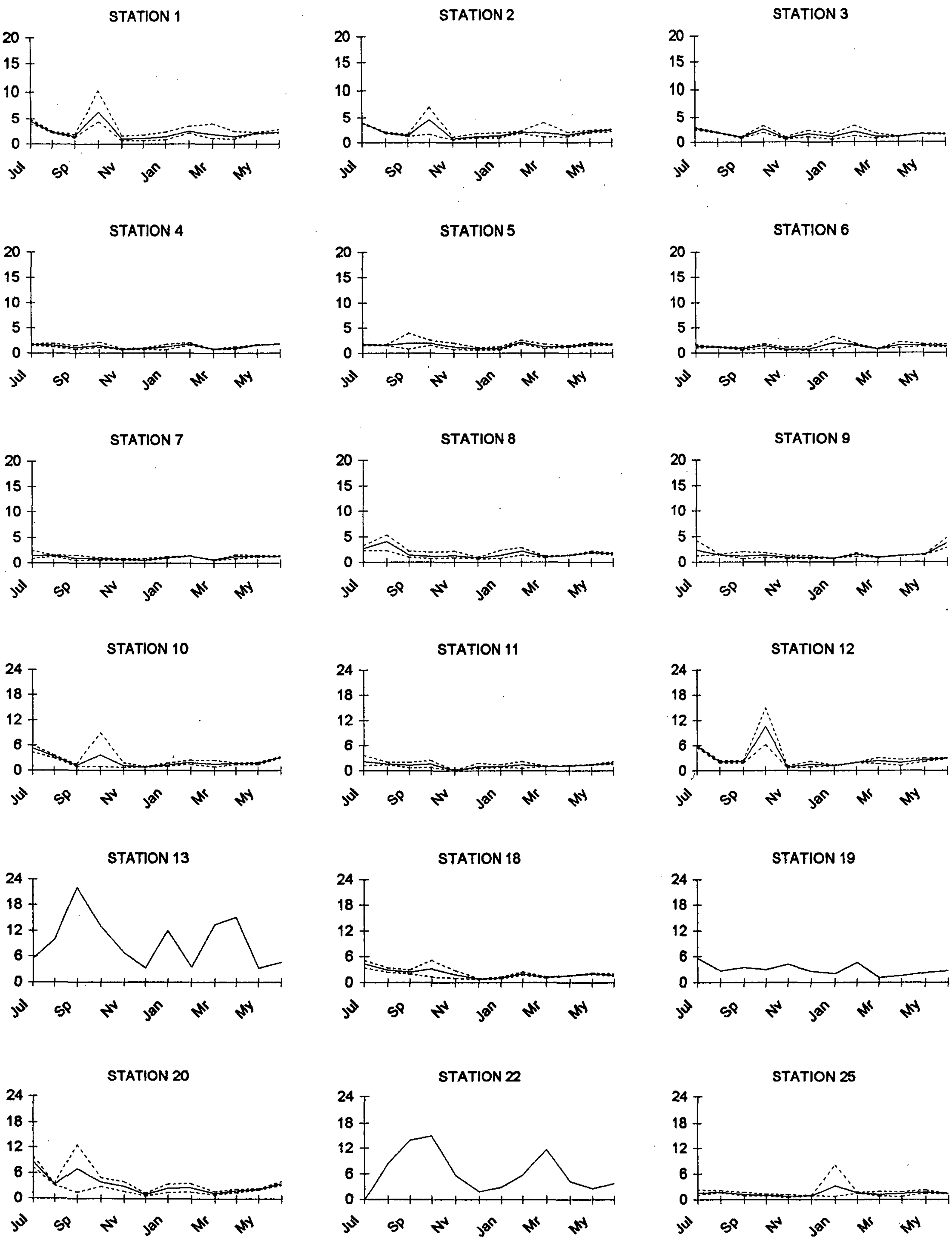


FIGURE 3-19. MINIMUM, AVERAGE, AND MAXIMUM BOD (MG/L) VS. MONTH AT 18 WATER COLUMN STATIONS.



Spatial BOD patterns. Similar to last year, highest average BOD values were in Oxford Lagoon (Stations 13 and 22 - 9.4 and 6.9 mg/l, respectively), Basin E (Station 20 - 3.4 mg/l), and near Ballona Creek (Station 12 - 3.0 mg/l) (Figure 3-20). Mother's Beach (Station 19) also exhibited increased average BOD (2.9 mg/L). All other stations ranged from 1.1 to 2.4 mg/l.

BOD ranges compared with past years. Compared with the previous eight years, BOD values for 2001-2002 exceeded the average range in the Fall and Spring (Table 3-7).

3.3.7. Light Transmissance

Water clarity in Marina del Rey Harbor is important for aesthetic and ecological reasons. Phytoplankton, as well as multicellular plants, depends on light for photosynthesis and therefore growth. Since nearly all higher-level ocean organisms depend on these plants for survival (except animals living in deep-ocean volcanic vents), the ability of light to penetrate into the ocean depths is clearly important. Water is least clear during spring upwelling and winter rain. In early summer, increased day length promotes plankton growth and reduces water clarity. Late summer and early fall typically have the greatest water clarity since shorter days and sediment carrying rain have yet to begin. Anthropogenic inputs such as, wastewater effluents, storm drain discharges and non-point runoff also greatly influence local water quality. Surface transparency is measured using a weighted, white plastic, 30-cm diameter disk (a Secchi Disk) attached to a marked line. The depth at which the disk disappears in the water column is recorded. The depth to which light is available for photosynthesis is generally considered about 2.5 times the Secchi disk depth, therefore, this provides an estimate of light available to plankton. Recent findings indicate net photosynthesis may occur at lower light levels. (SCCWRP, 1973).

Light transmissance is measured using a transmissometer, an open tube containing an electrical light source at one end and a sensor at the other. The amount of light that the sensor receives is directly dependent upon clarity of the water between them. Results are recorded as percent light transmissance (converted to 0.1-m path length to be comparable with past surveys). Since transmissance is independent of ambient sunlight, it can be used at any depth and under any weather conditions. In general, light transmissance is usually positively correlated with surface transparency and negatively correlated with color (i.e. Forel-Ule). Light transmissance, surface transparency and water color measurements are not taken within Oxford Basin (Stations 13 and 22) or at the Mother's Beach shoreline station (19) because of the shallowness of the water.

Vertical light transmissance patterns. Profiles shown in Figure 3-21 suggest that, at most stations, the average transmissance is fairly constant with depth. The exceptions was Station 12 (Ballona Creek) where transmissance increased with depth. Transmissance minima and maxima were similar at all stations from surface to bottom, except at Station 12 in Ballona Creek where the surface minimum was the lowest for all stations (<60%).

FIGURE 3-20. AVERAGE ANNUAL BOD (MG/L) AT 18 WATER COLUMN STATIONS.

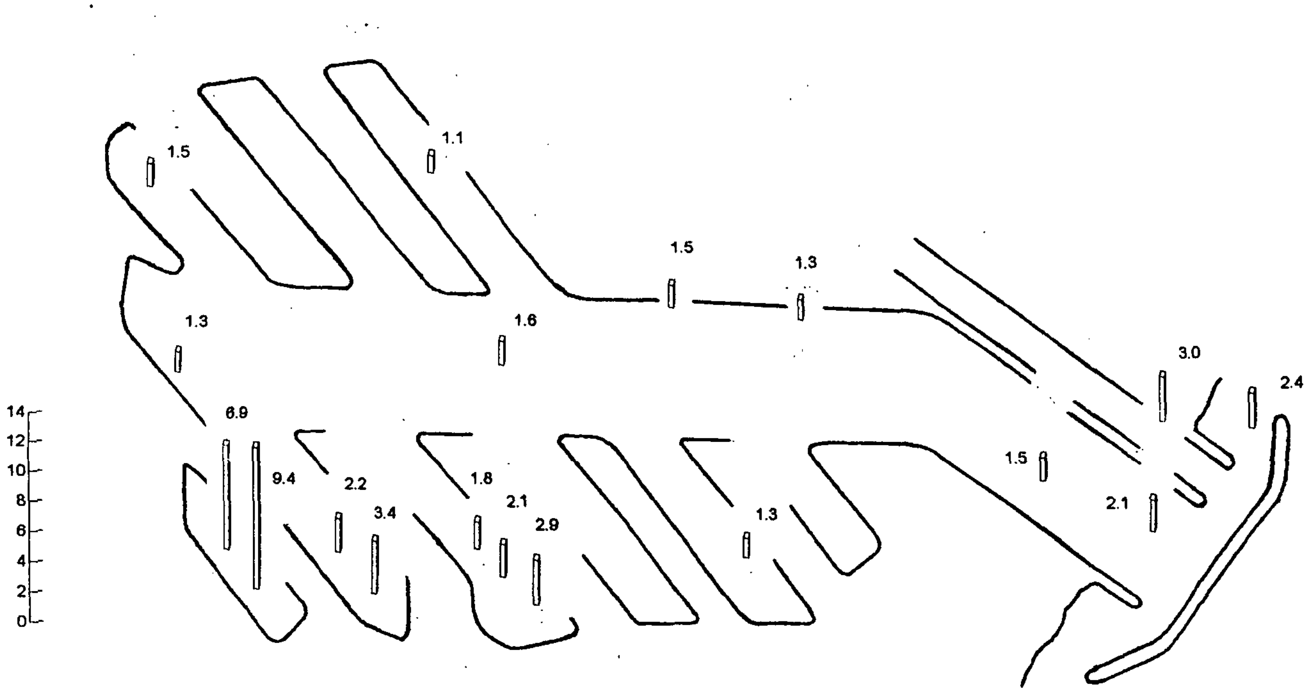
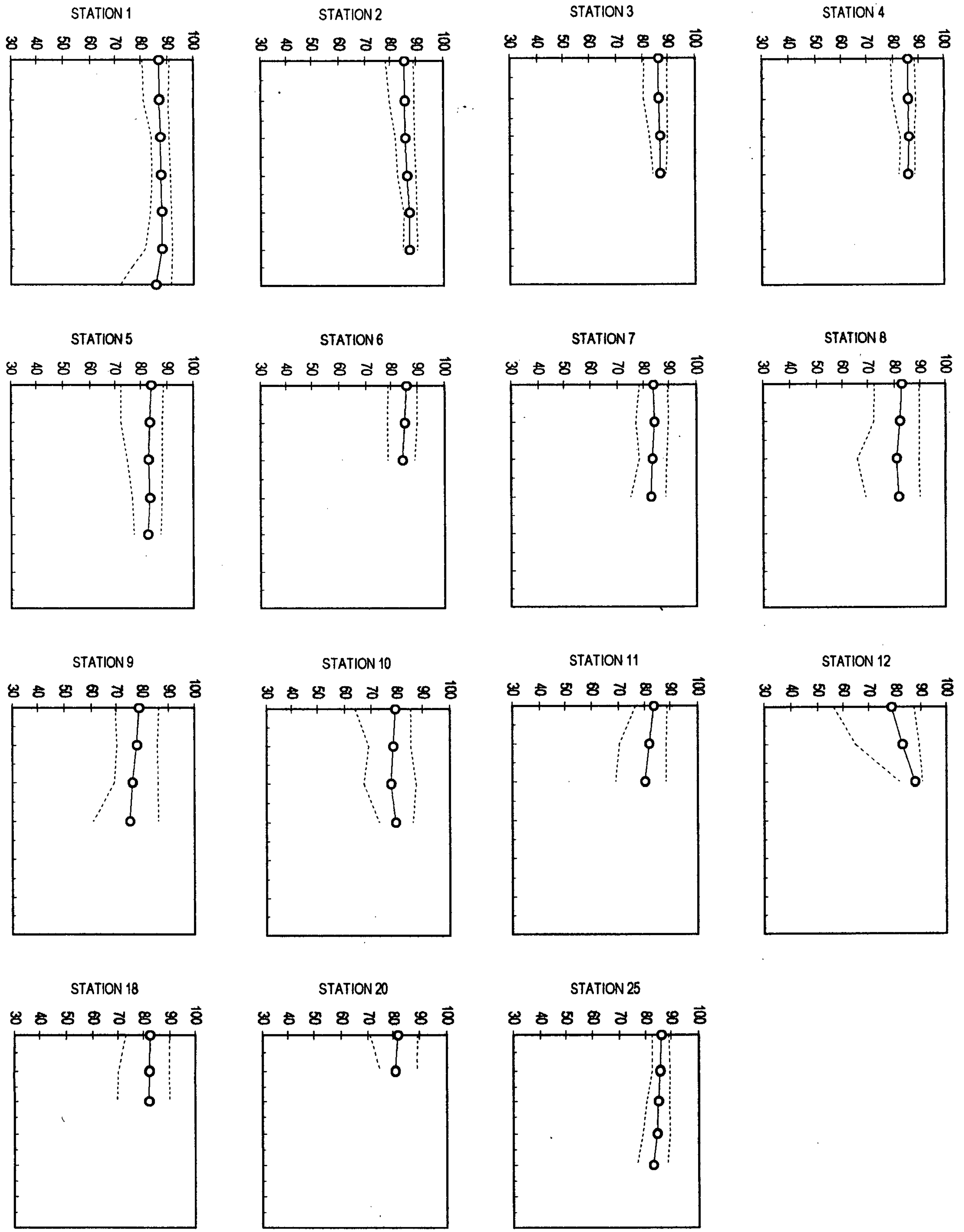


TABLE 3-7. SEASONAL BOD RANGES (MG/L) FOR ALL DEPTHS AND STATIONS.

Survey	Fall	Winter	Spring	Summer
1994-95	0.6 - 5.2	0.5 - 10.3	0.6 - 13.0	0.9 - 11.2
1995-96	0.8 - 3.4	0.6 - 8.7	0.6 - 6.8	0.1 - 7.5
1996-97	0.1 - 7.8	0.4 - 6.8	1.0 - 13.0	0.8 - 15.2
1997-98	0.4 - 13.4	0.2 - 6.1	0.7 - 8.7	0.8 - 12.5
1998-99	0.0 - 19.3	0.3 - 8.7	0.4 - 7.6	0.5 - 8.4
1999-00	0.4 - 6.6	0.0 - 18.7	0.6 - 7.2	0.8 - 6.8
2000-01	0.2 - 8.0	0.3 - 6.3	0.8 - 9.5	1.0 - 9.9
Overall range	**0.0 - 19.3**	**0.2 - 18.7**	**0.4 - 13.0**	**0.1 - 15.2**
2001-02[1]	0.1 - 22.0	0.5 - 12.0	0.6 - 15.2	1.1 - 4.8

GURE 3-21. MIN, AVERAGE, AND MAX TRANSMISSANCE (%) VS. DPTH.(M) AT 15 WATER COLUMN STATIONS.



Light transmissance patterns over the year. Most stations showed a decrease in light transmissance in the fall and spring (Figure 3-22). A dark brown discoloration was noted in October which may account for the fall drop in transmissance. Basin Stations 7, 8, 9, 10 and 20 showed more dramatic decreases in light transmissance in the spring likely related to the low rainfall. Small, infrequent storm events probably introduced debris and nutrients at each event. The highest fluctuation in transmissance occurred at Station 12 in Ballona Creek, Stations 10 and 20 in Oxford Lagoon as expected. Stations 11 in the back channel and Station 9 in Basin F also experienced high variability in transmissance especially in the spring.

Spatial light transmissance patterns. Transmissance averages were fairly high throughout the Harbor (Figure 3-23). Lowest averages were in Basin F (Station 9 - 76.7%) and Basin E (Station 10 - 78.7%). The highest averages were Stations 1, 2 and 3 (87.3%, 86.4% and 86.5%, respectively). Remaining stations were relatively high (81.0% to 85.5%).

Light transmissance ranges compared with past years. Transmissance values were within the overall seasonal ranges for the previous years (Table 3-8). The minimum values were higher compared to 2000-2001.

3.3.8. Surface Transparency

As discussed in more detail in Section 3.3.1.6 above, surface transparency is recorded as the depth (m) at which a weighted, 30 cm, white plastic disk (Secchi Disk) disappears from view. Transparency is not measured in Oxford Lagoon or at the surface station at Mother's Beach.

Surface transparency patterns over the year. Surface transparency varied throughout the year (Figure 3-24). Stations 1, 2, 3 and 12 at the Harbor entrance showed a decline in transparency in October likely associated with the first rain of the season. Transparency at most stations increased in December and January and fell again in the spring when warmer temperatures increased plankton production. Stations 1 and 12 in Ballona Creek and Harbor entrance area experienced the widest fluctuation in surface transparency with drops in clarity occurring in October and March. Station 25 showed a marked decrease in May.

Spatial surface transparency patterns. Surface transparency values averaged over the year are depicted in Figure 3-25. Despite the high variability seen over the survey year, the highest average annual values occurred at Ballona Creek (Station 12 – 2.5m), the Harbor entrance (Stations 1, 2 and 3 – 3.3m, 3.1m and 2.8m, respectively) and the main channel (Stations 4, 5 and 25 – 2.8m, 2.5m and 2.9m, respectively). Station 6 in Basin B also had a higher clarity (2.9m). Lowest averages were in Basin E (Stations 10 and 20 – 1.8m and 1.9m, respectively) and Basin F (Station 9 - 2.0m). Values for other stations ranged from 2.2m to 2.4m.

Surface transparency ranges compared with past years. 2001-2002 surface transparency values (Table 3-9) were within the overall seasonal ranges for the preceding eight years except in the fall where the minimum value was 0.2m (range: 0.4 – 6.5m). During 2001-2002, transparency values in the fall tended to be higher than those of the remaining three seasons.

GURE 3-22. MINIMUM, AVERAGE, AND MAXIMUM TRANSMISSANCE (%) VS.MONTH AT 15 WATER COLUMN STATIONS

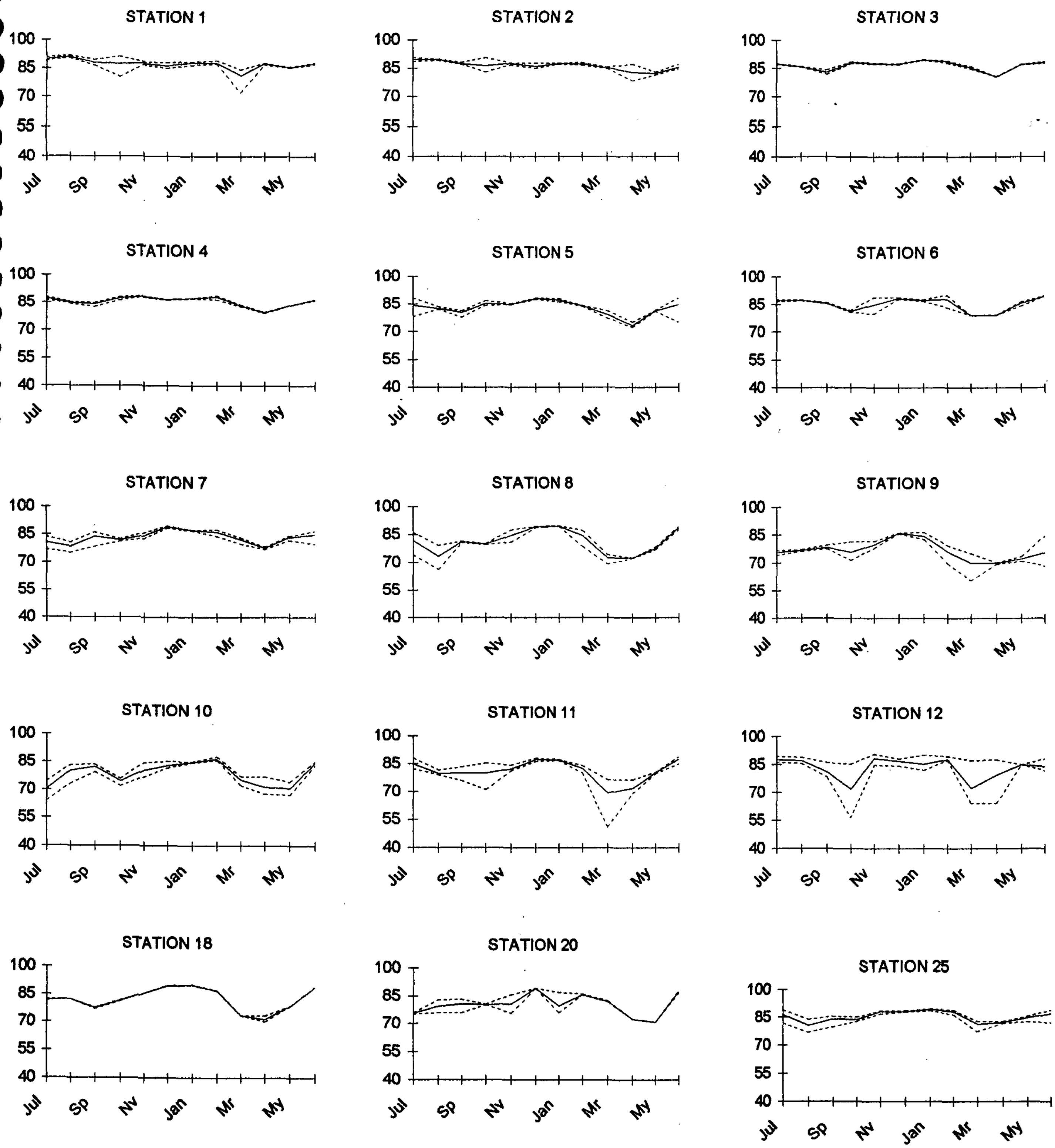


FIGURE 3-23. AVERAGE ANNUAL LIGHT TRANSMISSANCE (%) AT 15 WATER COLUMN STATIONS.

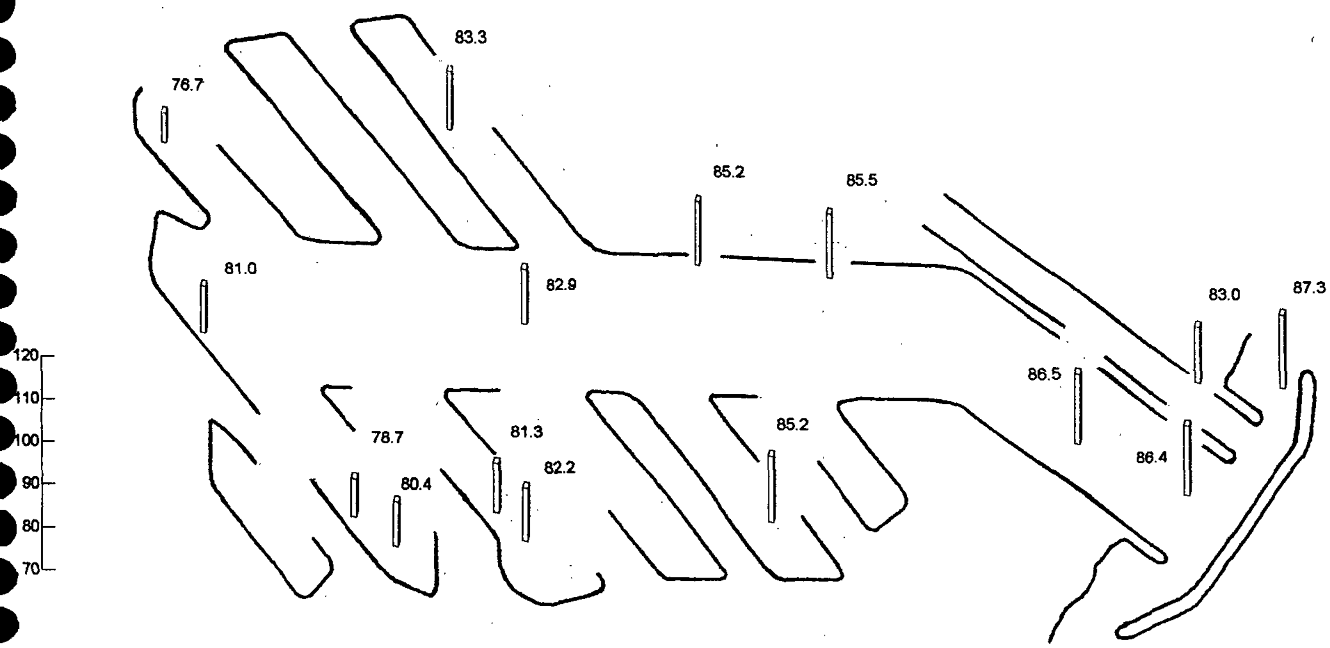


TABLE 3-8. SEASONAL LIGHT TRANSMISSANCE RANGES (%) FOR ALL DEPTHS AND STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1.]	20 - 90	50 - 98	46 - 89	62 - 94
1994-95	53 - 96	5 - 93	41 - 88	41 - 88
1995-96	38 - 93	4 - 93	15 - 84	43 - 81
1996-97	71.4 - 93.3	57.2 - 92.0	33.8 - 89.8	74.9 - 93.8
1997-98	46.4 - 91.9	50.6 - 94.1	69.4 - 90.2	38.8 - 94.3
1998-99	74.5 - 94.7	54.7 - 94.4	62.3 - 93.1	65.2 - 92.1
1999-00	67.5 - 94.0	72.3 - 93.3	48.1 - 92.7	67.4 - 90.6
2000-01	67.4 - 92.2	51.9 - 90.6	62.5 - 95.7	63.9 - 91.8
Overall range	**20 - 96**	**4 - 98**	**15 - 95.7**	**41 - 94.3**
2001-02[2.]	56.4 - 91.5	69.8 - 90.2	51.0 - 87.8	68.4 - 89.8

1. Two months only in winter and summer. One month in fall.

2. One month only in the summer. No July data reported for Station 22.

FIGURE 3-24. AVERAGE SURFACE TRANSPARENCY (M) VS.MONTH AT 15 WATER COLUMN STATIONS

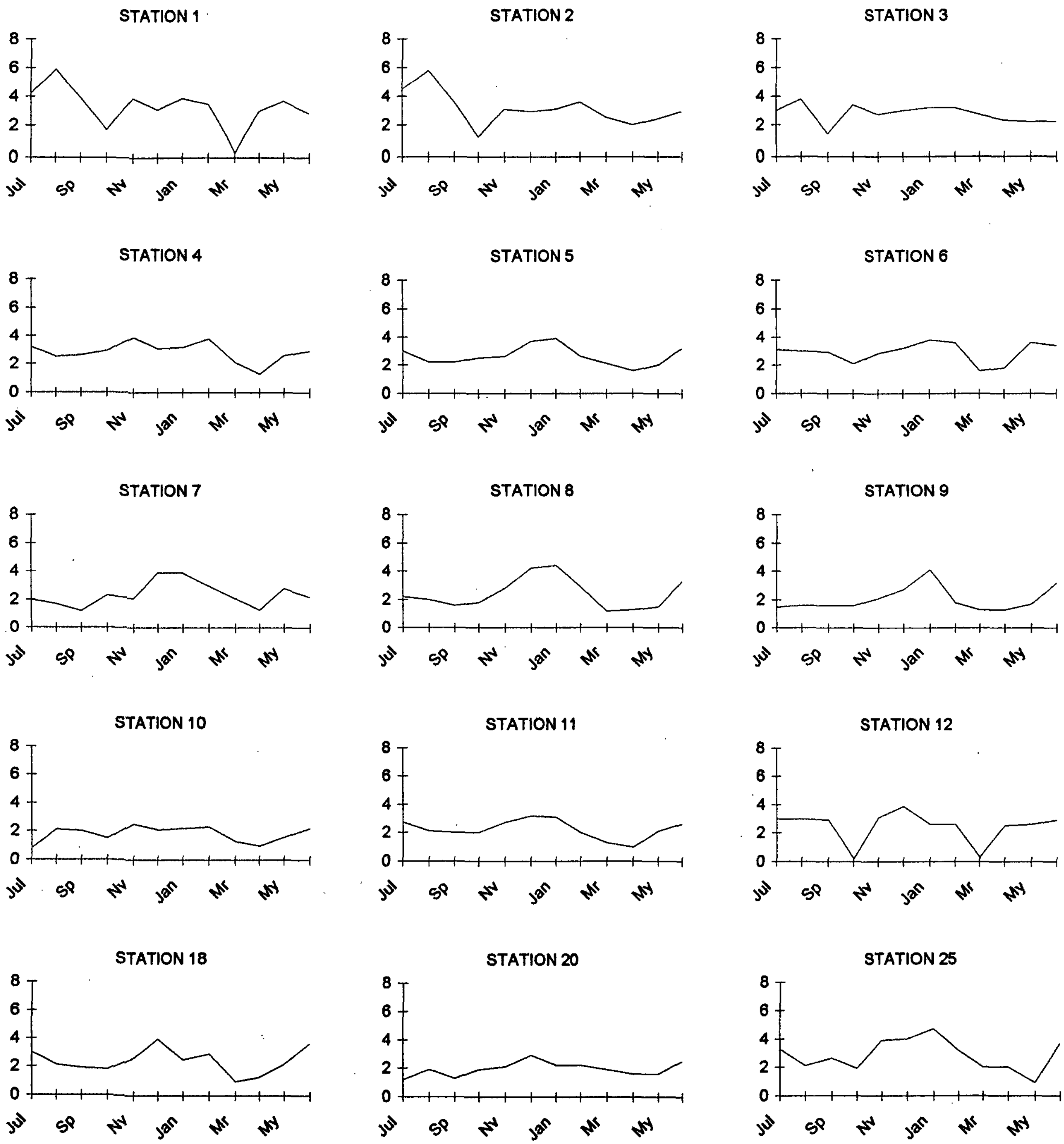


FIGURE 3-25. AVERAGE ANNUAL SURFACE TRANSPARENCY (M) AT 15 WATER COLUMN STATIONS.

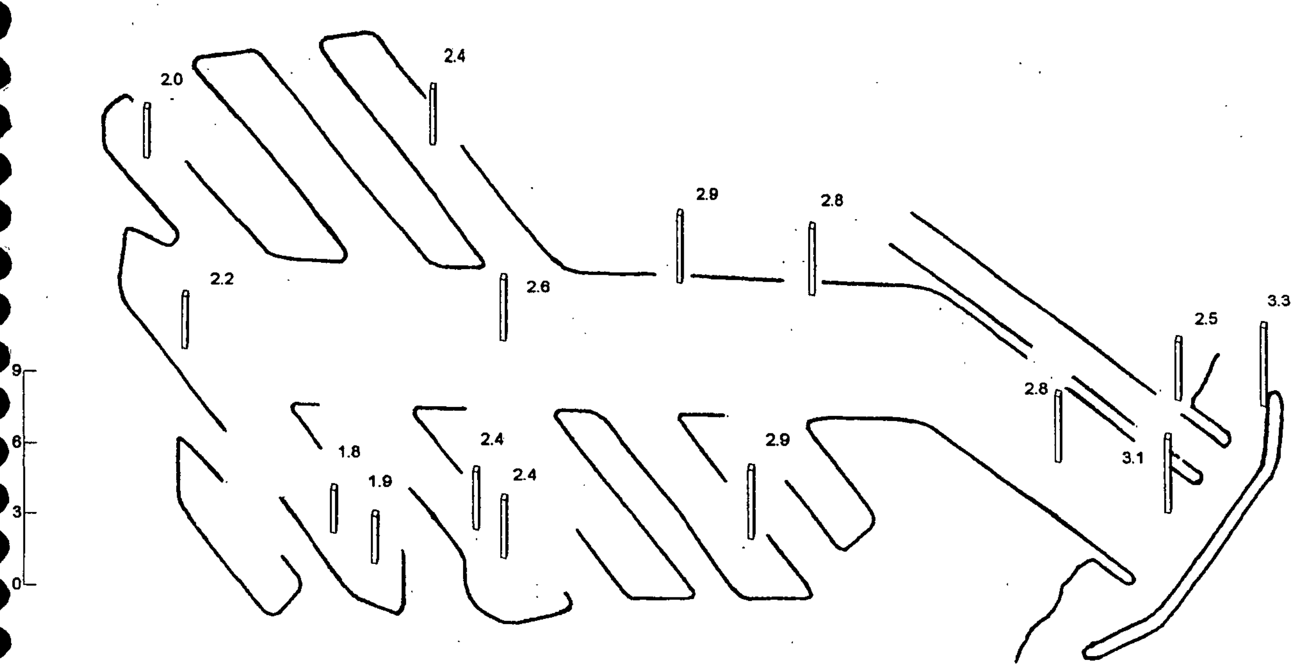


TABLE 3-9. SEASONAL SURFACE TRANSPARENCY RANGES (M) FOR ALL STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1]	1.5 - 4.5	2.0 - 7.0	1.0 - 4.0	1.5 - 4.5
1994-95	1.5 - 6.0	0.2 - 5.0	0.9 - 4.0	1.0 - 4.0
1995-96	1.5 - 6.5	0.1 - 3.5	0.3 - 4.4	1.3 - 2.0
1996-97	1.5 - 5.8	1.6 - 5.5	0.7 - 4.2	1.3 - 5.6
1997-98	0.4 - 4.3	0.9 - 5.8	1.8 - 4.5	1.4 - 5.6
1998-99	1.3 - 5.9	1.2 - 4.9	1.3 - 3.9	1.6 - 4.0
1999-00	1.5 - 4.2	2.0 - 4.5	0.4 - 3.9	1.9 - 4.1
2000-01	1.5 - 6.5	0.4 - 4.1	0.0 - 3.6	0.8 - 5.9
Overall range	**0.4 - 6.5**	**0.1 - 7.0**	**0.3 - 4.5**	**0.8 - 5.9**
2001-02[2]	0.2 - 3.9	1.8 - 4.7	0.3 - 3.7	2.2 - 3.7

[1] Two months only in winter and summer. One month in fall.

[2] One month only in the summer. No July data reported for Station 22.

3.3.9. Color

Water color is influenced by a number of physical, chemical and biological factors. Color is determined both by light scattering from particulates in the water and the true color of particles present. Pure, fresh water appears to be black in color as no light is scattered (reflected) back to the observer. Pure seawater has a blue color due to light scattering from salt molecules from the short wavelengths at the blue end of the light spectrum. Increased phytoplankton concentrations cause the water to appear blue green to green since more light scatters at longer wavelengths. If phytoplankton numbers get very high as in a "bloom", the water may take on the color of the particular algal species. A green algae bloom might color the water green or yellow-green to yellow-brown with a diatom bloom. Red tides, caused by a bloom of dinoflagellates, may be red to brown in color. Increased sediment load due to runoff or the mixing of bottom sediments into the water column may turn the water color to a brown or brown-black color (Soule 1997). Rainfall also affects water color indirectly by providing nutrients to fuel phytoplankton blooms.

The Forel-Ule (FU) scale involves comparing a series of small vials filled with various shades of colored liquid mimicking those typically observed for marine waters to the seawater viewed above the white Secchi disk suspended beneath the water surface. Numbers 1-3 represent deep-sea blues, the clearest of oceanic waters. Number increase to the blue-greens (4-6), greens (7-9), yellow-greens (10-12), yellow-green-browns (13-15), yellow-browns (16-18), and brown-reds (19-20). It is not appropriate to use the FU scale in the shallow, muddy waters of Oxford Basin. Color estimates using the Forel-Ule scale are very subjective, the same person should perform the observations in all surveys. With this proviso, color estimates provide a good indication of events occurring in marine waters (Soule 1997).

Color patterns over the year. Most stations had Forel-Ule values between 6 and 14 (green to yellow-green-brown, Figure 3-26). The highest variation in Forel-Ule values occurred at Stations 1, 2, 3, and 12 all located at the mouth of the Harbor and influenced by Ballona Creek. A brown coloration of the water was noted in October at Station 12 which may account for the high readings in that month.

Spatial color patterns. Forel-Ule values averaged over the year are depicted in Figure 3-27. Averages were similar at all stations. The highest relative averages were in Basin E (Stations 10 and 20 - 10.3 units each). Other stations with relatively high values were located at the back harbor (Station 11 - 10.2 units) and in Basins B (Station 6), D (Station 8) and F (Station 9) and were all 10.0 units. All other stations were relatively moderate in Forel-Ule values (9.3 to 9.8 units).

Color ranges compared with past years. All 2001-2002 surface transparency values were within the overall seasonal ranges for the preceding eight years (Table 3-10). When compared to 2000-01, values tended to be lower.

3.3.10. Total Coliforms

Coliform bacteria (those inhabiting the colon) have been used for many years as indicators of fecal contamination; they were initially thought to be harmless indicators of pathogens at a time when waterborne diseases such as typhoid fever, dysentery and cholera were severe problems. Recently it was recognized that coliforms themselves might cause infections and diarrhea. However, the total coliform test is not effective in identifying

FIGURE 3-26. AVERAGE FOREL-ULE COLOR (UNITS) VS. MONTH AT 15 WATER COLUMN STATIONS

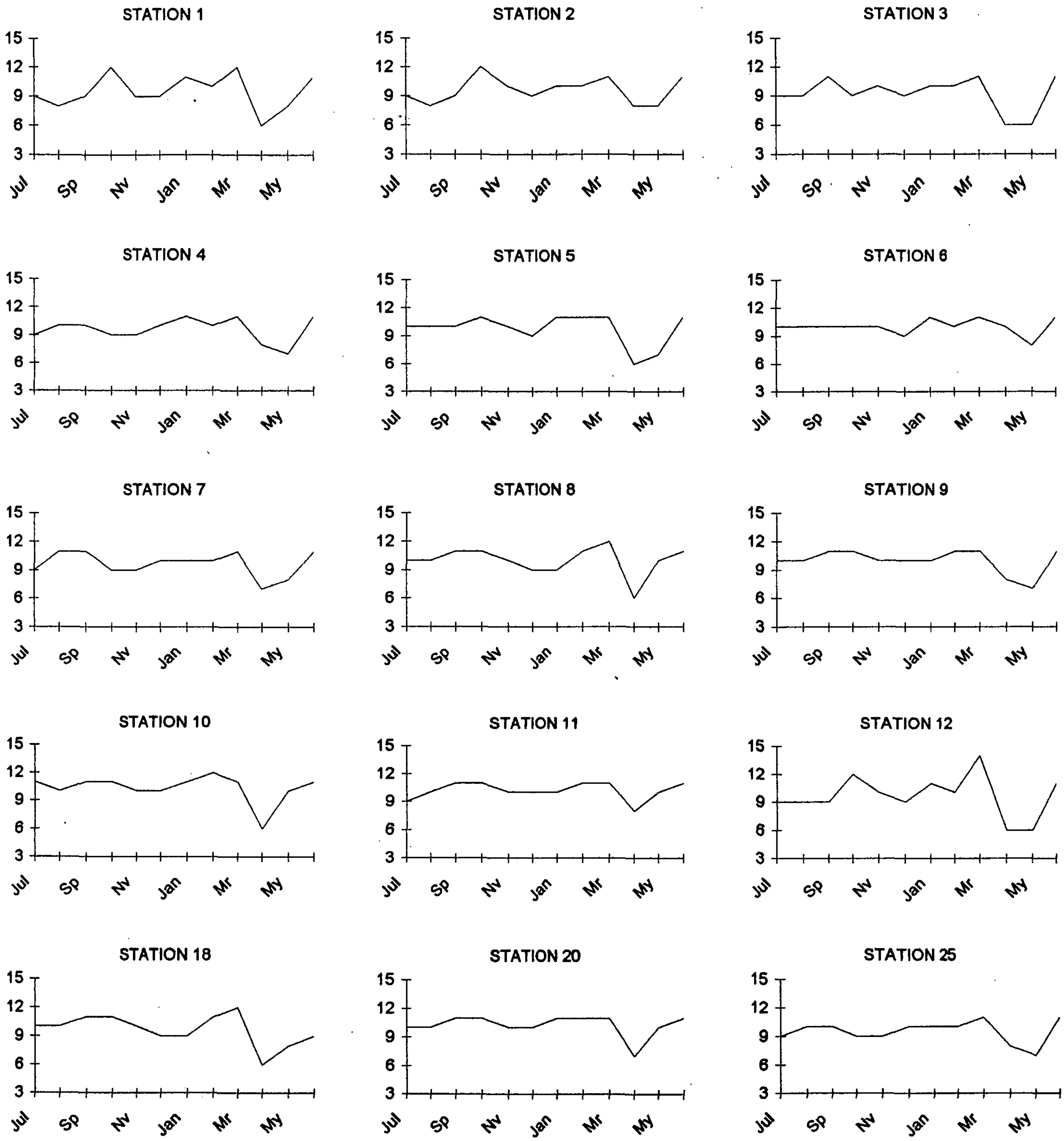


FIGURE 3-27. AVERAGE ANNUAL FOREL-ULE COLOR AT 15 WATER COLUMN STATIONS.

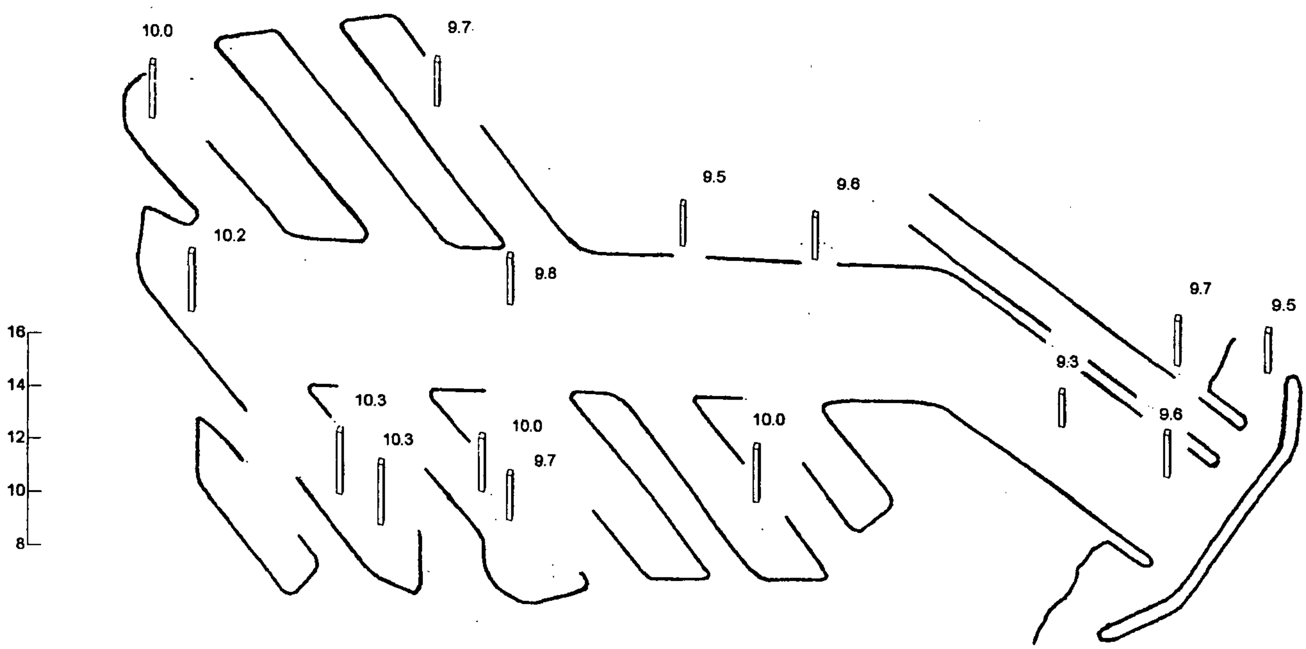


TABLE 3-10. SEASONAL FOREL-ULE COLOR RANGES FOR ALL STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1.]	7 - 14	5 - 12	6 - 17	4 - 14
1994-95	4 - 14	4 - 17	5 - 17	4 - 14
1995-96	4 - 14	10 - 18	8 - 17	12 - 14
1996-97	9 - 12	9 - 12	10 - 17	10 - 17
1997-98	7 - 14	7 - 17	10 - 16	7 - 16
1998-99	8 - 16	9 - 16	10 - 15	10 - 15
1999-00	9 - 14	9 - 16	10 - 16	9 - 12
2000-01	11 - 12	10 - 18	8 - 17	8.0 - 15
Overall range	**4 - 16**	**4 - 18**	**5 - 17**	**4 - 17**
2001-02[2.]	9.0 - 12.0	9.0 - 12.0	6.0 - 14.0	9.0 - 11.0

1. Two months only in winter and summer. One month in fall.

2. One month only in the summer. No July data reported for Station 22.

human contamination because these bacteria may also occur as free living in soils, and are present in most vertebrate fecal material. Federal EPA, State and County public health standards for total coliform counts in recreational waters are that no single sample, when verified by a sample repeated in 48 hours, shall exceed 10,000 most probable number (MPN) per 100 ml. The program is limited to one sample per station per month, so 10,000 MPN/100 ml has been used as the relevant standard. Regulations state that if sampling were done on a daily basis, however, no more than 20 percent of the samples in a 30-day period could exceed 1,000 MPN/100 ml, and no single sample could exceed 10,000 MPN/100 ml. This is not normally done unless some persistent problem is identified (Soule et. al. 1996, 1997).

Total coliform patterns over the year. Total coliform counts ranged from <20 to ≥16,000 MPN/100 ml during the year (Figure 3-28). Out of 214 measurements over the year, counts exceeded public health standards (greater than 10,000 MPN/100 ml) 33 times (Table 3-14). Almost all of these were at stations associated with either Oxford Lagoon, including Basin E (Stations 13, 20, and 22) or Ballona Creek (Stations 1, 2 and 12). Mid channel stations 4, 5 and 25 were also exceeded public health criteria several times over the survey year. Bathing standard limits were exceeded most often in October (11 stations). The 0.04 inches of rainfall in October do not fully explain these high counts. During the rest of the year, total coliform exceedances ranged from zero to six stations per month. No samples were taken at Station 22 in July, 2001 and Station 25 in March, 2002.

Spatial total coliform patterns. Total coliform values averaged over the year are depicted in Figure 3-29. Oxford Lagoon had some of the highest averages (Stations 13 and 22 - 2622 and 5158 MPN/100 ml) as did Ballona Creek (Stations 1 and 12 - 1451 and 5415 MPN/100 ml), and Basin E (Stations 10 and 20 - 2450 and 1338 MPN/100 ml). The remainder of the Harbor averaged much lower (83 to 308 MPN/100 ml).

Total coliform ranges compared with past years. Numbers of total coliform exceedances for 2001-2002 (Table 3-11) exceeded the overall range from past years in the fall (15 violations). In all other seasons, the number of public health standard exceedances was within the average range of the past eight years

3.3.11. Fecal Coliforms

The fecal coliform test discriminates primarily between soil bacteria and those in human wastes, warm-blooded animals such as dogs, cats, birds, horses and barnyard animals, and some cold-blooded fish. Standards for fecal coliform provide that a minimum of not less than five samples in a 30-day period shall not exceed a geometric mean of 200 MPN/100 ml, nor shall more than 10 percent of the total samples during a 60-day period exceed 400 MPN/100 ml. 400 MPN has been historically used as the standard for single fecal coliform violations (Soule et. al. 1996, 1997).

Fecal coliform patterns over the year. Fecal coliform counts ranged from <20 to ≥16,000 MPN/100 ml (Figure 3-30). Out of 214 measurements over the year, counts exceeded public health standards (greater than 400 MPN/100 ml) 60 times (Table 3-14). Over half (43) of these were at stations associated with either Oxford Lagoon, including Basin E (Stations 10, 13, 20, and 22), or Ballona Creek (Stations 1 and 12). The exceptions were exceedances at Stations 2, 3, 4, 5 and 11 in the front harbor, mid channel and back channel, Station 6 in Basin B and Stations 18 and 19 in Basin D. Violations occurred most often in October (10 stations) followed by February, March and May (9 times each). Peak rainfall was within these months and the intermittent nature of storms may have

FIGURE 3-28. TOTAL COLIFORM (MPN/100 ML) VS. MONTH AT 18 WATER COLUMN STATIONS.

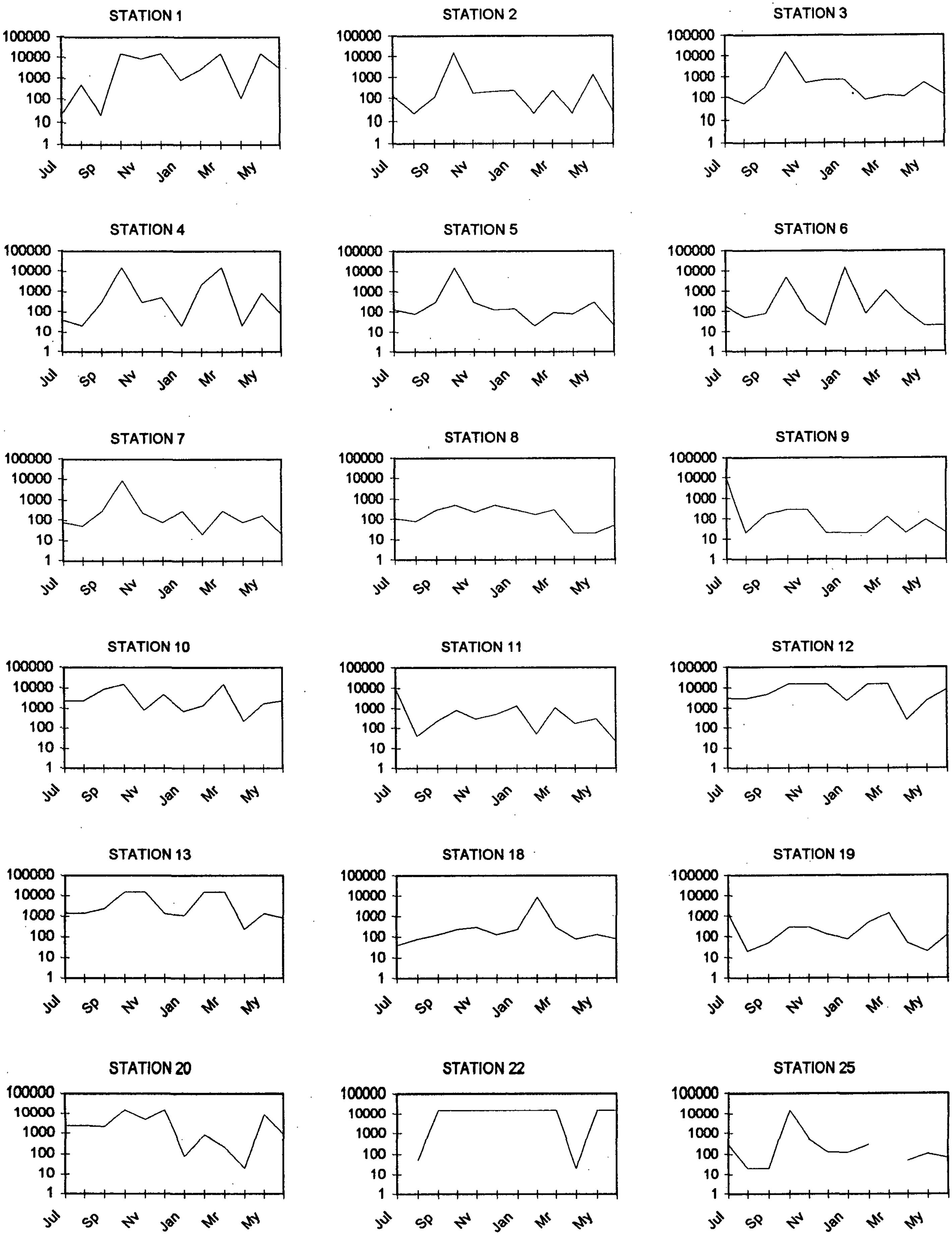


FIGURE 3-29. GEOMETRIC MEANS OF TOT. COLIFORM (MPN/100 ML) AT 18 WATER COLUMN STATIONS.

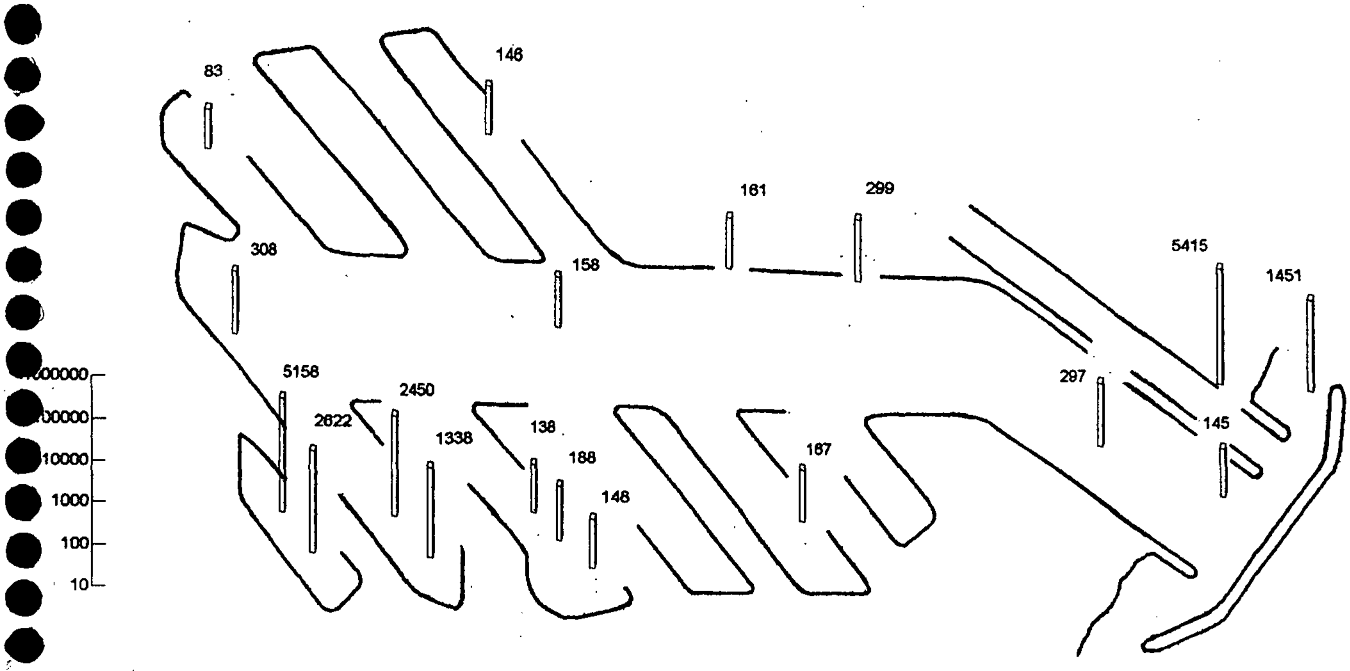


TABLE 3-11. FREQUENCY OF TOTAL COLIFORM VIOLATIONS (>10,000 MPN/100 ML) FOR ALL STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1]	-----	6	4	0
1994-95	0	1	1	3
1995-96	2	6	5	0
1996-97	2	5	4	8
1997-98	5	8	3	7
1998-99	5	5	8	7
1999-00	7	9	5	3
2000-01	4	10	3	1
Overall range	**0 - 7**	**1 - 10**	**1 - 8**	**0 - 8**
2001-02[2]	15	9	8	1

[1] Two months only in winter and summer. One month in fall.

[2] One month only in the summer. No July data reported for Station 22. No data reported for Station 25 in March.

FIGURE 3-30. FECAL COLIFORM (MPN/100 ML) VS. MONTH AT 18 WATER COLUMN STATIONS.

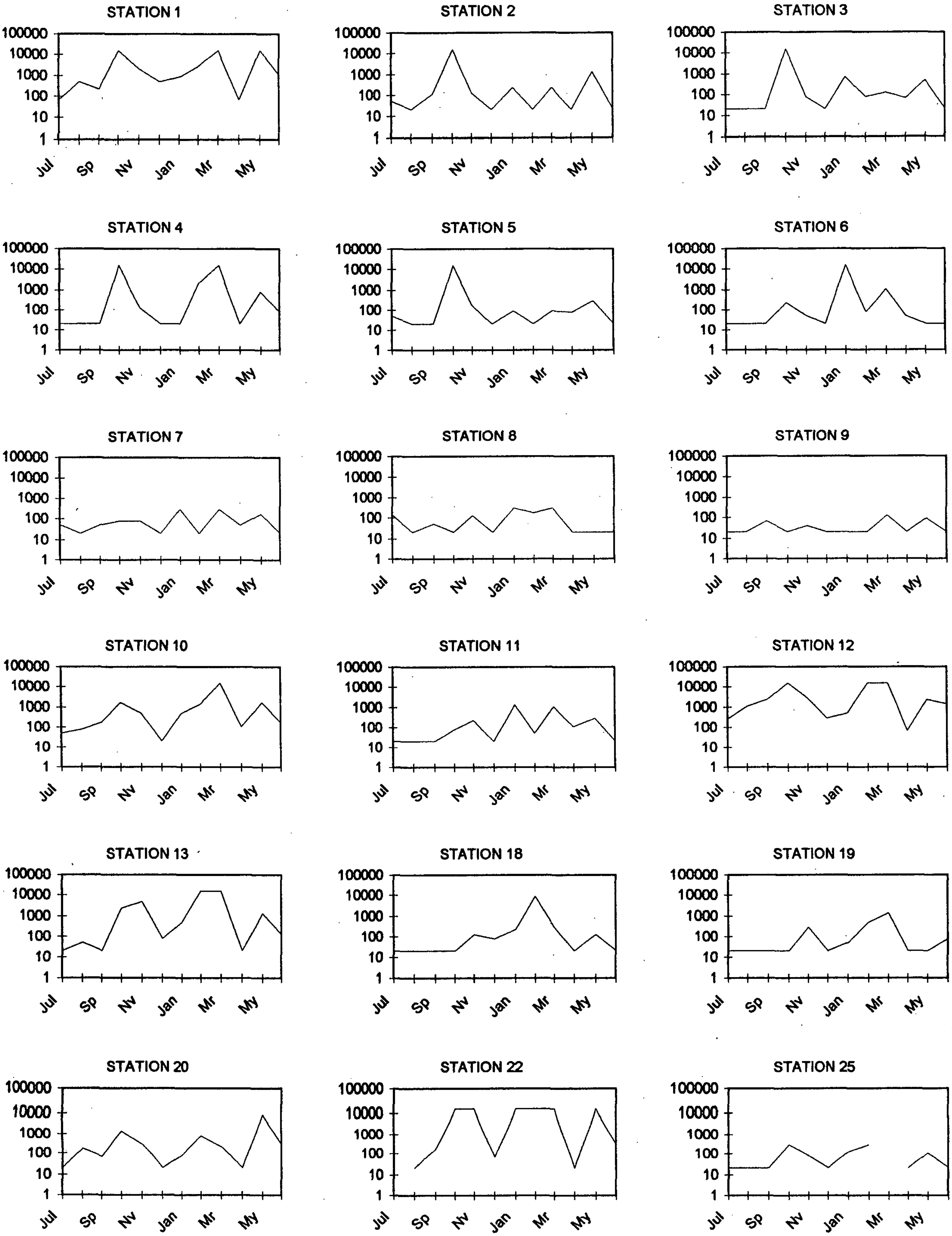


FIGURE 3-31. GEOMETRIC MEANS OF FEC. COLIFORM (MPN/100 ML) AT 18 WATER COLUMN STATIONS.

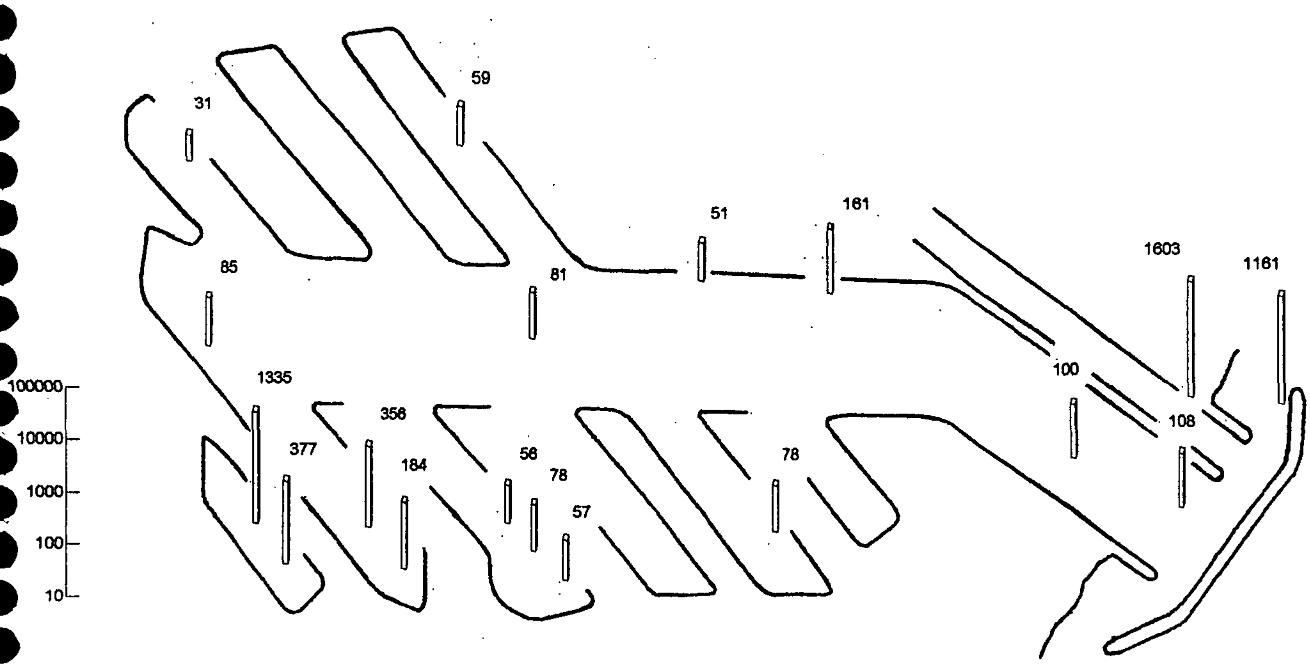


TABLE 3-12. FREQUENCY OF FECAL COLIFORM VIOLATIONS (>400 MPN/100 ML) FOR ALL STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1]	-----	6	9	9
1994-95	2	27	5	2
1995-96	5	18	6	2
1996-97	5	6	3	6
1997-98	18	23	3	7
1998-99	6	12	11	10
1999-00	9	9	9	7
2000-01	5	6	6	0
Overall range	**2 - 18**	**6 - 27**	**3 - 11**	**0 - 10**
2001-02[2]	17	18	18	5

[1] Two months only in winter and summer. One month in fall.

[2] One month only in the summer. No July data reported for Station 22. No data reported for Station 25 in March.

contributed to high counts by allowing the build up of pollutants in between rain events. Fecal coliform exceedances ranged from zero to eight stations per month. No samples were taken at Station 22 in July, 2001 and Station 25 in March, 2002.

Spatial fecal coliform patterns. Fecal coliform values averaged over the year are depicted in Figure 3-31. Highest averages were around Ballona Creek (Stations 1 and 12 - 1161 and 1603 MPN/100 ml, respectively), Oxford Lagoon (Stations 13 and 22 - 1335 and 377 MPN/100 ml) and Basin E (Station 10 - 356 MPN/100 ml). Averages at the remaining stations were considerably lower (31 to 184 MPN/100 ml).

Fecal coliform ranges compared with past years. The number of times fecal coliform counts exceeded public health standard in 2001-2002 was higher than the overall seasonal ranges for the preceding eight years in the spring and were nearly triple the number of exceedances seen in 2000-2001 (Table 3-12).

3.3.12. **Enterococcus**

Enterococcus bacteria comprise a portion of the Streptococcus bacteria. Once believed to be exclusive to humans, they are now found in feces of cows, horses, chickens and other birds. Enterococci die off rapidly in the environment, making them indicators of fresh contamination, but not exclusively from humans. The enterococcus standard used by the County has been the geometric mean of 35 colonies per 100 ml, or that no single sample shall exceed 104 Colonies/100 ml. The latter has been historically used. The State Water Resources Board Ocean Plan (1990, Amendments, 1995) limitations are a geometric mean of 24 Colonies/100 ml for a 30-day period. A survey to determine the source of the contamination is required if 12 colonies per 100 ml are exceeded for a six-week period (Soule et. al. 1996, 1997).

Enterococcus patterns over the year. Enterococcus counts ranged from <2 to ≥1600 Colonies/100 ml (Figure 3-32). Out of 214 measurements, counts exceeded County public health standards (greater than 104 Colonies/100 ml) 42 times (Table 3-14). Most of these (34) were at stations associated with Oxford Lagoon, including Basin E (Stations 10, 13, 20, and 22), or Ballona Creek (Stations 1 and 12). The exceptions were exceedances in October (Station 5 and 11 in mid channel and the back harbor), January (Station 2 - harbor mouth), February (Station 8 - Basin D), March (Station 19 - Mother's Beach) and June (Station 8 - Basin D and Station 19 - Mother's Beach). October and March saw frequent violations (7 times each) and June (6 times). Rainfall does not completely explain these exceedances. In all other months, counts above 104 colonies/100 ml ranged from zero to five per month. No samples were taken at Station 22 in July, 2001 and Station 25 in March, 2002.

Spatial enterococcus patterns. Enterococcus values averaged over the year are depicted in Figure 3-33. Similar to past years, highest averages were in Oxford Lagoon (Stations 13 and 22 - 111.0 and 184.1 Colonies/100 ml, respectively), Basin E (Stations 10 and 20 - 40.1 and 48.4 Colonies/100 ml), and near Ballona Creek (Stations 1 and 12 - 58.9 and 50.0 Colonies/100 ml). Remaining station counts averaged lower (4.7 to 18.2 Colonies/100 ml).

Enterococcus ranges compared with past years. The number of times enterococcus counts exceeded public health standards in 2001-2002 were within the overall seasonal ranges for the preceding eight years (Table 3-13) except for in the fall when the counts were higher (13). When compared to 2000-01, exceedances occurred more frequently in the spring and summer.

FIGURE 3-32. ENTEROCOCCUS (COL/100 ML) VS. MONTH AT 18 WATER COLUMN STATIONS.

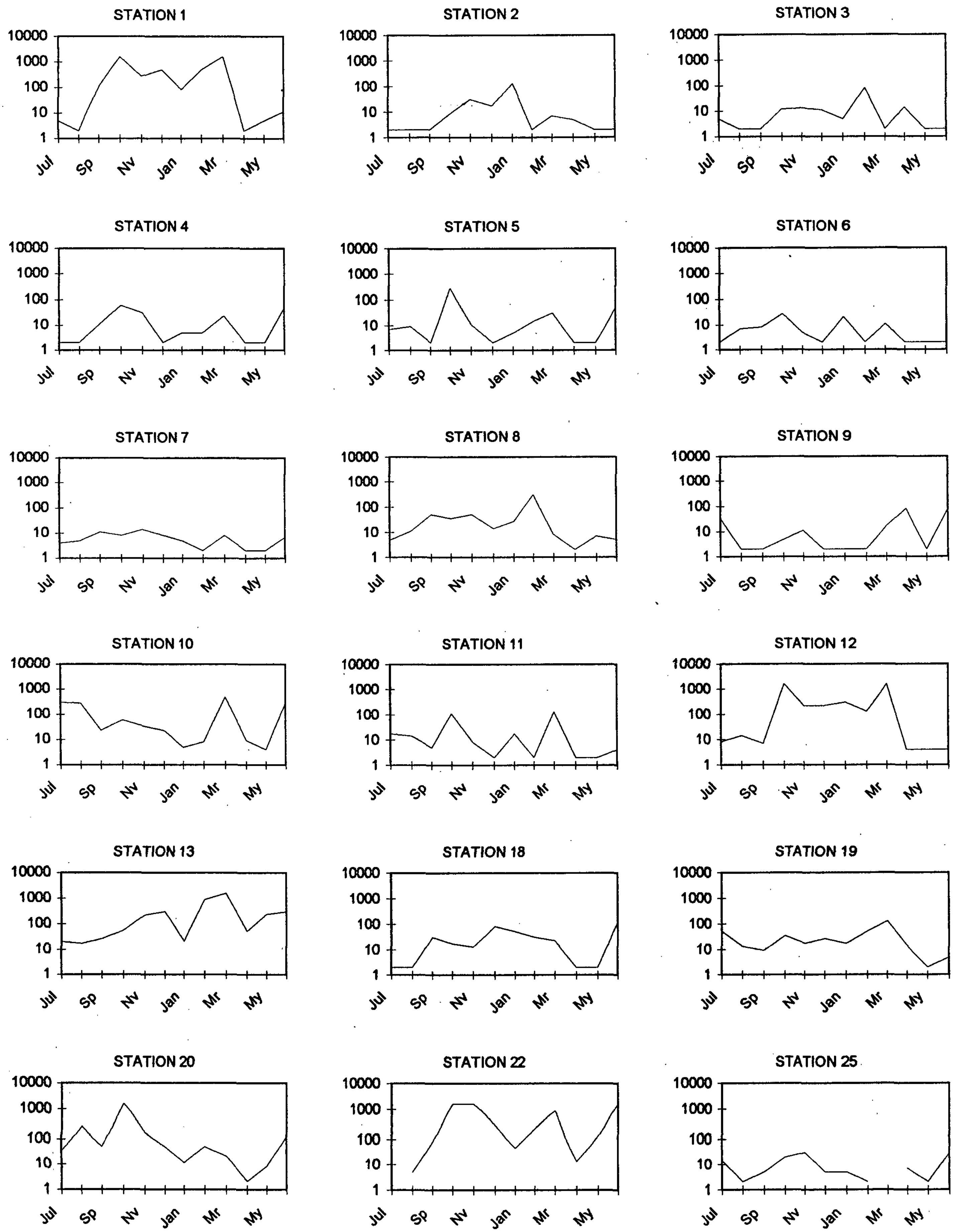


FIGURE 3-33. GEOMETRIC MEANS OF ENTEROCOCCUS (COL./100 ML) AT 18 WATER COLUMN STATIONS

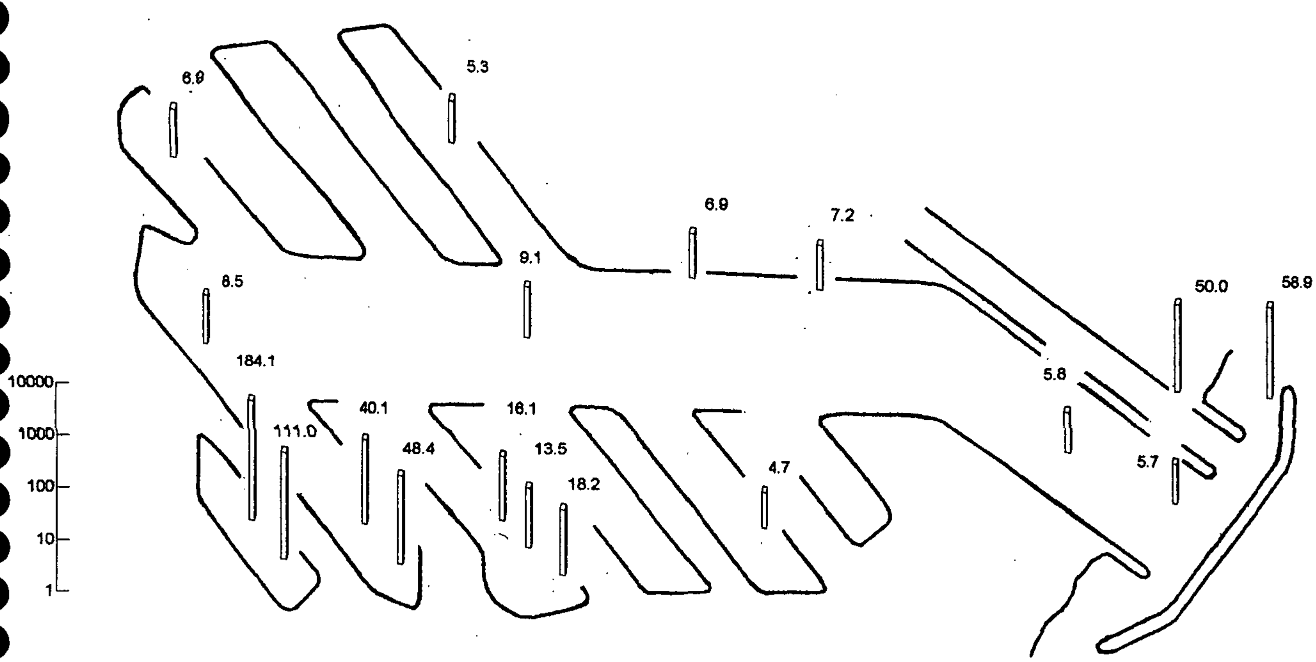


TABLE 3-13. FREQUENCY OF ENTEROCOCCUS VIOLATIONS (>104 MPN/100 ML) FOR ALL STATIONS.

Survey	Fall	Winter	Spring	Summer
1993-94[1]	-----	3	7	0
1994-95	0	0	0	2
1995-96	2	5	10	2
1996-97	2	8	1	1
1997-98	3	10	0	5
1998-99	10	14	9	3
1999-00	6	7	6	9
2000-00	18	12	7	0
Overall range	**0 - 10**	**0 - 35**	**0 - 10**	**0 - 9**
2001-02[2]	13	11	9	6

[1] Two months only in winter and summer. One month in fall.

[2] One month only in the summer. No July data reported for Station 22. No data reported for Station 25 in March.

TABLE 3-14. MONTHS AND LOCATIONS OF BACTERIAL VIOLATIONS.

TOTAL COLIFORM (>10,000 MPN/100 ML)

STATION	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	—	—	—	≥ 16,000	—	≥ 16,000	—	—	≥ 16,000	—	16,000	—
2	—	—	—	≥ 16,000	—	—	—	—	—	—	—	—
3	—	—	—	≥ 16,000	—	—	—	—	—	—	—	—
4	—	—	—	≥ 16,000	—	—	—	—	≥ 16,000	—	—	—
5	—	—	—	≥ 16,000	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	≥ 16,000	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	≥ 16,000	—	—	—	—	≥ 16,000	—	—	—
11	—	—	—	—	—	—	—	—	—	—	—	—
12	—	—	—	≥ 16,000	≥ 16,000	≥ 16,000	—	≥ 16,000	≥ 16,000	—	—	—
13	—	—	—	≥ 16,000	16,000	—	—	≥ 16,000	≥ 16,000	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	≥ 16,000	—	16,000	—	—	—	—	—	—
22	—	—	16,000	≥ 16,000	≥ 16,000	≥ 16,000	≥ 16,000	≥ 16,000	16,000	—	16,000	≥ 16,000
25	—	—	—	≥ 16,000	—	—	—	—	—	—	—	—

FECAL COLIFORM (>400 MPN/100 ML)

STATION	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	—	500	800	≥ 16,000	2,200	500	800	2,800	≥ 16,000	—	16,000	700
2	—	—	—	≥ 16,000	—	—	—	—	—	—	1,300	—
3	—	—	—	≥ 16,000	—	—	700	—	—	—	500	—
4	—	—	—	≥ 16,000	—	—	—	2,200	≥ 16,000	—	800	—
5	—	—	—	≥ 16,000	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	≥ 16,000	—	1,100	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	1,700	500	—	500	1,400	≥ 16,000	—	1,700	5,000
11	—	—	—	—	—	—	1,300	—	1,100	—	—	—
12	—	1100	2,400	≥ 16,000	2,800	—	500	≥ 16,000	≥ 16,000	—	2,400	—
13	—	—	—	2,400	5,000	—	500	≥ 16,000	≥ 16,000	—	1,300	700
18	—	—	—	—	—	—	—	9,000	—	—	—	—
19	—	—	—	—	—	—	—	500	1,400	—	—	—
20	—	—	—	1,400	—	—	—	800	—	—	9,000	5,000
22	—	—	—	≥ 16,000	16,000	—	≥ 16,000	≥ 16,000	16,000	—	16,000	≥ 16,000
25	—	—	—	—	—	—	—	—	—	—	—	—

ENTEROCOCCUS (>104 COLONIES/100 ML)

STATION	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	—	—	110	≥ 1,600	280	500	—	500	1,600	—	—	—
2	—	—	—	—	—	—	130	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	280	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	300	—	—	—	130
9	—	—	—	—	—	—	—	—	—	—	—	—
10	300	280	—	—	—	—	—	—	500	—	—	500
11	—	—	—	110	—	—	—	—	130	—	—	—
12	—	—	—	≥ 1,600	220	220	300	130	1,600	—	—	—
13	—	—	—	220	220	300	—	900	≥ 1,600	—	240	500
18	—	—	—	—	—	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	130	—	—	130
20	—	280	—	≥ 1,600	170	—	—	—	—	—	—	220
22	—	—	—	≥ 1,600	1,600	300	—	240	900	—	130	300
25	—	—	—	—	—	—	—	—	—	—	—	—

3.4 STATION GROUPINGS BASED ON WATER QUALITY

In addition to characterizing Marina del Rey Harbor based upon individual water quality parameters, we opted to group stations based upon all of the water quality variables together. The technique used was a simple clustering technique called the Bray-Curtis Similarity Index (Clifford and Stephenson 1975). With this method, each station was ranked highest to lowest for each of the above measurements (e.g. temperature, salinity, dissolved oxygen, etc.). Each station was then compared to every other station based on its ranks. Station pairs, which ranked similarly for all of the variables as a whole, tended to produce a high index value (near 1.0). Stations where rankings were dissimilar to each other produced a low index value (near 0.0). With this information, stations could be clustered based upon their similarity or dissimilarity to all of the water variables measured (Figure 3-34).

Stations 10, and 20. These stations are both located in Basin E. These stations tended to be turbid, warm; lower in dissolved oxygen and pH; and higher in all three types of bacteria. Contaminated freshwater from Oxford Lagoon clearly impacts these stations.

Stations 12, 13 and 22. One of these stations is in Ballona Creek and the others in Oxford Lagoon. Low salinity, dissolved oxygen and pH coincide with high bacteria counts, biochemical oxygen demand and an overall brownish color. Several incidents of red tide were noted at these stations which may account for the color. Freshwater from these stations are a major source of organics, nutrients and bacteria into the Harbor.

Stations 5, 8, 9, 11, 18 and 19. These stations are located in the mid and back Harbor, Basin D, Mother's Beach and Basin F in areas of low circulation and of limited exposure to tidal flushing. The water here tended to be turbid but moderate in all remaining measurements.

Stations 2, 3, 4, 6, and 25. These stations represent the front Harbor and mid channel plus Basin B. Water here tends to be more saline, cool, clear and high in pH and dissolved oxygen. Bacteria counts were low and other measurements were moderate. These stations are the most natural in the Harbor.

Station 7. This station sits in Basin H. Water is warm, saline and low in total coliforms and biochemical oxygen demand.

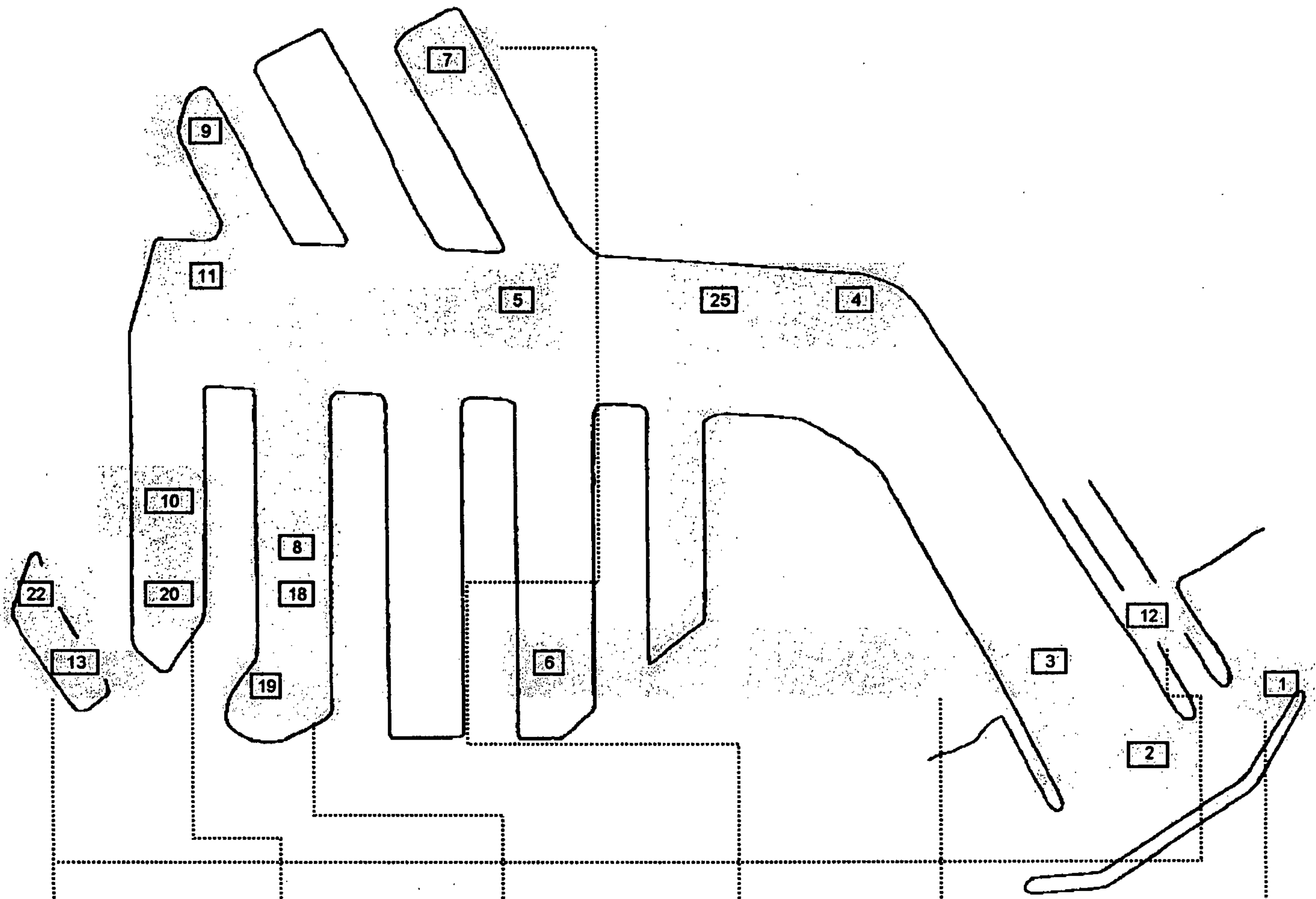
Station 1. This station is strongly influenced by both the flow from Ballona Creek and the tide from the open ocean. Ballona Creek influences bring the green-yellow water color and higher levels of BOD, ammonia and all bacteria. The open ocean brings clarity, cooler temperatures, high dissolved oxygen and pH.

3.5. DISCUSSION

As in past years, water quality in Marina del Rey Harbor was mostly impacted temporally by season and rainfall; and spatially impacted by proximity to Oxford Lagoon, Ballona Creek, and the Harbor entrance. Samples were not taken or not analyzed for water quality and bacteria at Station 22 in July, 2001 and bacteria counts were not assessed at Station 25 in March, 2002.

Weather during 2001-2002 was characterized by cooler water temperatures and low rainfall. When rainfall did occur, however, numerous physical and chemical properties of

FIGURE 3-34. WATER QUALITY CHARACTERISTICS BASED ON BRAY-CURTIS CLUSTERING TECHNIQUE.



	Stations 12, 13, 22	Station 20, 10	Stations 5, 8, 9, 11, 18, 19	Station 7	Stations 2, 3, 4, 6, 25	Station 1
Relatively High In:	Color Biochem. Oxygen Dem. Total Coliform Fecal Coliform Enterococcus	Temperature Total Coliform Fecal Coliform Enterococcus		Temperature Salinity	Salinity Dissolved Oxygen pH	Dissolved Oxygen pH Light Transmissance Color Surface Transparency Ammonia Biochem. Oxygen Dem. Total Coliform Fecal Coliform Enterococcus
Relatively Low In:	Salinity Dissolved Oxygen pH	Dissolved Oxygen pH Light Transmissance Surface Transparency Color	Light Transmissance Surface Transparency	Color Biochem. Oxygen Dem. Total Coliform	Temperature Total Coliform Fecal Coliform Enterococcus	Temperature
Characteristics:	Characteristic of Oxford Lagoon and Ballona Creek. Water is warmer, brownish, low in oxygen, pH and salinity. A major source of of organics, nutrients and bacteria into the Harbor.	Influenced by Oxford Lagoon. Water is warm, cloudy and high in bacteria. Dissolved oxygen is decreased.	Fairly typical of back-harbor areas. Water is moderate in most quality evaluations but cloudy.	Water is clear, warm and saline. Oxygen demand and bacteria counts are low.	Typical of entrance and mid-channel water quality. Water is cool saline, high in oxygen and pH. Bacteria counts are low compared to other areas less exposed to oceanic waters.	Appears that Ballona Creek influenced water quality at this station. Water is cold, high in oxygen, pH, ammonia and oxygen demand. Water looks yellow-green and is high in bacteria counts.

the water column were affected. The majority of rain fell between November and March which lowered water clarity, salinity, and pH; and increased ammonia and perhaps BOD. For all parameters, it should be noted that differences during the rainy seasons were very small. A mild red tide bloom was observed in July, 2001 and dark brown water discolorations were noted in October, 2001 and March 2002. Temperature alone in the Harbor was more strongly affected by seasonal oceanographic trends than rainfall with characteristically low values in the winter and higher measurements in the summer and early fall.

Spatially, Harbor waters were strongly affected by tidal flow from the open ocean and drainage from Ballona Creek and particularly Oxford Lagoon. Both Ballona Creek and fresh tidal ocean water impact stations immediately adjacent to the entrance. Stations in the main channel, however, appeared to be mostly influenced by open ocean waters and were typically the most natural in the Harbor. Stations further from the entrance do not generally mix as well as channel stations; therefore, they are usually warmer and more saline, and lower in oxygen and pH. Station 7 in Basin H experienced elevations in temperature and salinity and also had low BOD and bacteria counts. Remaining channel and basin stations were clear and moderate in all other characteristics.

Station 19 near Mother's Beach had moderate to low bacterial counts again this year. Stations 13, 22 and 12 in Oxford Lagoon and Ballona Creek, respectively, shared similar characteristics; reduced salinity, dissolved oxygen, and pH; and higher levels of BOD and bacteria counts and were generally yellow green to brown in color. The open ocean overshadowed the Ballona Creek effect at Stations 2, 3, 4, 6 and 25 this year, waters were cool, moderately saline, well oxygenated and clear but they were still high in bacteria, ammonia, BOD and nutrients as well as yellow to brown in color. Station 1 showed the greatest influence from Ballona Creek with high bacteria counts, BOD and ammonia but good oxygenation, clarity and low temperature. Stations 10 and 20 in Basin E showed similar characteristics as Oxford Lagoon and were warm, turbid and low in oxygen.

Among 648 bacterial measurements, 135 exceeded standard water quality limitations, almost twice the number of violations last year. Among these, 109 (81%) could be attributable to drainage from either Ballona Creek or Oxford Lagoon. As we have stated in previous reports, the flows from these two areas directly impact the Harbor entrance, Basin E, and the upper end of the main channel. Half of the stations sampled during these surveys lie in these areas. Spatially, every variable we measured was influenced by these two sources of water, and their negative influence upon the water quality in the Marina overshadows all other impacts.

4. PHYSICAL CHARACTERISTICS OF BENTHIC SEDIMENTS

4.1. BACKGROUND

The benthos (bottom) of the marina is mostly composed of fine and very fine sediments, due in part to the historic nature of the Ballona wetlands that formed a large estuarine depositional area, and to the continuing influx and deposition of fine grained sediments carried into the marina through storm drains and tidal flux. During dry periods, the marina is a very low energy environment. Heavy rainfall and swiftly moving waters transport heavier, coarse materials to sea whereas fine grained sediments may be carried farther out into Santa Monica Bay in a plume. In dry weather, fine particles settle out in the low energy basins and in the main channel where flows from the basins meet. In an isolated incident, extensive sediment build up in Basin E, adjacent to flow from Oxford Lagoon, broke up docks and moorings. Sediments beneath the floating docks were heavily contaminated, requiring landfill disposal. About 503 cubic yards of sediment were removed and the slips reconfigured for larger vessels during the summer of 1995. Since the breakwater was built in the 1960s, sand has accumulated at the mouth of Ballona Creek, along the inner side of the breakwater, around the ends of the jetties and along the northern jetty of the entrance channel, requiring periodic dredging. Unfortunately, high levels of lead and results of toxicity tests preclude ocean disposal or use of this material for beach replenishment. Sandbar deposits become barriers to flow and act as traps during dry weather/low energy periods, accumulating finer sediments behind them in the creek mouth and the entrance channel. Since the finer fractions of sediment complex or adsorb more metallic contaminants, the problems of disposal are exacerbated (Soule et.al. 1996).

Some sand accumulation occurs when winds from the northwest carry sand from the beach north of the entrance channel. Littoral drift in spring and summer bring sand south as well. Winter storms, with strong wave action from the south and southwest, often deposit large amounts of sand at the south entry. Current reversal can occur during the winter, associated with storms with counter-current flow, and El Nino events. Rainstorms can carry sediments through Ballona Creek which are deposited at the mouth when wind, wave and tidal action combine to slow the flow to a point where the sediment burden will largely be deposited there, or sediments may be carried seaward. Construction of the breakwater reduced the energy level of flow into and out of the marina, resulting in extensive deposition. Dredging especially disrupts the fish community that lives in and around the breakwater because of the particulates suspended in the water and changes in habitat. Disturbances to the benthic community are quickly overcome, with temporary species composition changes. In 1987, 131,000 cubic yards were dredged from the tips of the jetty and Ballona Creek mouth. In 1992, 17,000 cubic yards were taken from the south side of the entrance. The ends of the breakwall and the Ballona Creek mouth had 57,000 cubic yards excavated 1994. The Harbor entrances and the outside of the northern jetty had 203,000 cubic yards removed in 1996. In 1998, 300,000 cubic yards were dredged from the north entrance and in 1999-2000 – 530,000 cubic yards were removed from both entrances and the mouth of Ballona Creek. No dredge activity occurred during 2000-2001 surveys.

4.2. MATERIALS AND METHODS

Benthic grab sampling was conducted in accordance with *Techniques for Sampling and Analyzing the Marine Macrobenthos* March 1978, EPA 600/3-78-030; *Quality Assurance and Quality Control (QA/QC) for 301 (h) Monitoring Programs: Guidance on Field and Laboratory Methods* May 1986, Tetra Tech; and methods which have been developed by the Aquatic Bioassay Team over the past 26 years.

Samples were collected on October 9, 2002 with a chain-rigged, tenth square-meter Van Veen Grab. At each station, the grab was lowered rapidly through the water column until near bottom and slowly lowered until contact was made. The grab was then carefully raised until clear of the bottom. Once on board, the grab was drained of water and the sediment sample was gently removed and placed on a stainless steel screen, bottom side down. Initial qualitative observations of color, odor, consistency, etc. were recorded. Samples that were obviously smaller than others were rejected.

Sediments to be analyzed for physical properties were removed from the surface of the sample and placed in clean plastic jars. These were analyzed for particle size distribution in accordance with *Procedures for Handling and Chemical Analysis of Sediment and Water Samples*, R.H. Plumb, US EPA Contract 4805572010, May 1981. Sediment samples were dried and sorted through a series of screens. The sediments retained on each screen were weighed and the result recorded. These screen sizes represented granules through very fine sand. Sediments finer than 65 microns (i.e. course silts through clay) were sorted via the wet pipette method. Results were recorded as the percentages of the whole.

Data for each station were reduced to the median (middle) particle size (in microns) and the sorting index. The sorting index ranges between sediments which have a very narrow distribution (very well sorted) to those which have a very wide distribution (extremely poorly sorted). This index is simply calculated as the 84th percentile minus the 16th percentile divided by two (Gray 1981). Well sorted sediments are homogeneous and are typical of high wave and current activity (high energy areas), whereas poorly sorted sediments are heterogeneous and are typical of low wave and current activity (low energy areas).

Due to a project oversight, no particle size samples were analyzed for 2001. Generally since particle size does not change greatly over a one year period, we decided to assess if samples collected for the 2002 survey could be used. Median particle sizes from samples collected in 2000 were compared to those from the 2002 collection (Figure 4-1). A relative percent difference (RPD) was calculated to compare results. RPDs greater than 25%, a standard criteria, meant the difference between median particle sizes were quite different. Since the RPD values between 2000 and 2002 median particle size varied little, the results from the October, 2002 collection are reported here. Exceptions, such as Stations 6, 8, 13 and 22 are discussed in Section 4.3.

4.3. RESULTS

Figure 4-1 and Table 4-1 illustrate the overall particle size distributions from the fifteen sediment sampling stations. For both, results are presented for each size range as the percent of the whole. Two sediment characteristics can be inferred from the graphs. Position of the highest peak of the curve will tend to be associated with the median particle size. If the peak tends to be toward the larger micron sizes (e.g., Station 3), then it is probable that the sediments will tend to be coarser overall. If the peak is near the smaller

TABLE 4-1. PARTICLE SIZE DISTRIBUTIONS (PERCENTS) FROM 15 BENTHIC SEDIMENT STATIONS

	PARTICLE SIZE (MICRONS)																
	≥2000	1414	1000	707	500	354	250	176	125	88	63	31	16	8	4	2	≤2
STATION	granule	very course sand	very course sand	course sand	course sand	med sand	med sand	fine sand	fine sand	very fine sand	very fine sand	course silt	med silt	fine silt	very fine silt	clay	clay
1	0.1	0.0	0.1	0.2	0.3	0.8	0.8	3.9	17.5	26.9	16.1	22.0	6.8	0.9	1.1	1.9	0.8
2	0.1	0.1	0.2	0.4	0.6	1.1	1.8	3.9	17.3	33.0	15.0	10.9	6.6	2.5	0.5	2.0	3.9
3	0.7	0.4	0.6	1.8	17.0	57.8	13.5	3.7	0.7	0.3	0.1	0.6	0.2	0.2	0.2	0.2	2.0
4	0.2	0.2	0.5	0.8	1.1	2.8	2.4	8.3	25.2	32.2	9.8	3.0	2.3	1.7	1.0	5.0	3.6
5	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.9	1.3	7.0	22.6	19.6	15.2	8.7	24.1
6	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.6	1.8	3.8	5.9	4.9	9.3	12.9	15.7	14.7	30.3
7	0.0	0.0	0.0	0.0	0.1	0.1	0.3	1.2	5.8	13.4	15.5	18.0	16.4	6.4	6.9	4.5	11.4
8	0.5	0.4	0.6	1.4	1.7	3.1	1.7	3.0	8.9	11.9	6.7	1.3	8.9	13.4	5.8	9.4	21.4
9	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.5	0.9	5.1	12.0	18.9	16.9	12.3	32.8
10	0.0	0.1	0.4	0.6	1.0	1.3	1.7	1.7	1.8	1.6	1.8	4.1	8.5	12.8	14.9	13.1	34.7
11	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.3	0.3	2.0	17.7	24.3	14.9	9.2	31.0
12	0.7	1.1	3.4	10.1	19.6	21.7	11.9	4.2	2.8	6.2	8.0	3.5	2.4	1.2	0.5	0.2	2.6
13	8.1	2.7	2.9	2.9	3.5	6.3	3.6	5.7	7.7	7.4	6.1	14.6	7.8	5.1	2.9	4.2	8.7
22	3.6	1.0	1.3	1.8	3.2	6.5	3.1	6.0	9.2	8.5	6.1	10.3	12.2	3.9	6.3	5.1	11.7
25	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.3	0.7	1.7	2.1	12.1	21.5	14.6	13.2	5.2	27.8

TABLE 4-2. MEDIAN PARTICLE SIZES (MICRONS)[1] FROM 15 BENTHIC SEDIMENT STATIONS: MAY 1991 TO OCTOBER 2002.

	STATION														
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	22	25
May-91	80	<74	<74	<74	<74	80	<74	<74	<74	<74	<74	300	450	<74	<74
Oct-91	<74	<74	<74	<74	<74	<74	<74	<74	<74	<74	<74	<74	160	<74	<74
Oct-92	300	110	<74	<74	<74	90	<74	<74	<74	<74	<74	330	220	<74	<74
Apr-94	340	90	370	<74	<74	80	<74	100	<74	<74	<74	200	>700	470	<74
Sep-94	90	90	360	<74	<74	<74	<74	<74	<74	<74	<74	100	700	210	<74
Oct-95	360	100	290	<74	<74	80	<74	<74	<74	<74	<74	430	260	160	<74
Oct-96	141	91	20	36	11	75	32	70	4	3	5	428	126	82	16
Oct-97	139	109	23	23	18	44	42	6	4	3	5	402	632	63	9
Sep-98	167	97	320	23	16	5	27	23	5	10	5	361	207	356	15
Oct-99	121	104	381	53	17	16	32	6	4	11	3	83	113	370	14
Oct-00	112	105	444	99	10	68	31	9	4	5	6	354	288	46	10
Oct-02	89	97	419	114	8	5	37	16	5	4	6	393	92	64	10

1. 0-4 = clay, 4-8 = very fine silt, 8-16 = fine silt, 16-31 = medium silt, 31-63 = coarse silt, 63-125 = very fine sand, 125-250 = fine sand, 250-500 = medium sand, 500-1000 = coarse sand.

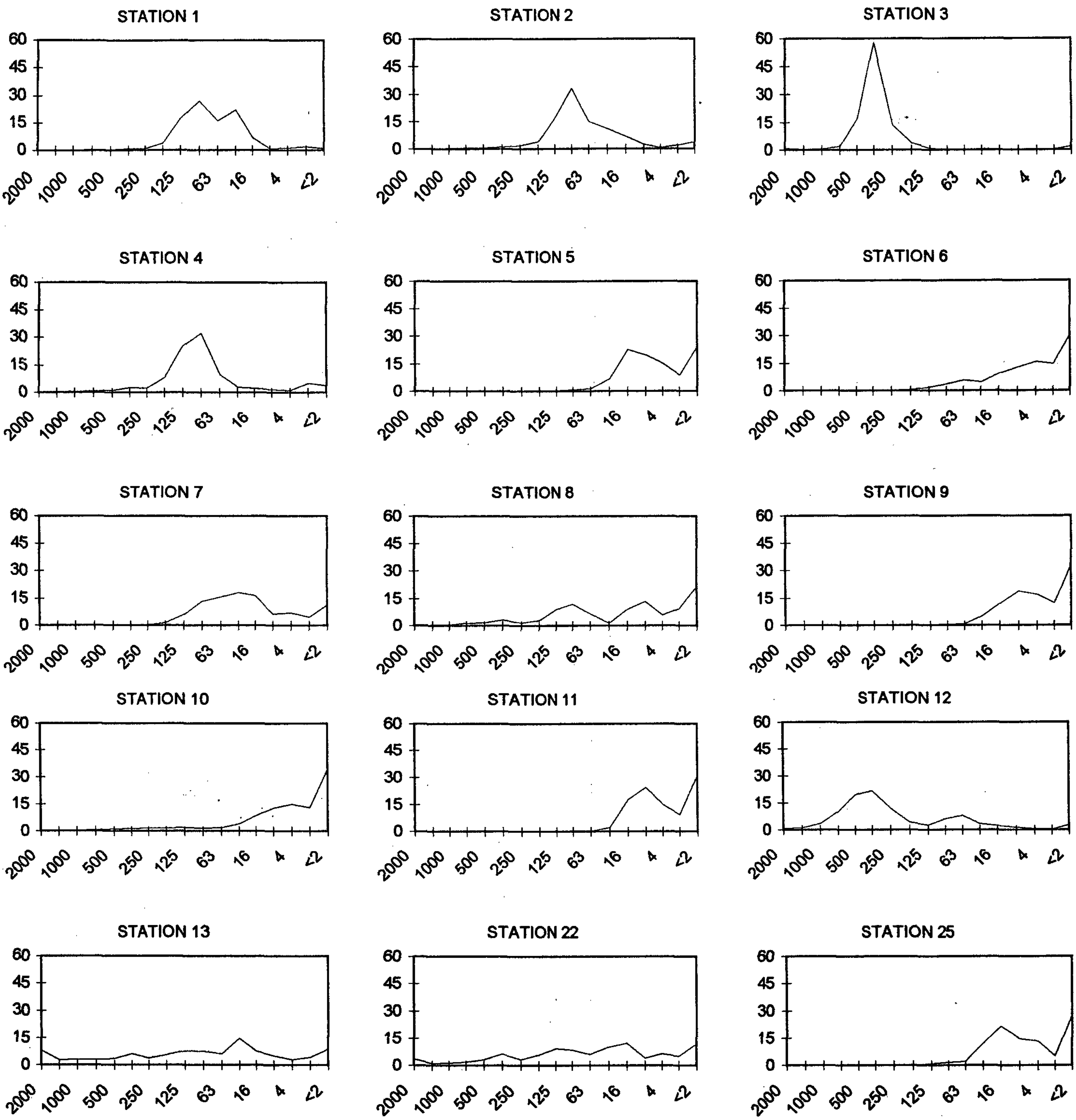
TABLE 4-3. SORTING INDEX VALUES[1] FROM 15 BENTHIC SEDIMENT STATIONS: OCTOBER 1997 TO OCTOBER 2002[2]

	STATION														
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	22	25
Oct-97	0.77	0.87	3.80	2.87	2.62	3.19	2.89	3.66	2.14	3.41	2.36	1.48	2.72	3.29	2.93
Sep-98	1.01	1.48	2.96	2.86	2.87	3.29	3.08	3.53	2.65	4.89	2.69	2.70	3.96	3.56	2.98
Oct-99	0.58	0.87	0.62	2.79	2.68	3.52	3.33	3.44	2.18	4.13	1.92	2.28	3.58	2.99	2.51
Oct-00	0.82	0.75	0.52	1.73	2.40	3.47	3.11	3.79	2.30	4.35	2.47	1.57	4.18	2.92	2.91
Oct-02	1.01	1.12	0.42	0.86	2.19	2.61	2.33	3.43	2.26	2.70	2.29	1.56	3.27	3.39	2.67

1. <0.35 = very well sorted, 0.35-0.50 = well sorted, 0.50-0.71 = moderately well sorted, 0.71-1.00 = moderately sorted, 1.0-2.0 = poorly sorted, 2.0-4.0 = very poorly sorted, >4.0 = extremely poorly sorted.

2. Unable to calculate sorting values from previous surveys because of fewer divisions.

FIGURE 4-1. PARTICLE SIZE (MICRONS) DISTRIBUTION (%) OF 15 BENTHIC SEDIMENT STATIONS.



micron sizes (Station 9), then it is probable that the sediments are mostly finer. Sediment medians, which range from 2000 to 63 microns, are defined as sand, sediments ranging from 63 to 4 are defined as silt, and sediments that are 4 or less are defined as clay (Wentworth Sediment Scale, see Gray 1981). Each category is also subdivided within the categories (e.g. coarse silt, very fine sand, etc., see Table 4-1).

The second pattern discernible from the graph is sediment homogeneity. Sediments, which tend to have a narrow range of sizes, are considered homogeneous or well sorted (Station 3). Others, which have a wide range of sizes (Station 13), are considered to be heterogeneous or poorly sorted. The graphs in Figure 4-1 indicate that sediments nearer the Harbor entrance (1, 2, 3, 4 and 12) tended to be relatively coarse and homogeneous in composition. One Station within Oxford Lagoon (Station 13) also tended to be coarse but was relatively heterogeneous in composition. Most other stations in the Harbor tended to be finer and relatively heterogeneous.

Relative percent differences (RPD) were calculated to compare 2000 particle size results to 2002 results and are presented in Table 4-4 and in Figure 4-1a. Only four stations had RPD higher than 25%, Station 6 in Basin B (173%), Station 8 in Basin D (56%), Stations 13 and 22 in Oxford Lagoon (103% and 33%, respectively). Particle size at Station 6 decreased from very fine sand to very fine silt, at Station 8 it increased from fine silt to medium silt and at Station 13, particle size decreased from medium sand to very fine sand. At Station 22, particle size increased slightly but remained in the same category; very fine sand. Sorting index values remained constant, at all stations except Station 22 with very poorly sorted sediments. Distribution at Station 22 declined from extremely poorly sorted to very poorly sorted.

Table 4-4. Relative Percent Difference (%) Between 2000 and 2002 Median Particle Size

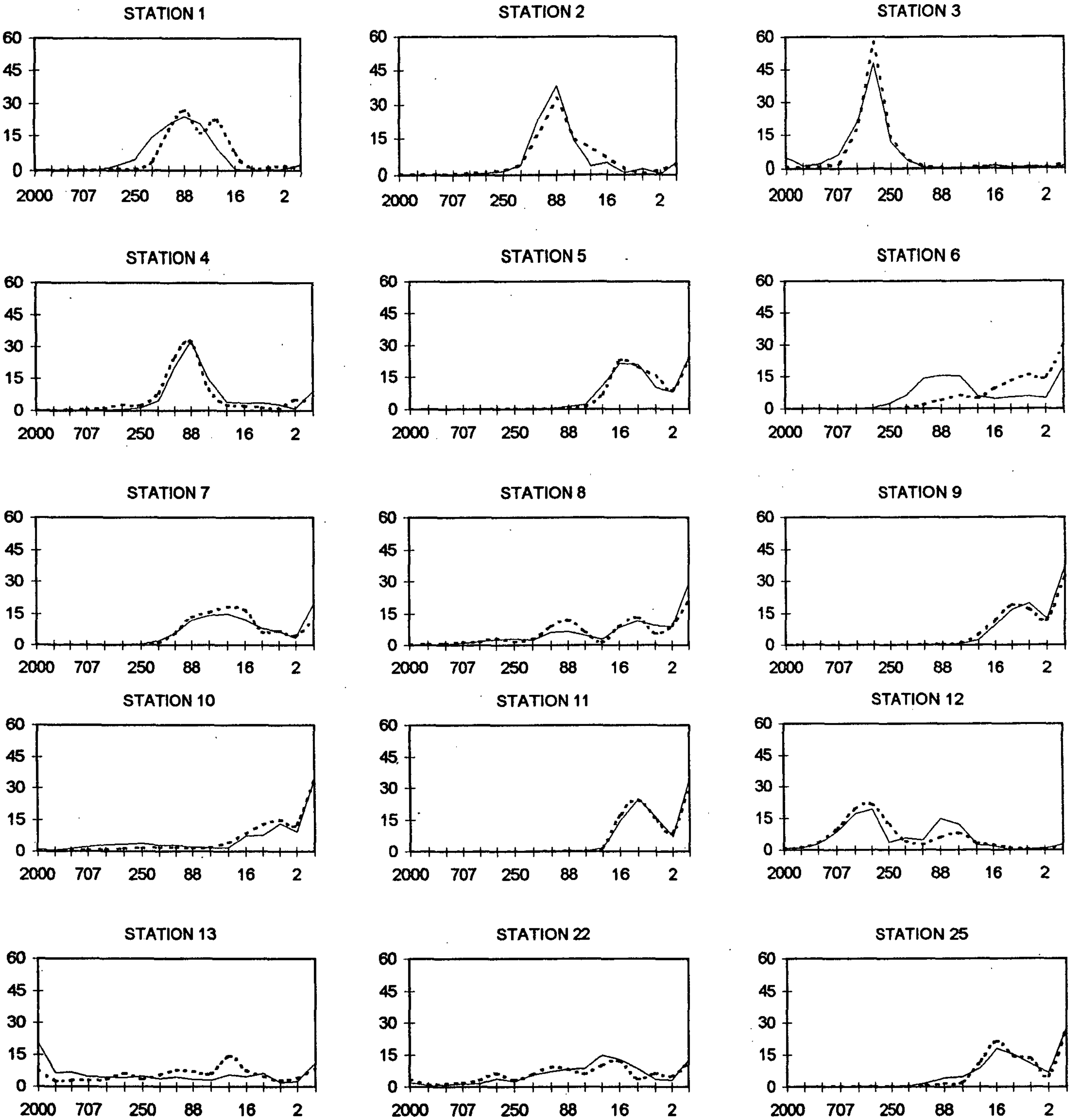
Station	1	2	3	4	5	6	7	8	9	10	11	12	13	22	25
RPD (%)	23	8	8	14	22	173	18	56	22	22	0	10	103	33	0

4.3.1. Median Particle Size

<u>Spatial particle size patterns.</u> Median particle sizes are depicted in Figure 4-2 (note that the scale is logarithmic) and listed as the last line of Table 4-2. The lowest median particle sizes (4-16 microns - medium silt to very fine silt) were at Station 5 in mid channel, Station 8 in Basin D, Station 9 in Basin F, Station 10 in Basin E, Station 11 at the end of the Harbor channel and Station 25 in mid channel. These stations lie far from the entrance and likely have very low current velocities. The largest median particle sizes were at Stations 1, 2, 3 and 4 near the Harbor entrance (89 to 419 microns), at Station 12 in Ballona Creek (393 microns), and Station 13 in Oxford Lagoon (92 microns) (all medium sand to very fine sand). These stations likely have the highest current velocities of the Harbor. Remaining stations had sediments, which were more moderate in median particle size (37 to 64 microns - very fine sand).

<u>Particle size ranges compared with past years.</u> Table 4-2 lists the median particle sizes per station from May 1991 through October 2002. In surveys prior to 1996, measurements were made only through the sand ranges. Less than 74 microns was reported for silts and clays. Largest changes in particle size occurred at Station 13 in Oxford Lagoon (from medium sand to very fine sand), Station 8 in Basin D (from fine silt to medium silt) and Station 6, in Basin B (very fine sand to very fine silt). These shifts in particle size may be related to the low rainfall this year compared to 2000. As has been mentioned in previous

FIGURE 4-1a. COMPARATIVE PARTICLE SIZE (MICRONS) DISTRIBUTION (%) OF 15 BENTHIC SEDIMENT STATIONS



Data from October, 2000

Data from October, 2002

FIGURE 4-2. MEDIAN PARTICLE SIZES (MICRONS) AT 15 BENTHIC SEDIMENT STATIONS.

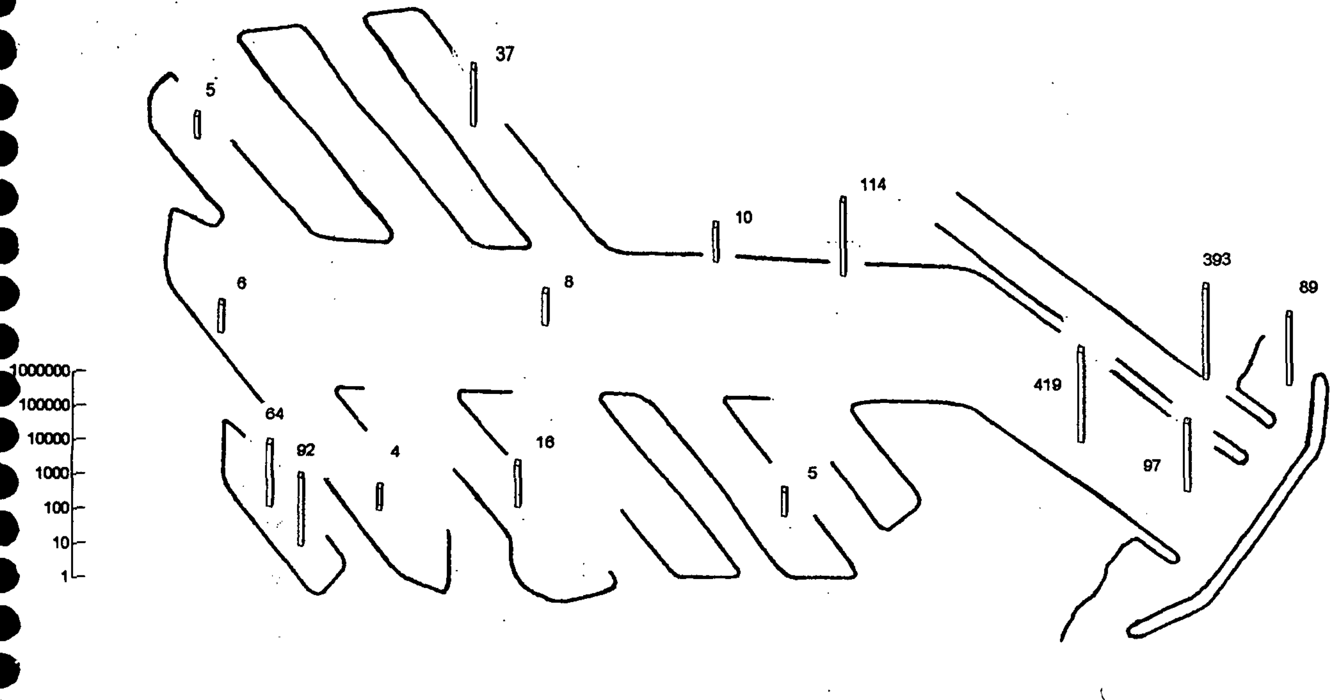
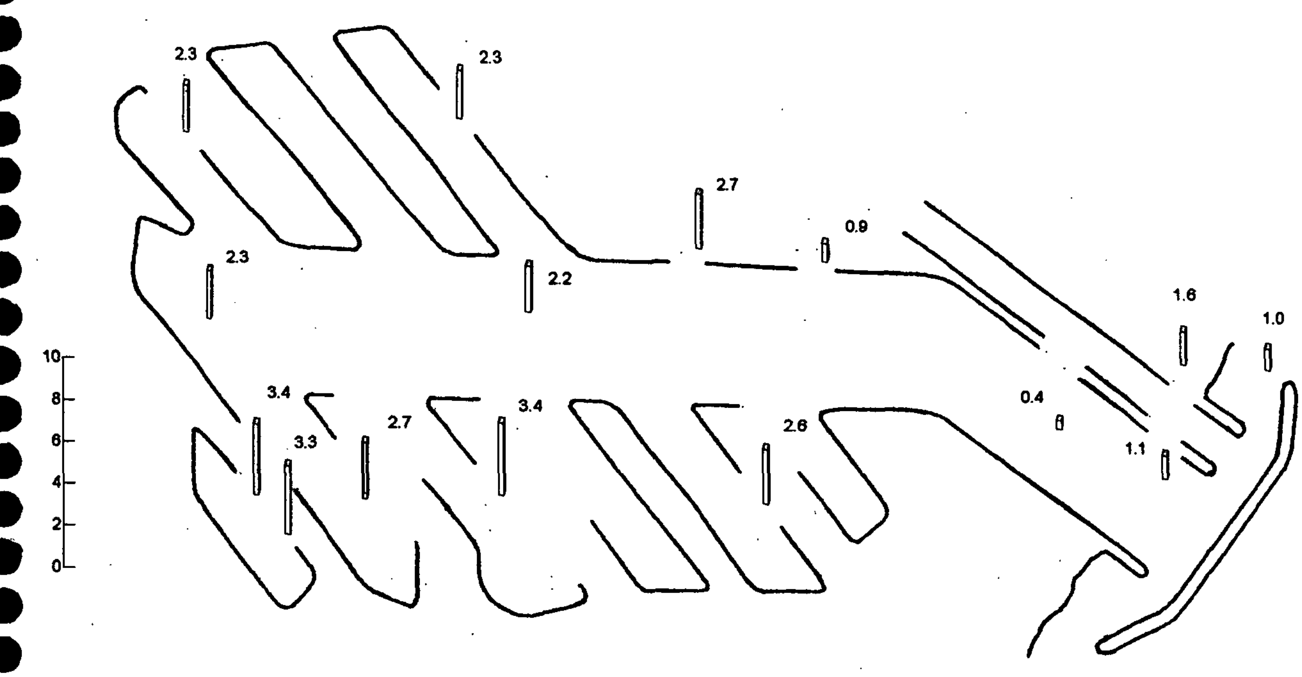


FIGURE 4-3. SORTING INDEX VALUES AT 15 BENTHIC SEDIMENT STATIONS.



reports (i.e. Soule, et. al. 1996, 1997), particle sizes at some locations appear to be related to rainfall and somewhat to dredging activity.

4.3.2. **Sorting Index**

Spatial sorting index patterns. Sorting index values are depicted in Figure 4-3 and Table 4-3. Sediments at Station 3 in the main channel (0.4 - well sorted) were the most homogeneous. Stations 1, 2 and 12 near the Harbor entrance and in Ballona Creek were poorly sorted (1.0 - 1.6). Station 4 in the mid channel has moderately sorted sediments (0.9). Stations in the Basins and back Harbor were the most heterogeneous with sorting index values ranging from 2.2 to 3.4 (very poorly sorted). Generally, high-energy area sediments (i.e. Harbor entrance) tend to have larger median particle sizes and more homogeneous sediments than low energy areas (Harbor channels and basins). The exceptions to this are Station 13 in Oxford Lagoon, which had relatively large median particle sizes but were sorted very poorly. It is probable that this area has both periods of high velocity currents, as well as periods of relative quiescence.

Sorting index ranges compared with past years. Sorting index values this year (0.4 to 3.4) indicate that sediments tended to be more homogeneous overall than during the past four years (0.5 to 4.9).

4.4. STATION GROUPINGS BASED ON MEDIAN PARTICLE SIZE AND SORTING INDEX

Stations were clustered by their similarities to median particle size and sorting index. The method used is described above for water quality (Section 3.3.3). Station groupings were resolved based upon their similarity or dissimilarity to physical sediment variables (Figure 4-4).

Stations 7, 8, 13, 22 and 25 (Basins H, D, Oxford Lagoon and mid channel). The median particle size was of moderate coarseness (very fine sand). Distribution was heterogeneous, (very poorly sorted). This area probably experienced moderate water velocity.

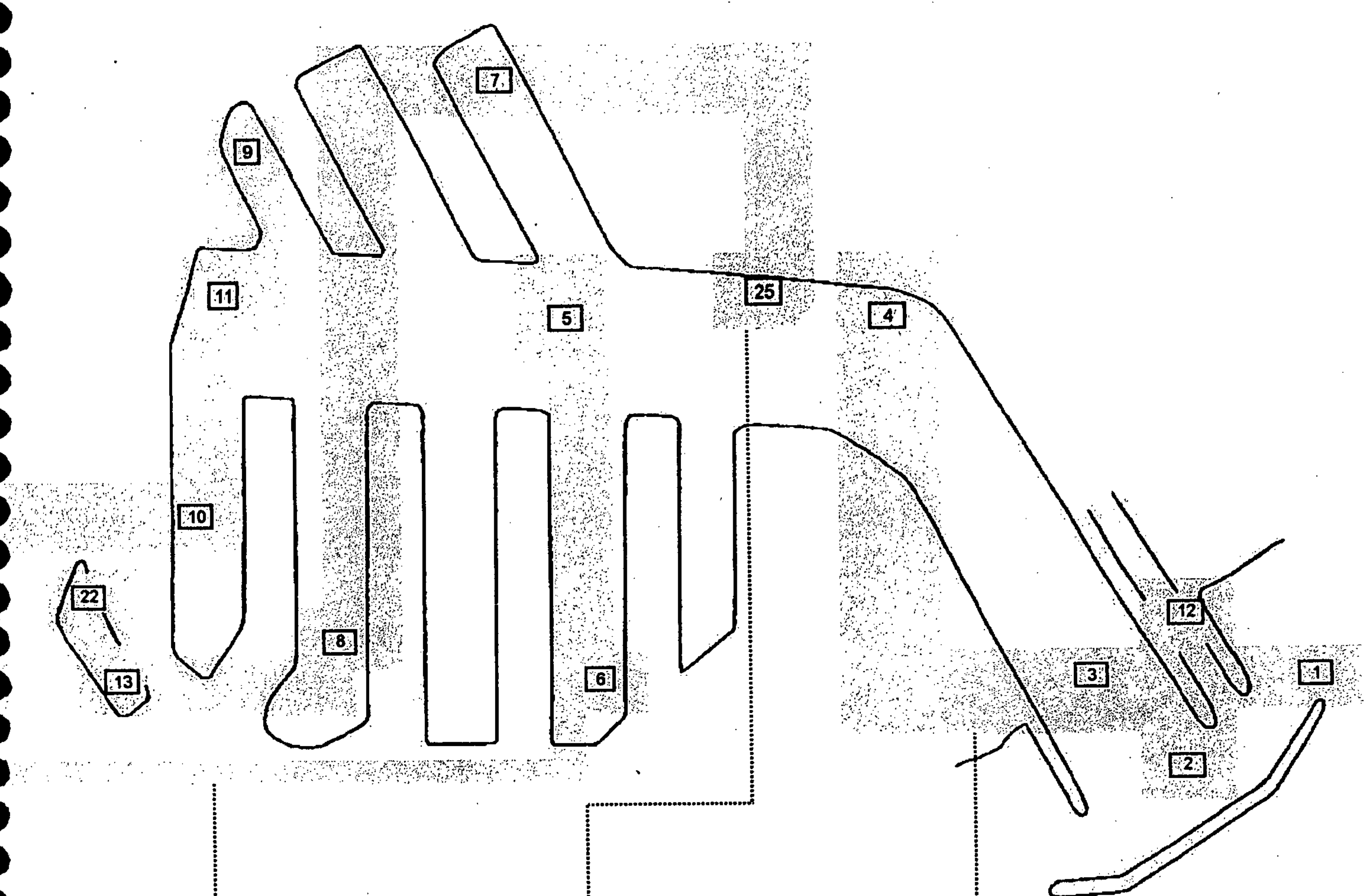
Stations 5, 6, 9, 10 and 11 (Mid channel, Basins B, F, E and back Harbor). Sediments at these stations are the finest and most heterogeneous (very poorly sorted) in the Harbor. Stations in these locations likely experience low current velocities allowing finer particles to settle out.

Stations 1, 2, 3, 4 and 12 (Harbor entrance, mid channel and Ballona Creek). The grain size distributions at these stations were the most homogenous compared to the other groups. The median particle size was the coarsest (fine sand to medium sand). Stations in these locations experience the highest current velocities in the Harbor.

4.5. DISCUSSION

The sources of sediment that enter Marina del Rey Harbor are numerous, however, all sediment leaves the Harbor through the entrance or, less frequently, through dredging operations. Sand from nearby nearshore areas may also enter the Harbor through the entrance. Various sediments continuously flow in from Ballona Creek, Venice Canal, Oxford Lagoon, and other smaller discharge points. During periods of precipitation, finer sediments are suspended in storm runoff and enter the Harbor. Slower dry weather water velocities in most areas of the Harbor allow finer particles to settle out. This allows for a

FIGURE 4-4. PHYSICAL SEDIMENT CHARACTERISTICS BASED ON BRAY-CURTIS CLUSTERING TECHNIQUE.



Stations 5, 6, 9, 10, 11

Median grain size:

Medium silt.

Sorting:

Very poorly sorted.

Characteristics:

These stations contain finest sediments in the Harbor. The grain size distribution is moderate.

Stations 7, 8, 13, 22, 25

Median grain size:

Very fine sand.

Sorting:

Very poorly sorted.

Characteristics:

These stations contain second finest sediments in the Harbor. The grain size distribution is moderate.

Stations 1, 2, 3, 4, 12

Median grain size:

Fine sand to medium sand

Sorting:

Poorly sorted.

Characteristics:

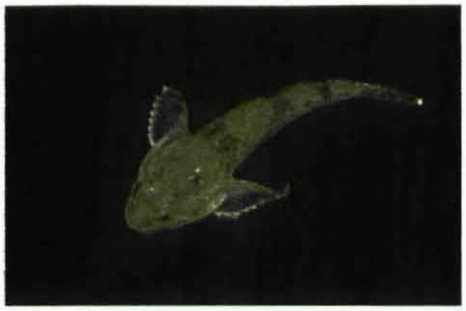
These stations contain the coarsest sediments in the Harbor. The grain size distribution is the most homogeneous.

more heterogeneous mix of sediments. In areas of higher velocities, finer particles remain suspended and continue to move on. Since finer particles do not settle out in these high-energy areas, the sediments are not only coarser but also usually narrower in range (more homogeneous).

Results from October 2002 were compared to results of 2000 using a relative percent difference (RPD) calculation since sediment samples were not analyzed for particle size for the 2001 survey. Most RPDs did not differ by more than 25%. Anomalies occurred at Station 6 in Basin B (173%), Station 8 in Basin D (56%) and Station 13 and 22 in Oxford Lagoon (103% and 33%, respectively). These discrepancies could be the result of either sampling variation or the low amount of precipitation between 2000 and 2002. Had high inflows of storm runoff occurred during this period, grain size differences between years may have been greater at more stations. The distribution of sediments did not change a great deal between years either. The sorting index at Station 22 changed from extremely poorly sorted to very poorly sorted while the rest remained very poorly sorted. The particle size differences between 2000 and 2002 at Stations 6 and 8 and 22, did not appear to affect the concentration of chemical contaminates or the biological communities found there.

Based upon physical characteristics this year, Harbor sediments in most basins and the main channel are relatively fine (silt) but have a wide range of values. Areas which have the narrowest ranges of sediments include those with the coarsest sediments (sand - Ballona Creek and the Harbor entrance). Usually both stations in Oxford Lagoon defy this concept. This year, only Station 13 had a coarse grain size (sand) and high heterogeneity. Station 22 had finer sediments and moderate heterogeneity. Station 22 may experience more dry weather flows than Station 13.

5. CHEMICAL CHARACTERISTICS OF BENTHIC SEDIMENTS



5.1. BACKGROUND

The natural, historic drainage patterns for Ballona wetlands were disrupted by channeling of runoff into Ballona Creek, creation of the Venice Canals and Ballona Lagoon behind the barrier beach, and formation of drainage ponds that became part of Basin E when the marina was built. Piecemeal filling occurred over many years, for farming, trash and soil disposal, and industrial development. During World War II, industrial development in areas contiguous to the marina resulted in contamination of terrestrial sediments. These contaminants may have leached into the ground water or may have been carried by runoff into the marina when land was eroded or excavated for newer development. Activities associated with boating such as fuel spillage, use of antifouling compounds, boat maintenance and debris from recreation also results in contamination of sediments (e.g., Soule and Oguri, 1988, 1990).

Ballona Creek Flood Control Channel is a notable source of visible debris: especially fast food containers, plus plastic grocery sacks, milk bottles and beverage cans, motor oil containers, and garden debris tossed into storm drains or the channel. Additionally, the Creek maintains a ball collection ranging from ping-pong and tennis to soccer and basketball sizes that attest to the route through storm drains. During dry weather low flow conditions; contaminated water and sediments accumulate in storm drains and channels, and during rainy seasons these contaminants are carried seaward. Part of the Ballona Creek flow is reflected off the breakwater, enters the marina, and moves inward on rising tides. Station 12, in Ballona Creek; generally has a medium to high ranking with regard to contaminants (Soule and Pieper 1996).

Because the basins are very low energy environments (see Section 4), fine sediments settle out there, sometimes carrying heavy contaminant loads. The inner end of the main channel (Station 11) and adjacent Basins E and F (Stations 10 and 9) are particularly prone to contamination. Station 5, in mid-main channel, is also surprisingly contaminated, probably due to settling (shoaling) where flows from the basins meet in the main channel under low flow conditions. In very wet seasons, sediments from the basins may be carried farther due to heavy stormwater runoff, sometimes to the bend in the entrance channel, sometimes to the sandbar at the entrance. Flow from Ballona Creek and the Marina entrance channel meet where waves and tidal influx may slow the seaward progression of sediment-laden waters, resulting in deposition. Oxford Flood Control Basin is a sump for street drainage, from the community north and east of the marina, draining into Basin E through a tide gate. Severe flooding has occurred along Washington Street, flooding houses and floating cars, and a new pumping station was built in Oxford Basin in 1994-1995 to ameliorate that, but if the tide is high during a storm, drainage into the marina through the tide gate is inadequate to clear the streets. A new tide gate is planned (Soule and Pieper, 1996).

Soils in some adjacent industrial areas are known to have high levels of contamination, with erosion during storms carrying sediments into the basin and into the marina. During dry weather flow, runoff is not extreme and sediments tend to settle out in the basin. Rank growth of weeds and brush can add to the debris accumulation. Tidal flow also may result in deposition in Oxford basin when marina waters contain suspended sediments that may be deposited at slack tide. Station 13 tends not to be highly contaminated when velocity of flow is relatively high, which is further enhanced by the narrow tide gate; similarly, at Station 22 contamination varies depending on the amount and timing of rainfall during the previous or current rainfall season (Soule and Pieper, 1996).

5.2. MATERIALS AND METHODS

Field sampling for all benthic sediment components is described above in Section 4.2. Sediment portions to be chemically analyzed were removed from the top two centimeters of the grab sample with a Teflon-coated spatula and placed in pre-cleaned glass bottles with Teflon-lined caps. Samples were immediately placed on ice and returned to the laboratory. CRG Marine Laboratories, Inc. in Torrance, California performed all chemical analyses.

5.3. RESULTS

Table 5-1 lists all of the chemical constituents measured in the 15 benthic sediment stations. These compounds have been separated here into four main groups: 1) heavy metals, 2) chlorinated pesticides and polychlorinated biphenyls (PCB's), 3) simple organics, and 4) minerals and other compounds. Table 5-2 lists physical and chemical parameters that are generally associated with freshwater mineral analysis for drinking water or for agricultural use. These constituents are neither commonly associated with marine toxicity nor are they common indicators of organic pollution. They will, therefore, not be dealt with to any great extent in this document. An overall range from surveys performed since 1989 is also included. Table 5-3 compares current Marina del Rey values with L.A. Harbor (City of Los Angeles 1995), and two SCCWRP Reference Site Surveys (SCCWRP 1979, 1987).

In 1990, Ed Long and Lee Morgan of the National Oceanic and Atmospheric Administration (NOAA) published *The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program* (NOAA Tech. Mem. NOS OMA 52). In this study the researchers compiled published information regarding the toxicity of chemicals to benthic organisms. The data for each compound were sorted, and the lower 10th percentile and median (50th) percentile were identified. The lower 10th percentile in the data was identified as an Effects Range-Low (ER-L) and the median was identified as an Effects Range-Median (ER-M). A third index was listed in the document as well, the Apparent Effects Threshold (AET). An AET concentration is the sediment concentration of a selected chemical above which statistically significant biological effects always occur, and, therefore, are always expected (PTI Environmental Services, 1988). AET values are somewhat similar in range to ER-M values, but individually may be higher or lower. In 1995, the list was revised (Morgan, et. al. 1995), and most values were lowered. Note that prior to 1998, all surveys utilized the 1990 values. In Table 5-4, ER-L, ER-M, and AET values are listed for those compounds that were measured in this survey. Compounds, which exceeded the ER-L value, are highlighted by bold type. Those, which also exceeded either the ER-M or AET values, are additionally highlighted with shading. Simple organic compounds are not included in the NOAA effects range ratings (Long and Morgan 1990), so that subsection will not be included for those compounds.

TABLE 5-1. CHEMICAL COMPOUNDS MEASURED FROM 15 BENTHIC SEDIMENT STATIONS. RESULTS AS DRY WEIGHT.

	STATION															
COMPOUND	1	2	3	4	5	6	7	8	9	10	11	12	13	22	25	**MEAN**
Heavy Metals (ppm)																
Arsenic	3.2	4.0	2.2	5.0	4.3	4.5	5.0	6.8	8.7	5.2	9.6	3.7	7.4	3.2	8.7	**5.44**
Cadmium	0.67	0.92	0.37	0.41	0.36	0.29	0.33	0.51	0.54	0.70	0.55	0.95	0.87	0.23	1.37	**0.604**
Chromium	28	29	12	28	30	37	46	68	86	45	94	22	55	18	93	**45.98**
Copper	16	29	21	64	72	146	131	354	333	122	359	35	65	25	229	**133.38**
Iron	13350	15680	7577	14290	17810	20950	25640	36830	44460	26850	48710	11220	27830	12820	41960	**24398**
Lead	42	66	30	61	40	53	60	79	143	45	106	58	178	35	144	**75.8**
Manganese	139.5	150	65.2	130	157	150	212	253	292	196	330	125	219	156	301.5	**191.7**
Mercury	0.165	0.160	0.080	0.190	0.180	0.560	0.460	0.780	1.040	0.650	0.800	0.130	0.150	0.050	0.540	**0.3957**
Nickel	12.7	17.0	7.0	13.1	14.5	16.9	19.6	28.0	35.1	19.8	37.6	10.4	28.1	10.0	33.2	**20.19**
Selenium	0.3	0.4	0.2	0.4	0.4	0.4	0.5	0.8	1.0	0.8	0.9	0.3	0.6	0.3	1.0	**0.55**
Silver	0.93	1.48	1.11	1.85	1.30	1.29	1.36	1.75	2.86	0.87	2.70	1.27	1.09	0.36	4.79	**1.6668**
Tributyl Tin	0.002	<0.001	<0.001	0.008	0.013	0.017	0.023	0.012	0.023	0.008	0.032	<0.001	0.002	0.001	<0.001	**0.009**
Zinc	64	114	54	104	108	146	153	293	324	155	339	115	207	96	322	**172.9**
Pesticides & PCB's (ppb)																
p,p' DDD	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0.00**
p,p' DDE	8.6	12.9	4.4	8.2	10.8	12.4	16.8	14.2	48.6	21.0	27.9	6.9	4.3	3.1	30.8	**15.40**
p,p' DDT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0.00**
All DDT & Derivatives	**8.6**	**12.9**	**4.4**	**8.2**	**10.8**	**12.4**	**16.8**	**14.2**	**48.6**	**21.0**	**27.9**	**6.9**	**4.3**	**3.1**	**30.8**	**15.40**
Delta BHC	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0.00**
Alpha Chlordane	1.3	3.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5.8	0.5	<1.0	3.3	**0.98**
Gamma Chlordane	3.5	6.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	7.4	0.9	<1.0	8.1	**1.79**
Dieldrin	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0.00**
Endosulfan I	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0.00**
Endrin Aldehyde	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0.00**
Endrin Ketone	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0.00**
All Non-DDT Pesticides	**4.9**	**10.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**13.1**	**1.4**	**0.0**	**11.4**	**2.76**
PCB's	**10.29**	**18.58**	**<1.0**	**3.73**	**3.4**	**26.69**	**33.7**	**22.66**	**137.1**	**50.06**	**58.82**	**18.44**	**1.27**	**5.195**	**71.95**	**30.79**
Organic Content																
Tot. Organic Carbon (%)	0.830	0.900	0.770	0.870	0.960	0.830	0.920	1.060	1.010	0.870	1.120	0.630	0.830	2.060	3.030	**1.1127**
Volatile Solids (%)	2.3	4.0	1.6	3.7	2.5	3.0	3.3	5.3	7.1	3.7	5.8	2.3	3.4	2.3	8.1	**3.89**
Immed. Oxy. Dmd. (%)	0.006	0.077	0.026	0.019	0.030	0.037	0.042	0.043	0.048	0.062	0.036	0.048	0.050	0.016	0.020	**0.037**
Chem. Oxy. Dmd. (%)	1.60	1.80	1.50	1.40	1.50	1.60	2.20	2.20	2.20	2.00	2.20	1.80	1.70	1.30	2.40	**1.83**
Oil and Grease (ppm)	1230	2320	779	834	502	631	620	770	1720	1570	1190	2050	361	1315	3220	**1274.1**
Organic Nitrogen (ppm)	2000	1900	1700	2000	2300	2000	2300	2400	3100	1800	2500	<100	1800	12700	<100	**2566.7**
Ortho Phosphate (ppm)	24	9	92	78	80	41	60	79	110	63	197	26	29	91	203	**78.8**
Sulfides (ppm)	423	889	29.3	9.9	<0.10	122	73.3	272	891	470	496	315	<0.10	1.6	306.5	**286.6**
Minerals, etc. (ppm)																
Moisture (%)	29.4	33.7	24.6	35.0	33.6	39.4	39.4	55.4	57.5	42.8	53.4	24.8	24.9	25.9	55.3	**38.34**
Spec. Cond. (mmhos/cm)	55.2	21.9	41	40.9	52.8	44.8	43.6	51.5	44.1	55.2	54.1	59.5	54.5	40	57.6	**48**
Alkalinity as CaCO3	240	200	160	150	171	140	120	168	84	180	119	420	180	120	198	**176.7**
Hardness as CaC03	2930	2720	3040	2910	2210	3000	2510	2960	2380	2490	2530	2460	3950	2230	2810	**2742**
Total Dis. Solids (%)	27000	17200	30000	34100	52300	72200	68100	72800	59100	72700	66500	22400	48100	12200	69000	**48247**
Barium	78	70	33	74	76	71	116	126	144	114	175	83	239	61	145	**106.9**
Boron	1.4	1.9	1.7	1.6	1.2	1.8	1.6	1.4	1.3	1.1	1.5	1.6	1.3	1.1	1.7	**1.49**
Calcium	222	202	197	194	165	196	199	185	215	177	191	189	277	146	192.5	**197**
Chloride	23800	19300	18800	17800	18000	19300	22100	18700	17200	19300	20200	18900	32500	13800	20800	**20033**
Fluoride	18.0	3.4	6.0	4.7	6.3	4.4	4.3	3.5	2.6	5.0	3.4	9.3	7.5	3.6	3.1	**5.67**
Nitrogen	6.02	0.31	0.76	0.25	0.27	0.16	0.45	0.32	3.95	0.36	0.23	0.76	1.11	0.40	0.22	**1.0**
Nitrate	4.80	0.20	0.60	0.15	0.17	0.10	0.40	0.24	2.34	0.30	0.20	0.60	0.90	0.30	0.14	**0.76**
Potassium	350	303	311	285	318	329	329	306	236	341	319	282	377	206	304.5	**306**
Sulfate	3460	2560	2170	2540	2540	1900	1930	1150	1800	3380	2130	2110	4050	1770	2300	**2386**
Sodium	5900	5510	6570	6620	5490	6210	6350	6560	4870	6090	5520	6340	7690	4420	5210	**5957**

[illegible] RESULTS IN DRY WEIGHT

COMPOUND	October 1989[1]	October 1990[2]	May 1991	October 1991	October 1992	April 1994	September 1994	October 1995	October 1996	October 1997	October 1998	September 1999	October 2000	**Overall Range**	October 2001
Metals (ppm)															
Arsenic	1.13 - 11.3	2.99 - 13.80	2.62 - 10.54	2.22 - 5.51	1.81 - 12.60	2.44 - 19.8	2.86 - 11.2	3.56 - 11.8	2.5 - 11.5	3.2 - 15.0	2.2 - 12.6	2.5 - 13.1	<3 - 13.5	**<3 - 19.8**	2.2 - 7.4
Cadmium	<0.26 - 2.12	0.32 - 2.13	0.43 - 5.54	<0.63 - 3.0	0.13 - 2.22	<0.2 - 2.93	<2.8 - 1.14	<0.31 - 1.23	0.226 - 1.470	0.24 - 1.56	0.20 - 1.18	0.19 - 1.32	0.03 - 0.89	**<0.2 - 5.54**	0.23 - 1.37
Chromium	4.68 - 65.2	6.78 - 69.80	16.5 - 67.8	12.5 - 57.9	8.73 - 72.6	5.74 - 67.5	11.9 - 81.7	15 - 83.3	17.0 - 81.1	17 - 70	14 - 86	12.5 - 84.0	5.9 - 46	**4.68 - 86**	12.3 - 94
Copper	8.19 - 333	10.4 - 399	24 - 348	13.8 - 455	5.50 - 322	6.55 - 339	25.3 - 402	29.4 - 380	10.6 - 346.0	9 - 390	8 - 320	7.8 - 450	6.9 - 420	**5.50 - 455**	16.2 - 359
Iron[3]	3.21 - 47.1	3.84 - 71.5	14.4 - 62.8	8.27 - 63.2	5.7 - 49.6	3.36 - 51.80	6.40 - 49.8	7.3 - 49.6	14.7 - 59.8	12 - 50	11.5 - 54.0	9 - 59	4.9 - 37	**3.21 - 71.5**	7.6 - 48.7
Lead	17.0 - 305	7.95 - 325	41.3 - 575	62.2 - 487	22.90 - 372	12.50 - 427	32.3 - 413	54.3 - 295	45.8 - 292.0	40 - 250	40 - 380	28.8 - 198	18 - 155	**7.95 - 575**	30.2 - 178
Manganese	27.5 - 283	30.3 - 273	147 - 315	86.3 - 263	63.1 - 279	26.20 - 292	52.2 - 328	74.6 - 315	117 - 366	125 - 330	115 - 340	64 - 360	44 - 264	**26.2 - 366**	65.2 - 330
Mercury	<0.12 - 0.92	<0.10 - 1.08	<0.07 - 1.2	<0.09 - 0.94	<0.10 - 2.8	<0.09 - 1.01	0.11 - 0.97	<0.09 - 0.92	0.064 - 0.903	0.08 - 1.40	0.03 - 0.81	0.04 - 0.96	0.03 - 1.65	**<0.07 - 2.8**	0.05 - 1.04
Nickel	3.88 - 36.4	4.18 - 41.20	12 - 43.2	8.02 - 32.0	4.91 - 37.3	3.67 - 39.40	7.14 - 58.1	7.54 - 41.1	8.57 - 66.90	10 - 210	6.5 - 28.2	7.5 - 31.4	4.0-30	**3.67 - 210**	7.0 - 37.6
Selenium	—	—	—	—	—	—	<0.14 - 2.35	<0.47 - 0.99	0.30 - 1.80	0.4 - 2.4	<1 - 1.9	—	<2	**<0.14 - 2.4**	0.23 - 0.99
Silver	—	—	—	—	—	—	—	—	0.280 - 2.720	0.20 - 3.50	0.10 - 2.22	0.16 - 2.58	0.10 - 2.50	**0.10 - 3.50**	0.36 - 4.79
Tributyl Tin	<0.1 - 0.4	<0.03 - 0.52	<0.01 - 0.44	<0.02 - 0.53	<0.003 - 2.2	<0.04 - 0.34	0.05 - 0.88	0.08 - 3.04	0.005 - 0.023	<0.002 - 0.014	<0.002 - 0.010	<0.002 - 0.01	<0.002-0.004	**<0.002 - 3.04**	<1.0 - 0.032
Zinc	20.3 - 444	28 - 491	102 - 640	55.8 - 624	27.0 - 523	20.30 - 647	55.3 - 446	87.9 - 455	61.3 - 440.0	55 - 480	36 - 500	41 - 450	29 - 390	**20.3 - 647**	54 - 339
Chlor. Hyd. (ppb)[4]															
p,p' DDD	2 - 40	4 - 100	<4 - 15	<4 - 23	<4 - 36	<4 - 40	8 - 47	<4 - 70	<0.5 - 6.6	<0.5 - 5.0	<0.5 - 18.0	<0.5 - 4.0	<0.05 - 5.5	**<0.05 - 100**	<1.0
p,p' DDE	<4 - 77	<4 - 104	3.5 - 110	3 - 67	<4 - 169	<4 - 94	11 - 63	<4 - 60	4.0 - 16.0	3.0 - 23.0	<0.05 - 2.0	1.0 - 9.5	<0.5 - 14	**<0.05 - 169**	3.06 - 48.6
p,p' DDT	4 - 200	<4 - 29	<4 - 14	<4 - 48	<4 - 56	<4 - 86	<4 - 49	<4 - 60	<0.4 - 12.0	<1.0	<0.6 - 12.0	<0.5 - 5.0	<0.5 - 4.0	**<0.4 - 200**	<1.0
Alpha-Chlordane	—	—	—	—	—	—	—	—	<0.1 - 6.6	<0.5	<0.3 - 8.3	<0.3 - 3.9	0.8 - 3.6	**<0.1 - 6.6**	0.51 - 5.75
Gamma-Chlordane	—	—	—	—	—	—	—	—	<0.2 - 7.7	<0.3 - 8.1	<0.4 - 11.0	<0.3 - 6.2	1.0 - 4.6	**<0.2 - 11.0**	0.86 - 8.15
Chlordane[5]	<20 - 630	10 - 410	<20 - 360	31 - 436	<20 - 270	<20 - 167	<20 - 109	<20 - 380	<0.1 - 14.3	<0.3 - 8.1	<0.3 - 19.3	<0.3 - 9.8	0.8 - 8.1	**<0.1 - 630**	<1.0 - 13.2
Dieldrin	<1.0 - 30	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5 - 2.0	<0.5 - 2.0	<0.5 - <1.0	**<0.5 - 30**	<1.0
Endrin Aldehyde	<2	<2	<2	<2	<2	<2	<2	<2	<0.6 - 2.0	<0.5 - 9.0	<0.6 - 6.6	<0.5 - 2.0	<0.5 - <3.0	**<0.5 - 9.0**	<1.0
Heptachlor Epoxide	<1	<1	<1	<1	<1	<1	<1	<1	<0.2 - 2.0	<0.3 - 1.0	<0.2 - 3.9	<0.4	<0.3 - <0.5	**<0.2 - 3.9**	<1.0
Heptachlor	—	—	—	—	—	—	—	—	—	—	<0.2 - 0.3	<0.4	<0.3 - <0.5	**<0.2 - 0.3**	<1.0
Aldrin	—	—	—	—	—	—	—	—	—	—	<0.2 - 0.6	<0.4	<0.3 - <0.5	**<0.2 - 0.6**	<1.0 - 4.64
Methoxychlor	—	—	—	—	—	—	—	—	—	—	<2.0 - 6.5	<4	<3 - <50	**<2.0 - 6.5**	<1.0
Endosulfan I	—	—	—	—	—	—	—	—	—	—	<0.2 - 2.0	<0.3 - 3.0	<0.3 - <0.9	**<0.2 - 3.0**	<1.0
Endosulfan II	—	—	—	—	—	—	—	—	—	—	<0.5 - 3.0	<0.7	<0.5 - <3.0	**<0.5 - 3.0**	<1.0
Endosulfan Sulfate	—	—	—	—	—	—	—	—	—	—	<0.5 - 2.0	<0.7	<0.5 - <1.0	**<0.5 - 2.0**	<1.0
Endrin Ketone	—	—	—	—	—	—	—	—	—	—	<0.5 - 4.0	<0.5 - 1.0	<0.5 - <3.0	**<0.5 - 4.0**	<1.0
Alpha-BHC	—	—	—	—	—	—	—	—	—	—	<0.2 - 0.4	<0.4	<0.3 - <0.5	**<0.2 - 0.4**	<1.0 - 0.69
Delta-BHC	—	—	—	—	—	—	—	—	—	—	—	<0.3 - 0.4	<0.3 - <0.5	**<0.3 - 0.4**	<1.0
Gamma-BHC	—	—	—	—	—	—	—	—	—	—	<0.2 - 1.0	<0.4	<0.3 - <0.5	**<0.2 - 1.0**	<1.0 - 3.53
Tot. Non-DDT Pest.	—	—	—	—	—	—	—	—	0.5 - 15.2	<0.9 - 13.6	2.0 - 31.7	<0.3 - 14.7	<0.3 - 8.2	**<0.3 - 31.7**	<1.0 - 13.11
Arochlor 1254	<50 - 330	<50 - 153	—	—	—	<50 - 110	<50 - 231	<50 - 90	<10 - 100	<20	<10 - <20	<10 - <20	<10 - 110	**<10 - 330**	10 - 171
Arochlor 1260	<50 - 200	<50 - 172	<50 - 300	<50	<50 - 90	<50	<50	<50	<20	<20	<10 - <20	<10 - <20	<10 - <30	**<10 - 300**	<10
Organics (ppm)															
Tot. Org. Carbon (%)	0.28 - 8.07	0.52 - 4.71	1.18 - 4.58	0.88 - 6.45	0.46 - 5.43	0.50 - 4.9	1.2 - 4.7	0.6 - 3.3	0.46 - 3.9	0.23 - 2.31	0.41 - 1.14	0.33 - 2.4	0.19 - 3.1	**0.19 - 8.07**	0.63 - 3.03
Volatile Solids (%)	0.84 - 13.91	1.3 - 11.78	2.96 - 11.45	2.22 - 16.12	1.13 - 13.58	1.20 - 12.2	2.94 - 11.72	1.47 - 8.26	0.8 - 11.0	0.6 - 4.0	0.7 - 3.7	1.3 - 7.5	19.7 - 61.8	**0.6 - 61.8**	1.6 - 8.1
Immed. Ox. Dmd.(%)	0.001 - 0.05	0.001 - 0.04	0.002 - 0.04	0.003 - 0.06	<0.001 - 0.04	<0.001 - 0.03	0.003 - 0.05	0.001 - 0.04	0.13 - 1.3	1.3 - 2.0	0.016 - 0.68	0.07 - 4.0	ND - 3.1	**<0.001 - 4.0**	0.006 - 0.077
Chem. Ox. Dmd.(%)	0.244 - 21.56	0.677 - 15.31	3.44 - 12.0	1.55 - 18.63	0.314 - 16.50	0.268 - 15.40	0.86 - 17.1	2.04 - 7.98	0.73 - 8.0	0.49 - 4.12	0.43 - 6.72	0.37 - 6.4	1.6 - 8.6	**0.24 - 21.56**	1.30 - 2.40
Oil and Grease	390 - 11070	360 - 4860	1280 - 7300	1080 - 8700	227 - 4160	508 - 9200	800 - 6760	520 - 2840	30 - 350	40 - 360	3 - 140	<30 - 1500	<10-1510	**3 - 11070**	361 - 3220
Organic Nitrogen	380 - 4770	235 - 4125	1060 - 3125	334 - 4910	105 - 4010	110 - 3180	452 - 2960	692 - 1940	120 - 1400	120 - 1499	37 - 768	<300 - 1900	<16-183	**<16 - 4910**	<100 - 12700
Ortho Phosphate	1900 - 13300	1.51 - 179	3.24 - 101.1	<1 - 43.5	0.53 - 15.1	290 - 1640	280 - 2220	288 - 1260	14 - 225	1.5 - 28.8	<10 - <20	—	3.4 - 54	**<1 - 13300**	9.1 - 203
Sulfides	<0.1 - 40.7	<0.2 - 3.22	0.13 - 14.44	<0.1 - 6.33	0.4 - 13.8	0.60 - 1350	1.5 - 2310	1.0 - 1322	75 - 580	130 - 850	<3 - 620	210 - 1800	<1.0 - 1130	**<0.1 - 2310**	<0.10 - 891

[1] Station 25 added in 1989. [2] Station 22 added in 1990. [3] Results reported in thousands. [4] Previous to 1996, pesticide and PCB detection limits were either much higher or not recorded individually.

[5] Chlordane separated into subcategories after 1995.

TABLE 5-3. AVERAGE AND RANGES OF CHEMICAL COMPOUNDS FROM 15 BENTHIC SEDIMENT STATIONS COMPARED TO SCCWRP REFERENCE AND LOS ANGELES HARBOR SEDIMENT SURVEYS.

COMPOUND	MARINA DEL REY (2001) AVERAGE	MARINA DEL REY (2001) RANGE	LOS ANGELES HARBOR (1995) AVERAGE	LOS ANGELES HARBOR (1995) RANGE	SCCWRP (1977) AVERAGE	SCCWRP (1977) RANGE	SCCWRP (1985) AVERAGE
Metals (ppm)							
ARSENIC	5.44	2.2 - 54.2	5.25	2.2 - 8.5	–	–	–
CADMIUM	0.6	0.23 - 1.37	0.55	0.28 - 1.27	0.42	0.1 - 1.4	0.14
COPPER	133	16.2 - 359	39.9	13.1 - 69.6	24	6.5 - 43	10.4
CHROMIUM	46	12.3 - 94	41.2	21.0 - 71.7	9.6	2.3 - 40	25.4
MERCURY	0.4	0.05 - 1.04	0.21	0.11 - 0.32	–	–	–
LEAD	75.8	30.2 - 178	21.3	7.3 - 47	6.8	2.7 - 12	4.8
NICKEL	20.1	6.95 - 37.6	22.6	10.1 - 42.3	16	1.6 - 51	12.9
SILVER	1.67	0.36 - 4.79	0.55	0.05 - 2.66	0.35	0.04 - 1.7	0.03
ZINC	173	54 - 339	87.5	42.2 - 148	45	9.8 - 110	48
Chl. Hyd. (ppb)							
TOTAL DDT'S	2.76	<1.0 - 48.6	94.1	29.7 - 196	30	<3 - 70	18.9
PCB'S	30.79	<1.0 - 137	58.3	27.2 - 137	10	<2 - 40	19.2
Organics							
TOC (%)	1.11	0.63 - 3.03	–	–	–	–	0.52
VOL. SOLIDS (%)	3.89	1.63 - 8.06	–	–	3.3	1.8 - 9.5	–
COD (%)	1.83	1.30 - 2.40	–	–	2.4	0.92 - 6.94	–
ORG.NITROGEN (ppm)	2567	<100 - 12700	–	–	790	393 - 1430	–

TABLE 5-4. CHEMICAL CONCENTRATIONS FROM 15 BENTHIC SEDIMENT STATIONS WITH ER-L (BOLD), ER-M, AND AET (SHADED) VALUES (FROM LONG AND MORGAN 1990, MORGAN ET. AL. 1995).

COMPOUND	ER-L	ER-M	AET	STATION 1	2	3	4	5	6	7	8	9	10	11	12	13	22	25
Metals (ppm)																		
Arsenic	8.2	70	50	3.2	4.0	2.2	5.0	4.3	4.5	5.0	6.8	8.7	5.2	9.6	3.7	7.4	3.2	8.7
Cadmium	1.2	9.6	5	0.67	0.92	0.37	0.41	0.36	0.29	0.33	0.51	0.54	0.70	0.55	0.95	0.87	0.23	1.37
Chromium	81	370	—	28	29	12	28	30	37	46	68	86	45	94	22	55	18	93
Copper	34	270	300	16	29	21	64	72	146	131	354	333	122	359	35	65	25	229
Lead	46.7	218	300	42	66	30	61	40	53	60	79	143	45	106	58	178	35	144
Mercury	0.15	0.71	1	0.165	0.160	0.080	0.190	0.180	0.560	0.460	0.780	1.040	0.650	0.800	0.130	0.150	0.050	0.540
Nickel	20.9	51.6	—	12.7	17.0	7.0	13.1	14.5	16.9	19.6	28.0	35.1	19.8	37.6	10.4	28.1	10.0	33.2
Silver	1	3.7	1.7	0.93	1.48	1.11	1.85	1.30	1.29	1.36	1.75	2.86	0.87	2.70	1.27	1.09	0.36	4.79
Zinc	150	410	260	64	114	54	104	108	146	153	293	324	155	339	115	207	96	322
Metals exceeding ER-L				1	3	1	4	3	3	5	6	8	3	8	3	6	0	9
Metals exceeding ER-M or AET				0	0	0	1	0	0	0	4	4	0	4	0	0	0	2
Hydrocarbons (ppb)																		
p,p' DDD	2	20	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
p,p' DDE	2.2	27	7.5	8.6	12.9	4.4	8.2	10.8	12.4	16.8	14.2	48.6	21.0	27.9	6.9	4.3	3.1	30.8
p,p' DDT	1	7	6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total DDT & Deriv.	1.58	180	—	8.6	12.9	4.4	8.2	10.8	12.4	16.8	14.2	48.6	21.0	27.9	6.9	4.3	3.1	30.8
Chlordane	0.5	6	2	4.8	10.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	13.2	1.4	<1.0	11.4
Dieldrin	0.02	8	—	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
PCB's	22.7	180	370	10.3	18.6	<1.0	3.7	3.4	26.7	33.7	22.7	137.1	50.1	58.8	18.4	1.3	5.2	72.0
Hydrocarbons exceeding ER-L				3	3	2	2	2	3	3	3	3	3	3	3	3	2	4
Hydrocarbons exceeding ER-M or AET				2	2	0	1	1	1	1	1	1	1	1	1	0	0	2
Total Contaminants																		
Total exceeding ER-L				4	6	3	6	5	6	8	9	11	6	11	6	9	2	13
Total exceeding ER-M or AET				2	2	0	2	1	1	1	5	5	1	5	1	3	0	4

5.3.1. **Arsenic**

Arsenic is carcinogenic and teratogenic (causing abnormal development) in mammals and is mainly used as a pesticide and wood preservative. Inorganic arsenic can affect marine plants at concentrations as low as 13 to 56 ppm and marine animals at about 2000 ppm (Long and Morgan 1990). The USEPA (1983) gives a terrestrial range of 1-50 ppm, with an average of 5 ppm.

Spatial arsenic patterns. Arsenic concentrations at the 15 sampling stations are listed in Table 5-1 and in Figure 5-1. Arsenic values were substantially higher compared to the rest of the marina at Station 13 in Oxford Lagoon (54.2 ppm). Station 11 in the back channel had a relatively moderate concentration (9.6 ppm). All other stations ranged from 2.2 ppm to 8.7 ppm with the lowest values reported close to the harbor entrance.

Arsenic ranges compared with past years. The range of this year's arsenic values (2.2 to 7.4 ppm) exceeded the overall range of previous years (Table 5-2). Despite the high concentration reported for Station 13, arsenic in the Harbor appears to have neither greatly increased nor decreased since 1989.

Arsenic values compared with other surveys. The Marina del Rey arsenic average and range (8.56 ppm, 2.2 to 7.4 ppm) were higher than Los Angeles Harbor (5.25 ppm, 2.2 to 8.5 ppm) (Table 5-3). Arsenic was not analyzed in either the 1977 or 1985 SCCWRP Reference Site Surveys; however, background levels were estimated by Mearns et. al. (1991) to be about 10 ppm.

Arsenic values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for arsenic are 8.2, 70, and 50 ppm (Table 5-4), and the range for Marina del Rey Harbor sediments this year was 2.2 to 7.4 ppm. Stations 9, 11, 13 and 25 exceeded the ER-L value, and Station 13 exceeded the AET value.

5.3.2. **Cadmium**

Cadmium is widely used in electroplating, paint pigment, batteries and plastics, but point source control and treatment processes have greatly reduced cadmium in the marina (Soule et. al. 1996). Toxicity in water to freshwater animals ranges from 10 ppb to 1 ppm, as low as 2 ppm for freshwater plants, and 320 ppb to 15.5 ppm for marine animals (Long and Morgan 1990). The USEPA (1983) gives the terrestrial range of 0.01 to 0.7 ppm, with an average of 0.06 ppm.

Spatial cadmium patterns. Cadmium concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-2. Highest cadmium values were at Station 25 in mid harbor (1.4 ppm), Station 13 in Oxford Lagoon (0.9 ppm), Station 2 at the harbor entrance (0.9 ppm) and Station 12 in Ballona Creek (1.0 ppm). Remaining stations ranged from 0.3 to 0.7 ppm.

Cadmium ranges compared with past years. The range of this year's cadmium values (0.23 to 1.37 ppm) was within the overall range of past surveys (Table 5-2). Since a high of 5.54 ppm was recorded in May of 1991, cadmium values have seemed to exhibit a slight downward trend.

Cadmium values compared with other surveys. The Marina del Rey cadmium average and range (0.60 ppm, 0.23 to 1.37 ppm) were slightly higher than values from Los Angeles Harbor in 1995 (0.55 ppm, 0.28 to 1.27 ppm), the 1977 SCCWRP Reference Site values

FIGURE 5-1. ARSENIC CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

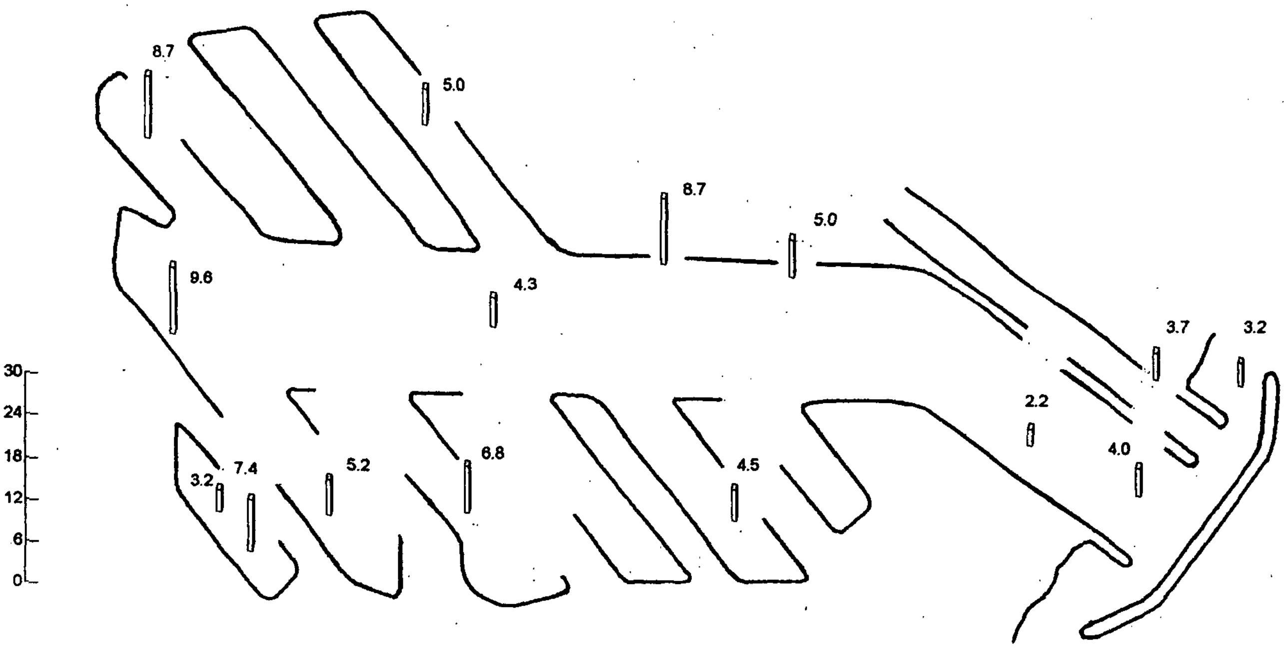
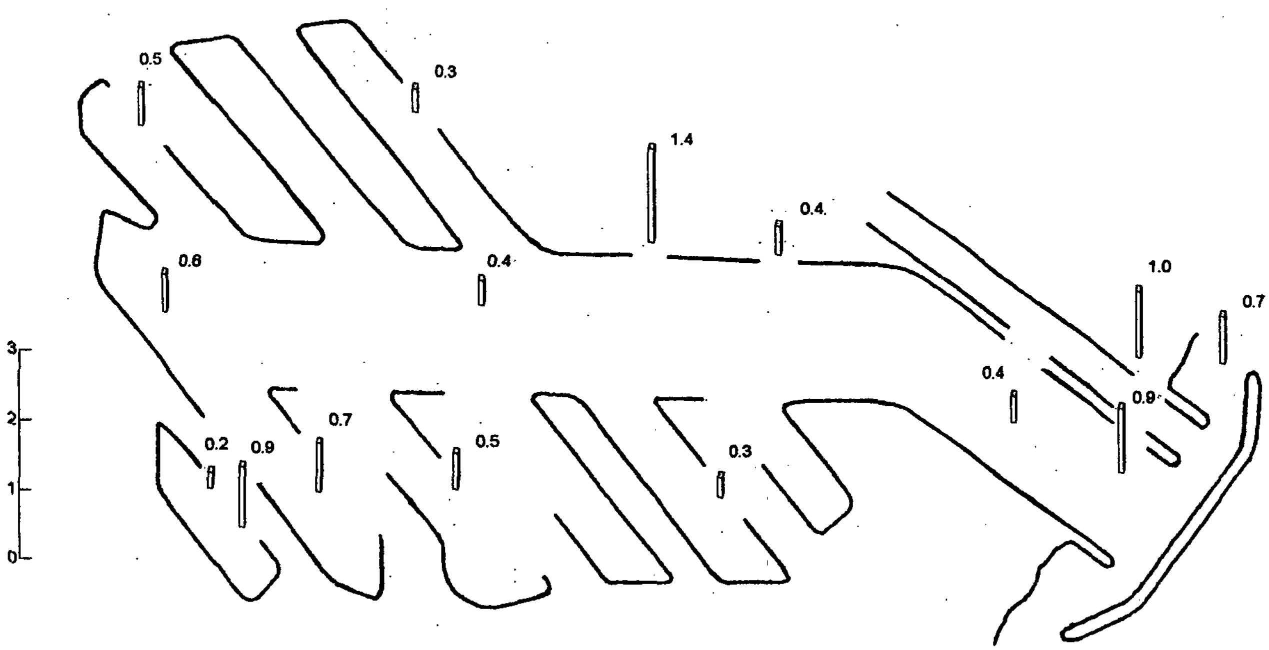


FIGURE 5-2. CADMIUM CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



(0.42 ppm, 0.1 to 1.4 ppm) and the 1985 (0.14 ppm) SCCWRP Reference Site average (Table 5-3).

Cadmium values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for cadmium are 1.2, 9.6, and 5 ppm (Table 5-4). Station 25 exceeded the ER-L value but no other stations exceeded the ER-M and AET values.

5.3.3. Chromium

Chromium is widely used in electroplating, metal pickling, and many other industrial processes. Chromium typically occurs as either chromium (III) or chromium (VI), the latter being considerably more toxic. Acute effects to marine organisms range from 2,000 to 105,000 ppm for chromium (VI) and 10,300 to 35,500 ppm for chromium (III). Chronic effects range from 445 to 2,000 ppb for chromium (VI) and 2,000 to 3,200 ppb for chromium (III) (Long and Morgan 1990). The terrestrial range is 1–1,000 ppm with an average of 100 ppm (USEPA, 1983).

Spatial chromium patterns. Chromium concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-3. Values were highest in the back harbor (Station 11 - 94 ppm), Basin D (Station 6 - 68 ppm), Basin F (Station 9 - 86 ppm) and mid channel (Station 25 - 93 ppm). Lowest values were near the Harbor entrance (Stations 1, 2, 3 and 12 - 12 to 29 ppm) and Station 22 (18 ppm) at Oxford Lagoon. All other chromium concentrations ranged from 28 to 46 ppm.

Chromium ranges compared with past years. The range of this year's chromium values (12.3 to 94 ppm) slightly exceeded the overall range from past surveys (Table 5-2).

Chromium values compared with other surveys. The Marina del Rey chromium average and range (46 ppm, 12.3 to 94 ppm) were higher than Los Angeles Harbor's (41.2 ppm, 21 to 72 ppm) and both the 1977 (9.6 ppm, 2.3 to 40 ppm) or 1985 (25.4 ppm) SCCWRP Reference Site Surveys (Table 5-3).

Chromium values compared with NOAA effects range ratings. The ER-L and ER-M values for chromium are 81 and 370 ppm (Table 5-4). Stations 9, 11 and 25 exceeded the ER-L value. No stations exceeded the ER-M value and there is no AET value for chromium.

5.3.4. Copper

Copper is widely used in anti-fouling paints. Saltwater animals are acutely sensitive to copper in water at concentrations ranging from 5.8 to 600 ppm. Mysid shrimp indicate chronic sensitivity at 77 ppm (Long and Morgan 1990).

Spatial copper patterns. Copper concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-4. Station 11 in the upper channel (359 ppm), Station 8 in Basin D (354 ppm), Station 9 in Basin F (333 ppm) and Station 25 in mid channel (223 ppm) contained the highest copper concentrations. Lowest values were near the Harbor entrance (Stations 1, 2, 3 and 12 - 16 to 35 ppm) and in Oxford Lagoon (Station 22 - 25 ppm). Station 4 in mid channel (next to Station 25) had a moderate copper value 64 ppm.

Copper ranges compared with past years. The range of this year's copper values (16.2 to 359 ppm) was within the overall range of past surveys (Table 5-2). Copper in the Harbor appears to have neither greatly increased nor decreased since 1989.

FIGURE 5-3. CHROMIUM CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

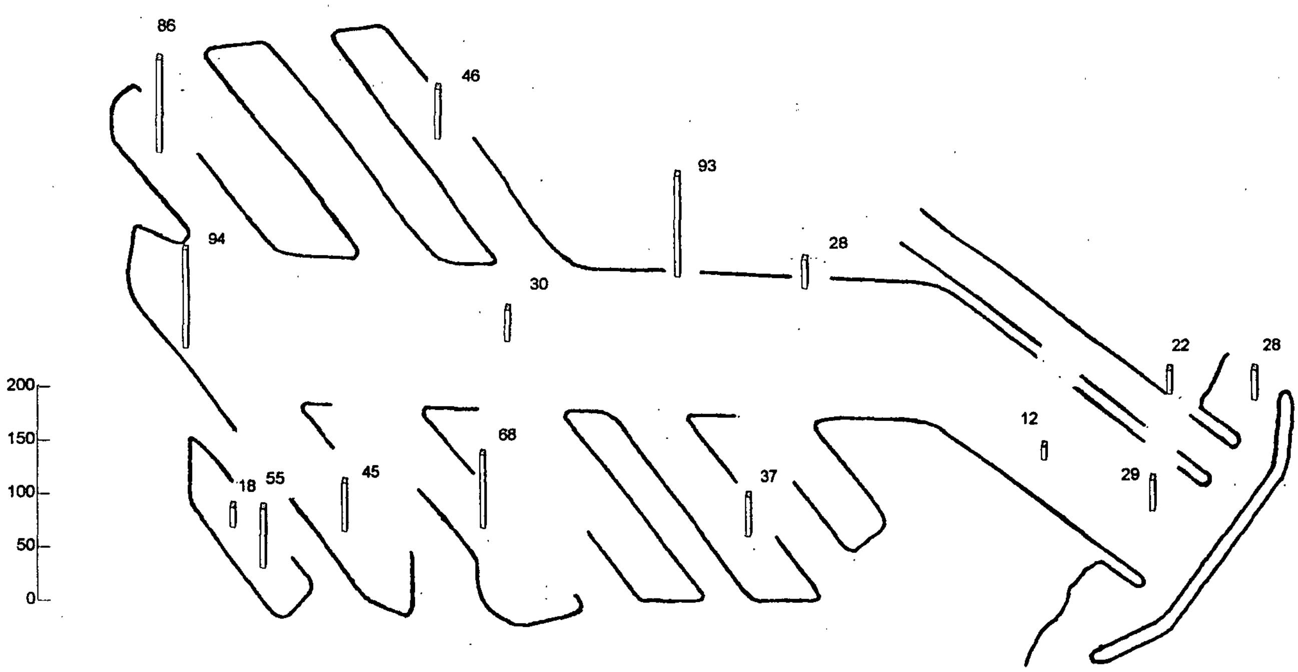
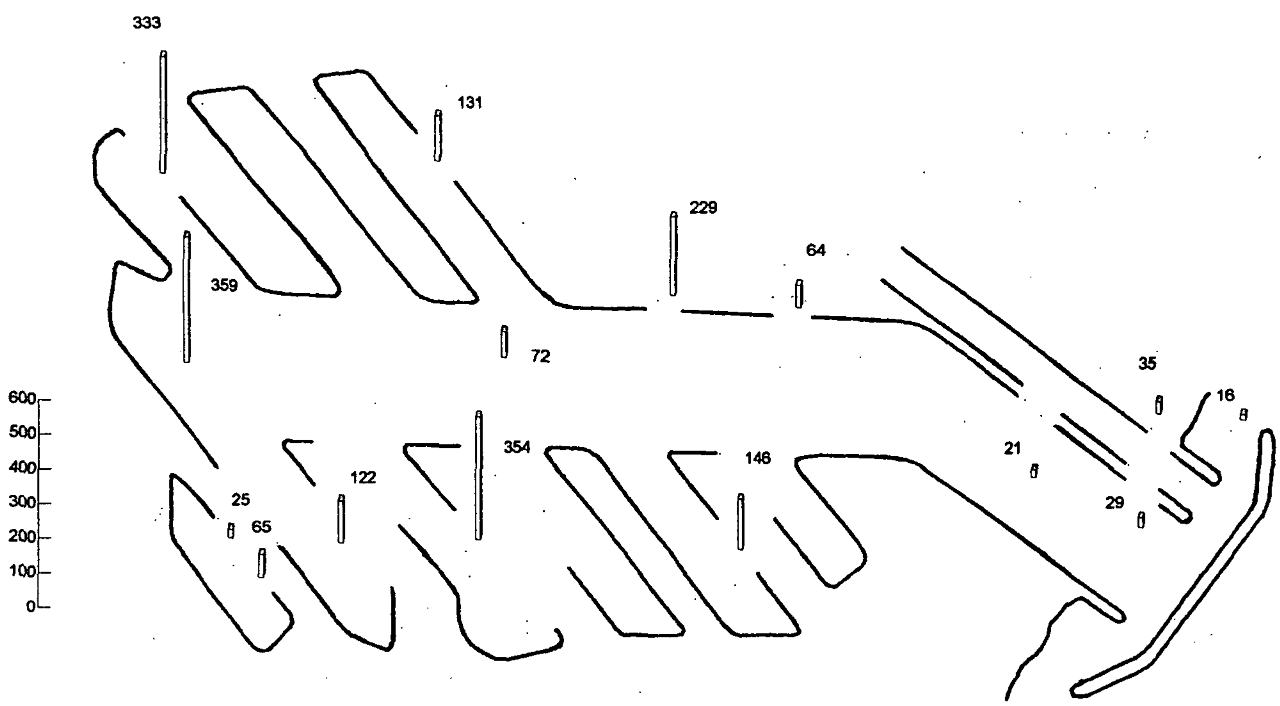


FIGURE 5-4. COPPER CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



Copper values compared with other surveys. The Marina del Rey copper average and range (133 ppm, 16.2 to 359 ppm) were higher than Los Angeles Harbor (39.9 ppm, 13.1 to 69.6 ppm) and both the 1977 (24 ppm, 6.5 to 43 ppm) and 1985 (10.4 ppm) SCCWRP Reference Site Surveys (Table 5-3).

Copper values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for copper are 34, 270, and 300 ppm (Table 5-4). Stations 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 25 exceeded the ER-L value, and Stations 8, 9 and 11 exceeded both ER-M and AET values.

5.3.5. Iron

Iron is generally not considered toxic to marine organisms. Iron, in some organic forms, is a stimulator for phytoplankton blooms. Recent experiments in deep-sea productivity have shown a considerable increase in phytoplankton in normally depauperate mid-ocean waters (Soule et al. 1996).

Spatial iron patterns. Iron concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-5. Highest iron values were Station 11 in the upper channel (48,710 ppm), Station 9 in Basin F (44,460 ppm) and Station 25 in mid channel (41,960 ppm). Relatively moderate concentrations were found in Basin E (Station 10 - 26,850 ppm), Basin D (Station 8 - 36,830 ppm) Basin B (Station 6 - 20,950 ppm) and Basin H (Station 7 - 25,640 ppm). Lowest values were near the Harbor entrance (Stations 1, 2, 3, and 12 - 7,577 to 15,680 ppm) and Oxford Lagoon (Station 22 - 12,820 ppm) however, Station 13 had a moderate iron concentration of 27,830 ppm

Iron ranges compared with past years. The range of this year's iron values (7,577 to 48,710 ppm) was within the overall range of past surveys (Table 5-2). Iron in the Harbor appears to have neither greatly increased nor decreased since 1989.

Iron values compared with past surveys. Iron was not analyzed by either Los Angeles Harbor or by SCCWRP in their Reference Site Surveys.

Iron values compared with NOAA effects range ratings. There are no ER-L, ER-M, or AET values listed for iron.

5.3.6. Lead

Older paints and leaded gasoline are a major source of lead. Lead may be washed into the Harbor or become waterborne from aerial particulates. Adverse effects to freshwater organisms range from 1.3 to 7.7 ppm, although marine animals may be more tolerant (Long and Morgan 1990).

Spatial lead patterns. Lead concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-6. The highest lead concentrations were found at Station 13 in Oxford Lagoon (178 ppm), Station 25 in mid channel (144 ppm), Station 9 in Basin F (143 ppm) and Station 11 in the upper harbor (106 ppm). The lowest values were found at the harbor entrance (Stations 1, 2, 3, and 12 - 30 to 66 ppm). All other stations ranged from 40 to 79 ppm.

Lead ranges compared with past years. The range of this year's lead values (30.2 to 178 ppm) was within the overall range of past surveys (Table 5-2). Lead in the Harbor appears to have neither greatly increased nor decreased since 1989.

FIGURE 5-5. IRON CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

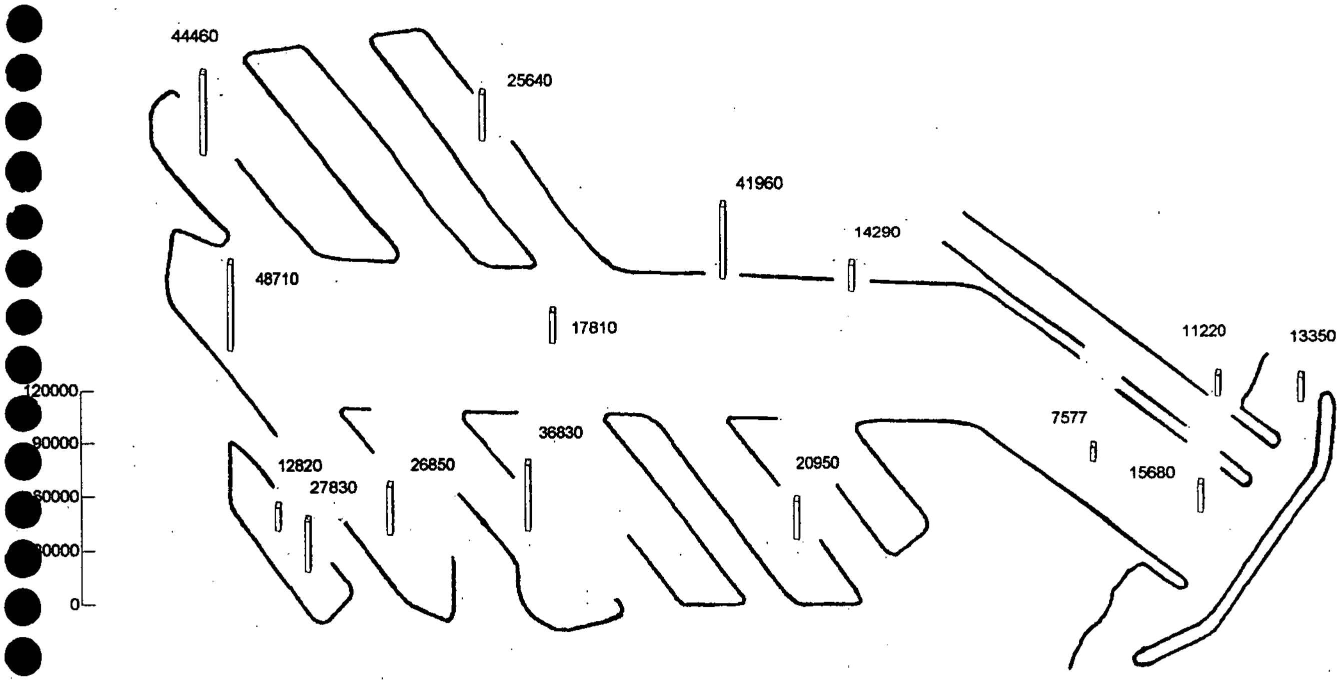
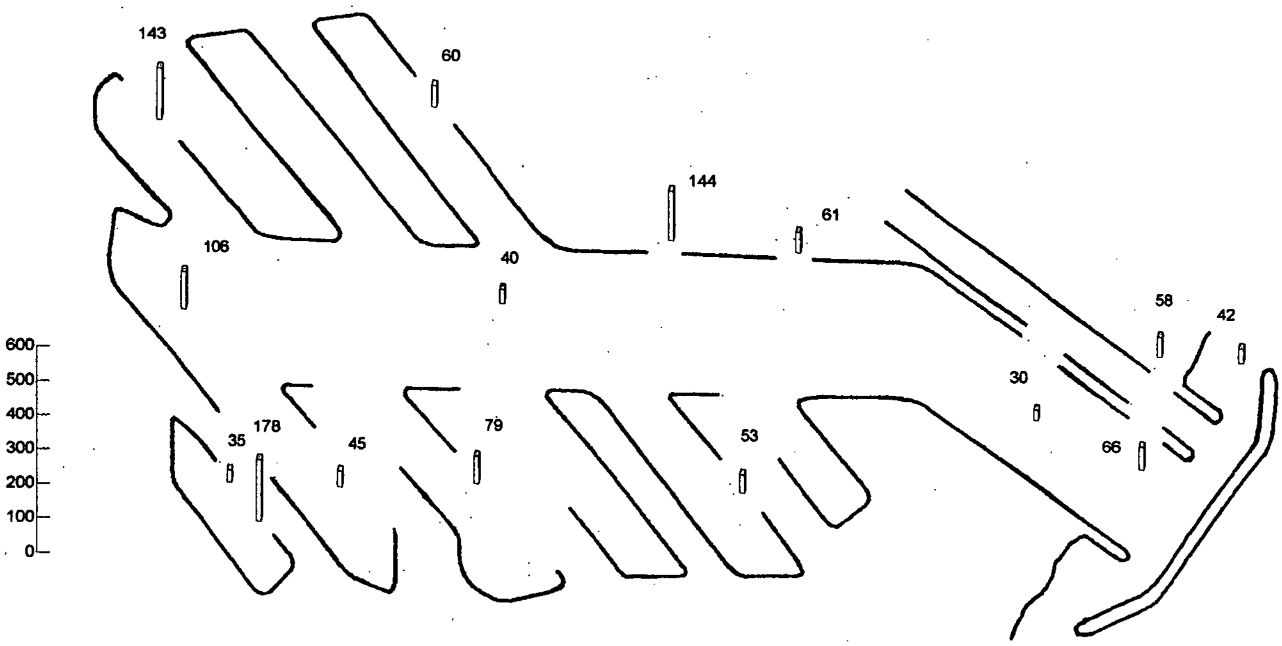


FIGURE 5-6. LEAD CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



Lead values compared with other surveys. This year's Marina del Rey lead average and range (75.8 ppm, 30.2 to 178 ppm) were higher than Los Angeles Harbor (21.3 ppm, 7.3 to 47 ppm) and both the 1977 (6.8 ppm, 2.7 to 12 ppm) and 1985 (10.4 ppm) SCCWRP Reference Site Surveys (Table 5-3).

Lead values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for lead are 46.7, 218, and 300 ppm (Table 5-3). Stations 2, 4, 6, 7, 8, 9, 11, 12, 13 and 25 exceeded the ER-L value; no station exceeded either the ER-M or AET values.

5.3.7. Manganese

Manganese is generally not considered to be toxic to marine plants or animals. It is an essential trace mineral in micro quantities for organisms.

Spatial manganese patterns. Manganese concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-7. Highest manganese values were at Station 11 in the upper channel (330 ppm), Station 9 in Basin F (292 ppm) and Station 25 in mid channel (302 ppm). Station 10 in Basin E (196 ppm), Station 8 in Basin D (253 ppm), Station 13 in Oxford Lagoon (219 ppm) and Station 7 in Basin H (212 ppm) had elevated manganese concentrations. Stations near the Harbor entrance had lower values (Stations 1, 2, 3 and 12 – 65 to 150 ppm).

Manganese ranges compared with past years. The range of this year's manganese values (65.2 to 330 ppm) was within the overall range of past surveys (Table 5-2). Manganese in the Harbor appears to have neither greatly increased nor decreased since 1989.

Manganese values compared with past surveys. Manganese was not analyzed by either Los Angeles Harbor or by SCCWRP in their Reference Site Surveys.

Manganese values compared with NOAA effects range ratings. There are no ER-L, ER-M, or AET values listed for manganese.

5.3.8. Mercury

Mercury is a common trace metal used in industry and as a biocide. Acute toxicity to marine organisms in water ranges from 3.5 to 1678 ppm. Organomercuric compounds may be toxic in the range of 0.1 to 2.0 ppm (Long and Morgan 1990).

Spatial mercury patterns. Mercury concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-8. The highest mercury value was at Station 9 in Basin F (1.04 ppm), Station 11 in the upper harbor (0.80 ppm), Station 8 in Basin D (0.78 ppm) and Station 10 in Basin E (0.65 ppm). The lowest values of mercury were found at the Harbor entrance (Stations 1, 2, 3 and 12 - 0.0 to 0.17 ppm) and within Oxford Lagoon (Stations 13 and 22 - 0.15 and 0.05 ppm, respectively). All other values ranged from 0.18 to 0.56 ppm.

Mercury ranges compared with past years. The range of this year's mercury values (0.05 to 1.04 ppm) was within the overall range for the past 13 years (Table 5-2). Mercury in the Harbor appears to have neither greatly increased nor decreased since 1989.

Mercury values compared with other surveys. The Marina del Rey mercury average and range (0.40 ppm, 0.05 to 1.04 ppm) were higher than Los Angeles Harbor (0.21 ppm, 0.11 to 0.32 ppm) (Table 5-3). Neither the 1977 nor the 1985 SCCWRP Reference Site Surveys measured mercury, however Mearns et al. (1991) estimated the background level in the Southern California Bight to be 0.05 ppm.

FIGURE 5-7. MANGANESE CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

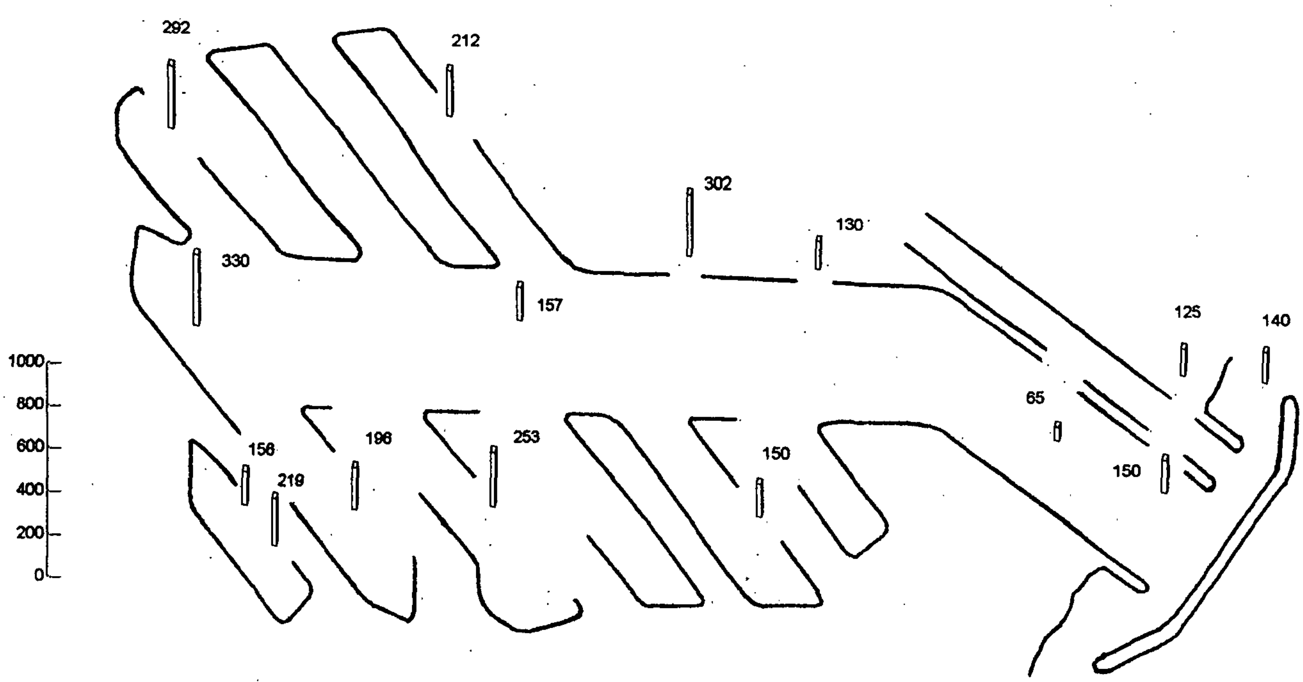
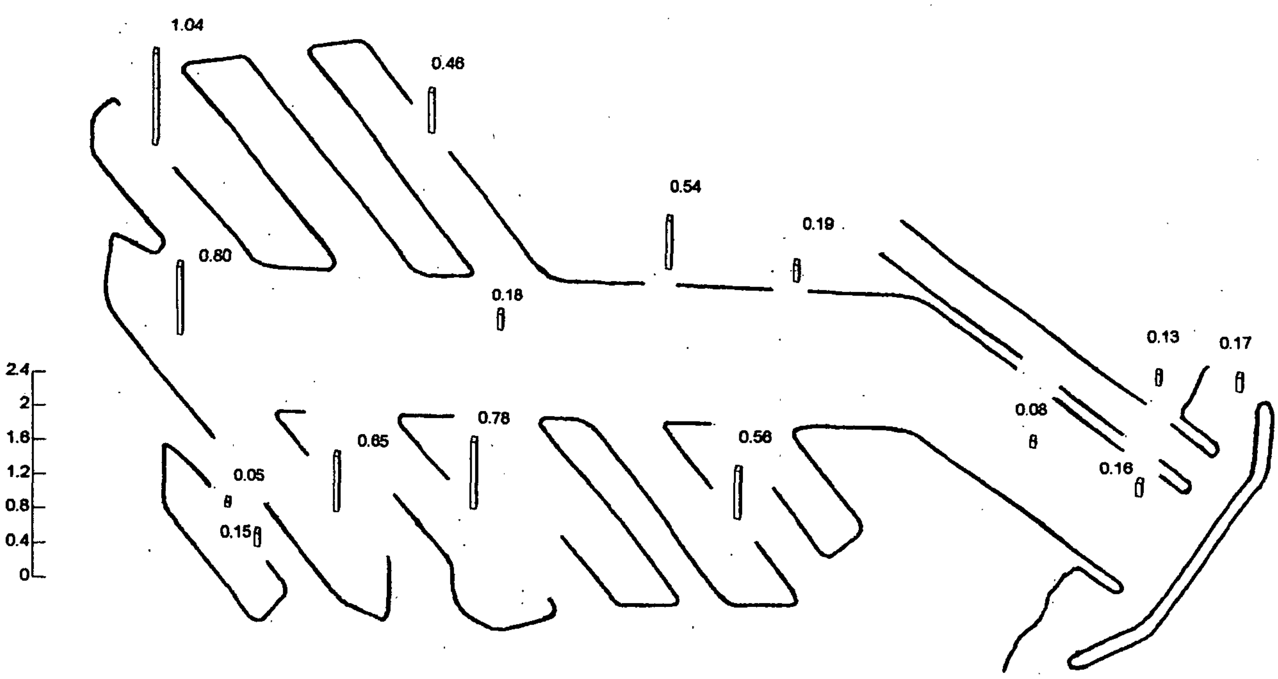


FIGURE 5-8. MERCURY CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



Mercury values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for mercury are 0.15, 0.71, and 1 ppm (Table 5-4). Stations 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13 and 25 met or exceeded the ER-L value, and Stations 8, 9 and 11 exceeded both the ER-M and AET values.

5.3.9. **Nickel**

Nickel is used extensively in steel alloys and plating. Marina sediments contain particulates from vessel maintenance and corrosion. Nickel is chronically toxic to marine organisms in seawater at 141 ppm (Long and Morgan 1990).

Spatial nickel patterns. Nickel concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-9. Highest nickel values occurred at Station 11 in the back Harbor (38 ppm), Station 9 in Basin F (35 ppm) and Station 25 in mid channel (33 ppm). The lowest value was at Station 3 at the Harbor entrance (7 ppm). All other stations ranged from 10 to 28 ppm.

Nickel ranges compared with past years. The range of this year's nickel values (7.0 to 37.6 ppm) was within the overall range of past surveys (Table 5-2). Overall, nickel in the Harbor appears to have neither greatly increased nor decreased since 1989.

Nickel values compared with other surveys. The Marina del Rey Harbor nickel average and range (20.2 ppm, 7 to 37.6 ppm) were comparable to Los Angeles Harbor (22.6 ppm, 10.1 to 42.3 ppm) and higher than the 1977 (16 ppm, 1.6 to 51 ppm) and the 1985 (12.9 ppm) SCCWRP Reference Site Surveys (Table 5-3).

Nickel values compared with NOAA effects range ratings. The ER-L and ER-M values for nickel are 20.9 and 51.6 ppm (Table 5-4). Stations 8, 9, 11, 13 and 25 exceeded the ER-L values, but no station exceeded the ER-M values. There is no AET value listed for nickel.

5.3.10. **Selenium**

Selenium is used as a component of electrical apparatuses and metal alloys and as an insecticide. Although there is no data available for selenium toxicity to marine organisms, the present protection criteria range is from 54 to 410 ppb (USEPA 1986). The normal terrestrial range is from 0.1 to 2.0 ppm with a mean of 0.3 ppm. Selenium and lead levels found and reported in Least Tern eggs from Venice Beach and North Island Naval Station in San Diego County were considered to be harmful to development (Soule et al. 1996).

Spatial selenium patterns. Selenium concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-10. The highest values were found at Station 9 in Basin F and Station 25 in mid harbor (1.0 ppm, each) and Station 11 in the upper harbor (0.9 ppm) and Station 8 in Basin D and Station 9 in Basin E (0.8 ppm, each). Selenium values at all other stations ranged from 0.2 to 0.6 ppm.

Selenium ranges compared with past years. The range of selenium values (0.23 - 0.99 ppm) were within the overall range of past surveys (Table 5-2).

Selenium values compared with other surveys. Selenium was not analyzed by either Los Angeles Harbor or by SCCWRP in their Reference Site Surveys.

Selenium values compared with NOAA effects range ratings. There are no ER-L, ER-M, or AET values listed for selenium.

FIGURE 5-9. NICKEL CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

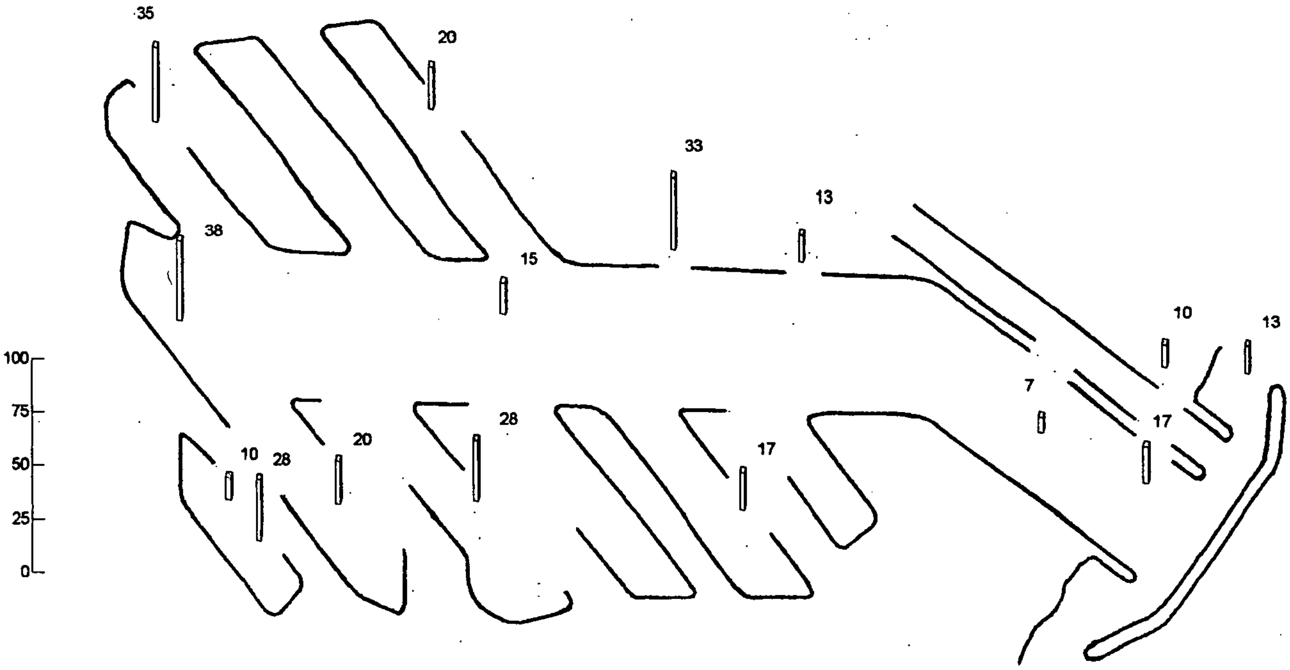
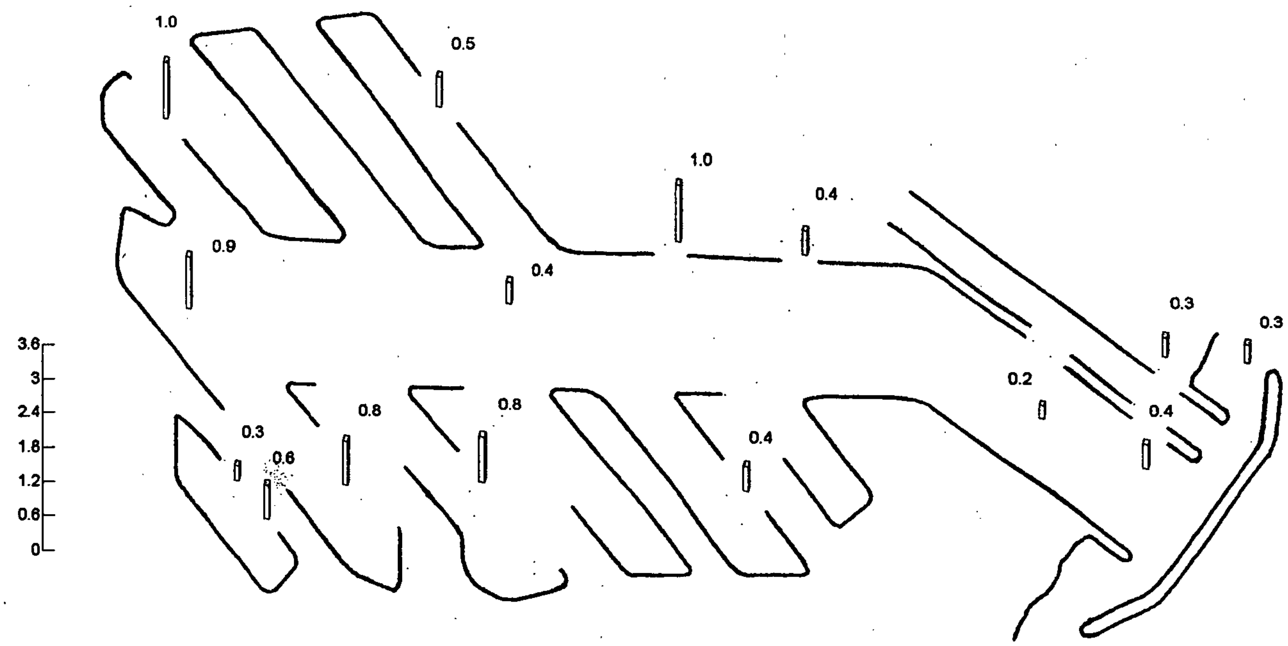


FIGURE 5-10. SELENIUM CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



5.3.11. Silver

Silver has many uses in commerce and industry including photographic film, electronics, jewelry, coins, and flatware and in medical applications. Silver is toxic to mollusks and is sequestered by them and other organisms. Silver increases in the Southern California Bight with increased depth, high organic content and percent silt (Mearns et. al., 1991). The range in the rural coastal shelf is from 0.10 to 18 ppm, in bays and harbors from 0.27 to 4.0 ppm, and near outfalls 0.08 to 18 ppm (Soule et al. 1996). The normal terrestrial level ranges from 0.01 to 5.0 ppm, with a mean of 0.05 ppm.

Spatial silver patterns. Silver concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-11. Highest silver concentrations were found at Station 25 in mid channel (4.8 ppm), Station 11 in the upper channel (2.7 ppm), and at Station 9 in Basin F (2.9 ppm). All other stations ranged from 0.4 to 1.9 ppm.

Silver ranges compared with past years. The range of this year's silver values (0.36 to 4.8 ppm) was slightly higher compare to past surveys (Table 5-2). Overall, silver in the Harbor appears to have neither greatly increased nor decreased since 1996.

Silver values compared with other surveys. The Marina del Rey silver average and range (1.7 ppm, 0.36 to 4.8 ppm) were higher compared to Los Angeles Harbor (0.55 ppm, 0.05 to 2.66 ppm), the 1977 (0.35 ppm, 0.04 to 1.7 ppm) SCCWRP Reference Site Survey and the 1985 (0.03 ppm) Survey (Table 5-3).

Silver values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for silver are 1.0, 3.7, and 1.7 ppm (Table 5-4). Stations 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13 and 25 exceeded the ER-L value; Stations 4, 8, 9, 11 and 25 exceeded the AET value; and Station 25 exceeded the ER-M value.

5.3.12. Tributyl Tin

Soule and Oguri (1987, 1988) reviewed the literature on the effects of tributyl tin and found it can be toxic in concentrations as low as 50 parts per trillion in water (this value is equivalent to 0.00005 ppm). The terrestrial range for tin is 2 to 200 ppm, with a mean of 10 ppm. No sediment tests other than Soule and Oguri (1988) were mentioned in the literature. The California Department of Fish and Game considers tributyl tin to be the most toxic substance ever released in the marine environment. The Los Angeles Department of Beaches and Harbors banned its use prior to the Federal ban for vessels less than 25 m in length except for copolymer paints used on aluminum hulls or in spray paints for some portable boats. Tributyl tin may not be as bioavailable in sediments as it is in seawater, and therefore may not affect the benthic biota in the same fashion. Tributyl tin in the marina can only come from anti-fouling coatings (Soule et al. 1996).

Spatial tributyl tin patterns. Tributyl tin concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-12. The highest tributyltin concentrations were found at Station 11 in the upper harbor (0.032 ppm), Station 9 in Basin F and Station 7 in Basin H (0.023 ppm, each). Moderate concentrations occurred at Station 6 in Basin B (0.017 ppm), Station 8 in Basin D (0.012 ppm) and Station 5 in mid channel (0.013 ppm). Concentrations at all other stations were (<0.001 to 0.008 ppm).

Tributyl tin ranges compared with past years. Values reported for the 2001-02 survey (<0.001 - 0.032 ppm) were higher compared to last year, but within the overall range for the past 13 years (Table 5-2). The decrease over time of TBT values may reflect a response to the banning of this compound in the Harbor (see above).

FIGURE 5-11. SILVER CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

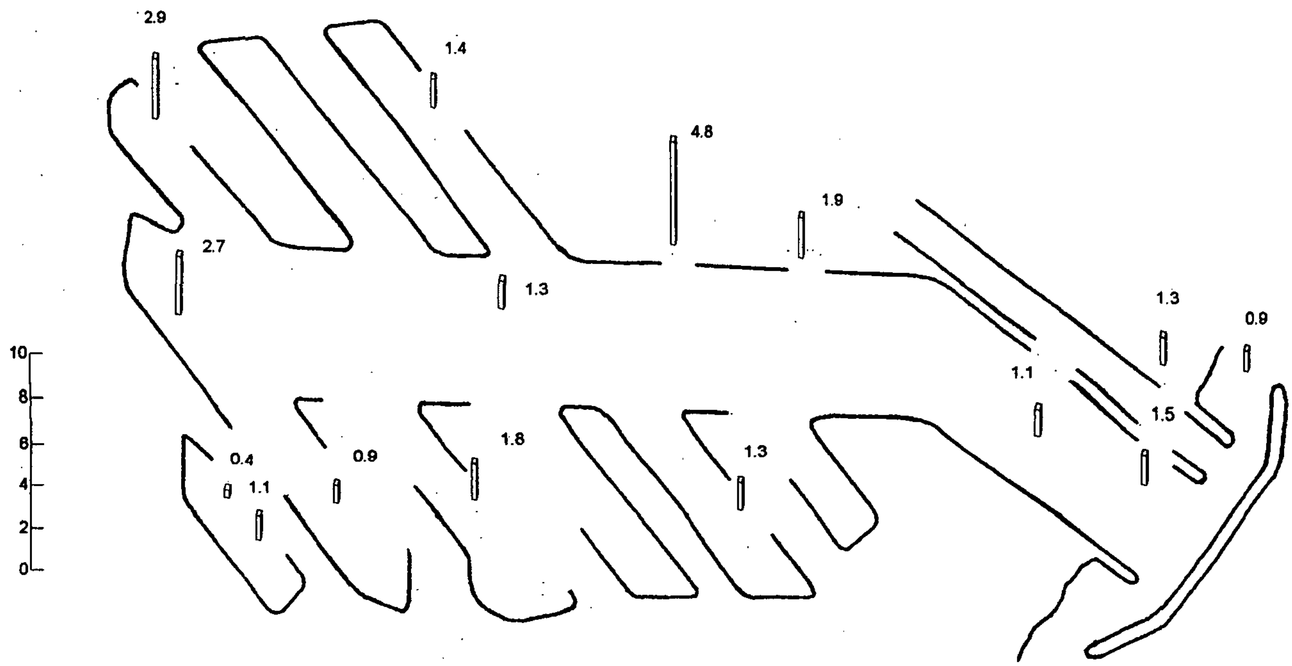
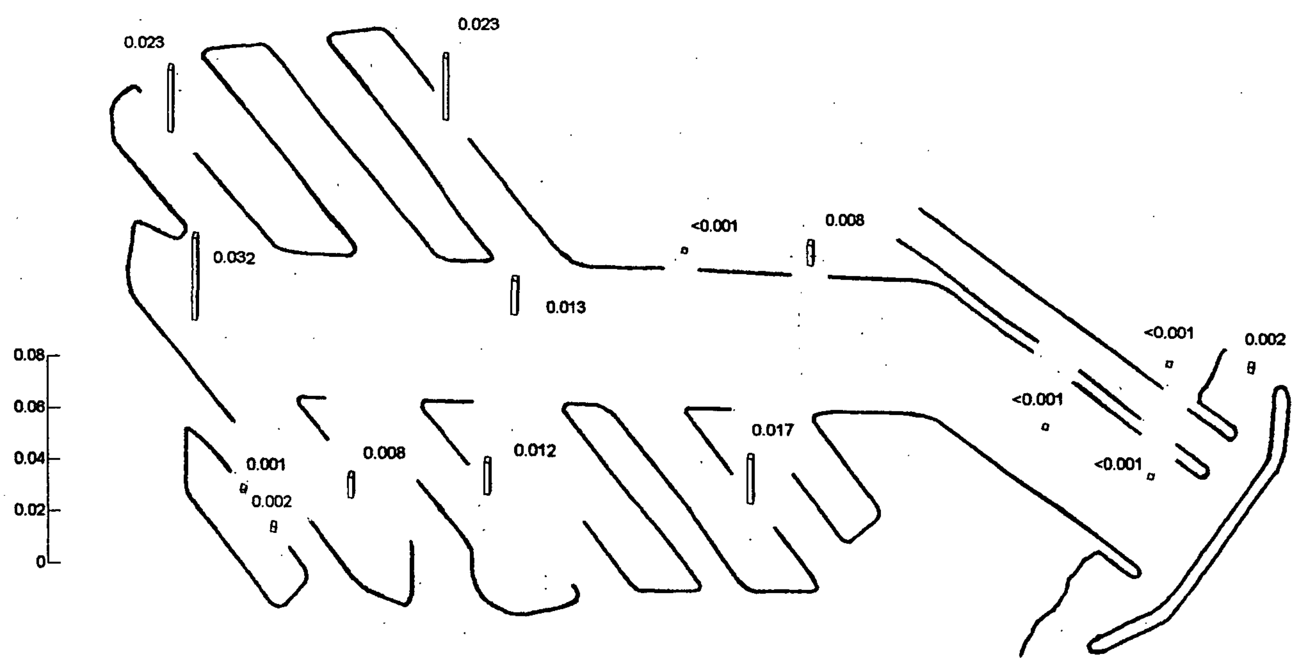


FIGURE 5-12. TRIBUTYL TIN CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



Tributyl tin values compared with past surveys. Tributyl tin was not analyzed by either Los Angeles Harbor or by SCCWRP in their Reference Site Surveys.

Tributyl tin values compared with NOAA effects range ratings. There are no ER-L, ER-M, or AET values listed for tributyl tin, although values at many stations may be high enough to cause chronic toxicity to mollusks and other marine organisms.

5.3.13. Zinc

Zinc is widespread in the environment and is also an essential trace element in human nutrition. It is widely used for marine corrosion protection, enters the waters as airborne particulates, and occurs in runoff and sewage effluent. Acute toxicity of zinc in water to marine fish range from 192 to 320,400 ppm, and chronic toxicity to marine mysid shrimp can occur as low as 120 ppm (Long and Morgan 1990). The normal terrestrial range is from 10 to 300 ppm, with a mean of 50 ppm (Soule et al. 1996).

Spatial zinc patterns. Zinc concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-13. Highest zinc values occurred at Station 11 in the upper channel (339 ppm), Station 25 in mid channel (322 ppm), Station 9 in Basin F (324 ppm), and Station 8 in Basin D (293 ppm). Stations 1 and 3, near the Harbor entrance, had the lowest values (64 and 54 ppm, respectively). Concentrations at other stations ranged from 96 to 207 ppm.

Zinc ranges compared with past years. The range of this year's zinc values (54 to 339 ppm) was within the overall range of past surveys (Table 5-2). Zinc in the Harbor appears to have neither greatly increased nor decreased since 1989.

Zinc values compared with other surveys. The zinc average and range (173 ppm, 54 to 339 ppm) were higher than Los Angeles Harbor (87.5 ppm, 42.2 to 148 ppm), the 1977 SCCWRP Reference Site Survey (45 ppm, 9.8 to 110 ppm), and the 1985 (48 ppm) Survey (Table 5-3).

Zinc values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for zinc are 150, 410, and 260 ppm (Table 5-4). Stations 7, 8, 9, 10, 11, 13 and 25 exceeded ER-L values; and Stations 8, 9, 11, and 25 exceeded AET value. No stations exceeded the ER-M value.

5.3.14. DDT and Derivatives

DDT has been banned since the early 1970's, but the presence of nondegraded DDT suggests that either subsurface DDT is being released during erosion and runoff in storms, or that fresh DDT is still in use and finding its way into the marina (Soule et al. 1996). DDT has been found to be chronically toxic to bivalves as low as 0.6 ppb in sediment. Toxicity of two of DDT's breakdown products, DDE and DDD, were both chronically toxic to bivalve larvae as low as about 1 ppb (Long and Morgan 1990).

Spatial DDT patterns. DDT and derivative concentrations at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-14. Highest combined DDT values were at Station 9 in Basin F (48.6 ppb), Station 25 in mid channel (30.8 ppb), Station 11 in the upper harbor (27.9 ppb) and Station 10 in Basin E (21.0 ppb). Lowest concentrations were found at Stations 1, 3, and 12 at the Harbor entrance (4.4 to 8.6 ppb) and at Stations 13 and 22 in Oxford Lagoon (4.3 and 3.1 ppb, respectively). Concentrations at other stations ranged from 8.2 to 16.8 ppb.

FIGURE 5-13. ZINC CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

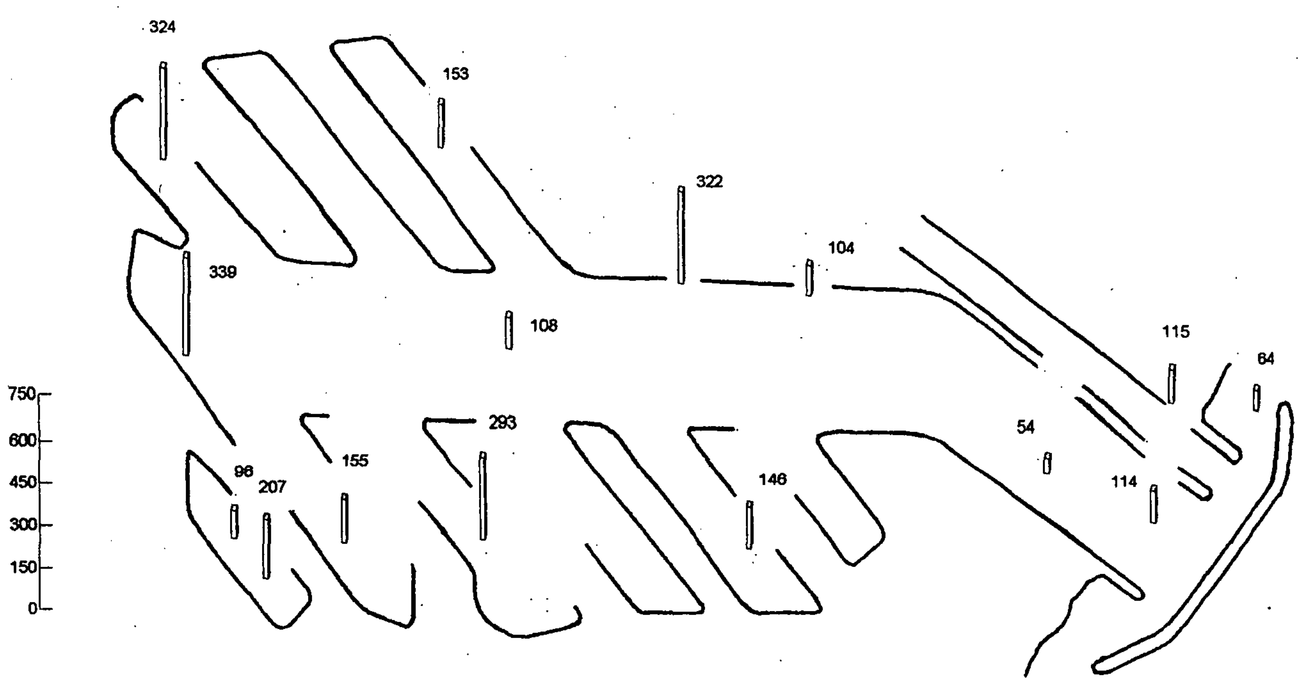
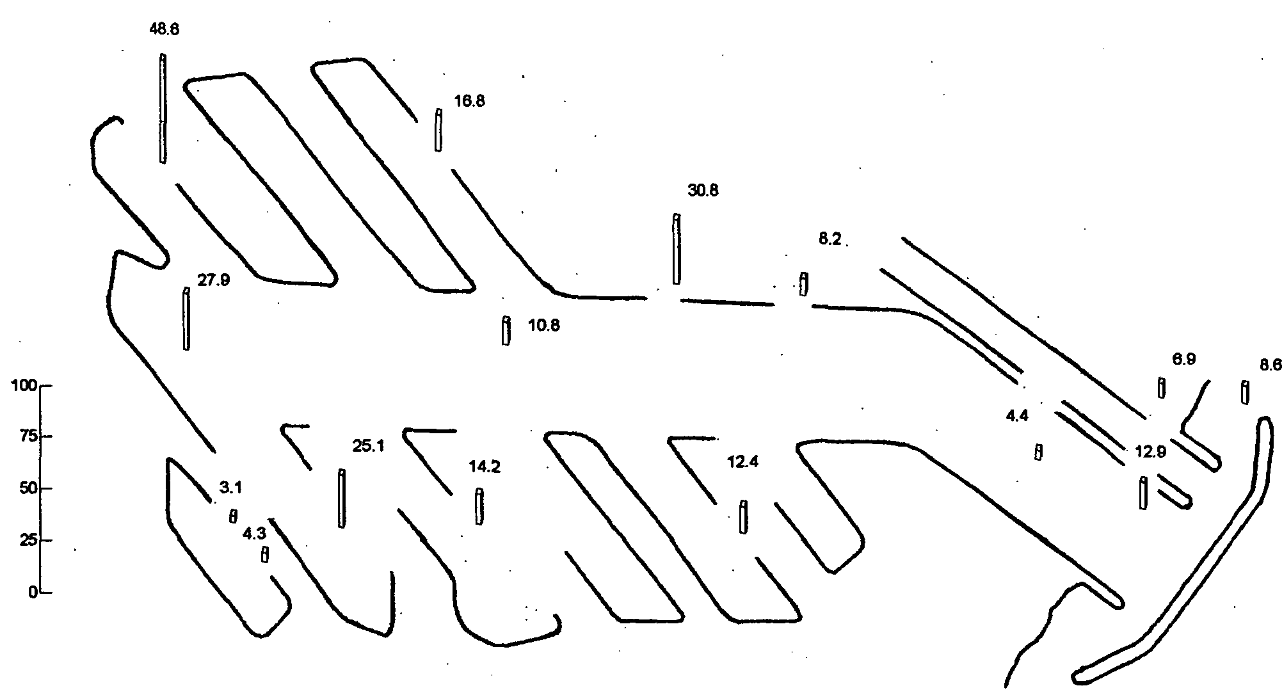


FIGURE 5-14. DDT AND DERIVATIVES CONCENTRATIONS (PPB) AT 15 BENTHIC SEDIMENT STATIONS.



DDT ranges compared with past years. The range of this year's values were <1.0 ppb for DDT, <1.0 ppb for DDD, and 3.1 to 48.6 ppb for DDE. DDT and DDD have declined by an order of magnitude since 1989 (Table 5-2), while concentrations of DDE have remained relatively unchanged.

DDT values compared with other surveys. The Marina del Rey total DDT's average and range (2.8 ppb, <1.0 to 48.6 ppb) were considerably lower than Los Angeles Harbor (94.1 ppb, 29.7 to 196 ppb), the 1977 SCCWRP Reference Site Survey (30 ppb, <3 to 70 ppb), and the 1985 (18.9 ppb) Survey (Table 5-3).

DDT values compared with NOAA effects range ratings. The ER-L, ER-M, and AET values are 1, 7, and 6 ppb for DDT; 2, 20, and 10 ppb for DDD; 2.2, 27, and 7.5 ppb for DDE; and 1.58 and 180 ppb (no AET value listed) for total DDT's (Table 5-4). No stations exceeded these values for DDD. All Stations exceeded the ER-L for DDE. Stations 1, 2, 4, 5, 6, 7, 8, 9, 10, 11 and 25 exceeded the AET value and Stations 9, 11 and 25 exceeded the ER-M value. No stations exceeded the ER-L, ER-M and AET for DDT. All stations exceeded the ER-L for total DDT and derivatives but none exceeded the ER-M. No AET value exists for combined DDT values.

5.3.15. Remaining Chlorinated Pesticides

Concentrations of chlordane between 2.4 and 260 ppm in water are acutely toxic to marine organisms. Heptachlor is acutely toxic in water from 0.03 to 3.8 ppm. Heptachlor epoxide, a degradation product of heptachlor, is acutely toxic to marine shrimp at 0.04 ppm in water to pink shrimp. Dieldrin is acutely toxic to estuarine organisms from 0.7 to 10 ppb. Endrin shows acute toxicity within a range of 0.037 to 1.2 ppb. Aldrin is acutely toxic to marine crustaceans and fish is between 0.32 and 23 ppb. The EPA freshwater and saltwater criteria for aldrin are 3.0 and 1.3 ppb, respectively (Long and Morgan 1990). No toxicity data were found for any of the other chlorinated compounds detected during this survey (Table 5-2).

Spatial remaining chlorinated pesticide patterns. Concentrations of combined chlorinated pesticides (excluding DDT and derivatives) at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-15. Highest combined pesticide values occurred near the Harbor entrance at Station 2 (11 ppb), Station 1 (4.9 ppb) and at Station 12 in Ballona Creek (13 ppb). Station 25 in mid channel also showed a relatively high concentration (11 ppb). Concentrations at all other stations ranged from <1.0 ppb to 1.4 ppb.

Remaining chlorinated pesticide ranges compared with past years. The range of this year's values for all non-DDT chlorinated pesticides was <1.0 to 13.1 ppb (Table 5-2). Concentrations of non-DDT chlorinated pesticides have neither increased nor decreased greatly since 1996. Prior to 1996, few compounds were detected due to higher detection limits.

Remaining chlorinated pesticide values compared with previous surveys. Chlorinated pesticides (other than DDT and derivatives) were not analyzed or could not be determined from surveys in Los Angeles Harbor or SCCWRP Reference Sites.

Remaining chlorinated pesticide values compared with NOAA effects range ratings. The ER-L and ER-M values for chlordane are 0.5 and 6.0 ppb, and 0.02 and 8.0 ppb for dieldrin (Table 5-4). There is no AET for dieldrin; however, the AET for chlordane is 2.0 ppb. There are no effects range ratings for any of the other chlorinated pesticides. For chlordane, Stations 1, 2, 12, 13 and 25 exceeded the ER-L value; Stations 2, 12 and 25

FIGURE 5-15. TOTAL NON-DDT PESTICIDE CONCENTRATIONS (PPB) AT 15 BENTHIC SEDIMENT STATIONS.

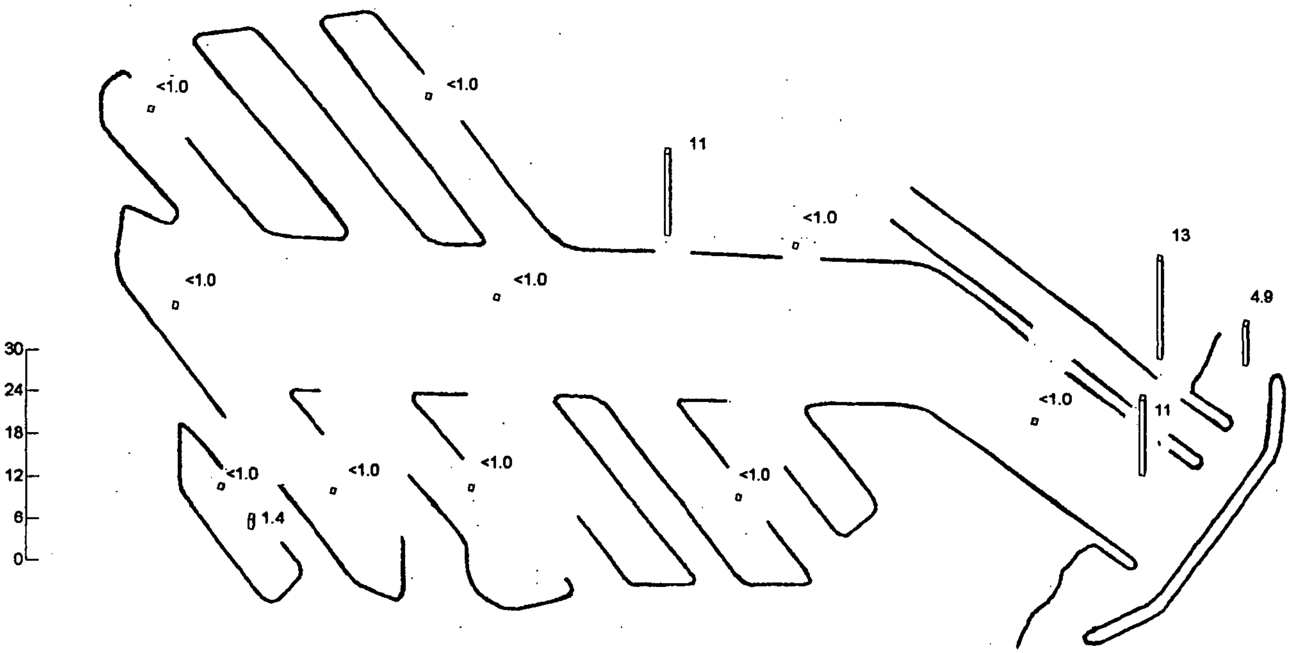
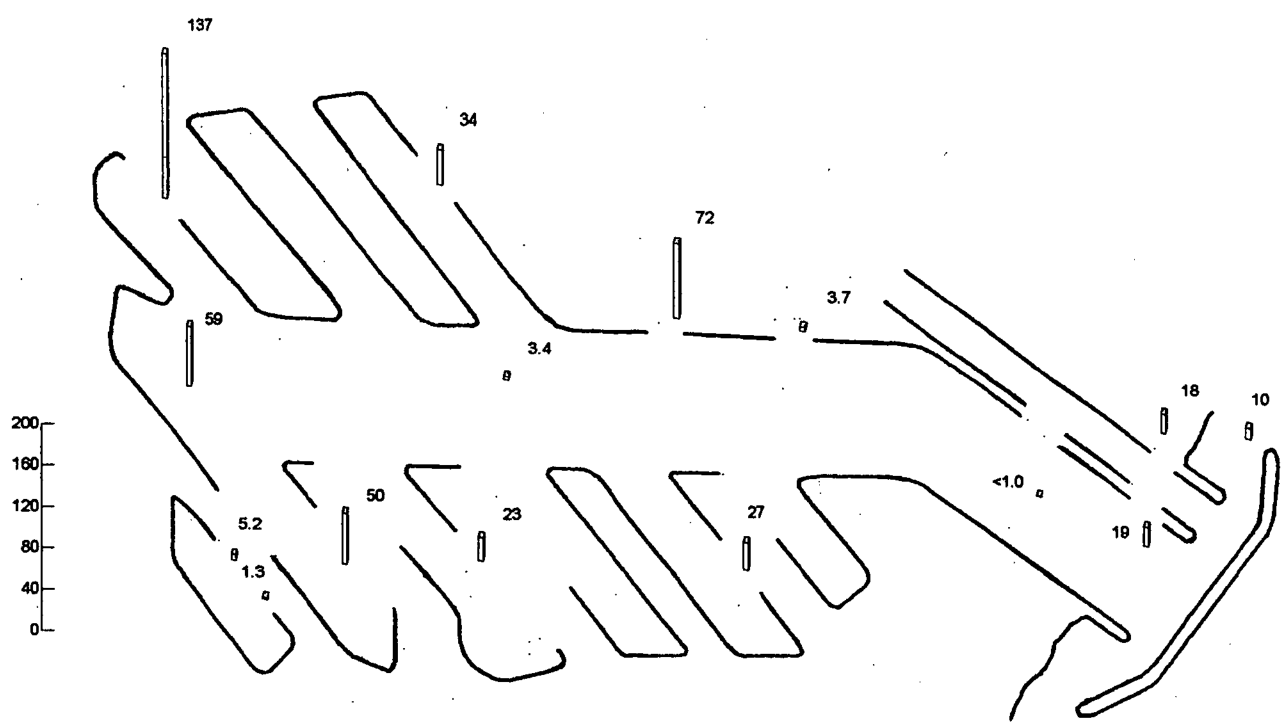


FIGURE 5-16. TOTAL PCB CONCENTRATIONS (PPB) AT 15 BENTHIC SEDIMENT STATIONS.



exceeded the AET and ER-M values and Station 1 exceeded only the AET. For dieldrin, no stations exceeded the ER-L and ER-M values.

5.3.16. **Polychlorinated Biphenyls (PCB's)**

Although PCBs are not pesticides, their similarity to other chlorinated hydrocarbons makes their inclusion in this section appropriate. Before being banned in 1970, the principal uses of PCBs were for dielectric fluids in capacitors, as plasticizers in waxes, in transformer fluids, and hydraulic fluids, in lubricants, and in heat transfer fluids (Laws 1981). Arochlor 1242 was acutely toxic in water to marine shrimp in ranges of 15 to 57 ppm (Long and Morgan 1990).

Spatial PCB patterns. The highest PCB concentration, specifically Arochlor-1254, was detected at Station 9 in Basin F (137 ppb) (Table 5-1, Figure 5-16). High concentrations occurred at Station 25 in mid channel (72 ppb), Station 11 in the back Harbor (59 ppb) and at Station 10 in Basin E (50 ppb). Relatively moderate concentrations occurred at Station 7 in Basin H (34 ppb), Station 6 in Basin B (27 ppb) and Station 8 in Basin D (23 ppb). Concentrations at the Harbor entrance, Station 1 and 2 (10 and 19 ppb, respectively) and at Station 12 in Ballona Creek (18 ppb) were somewhat lower. Concentrations at other stations ranged from <1.0 to 5.2 ppb.

PCB's compared with past years. This year's values for PCBs fell between <10 to 171 ppb (as Arochlor 1254 and 1260) (Table 5-2). PBC concentrations have varied in the past, and do not appear to be decreasing or increasing over time.

PCB's values compared with other surveys. The Marina del Rey total PCB average and range values (30.79, <1.0 to 171 ppb) were comparable relative to Los Angeles Harbor (58.3 ppb, 27.2 to 137 ppb) and higher than the 1977 SCCWRP Reference Site Survey (10 ppb, <2 to 40 ppb) and the 1985 (19.2 ppb) Survey (Table 5-3).

PCB's compared with NOAA effects range ratings. The ER-L, ER-M, and AET values for total PCB's are 22.7, 180, and 370 ppb (Table 5-4). Stations 6, 7, 8, 9, 10, 11 and 25 exceeded the ER-L but not the ER-M or AET values.

5.3.17. **Total Organic Carbon (TOC)**

TOC is a more accurate measure of the amount of carbon derived from plant and animal sources that is percent volatile solids (Soule et al. 1996).

Spatial TOC patterns. Concentrations of TOC at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-17. The highest TOC values were at Station 25 in mid channel (3.0%) and Station 22 in Oxford Lagoon (2.1%). TOC concentrations at the remaining stations ranged from 0.6 to 1.1%.

TOC ranges compared with past years. The range of 2001 values for TOC was 0.63 to 3.0% (Table 5-2), which is well within the ranges of the previous surveys. TOC in the Harbor may have decreased slightly since 1989.

TOC values compared with previous surveys. TOC values were normalized to fine grain Los Angeles Harbor, so they were not comparable to values in this survey. The TOC average and range for Marina del Rey TOC (1.1%, 0.63% to 3.0%) exceeded the 1985 SCCWRP Reference Site Survey average of 0.52% (Table 5-3). TOC was not analyzed in the 1977 SCCWRP Survey.

FIGURE 5-17. TOTAL ORGANIC CARBON CONCENTRATIONS (%) AT 15 BENTHIC SEDIMENT STATIONS.

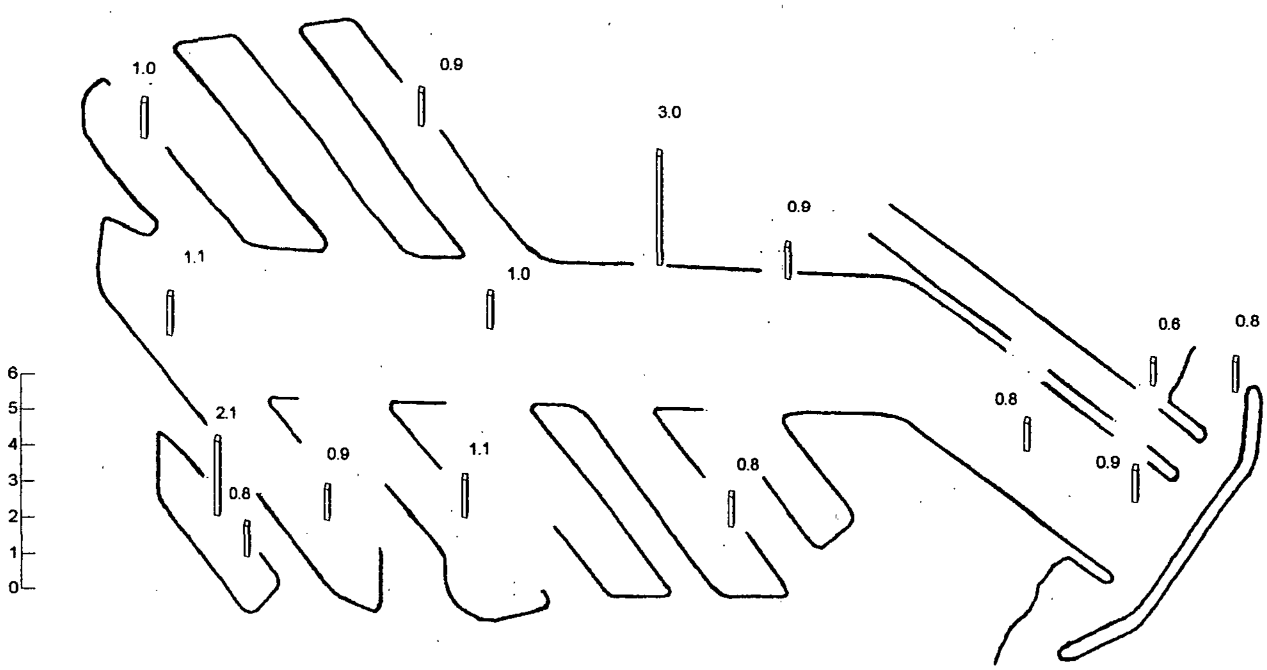
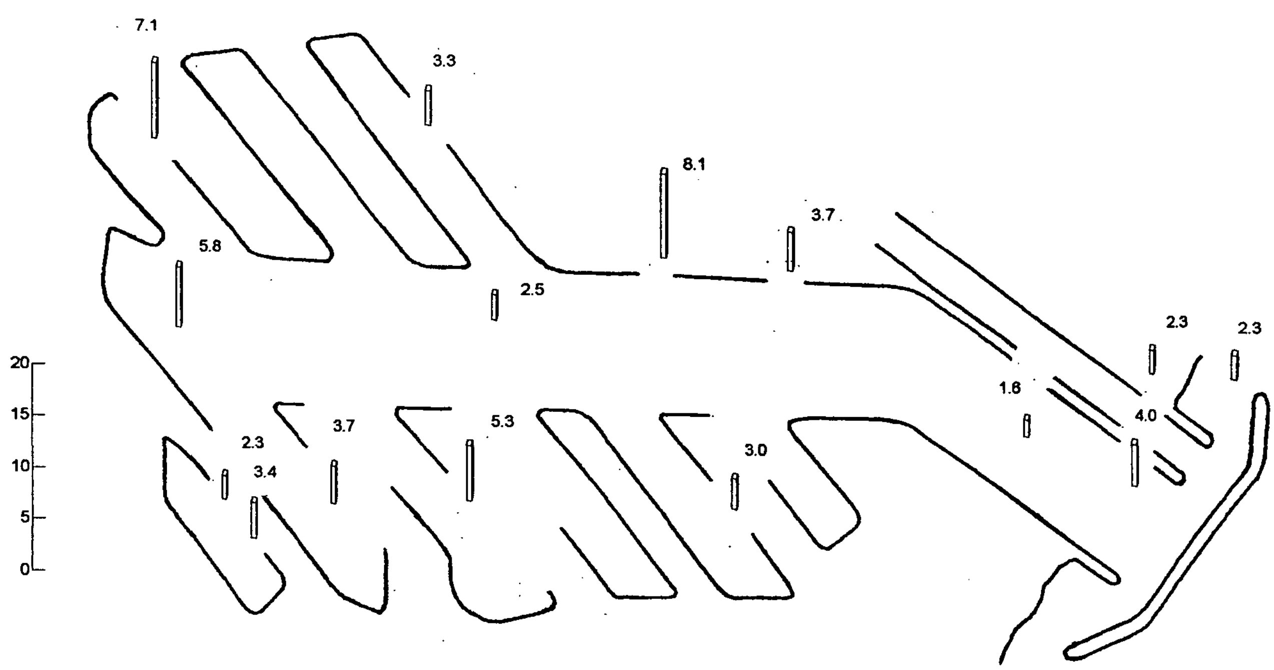


FIGURE 5-18. VOLATILE SOLIDS CONCENTRATIONS (%) AT 15 BENTHIC SEDIMENT STATIONS.



5.3.18. **Volatile Solids**

Percent volatile solids is a measure of the amount of carbonaceous material that can be driven off in a combustion furnace. Volatile solids offer a rough estimation of the organic matter present in sediments (APHA 1995).

Spatial volatile solids patterns. Concentrations of volatile solids at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-18. The highest values were at Station 25 in mid harbor (8.1%) and Station 9 in Basin F (7.1%). Moderate concentrations were found at Station 8 in Basin D (5.3%) and Station 11 in the upper harbor (5.8%). All other volatile solids values ranged from 1.6% to 3.7%.

Volatile solids ranges compared with past years. The range of this year's values for volatile solids was 1.6% to 8.1% (Table 5-2) was within the range of values for the previous 13 years.

Volatile solids values compared with previous surveys. The average and range for Marina del Rey volatile solids (3.9%, 1.6% to 8.1%) are within the 1977 SCCWRP Reference Site Survey (3.3%, 1.8% to 9.5%). Volatile solids were not analyzed in the 1985 SCCWRP Survey or in Los Angeles Harbor (Table 5-4).

5.3.19. **Immediate Oxygen Demand (IOD)**

Immediate Oxygen Demand (IOD) is related to the amount of oxygen (in mg/kg, = ppm) utilized during exposure of a sample to an oxidizing agent for a short time, usually 15 minutes. It measures organic and inorganic content as indicators of the amount of dissolved oxygen that will be removed from the water column or sediment due to bacterial and/or chemical activity (Soule et al. 1996). Since IOD is not a standardized test, no reference values are available. Results for IOD were reported in ppm and were converted to percent to maintain consistency with previous reports.

Spatial IOD patterns. Concentrations of IOD at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-19. Highest values were at the Harbor entrance (Station 2 – 0.077 %) and Basin E (Station 10 – 0.062 %). IOD concentrations at all other stations ranged from 0.006 to 0.050 %.

IOD ranges compared with past years. The range of this year's values for IOD was 0.006 to 0.077 % (Table 5-2). These values are lower compared to the range of values found in earlier studies (<0.001% to 4.0%). It is likely that, since the IOD analysis is a non-standardized methodology, these large differences are related to matrix interference and to differing analytical techniques being used by the previous and present chemistry laboratories.

IOD values compared with previous surveys. IOD was not analyzed from surveys in Los Angeles Harbor or SCCWRP Reference Site Surveys.

5.3.20. **Chemical Oxygen Demand (COD)**

Chemical Oxygen Demand (COD) is measured over a longer period of time than IOD (usually two hours) in the presence of potassium dichromate in sulfuric acid. Like IOD,

FIGURE 5-19. IMMEDIATE OXYGEN DEMAND CONCENTRATIONS (%) AT 15 BENTHIC SEDIMENT STATIONS.

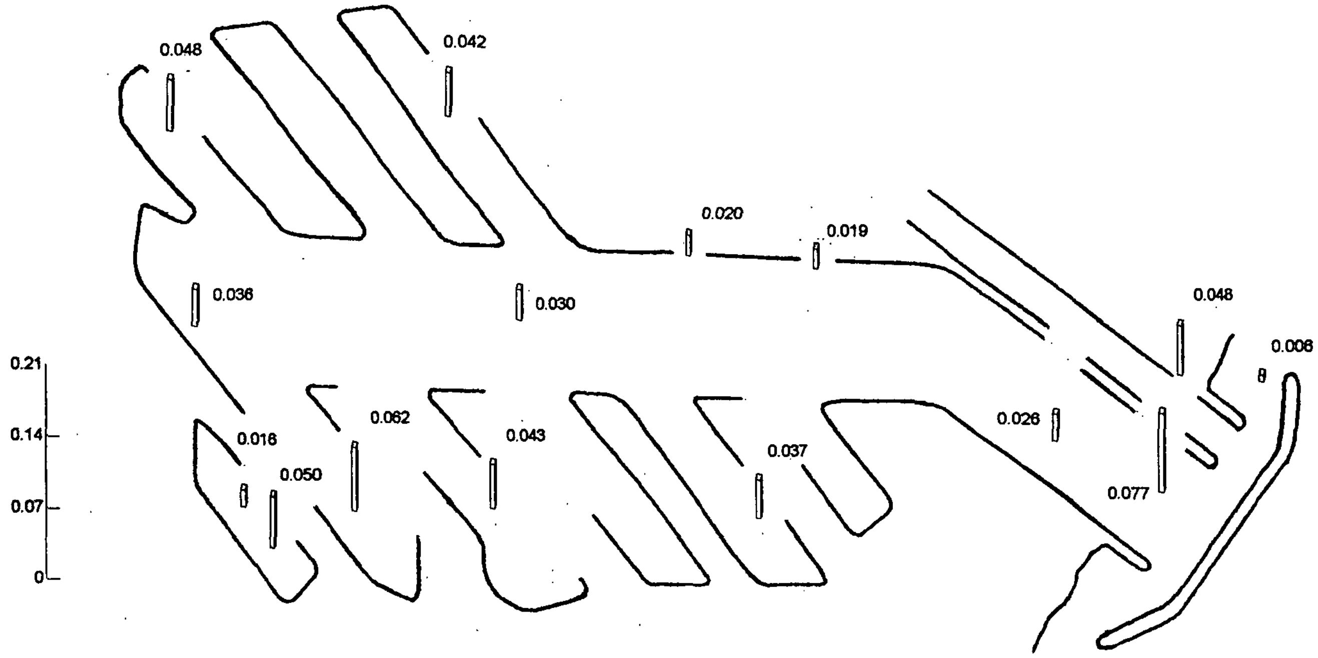
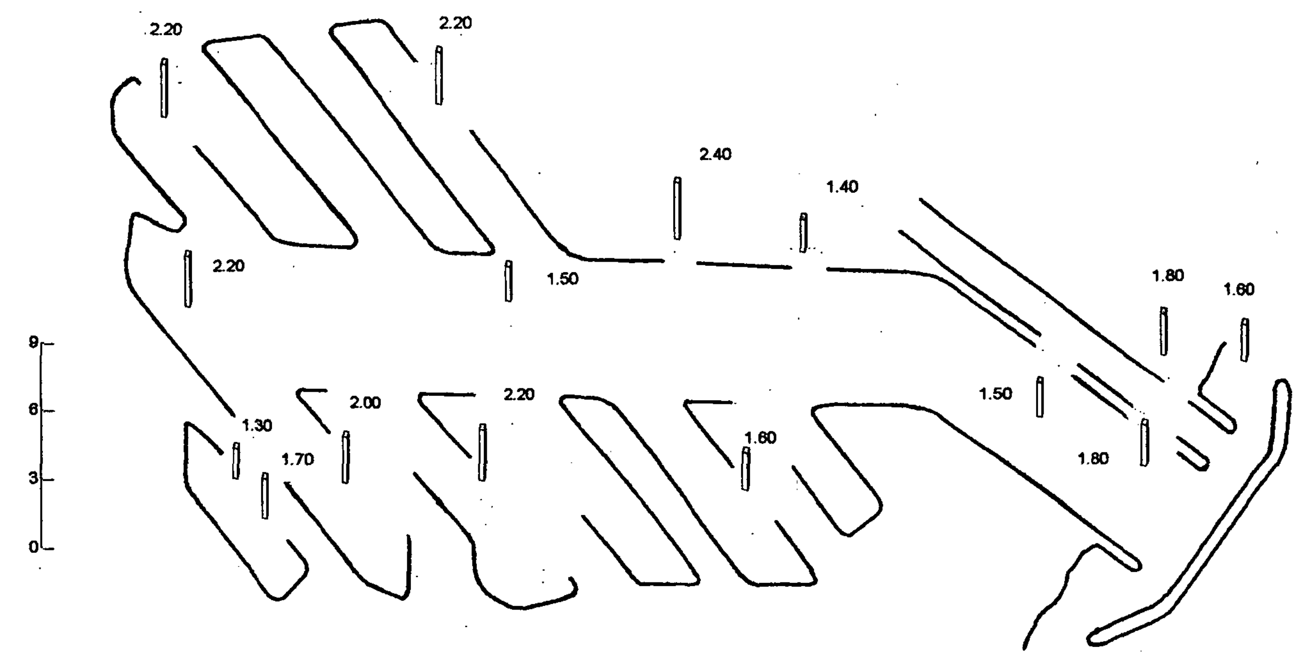


FIGURE 5-20. CHEMICAL OXYGEN DEMAND CONCENTRATIONS (%) AT 15 BENTHIC SEDIMENT STATIONS.



COD measures organic and inorganic content as indicators of the amount of dissolved oxygen that will be removed from the water column or sediment due to bacterial and/or chemical activity. Results for COD were reported in ppm and converted to percent to maintain consistency with previous reports.

Spatial COD patterns. Concentrations of COD at the 15 stations are listed in Table 5-1 and summarized in Figure 5-20. Similar to last year, the highest values were found at Station 25 near the Administration docks (2.4 %), Station 9 in Basin F (2.2 %), Station 11 at the back of the Harbor (2.2 %) and Station 8 in Basin D (2.2 %). The lowest value was found at Station 22 in Oxford Lagoon (1.3 %). Other COD values in the Harbor ranged from 1.4 % to 2.0 %.

COD ranges compared with past years. The range of 2001 values for COD was 1.3 % to 2.4 % (Table 5-2), which is well within the ranges of previous surveys. COD in the Harbor appears have decreased slightly since 1989.

COD values compared with previous surveys. The average and range for Marina del Rey COD (1.83 %, 1.3 % to 2.4 %) were comparable to the 1977 SCCWRP Reference Site Survey (2.4%, 0.92% to 6.94%). COD was not analyzed in the 1985 SCCWRP Survey or in Los Angeles Harbor (Table 5-3).

5.3.21. Oil and Grease

Sources of oil and grease are usually attributed to operations of marina vessels, but the highest values generally have been found in Ballona Creek and Oxford Basin. The extent to which people dump used motor oil into storm drains is unknown and may be a factor. Also, the marina is located in an area of historic oil fields, and oil from seeps may be a natural cause. Kitchen grease, apparently from nearby restaurants, may be a contributor. Station 25 is between the area of the administration building, where the Life Guard, Sheriff's patrol and Coast Guard dock, and Fisherman's Village, where the public fishing and bait boats dock are located. This is an area of concentrated activity of diesel engines prone to oil emission (Soule et al. 1996).

Spatial oil and grease patterns. Oil and grease values for the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-21. The highest value was found at Station 25 in mid channel (3220 ppm). High concentrations were also found at Stations 1, 2, and 12 at the Harbor entrance (1230 ppm, 2320 ppm and 2050 ppm, respectively), Station 10 in Basin E (1570 ppm), Station 22 in Oxford Lagoon (1315 ppm), Station 11 in the upper Harbor (1190 ppm) and Station 9 in Basin F (1720 ppm). Concentrations at all other stations ranged from 361 ppm to 834 ppm.

Oil and grease ranges compared with past years. The range of this year's values for oil and grease was 361 to 3220 ppm, which fell well within the overall range of values for past surveys (Table 5-2) but was higher than the previous five years.

Oil and grease values compared with previous surveys. Oil and grease were not analyzed from surveys in Los Angeles Harbor or SCCWRP Reference Site Surveys.

5.3.22. Organic Nitrogen

Organic nitrogen is present due to the breakdown of animal products. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea, and numerous synthetic organic materials (APHA 1995). Organic nitrogen concentrations were reported by the laboratory in percent dry weight. To maintain consistency with previous

FIGURE 5-21. OIL AND GREASE CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

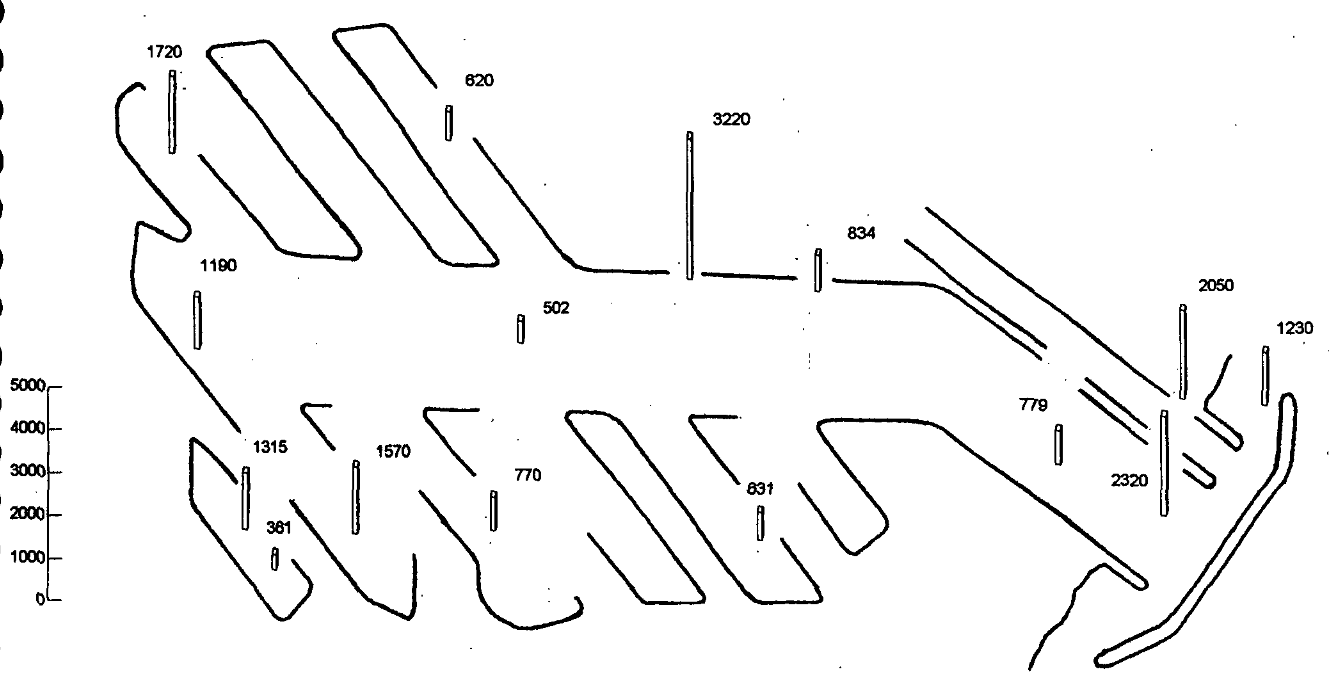
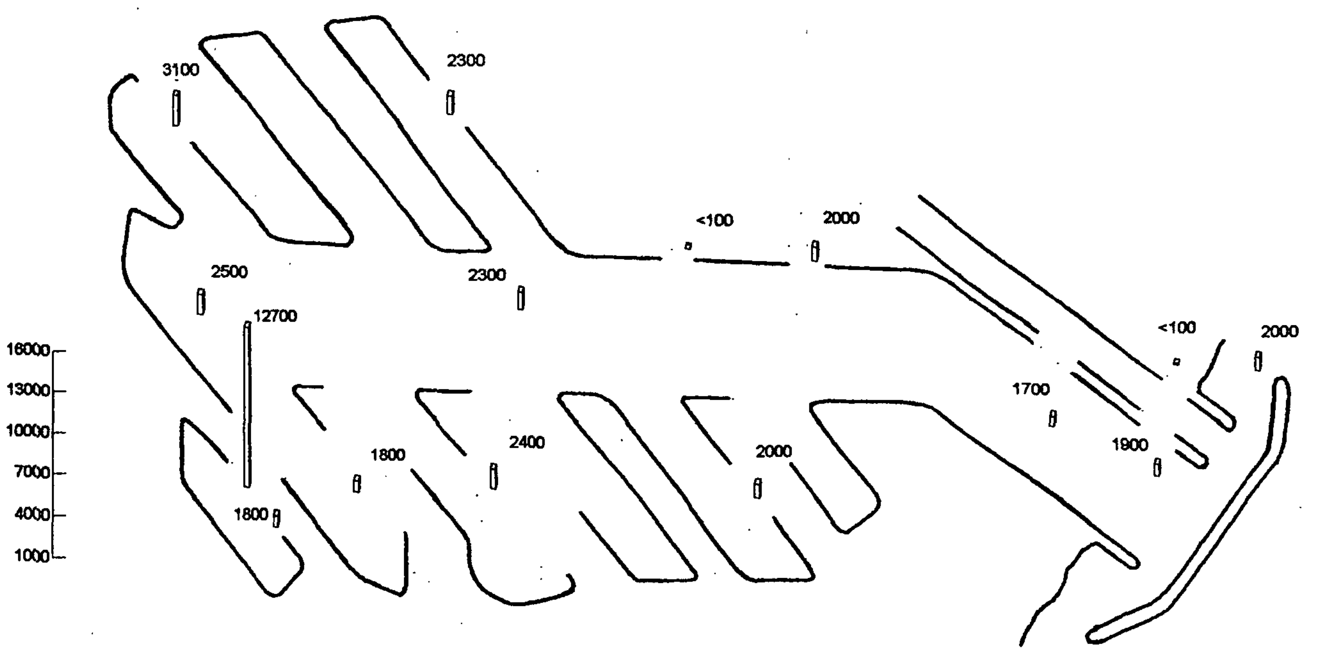


FIGURE 5-22. ORGANIC NITROGEN CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



reports, results and minimum detection limits (MDL) were converted to parts per million (ppm).

Spatial organic nitrogen patterns. Concentrations of organic nitrogen at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-22. The highest value was found at Station 22 in Oxford Lagoon (12,700 ppm). Concentrations at all other stations ranged from <100 to 3,100 ppm.

Organic nitrogen ranges compared with past years. The range of this year's values for organic nitrogen was <100 to 12,700 ppm (Table 5-2) was higher than those of past surveys, however, this was due to one very high value in Oxford Lagoon. Otherwise, organic nitrogen in the Harbor appears to have neither increased nor decreased since 1989.

Organic nitrogen values compared with previous surveys. The average and range for Marina del Rey nitrogen (2567 ppm, <100 to 12,700 ppm) were higher than the range of the 1977 SCCWRP Reference Site Survey (790 ppm, 393 to 1430 ppm). Nitrogen was not analyzed in the 1985 SCCWRP Survey or in Los Angeles Harbor (Table 5-3).

5.3.23. Ortho Phosphate

Phosphorus, as orthophosphate (PO_4) is found in the natural environment in sediments, water and in organic compounds of living organisms. Phosphate use, primarily in detergents, was highest in 1984 through 1987, decreasing by an order of magnitude through 1989 and two orders of magnitude through 1992. Citrates have replaced phosphates in detergents, but there is no database for determining the potential environmental impact. Surfactants in detergents dissolve the protective waxy or oily coatings on organisms and are thus harmful even if they are supposedly non-toxic (Soule et al. 1996). No sediment reference values are available for phosphorus.

Spatial ortho phosphate patterns. Concentrations of ortho phosphate at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-23. Highest values were found at Station 25 in mid channel (203 ppm), Station 11 in the upper Harbor (197 ppm) and Station 9 in Basin F (110 ppm). Station 22 in Oxford Lagoon (90.6 ppm), Station 3 at the Harbor entrance (91.6 ppm) Station 5 in mid channel (80.3 ppm) and Station 8 in Basin D (79.4 ppm) had moderately high concentrations of ortho phosphate. Values in the rest of the Harbor varied from 9.1 to 63.1 ppm.

Ortho phosphate ranges compared with past years. The range of this year's values for ortho phosphate was 9.1 to 203 ppm and is within past ranges (Table 5-2). Concentrations were higher this year compared to 2000-01 but overall, have greatly decreased since 1989.

Ortho phosphate values compared with previous surveys. Ortho phosphate was not analyzed from surveys in Los Angeles Harbor or SCCWRP Reference Site Surveys.

5.3.24. Sulfides

Hydrogen sulfide (H_2S) is an indicator of organic decomposition characterized by a rotten egg smell, occurring particularly in anoxic sediments. No sediment reference values are available for sulfides.

FIGURE 5-23. ORTHO PHOSPHATE CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.

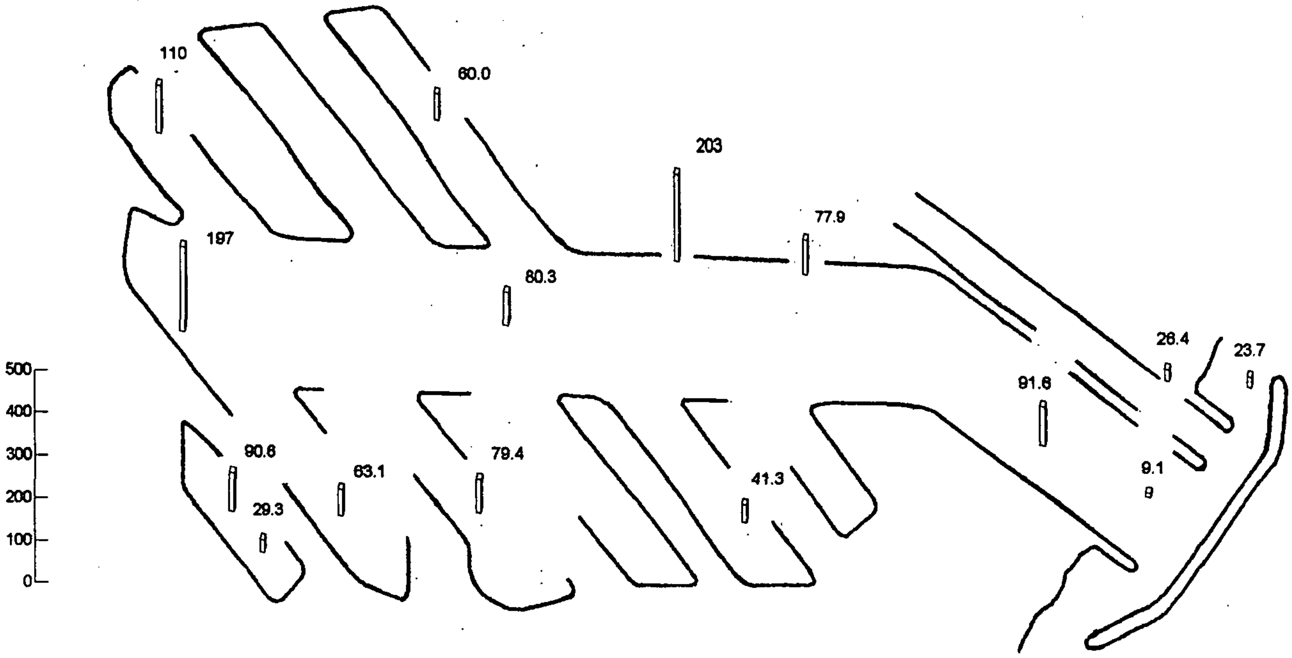
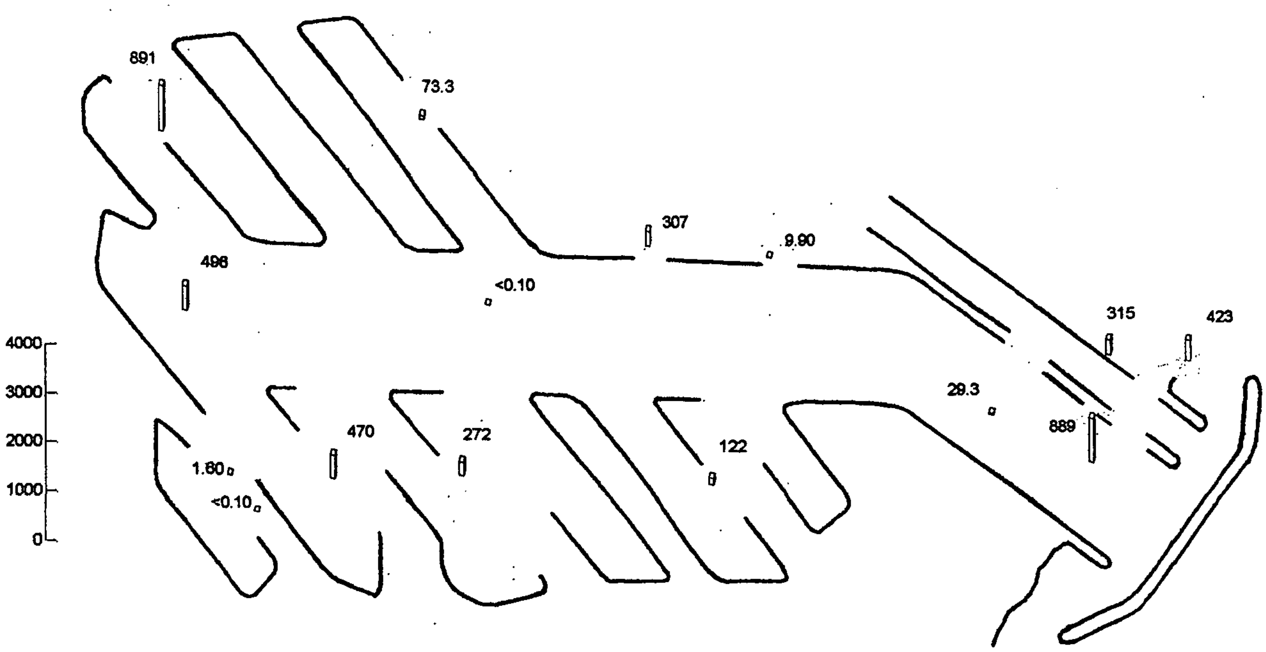


FIGURE 5-24. TOTAL SULFIDE CONCENTRATIONS (PPM) AT 15 BENTHIC SEDIMENT STATIONS.



Spatial sulfide patterns. Concentrations of sulfides at the 15 sampling stations are listed in Table 5-1 and summarized in Figure 5-24. Highest values were reported at Station 9 in Basin F (891 ppm) and Station 2 at the Harbor entrance (889 ppm). Moderate values occurred at Station 1 at the Harbor entrance (423 ppm), Station 11 in the upper Harbor (496 ppm) and Station 10 in Basin E (470 ppm). The lowest values were found at Stations 22 and 13 (1.60 and <0.10 ppm, respectively). Concentrations at the remaining Harbor stations ranged from 9.90 to 315 ppm.

Sulfide ranges compared with past years. The range of this year's values for sulfide was <0.10 to 891 ppm (Table 5-2), which is within the overall range from past surveys. Sulfide concentrations have varied widely over the past thirteen years.

Sulfide values compared with previous surveys. Sulfides were not analyzed for, or were not comparable to, surveys in Los Angeles Harbor or SCCWRP Reference Site Surveys.

5.4. STATION GROUPING BASED ON BENTHIC CONTAMINANTS

Stations were clustered by their similarities to the chemical constituents listed in Table 5-2. The method used is described above for water quality (Section 3.3.3). Station groupings were resolved based upon their similarity or dissimilarity to chemical sediment variables (Figure 5-25).

Station 13. This station is located in Oxford Lagoon. Station 13 contained high concentrations of most heavy metals, pesticides and immediate oxygen demand. Low concentrations of mercury and silver were found as well as low values for most organics. All other constituents were found in moderate quantities. Station 13 receives storm water runoff and also experiences low tidal flushing which may contribute to these results.

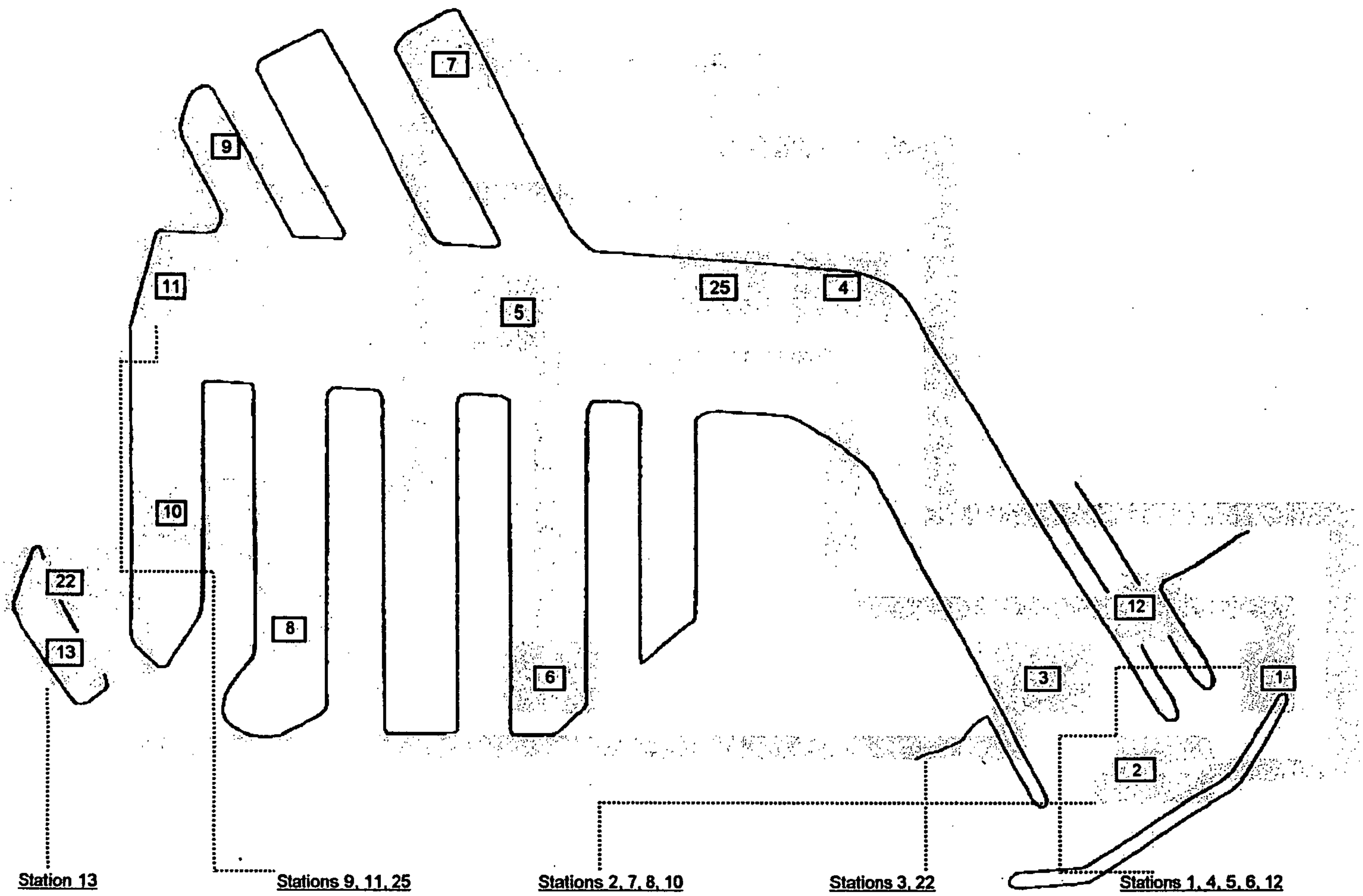
Stations 9, 11 and 25. These stations are located in Basin F, the back channel and mid channel. Stations in this group contained high concentrations of all metals reported, TBT, DDT, pesticides and most organics. Stations 9 and 25 are some of the more high traffic areas which may introduce pollutants and Station 11 is located in a low circulation area which may limit the flushing of contaminants. All other constituents were found in moderate concentrations.

Stations 2, 7, 8 and 10. Stations in this group share high concentrations of pesticides, immediate and chemical oxygen demand. All other constituents were found in moderate quantities. These stations are located at the Harbor entrance and Basins H, D and E.

Stations 3 and 22. These stations had high concentrations of only ortho phosphate and contained low amounts of heavy metals, TBT, DDT and most organics. Station 3 lies near the Harbor entrance and Station 22 lies in Oxford Lagoon. It seems Station 22 does not experience similar contamination levels as the adjacent Station 13. Station 3 is likely influenced more by the open ocean due to it's proximity to the Harbor entrance.

Stations 1, 4, 5, 6 and 12. Station 1 is located at the Harbor entrance, Stations 4 and 5 in mid channel, Station 6 lies in Basin B and Station 12 is in Ballona Creek. This group was low in heavy metals, some organic compounds, DDT, and immediate and chemical oxygen demand. Ballona Creek influences did not appear to exert a strong negative affect on Harbor entrance stations.

FIGURE 5-25. CHEMICAL SEDIMENT CHARACTERISTICS BASED ON BRAY-CURTIS CLUSTERING TECHNIQUE.



Station 13

High in:
Arsenic
Cadmium
Chromium
Iron
Lead
Manganese
Nickel
Zinc
Pesticides
Immediate Oxygen Demand
–
–

Low in:
Mercury
Silver
TOC
Oil and Grease
Organic Nitrogen
Ortho Phosphate
Sulfides

Charateristics:
High in heavy metals, pesticides and Immediate Oxygen Demand.
Low in mecury and silver and other organics.

Stations 9, 11, 25

High in:
Arsenic
Cadmium
Chromium
Copper
Iron
Lead
Manganese
Mercury
Nickel
Selenium
Silver
TBT
Zinc
DDT
Pesticides
TOC
Volatile Solids
COD
Oil and Grease
Ortho Phosphate
Sulfides

Low in:
–

Charateristics:
High in heavy metal organics, pesticides and DDT concentrations.
Moderate in all other constituents.

Stations 2, 7, 8, 10

High in:
Pesticides
Immediate Oxygen Demand
Chemical Oxygen Demand
–
–
–
–
–
–
–

Low in:
–
–
–

Charateristics:
High in pesticides and some organics. Moderate in all other constituents.

Stations 3, 22

High in:
Ortho Phosphate

Low in:
Arsenic
Cadmium
Chromium
Copper
Iron
Lead
Manganese
Mercury
Nickel
Selenium
Silver
TBT
Zinc
DDT
Volatile Solids
Immediate Oxygen Demand
Chemical Oxygen Demand
Sulfides

Charateristics:
Low in DDT, organics, and metals. High in ortho phosphate.

Stations 1, 4, 5, 6, 12

High in:
–

Low in:
Arsenic
Chromium
Copper
Iron
Lead
Manganese
Mercury
Nickel
Selenium
Silver
TBT
Zinc
DDT
TOC
Volatile Solids
Immediate Oxygen Demand
Chemical Oxygen Demand

Charateristics:
Low in heavy metals, DDT and some organics.
Moderate in all other constituents.

5.5. DISCUSSION

As with most past studies, several factors are responsible for distributions of benthic contaminants in Marina del Rey Harbor sediments. Major sources of contaminants are Oxford Lagoon, Ballona Creek, and the resident boat population itself. Other sources, which generally originate from nonpoint locations, contribute to pollution but are difficult to determine. Sediment particle size patterns also influence the distribution of many compounds.

Although the past four surveys (Aquatic Bioassay 1997, 1998, 1999, 2000), predict the highest concentrations of pesticides and DDT remain near the Harbor entrance once introduced by flow through Oxford Lagoon and Ballona Creek, the highest concentrations of DDT and PCBs were found at Stations 5, 9, 10 and 11 in the mid to back harbor and Basins E and F. These contaminants may be moving farther into the Harbor and settling out in the calmer waters and finer sediments of these locations. However, comparatively high concentrations of non-DDT pesticides still occurred at Stations 2, 7, 8 and 10 near the Harbor entrance and in Basins H, D and E and at Station 13 in Oxford Lagoon. Most of the DDT type pesticides were in the form of DDE. Considering the historic use of the area surrounding Marina del Rey as a toxic materials dumpsite, the presence of DDT breakdown products (i.e. DDD and DDE) is not surprising.

Despite declining concentrations of chlorinated hydrocarbons, all Harbor stations exceeded at least one pesticide sediment limit considered by NOAA to be above concentrations where adverse effects may begin to affect resident organisms or could chronically impact sensitive or younger marine organisms. Additionally, only Stations 3, 13 and 22 did not exceed the higher limits (ER-M and/or AET) for one or more pesticides, where effects are frequently or always observed or predicted among most species (Long and Morgan 1990, Long et. al. 1995). For PCB concentrations, Stations 6, 7, 8, 9, 10, 11 and 25 exceeded the ER-L criteria but none were higher than the ER-M or AET. Station 9 in Basin F produced the highest concentration of PCB. Average, total DDT and PCB concentrations in Marina del Rey Harbor sediments are much lower than those of Los Angeles Harbor, however, PCB concentrations were higher than the 1977 and 1985 SCCWRP Reference Site Surveys (Table 5-3).

Oxford Lagoon may still be a source of heavy metals to the Harbor but Stations 9, 11 and 25, located in the mid to back and basins, contain most of the metal concentrations. Many of these toxicants likely result from the historical industrial land uses of the Marina and were released by dredging or introduced through boating activity. These areas are in or next to the more highly traveled and used locations in the marina. Station 9 lies next to the boat launching ramp and parking lot which may introduce pollutants from cars. Metal components and boat engines constantly corrode from exposure to salt water and air. Anti-fouling paints contain heavy metals such as copper and tributyl tin that are designed to constantly ablate or leach out to effectively reduce fouling organisms. Short of banning these products, sediments in the Harbor will likely continue to accumulate heavy metals in toxic amounts. Arsenic, chromium, mercury, silver, lead and zinc concentrations were also found in toxic concentrations. Only Station 22 did not exceed any potentially toxic limits of any metals. Remaining stations exceeded one or more metal limit of "probable" toxicity to marine organisms, based on NOAA criteria.

Most heavy metal concentrations in Marina del Rey sediments exceeded the average and range of values measured in Los Angeles Harbor sediments often by a factor of two or more. Los Angeles Harbor, with two entrances, likely maintains better flushing compared to Marina del Rey Harbor with only one entrance. Additionally, the boat population per unit area in Marina del Rey may be higher than in Los Angeles Harbor. Most concentrations greatly exceeded those collected along the open coast.

Except for tributyl tin, heavy metal concentrations have varied since 1989, but haven't greatly increased nor decreased over time. Tributyl tin, which is present in many boat hull paints, is capable of causing deformities and partial sex reversal in mollusks, as well as acute toxicity in crustaceans, at part per *trillion* levels (Kusk and Peterson 1997). This level is much lower than those found in Marina del Rey sediments. Although not listed by NOAA as toxic, boat paints containing tributyl tin are banned from use in Marina del Rey Harbor.

Nonspecific organic materials (nutrients, oil and grease, carbonaceous organics, etc.) are not usually considered toxic, however, elevated levels in the sediment can cause anoxic conditions near the Harbor bottom which might denigrate sensitive fish and invertebrate habitats. Sources of nonspecific organic pollutants vary. Station 25, located between the public fishing and administration docks in mid harbor contained several organic materials. Frequently used for fishing, this attracts birds and dogs which, when combined with high boat traffic and compounded by low rainfall, organic materials could build up quickly.

Sediments in stations located in the Basins and mid channel contained organic nitrogen, and Stations 5, 9, 10 and 11 also contained ortho phosphate. Oil and grease was found in high quantities at Station 25 in mid channel. Stations 25 and 4, although close in location, did not influence each other as much this year. Various natural and anthropogenic seepages from boats and other nonpoint runoff undoubtedly contribute considerable amounts of organics to the benthos. Among the compounds historically measured (TOC, volatile solids, COD, and organic nitrogen), organic nitrogen values were higher than the 1979 SCCWRP Reference Site Survey, all other results were comparable. No NOAA limits for any nonspecific organic compounds exist.

As discussed in the past four annual reports (Aquatic Bioassay 1997, 1998, 1999, 2000), Harbor sediments that are composed of finer particles, such as silt and clay, also tend to be highest in heavy metals and organics. Sediments with particle sizes dominated by finer components tend to attract many chemical contaminants more readily. Conversely, sediments containing mostly sand and course silt tended to be lower in organics and heavy metals. The exception appears to be chlorinated hydrocarbons that do not appear to show any strong relationship to smaller particle size. Thus, many of the areas that have high concentrations of metals and nonspecific organics tend to be areas of relatively fine sediments.

6. BIOLOGICAL CHARACTERISTICS OF BENTHIC SEDIMENTS

6.1. BACKGROUND

The benthic community is composed of those species living in or on the bottom (benthos); the community is very important to the quality of the habitat because it provides food for the entire food web including juvenile and adult pelagic bottom feeders. Usually polychaete annelid worms, molluscans, and crustaceans dominate the benthic fauna in shallow, silty, sometimes unconsolidated, habitats. In areas where sediments are contaminated or frequently disturbed by natural events such as storms or by manmade events, the fauna may be dominated temporarily by nematode round worms, oligochaete worms, or polychaete worms tolerant of low oxygen/high organic sediments. Storms or dredging can cause faunas to be washed away or buried under transported sediment, or can cause changes in the preferred grain size for particular species. Excessive runoff may lower normal salinities, and thermal regime changes offshore may disturb the species composition of the community.

Some species of benthic organisms with rapid reproductive cycles or great fecundity can out-compete other organisms in recolonization, at least temporarily after disturbances, but competitive succession may eventually result in replacement of the original colonizers with more dominant species. Species with planktonic eggs or larvae may recolonize due to introduction on tidal flow from adjacent areas, while less mobile species may return more slowly, or not at all. In general, nematodes are more tolerant of lowered salinities and disturbances. (Soule et al. 1996).

6.2. MATERIALS AND METHODS

Field sampling for all benthic sediment components is described above in Section 4.2. Sediments to be analyzed for infaunal content were sieved through 1.0 and 0.5 millimeter screens. The retained organisms and larger sediment fragments were then washed into one-liter or four-liter plastic bottles (as needed), relaxed with magnesium sulfate, and preserved with 10% buffered formalin. Taxonomic experts from Osprey Marine Management in Costa Mesa, California identified animals. A complete list of infauna is included in Appendix 9.3.

6.3. RESULTS

6.3.1. **Infaunal Abundance**

The simplest measure of resident animal health is the number of infauna individuals collected per sampling effort. For this survey, numbers of individuals were defined as all of the non-colonial animals collected from one Van Veen Grab (0.1 square meter) per station and retained on either a 0.5 mm or 1.0 mm screen.

As has been stated by other authors (i.e. SCCWRP 1979), abundance is not a particularly good indicator of benthic infaunal health. For example, some of the most populous benthic areas along the California coast are those within the immediate vicinity of major wastewater outfalls. The reason for this apparent contradiction is that environmental stress can exclude many sensitive species from an area. Those few organisms that can tolerate the stressful condition (such as a pollutant) may flourish because they have few competitors. If an area becomes too stressful, however, even the tolerant species cannot survive, and the numbers of individuals decline, as well.

Spatial infaunal abundance patterns. Numbers of individuals at the 13 infaunal sampling stations are listed in Table 6-1 and summarized in Figure 6-1. Counts per grab ranged from 357 to 10,390 individuals. Lowest total abundance was at Station 9 in Basin F (357 individuals) and Station 11 in the upper Harbor (379 individuals). Highest values occurred at Station 12 in Ballona Creek (10,390 individuals), followed by Station 25 in mid channel (6,928 individuals), and Station 2 at the Harbor entrance (6,399 individuals). Moderate individual numbers were found at Stations 1 and 3 at the Harbor entrance (2,847 and 2,982 individuals, respectively), Stations 4 and 5 in mid channel (2,191 and 1,385 individuals, respectively), Station 6 in Basin B (1,852 individuals) and Station 10 in Basin E (2,165 individuals). Other stations ranged from 690 to 984 individuals.

Infaunal abundance patterns compared with past years. Table 6-2 lists abundance ranges per station since 1977. The range of individuals collected this year was 357 to 10,390, which is higher that the 2000-01 survey values but not uncommon over the past 17 years listed. Past surveys show that abundance varies widely.

Infaunal abundance values compared with other surveys. The Marina del Rey abundance average (3,042 individuals) and range (357 to 10,390 individuals) were much higher than in Los Angeles Harbor (105 individuals, 5 to 330 individuals) and the 1979 (422 species, 91 to 1213 individuals) and the 1987 (348 individuals) SCCWRP Reference Site Surveys (Table 6-3).

6.3.2. **Infaunal Species**

Another simple measure of population health is the number of separate infaunal species collected per sampling effort (i.e. one Van Veen Grab per station). Because of its simplicity, numbers of species is often underrated as an index. However, if the sampling effort and area sampled are the same for each station, this index can be one of the most informative. In general, stations with higher numbers of species per grab tend to be in areas of healthier communities.

Spatial infaunal species patterns. Species counts at the 13 sediment-sampling stations ranged from 25 to 96 per grab (Table 6-1 and Figure 6-2). Lowest species numbers were in the back Harbor and at the ends of Basins B, D and F (Stations 5, 6, 7, 8, 9 and 11 - 25 to 46 species). Highest values were at the Harbor entrance (Stations 1, 3 and 12 - 71 to 96 species) and mid channel (Stations 4 and 25 – 58 and 64 individuals, respectively).

Infaunal species patterns compared with past years. Table 6-2 lists the ranges of species collected per station since 1977. The range of species collected this year was 25 to 96, which falls within the overall range of values for past surveys but more species were found this year than in the past eight years.

Infaunal species values compared with other surveys. The Marina del Rey species count average (50 species) and range (25 to 96 species) were higher than the Los Angeles Harbor (35 species, 5 to 64 species), but lower than the 1979 (72 species, 32 to 135 species) and 1987 (68 species) SCCWRP Reference Site Surveys (Table 6-3).

TABLE 6-1. INDIVIDUALS, SPECIES DIVERSITY, DOMINANCE AND INFAUNAL INDEX VALUES AT 13 BENTHIC SEDIMENT STATIONS.

	STATIONS												
INDEX	1	2	3	4	5	6	7	8	9	10	11	12	25
No. Individuals[1.]	2847	6399	2982	2191	1385	1852	690	984	357	2165	379	10390	6928
No. Species	96	49	73	58	46	30	27	25	35	40	38	71	64
Diversity (SWI)	1.85	0.77	2.28	1.98	2.45	1.94	1.64	2.03	2.38	1.85	2.48	1.32	1.77
Infaunal Index	66.4	63.1	55.5	70.1	75.6	70.2	66.2	77.5	74.4	62.3	63.2	65.3	61.3
Dominance	0.22	0.09	0.48	0.40	0.59	0.43	0.30	0.50	0.58	0.30	0.56	0.11	0.34

[1.] To determine individuals per square meter, multiply by ten.

TABLE 6-2. RANGES OF INDIVIDUALS, SPECIES, AND DIVERSITY - SEPTEMBER 1978 THROUGH OCTOBER 2001.

	POPULATION INDICES				
DATE	Individuals	Species	Diversity	Dominance	Infaunal Index
Sep-78	177 - 1555	15 - 66	—	—	—
Oct-84	242 - 1270	19 - 60	1.81 - 3.09	—	—
Oct-85	196 - 1528	20 - 51	1.06 - 2.78	—	—
Oct-86[1.]	275 - 22,552	18 - 79	1.49 - 2.48	—	—
Oct-87	189 - 4216	12 - 50	1.19 - 2.76	—	—
Oct-88	63 - 5651	11 - 74	0.76 - 2.95	—	—
Oct-89[2.]	36 - 7610	10 - 72	0.58 - 2.99	—	—
Oct-90	153 - 9741	18 - 69	0.82 - 2.33	—	—
Oct-91	85 - 31,006	14 - 121	0.44 - 2.34	—	—
Oct-92	100 - 2080	10 - 55	1.51 - 2.34	—	—
Oct-94	120 - 105,390	15 - 70	0.48 - 2.83	—	—
Oct-95	65 - 7084	11 - 66	1.17 - 2.91	—	—
Oct-96	216 - 12,640	28 - 78	0.92 - 3.03	0.12 - 0.71	27 - 71
Oct-97	109 - 4818	20 - 88	0.98 - 2.81	0.13 - 0.70	30 - 77
Sep-98	241 - 32,760	18 - 77	1.24 - 2.43	0.22 - 0.65	58 - 72
Oct-99	80 - 16,933	24 - 68	0.48 - 2.79	0.04 - 0.70	61 - 86
Oct-00	199 - 4286	19 - 94	1.44 - 3.33	0.20 - 0.75	48 - 84
Overall Range	**36 - 105,390**	**10 - 121**	**0.44 - 3.33**	**0.04 - 0.75**	**27 - 86**
Oct-01	357 - 10,390	25 - 96	0.77 - 2.48	0.09 - 0.59	56 - 78

[1.] No sample at Station 2 due to dredging.
[2.] Stations 12 and 25 added this year.

TABLE 6-3. AVERAGES AND RANGES OF INFAUNAL VARIABLES FROM 13 BENTHIC SEDIMENT STATIONS COMPARED TO SCCWRP REFERENCE AND LOS ANGELES HARBOR SEDIMENT SURVEYS.

	MARINA DEL REY		L.A. HARBOR		SCCWRP (1979)		SCCWRP (1987)
INDEX	AVG.	INDEX RANGE	AVG.	INDEX RANGE	AVG.	INDEX RANGE	AVERAGE
No. Individuals	**3042**	**357 - 10,390**	105	5 - 330	422	91- 1213	348
No. Species	**50**	**25 - 96**	35	5 - 64	72	32 - 135	68
Diversity (SWI)	**1.9**	**0.77 - 2.48**	2.92	1.59 - 3.72	3.12	2.19 - 3.98	–
Infaunal Index	**67**	**56 - 78**	74	67 - 83	88	60 - 98	–

FIGURE 6-1. NUMBER OF INFAUNAL INDIVIDUALS AT 13 BENTHIC SEDIMENT STATIONS.

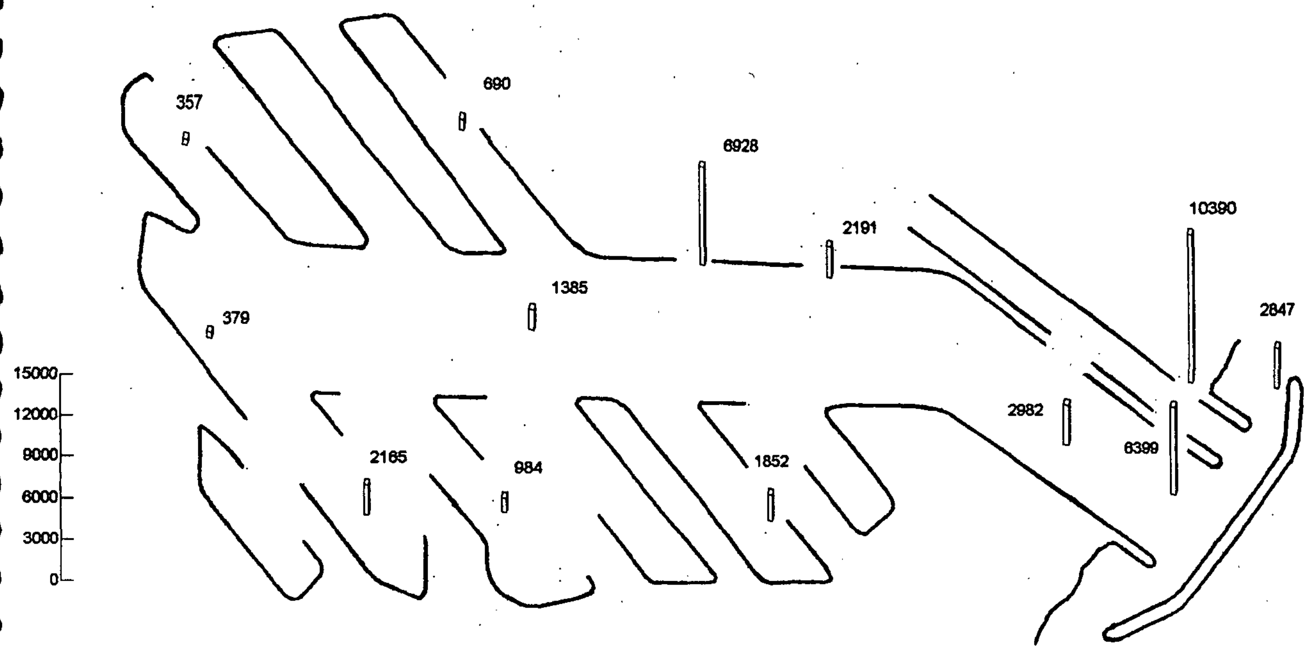
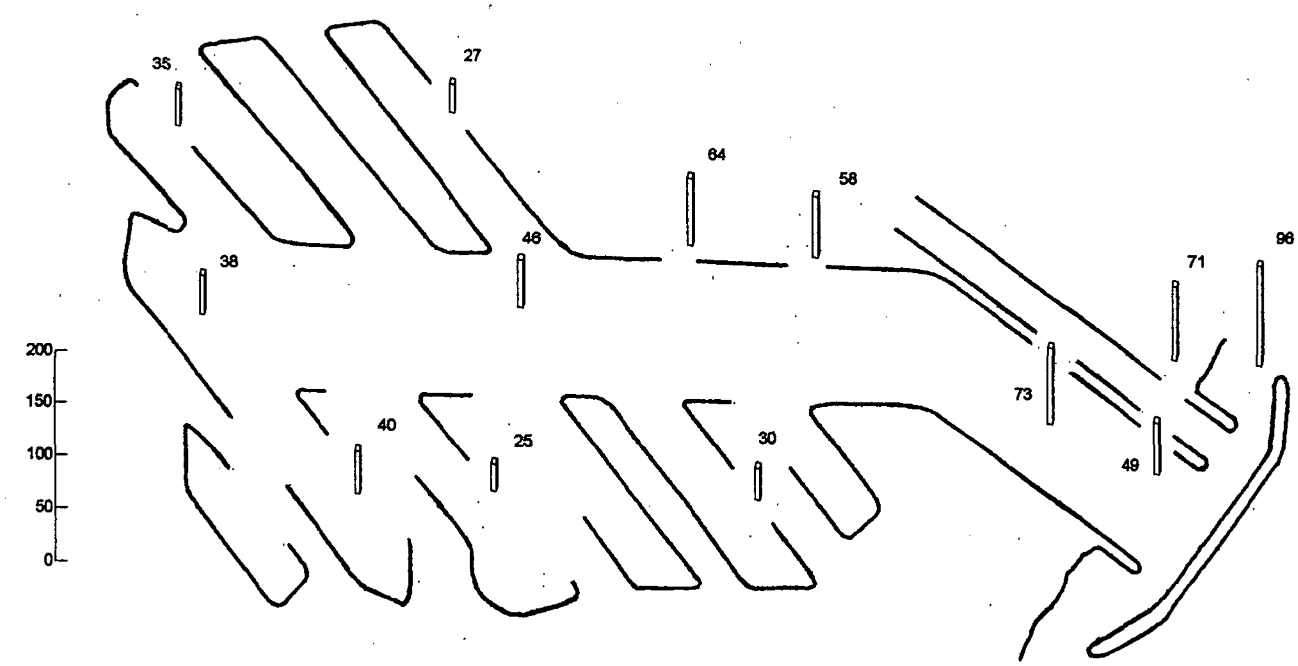


FIGURE 6-2. NUMBER OF INFAUNAL SPECIES AT 13 BENTHIC SEDIMENT STATIONS.



6.3.3. **Infaunal Diversity**

The Shannon species diversity index (Shannon and Weaver 1963), another measurement of community health, is similar to species count; however it contains an evenness component as well. For example, two samples may have the same numbers of species and the same numbers of individuals. However, one station may have most of its numbers concentrated into only a few species while a second station may have its numbers evenly distributed among its species. The Shannon diversity index would be higher for the latter station.

Spatial infaunal diversity patterns. Diversity index values at the 13 sediment-sampling stations ranged from 0.77 to 2.48 (Table 6-1 and Figure 6-3). The lowest diversity value (0.77) was at Station 2 at the Harbor entrance which had a high number of Nematode worms (5200 individuals). Highest values were found in the mid channel, Station 3 (2.28), Station 5 (2.45), Station 11 (2.48) and in Basins F (Station 9 – 2.38) and D (Station 8 – 2.03).

Infaunal diversity patterns compared with past years. Table 6-2 lists the ranges of diversity values calculated per station since 1984. The range of values this year was 0.77 to 2.48, which is comparable to past surveys. Diversity indices had not been calculated prior to 1984.

Infaunal diversity values compared with other surveys. The Marina del Rey diversity average (1.90) and range (0.77 to 2.48) were lower than Los Angeles Harbor (2.92, 1.59 to 3.72) and the 1979 SCCWRP Reference Site Survey (3.12, 2.19 to 3.98). No diversity values were calculated in the 1987 SCCWRP Survey (Table 6-3).

6.3.4. **Infaunal Dominance**

The community dominance index measures to what degree the two most abundant species in each sample dominate (McNaughton 1968). The author has modified the index so that when the top two species strongly dominate the sample population, the index is lower, and when they are less dominant the index is higher. The infaunal environment generally tends to be healthier when the modified dominance index is high, and it tends to correlate well with species diversity.

Spatial infaunal dominance patterns. Dominance values at the 13 sediment sampling ranged from 0.09 to 0.59 (Table 6-1 and Figure 6-4). The lowest dominance values were near the Harbor entrance (Stations 1, 2 and 12 - 0.09 to 0.22). Some of the highest values occurred near the Harbor entrance (Station 3 - 0.48), mid channel (Station 5 – 0.59) and Basin D (Station 8 – 0.50). High values also occurred in Basin F (Station 9 – 0.58) and Station 11 in the back harbor (0.56).

Infaunal dominance patterns compared with past years. The dominance range (0.09 to 0.59) was lower compared to those of the past five years (Table 6-2). Dominance indices had not been calculated previous to 1996.

Infaunal dominance values compared with previous surveys. Dominance was not analyzed in, or was not comparable to, studies in Los Angeles Harbor or SCCWRP Reference Site Surveys.

FIGURE 6-3. INFAUNAL DIVERSITY AT 13 BENTHIC SEDIMENT STATIONS.

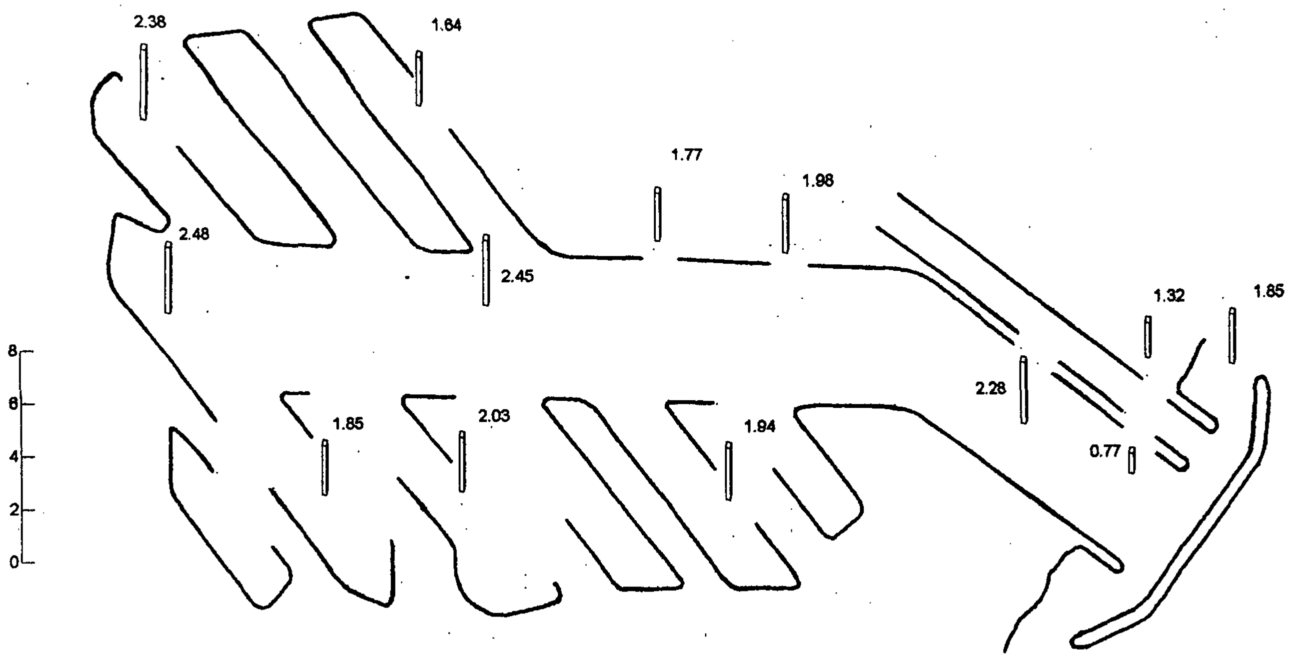
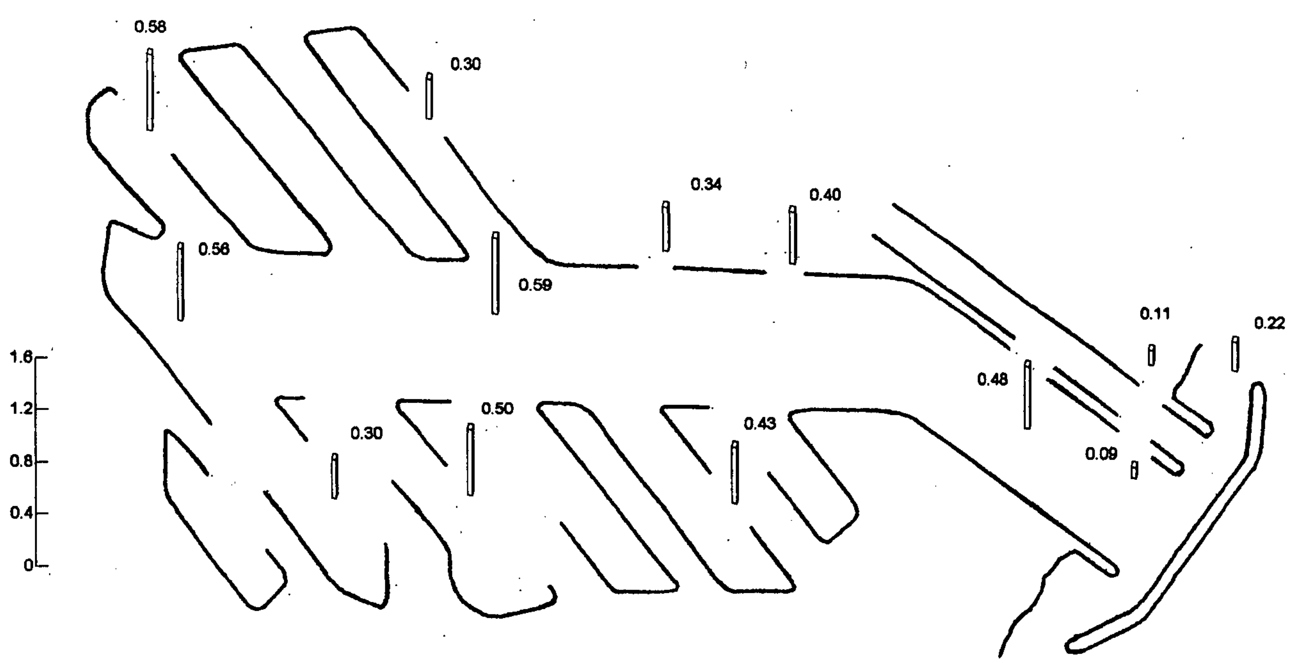


FIGURE 6-4. INFAUNAL DOMINANCE AT 13 BENTHIC SEDIMENT STATIONS.



6.3.5. Infaunal Trophic Index

The infaunal trophic index (SCCWRP 1978, 1980) was developed to measure the feeding modes of benthic infauna. Higher values denote California species assemblages dominated by suspension feeders, which are more characteristic of unpolluted environments. Lower index values denote assemblages dominated by deposit feeders more characteristic of sediments high in organic pollutants (e.g. near major ocean outfalls). SCCWRP has also provided definitions for ranges of infaunal index values. Values that are equal to 60 or above indicate "normal" bottom conditions. Values between 30 and 60 indicate "change", and values below 30 indicate "degradation". The infaunal trophic index is based on a 60-meter depth profile of open ocean coastline in southern California. Therefore, its results should be interpreted with some caution when applied to Harbor stations. Also note that nematode worms, which are indicative of disturbed sediment environments (see Section 6.1, above), are not included in the infaunal trophic index. This may be because the index is based on a sieve size four times as large as that used in this survey and nematodes probably pass through. Nematodes may also be less common in the open ocean.

Spatial infaunal trophic index patterns. Infaunal trophic index values at the 13 sampling stations ranged from 55 to 77 (Table 6-1 and Figure 6-5). Similar to last year, the lowest infaunal index value occurred at Station 3 near the Harbor entrance (55). The highest values occurred at Station 8 in Basin D (78), Station 5 in mid channel (76), and Station 9 in Basin F (74). All stations except Station 3 had index values (61 to 77) and were defined as "normal" (60 and above).

Infaunal trophic index patterns compared with past years. The infaunal index range (55 to 78) was within the range of the past four years (Table 6-2). No infaunal trophic index values were calculated previous to 1996.

Infaunal trophic index values compared with other surveys. The Marina del Rey infaunal index average (67) and range (56 to 78) were lower than Los Angeles Harbor (74, 67 to 83) and the 1979 SCCWRP Reference Site Survey (88, 60 to 98). No infaunal index values were calculated for the 1987 SCCWRP Survey (Table 6-3).

6.4. STATION GROUPINGS BASED ON INFAUNAL MEASUREMENTS

Stations were clustered by their similarities to the infaunal characteristics listed in Table 6-1. The method used is described above for water quality (Section 3.3.3). Station groupings were resolved based upon their similarity or dissimilarity to infaunal population variables (Figure 6-6). Included in the figure are listings of the ten most abundant infaunal organisms in the group. These are listed in order of relative frequency.

Stations 7, 10. These stations are located in Basins H and E. Station E may be influenced by inflow from Oxford Lagoon. Stations 7 and 10 are low in diversity, number of species and dominance. Within the ten most abundant species, there were eight polychaete worms, one oligochaete worm and one crustacean. Although the polycheate *Dorvillea (Schistomeringos) longicormis* and oligochaete worms are known to be associated with disturbed benthic environments, the average infaunal index value was normal (64). Station 10 had a high incidence of nematode worms which was likely muted by their paucity at Station 7. Additionally, the presence of a crustacean in the ten most common species indicates a somewhat healthy environment.

FIGURE 6-5. INFAUNAL TROPHIC INDEX AT 13 BENTHIC SEDIMENT STATIONS.

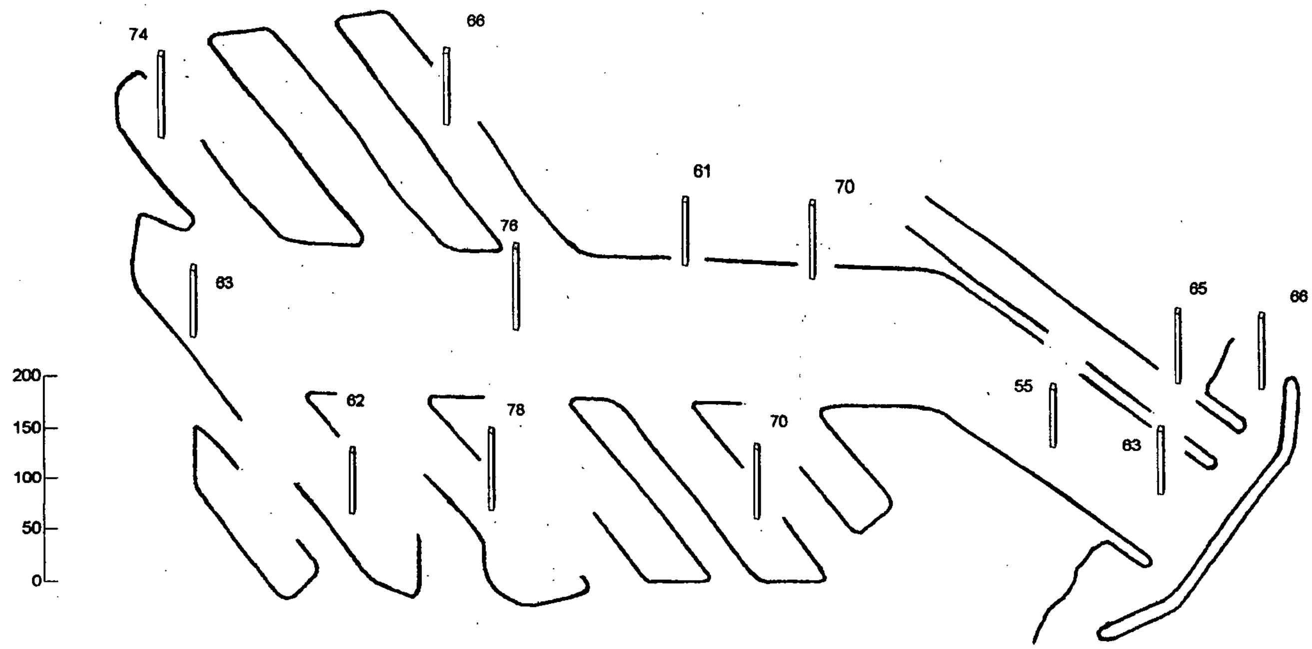
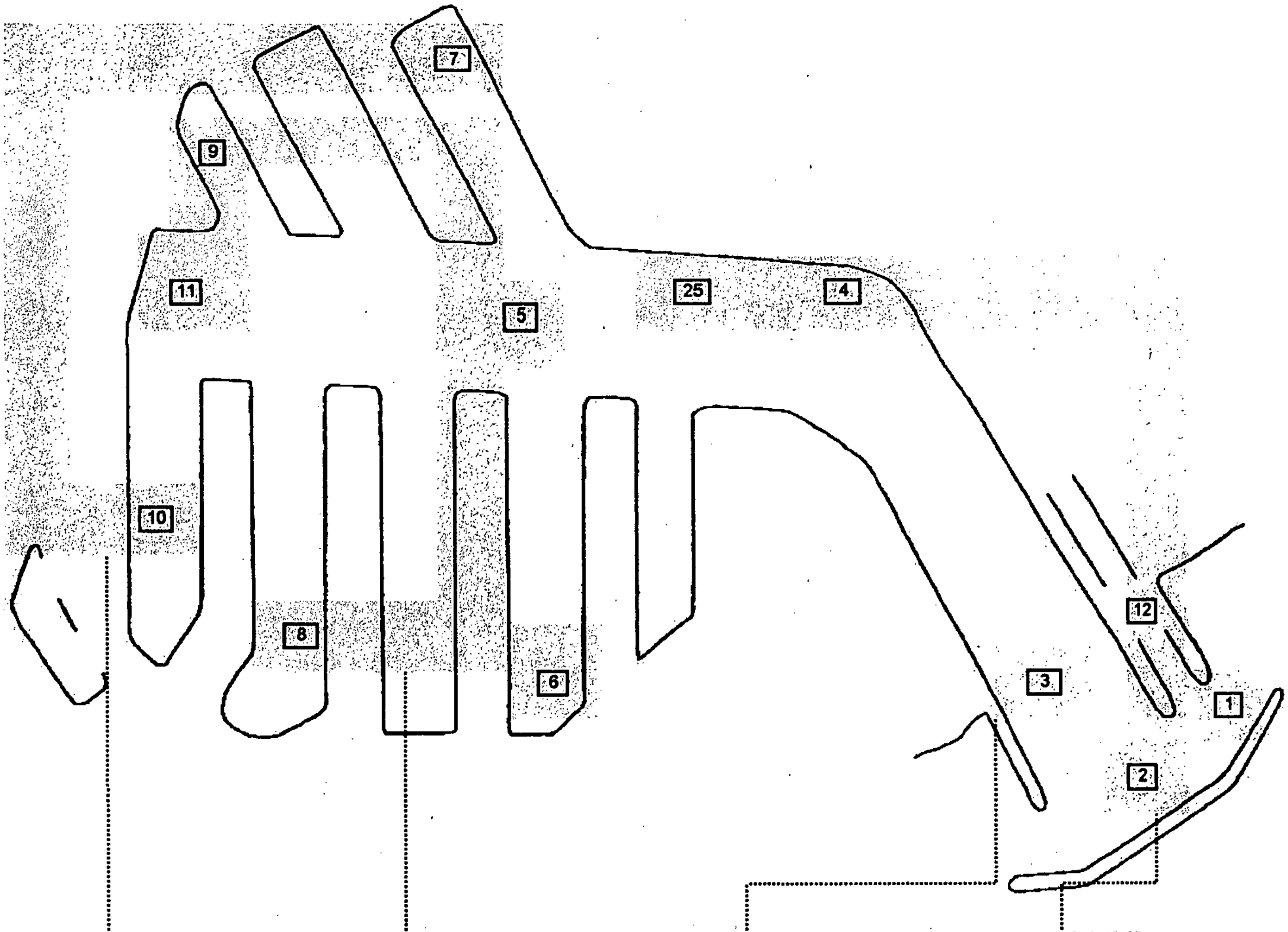


FIGURE 6-6. BIOLOGICAL SEDIMENT CHARACTERISTICS BASED ON BRAY-CURTIS CLUSTERING TECHNIQUE.



Stations 7, 10

High In:
–
–
–

Low In:
Species
Diversity
Dominance

Dominants:
Mediomastus spp. (p)
Aphelochaeta multifilis (p)
Exogone uniformis (p)
Euchone limnicola (p)
Leitoscoloplos pugettensis (p)
Pseudopolydora paucibranchiata (p)
Oligochaeta (o)*
*Dorvillea (Schistomeringos) longicornis (p)**
Mayerella banksia (cr)
Scoletoma sp. C (p)

Characteristics:
Two species present which are indicative of a stressed benthic environment.

Stations 5, 6, 8, 9, 11

High In:
Diversity
Infaunal Index
Dominance

Low In:
Individuals
Species
–

Dominants:
Leitoscoloplos pugettensis (p)
Euchone limnicola (p)
Aphelochaeta multifilis (p)
Mediomastus spp. (p)
Scoletoma sp. C (p)
Pseudopolydora paucibranchiata (p)
Exogone uniformis (p)
Cirriformia sp. MDR 1 (p)
Scoletoma spp. (p)
Prionospio heterobranchia (p)

Characteristics:
Healthy benthic environment with some evidence of stress.

Station 3

High In:
Individuals
Species
Diversity

Low In:
Infaunal Index
–
–

Dominants:
Mediomastus spp. (p)
Exogone uniformis (p)
Nematode (n)*
Oligochaeta (o)*
Prionospio heterobranchia (p)
*Dorvillea (Schistomeringos) longicornis (p)**
Phoronis sp. (ph)
Amphiodia urtica (cr)
Leitoscoloplos pugettensis (p)
Tubulanus polymorphus (ne)

Characteristics:
Contains three species that indicate a stressed benthic environment.

Stations 1, 2, 4, 12, 25

High In:
Individuals
Species
–

Low In:
Diversity
Dominance
–

Dominants:
Mediomastus spp. (p)
Prionospio heterobranchia (p)
Oligochaeta (o)*
Nematode (n)*
Exogone uniformis (p)
Prionospio lighti (p)
Macoma nastua (b)
Pseudopolydora paucibranchiata (p)
*Armandia brevis (p)**
Harpacticoida, unid. (cr)

Characteristics:
Three species present that are indicative of a stressed benthic environment.

(p) = polychaete worm, (o) = oligochaete worm, (n) = nematode worm, (cr) = crustacean, (b) = bivalve, (ph) = phoronid worm, (ne) = nemertean worm

* Infaunal species known to be associated with disturbed benthos.

Stations 5, 6, 8, 9 and 11. These stations are spread throughout the middle of the Harbor. Station 5 lies in the mid channel, Station 11 in the back Harbor, Station 9 in Basin F and Stations 6 and 8 in Basins B and D, respectively. This group was characterized by high values in diversity, infaunal index and dominance and low in number of species and individuals. Of the ten most abundant species, all were polychaete worms. None of these species indicate a stressed community, so the infaunal index values were normal (63 to 78). Despite the relatively low numbers, these stations appear to characterize a moderately healthy infaunal environment.

Station 3. Station 3 lies near the Harbor entrance. This station has a high number of individuals, species and diversity but has low infaunal index values. The ten most abundant species consist of five polychaete worms, one crustacean, a phroronid worm, a nematode worm and an oligocheate worm. Among these ten, the nematode, oligocheate and the polycheate, *Dorvillea (Schisotmeringos) longicormis* imply a disturbed benthic environment. This station presented the lowest infaunal index value (55). The presence of a crustacean in the top ten species and the high species and diversity values suggest that this station may be experiencing some moderate environmental stress.

Stations 1, 2, 4, 12 and 25. Stations 1 and 2 are located near the Harbor entrance, Station 12 is in Ballona Creek and Stations 4 and 25 are located in mid-channel. These stations are characterized by a high number of individuals and high species counts but have low diversity and dominance values. Of the ten most abundant species, six were polychaete worms, one was a bivalve, one was a nematode worm, another was an oligochaete worm and one was a crustacean. The presence of polycheate, (*Armandia brevis*) and the oligochaete and nematode worms could suggest an unhealthy infaunal environment, however the number of individuals and species were high but diversity was low. The presence of a crustacean may indicate that the area is a moderately healthy benthic environment.

6.5. DISCUSSION

As in past surveys, the infaunal community at stations at or near inflows from Oxford Lagoon (Station 10) and Ballona Creek (Stations 1, 2, 3 and 12) appear to be undergoing moderate environmental stress. Stations in mid Harbor such as, Stations 4 and 25 also appear to be influenced by Ballona Creek. These stations contained organisms which are present in sediment near wastewater outfall diffusers, or are otherwise known to be present in disturbed habitats and tended to show the greatest evidence of stress in the Harbor although only Station 3 had an below normal infaunal index value. Additionally, these stations contained crustaceans which generally occur in healthier benthic environments. Low annual rainfall could have protected these areas, allowing some recovery, or fewer pollutants were introduced into the habitat.

Back Harbor and Basin stations (5, 6, 8, 9, and 11) generally experience fewer disturbances tended to have lower number of individuals and species but high diversity, dominance and infaunal index values. These Stations appear to be the healthiest in the Harbor, despite low numbers. No animals were present that indicate disturbance in the ten most abundant species.

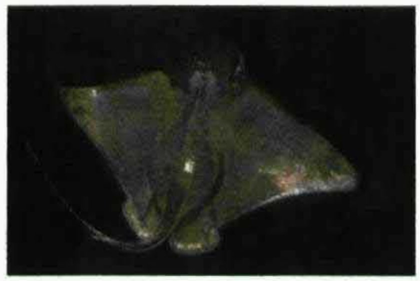
When compared to measurements made during reference site surveys performed by the Southern California Coastal Water Research Project (SCCWRP), the number of individuals was higher but the number of species, diversity and infaunal trophic index values fell below their averages and ranges. This is not surprising since SCCWRP reference sites are less contaminated open coast locations compared to the enclosed Harbor of Marina del

Rey. When compared to Los Angeles Harbor, numbers of individuals and species were higher, however, diversity and infaunal index values fell below the average and range.

Higher diversity patterns in Los Angeles Harbor may be related to open, flow through patterns related to the dual entrances to L. A. Harbor compared to a single entrance like Marina del Rey. Results from this year's survey compared well to past surveys. Overall, there were over twice as many individuals and slightly more species found this year than last, diversity and dominance values were lower and all infaunal trophic index values were above normal (>60) except Station 3 (56) although none were considered degraded (<30).

7. FISH POPULATIONS

7.1. BACKGROUND



Marina del Rey functions as an important small estuary in a southern California area where about ninety percent of the wetlands have been lost due to development. While the original configuration of the Ballona wetlands was a large natural estuarine system, it was altered radically by the channelization of flow into a creek in the 1920s. Filling and dumping occurred to create farmlands and oil or gas development, altering drainage patterns of small meandering streams and shallow waters. Excavation of the marina in the 1960s and building of the breakwater completed the reconfiguration of the wetlands to the north and west of the creek. Nevertheless, the marina provides a viable habitat for larval, juvenile and adult inshore fish species. The shallow, warm waters are nutrient laden, and the turbidity due to phytoplankton and sediment offer some protection from predatory fish and birds. Some species that frequent the marina as eggs, larvae or juveniles migrate from the warmer waters seaward as adults, returning to spawn outside or inside the marina. Marina fauna are sometimes disturbed by natural events such as large storms, heavy rains and excessive heat, and by manmade impacts due to dredging, oil films, slicks or spills. Illegal dumping of chemicals, sewage or debris may occur in the marina or in flood control channels that drain or impinge on the marina. Thus the marina may have a slightly lower average number of species as compared to marinas with more open access to the ocean, providing better flushing (Soule et al. 1996).

Surveys were first conducted as part of an experimental study of methods by Harbors Environmental Projects in the marina in 1977-1979 with funding assistance from the NOAA-Sea Grant Program. Dr. John S. Stephens, Jr., and his staff from the Vantuna Group at Occidental College continued them in 1980-81 on a voluntary basis. After a hiatus, the Vantuna Group in cooperation with the USC monitoring program for the Department of Beaches and Harbors resumed surveys in 1984 (Soule et al. 1996). Since 1996, Aquatic Bioassay of Ventura, California has conducted the surveys.

7.2. MATERIALS AND METHODS

Trawl sampling was conducted in accordance with *Use of Small Otter Trawls in Coastal Biological Surveys*, EPA 600/3-78/083, August 1978 and *Quality Assurance and Quality Control (QA/QC) for 301(h) Monitoring Programs: Guidance on Field and Laboratory Methods*, Tetra Tech 1986. Bottom fish were collected using a standard five-meter headrope otter trawl. Fish were collected at three locations within the Harbor (Figure 7-1) on October 25, 2001 and May 15, 2002. Data from replicate trawls were combined for analysis. Survey stations and techniques were standardized in 1984. and include: trawls performed using a semiballoon otter trawl towed in duplicate for five minutes at three locations; a 100 ft (32.8 m) multimesh gill net deployed at three locations for two hours each, and a 100 ft (32.8 m) beach seine deployed at 2.5 m depth about 30 m from the beach and fished to shore. 100-meter diver surveys were performed along the inner side of the breakwater and along the jetties in the entrance channel on October 24, 2001 and June 10, 2002. Due to low gill net catches, the deployment was extended to two hours in 1998.

Eggs and larvae (ichthyoplankton) were collected around Stations 2, 5, 8 using a 333 um mesh plankton net at 1.0 m depth for two minutes and near the bottom for three minutes.

A benthic sled kept the net just above the bottom. For all groups of fishes; numbers of animals, numbers of species, and species diversity were calculated (see Section 6.3.1.3). Figure 7-1 shows the locations of all fish sampling stations and Appendix 9.4 lists the age groups for all planktonic and reef organisms. Fish collections were conducted in the fall and again in spring.

7.3. RESULTS

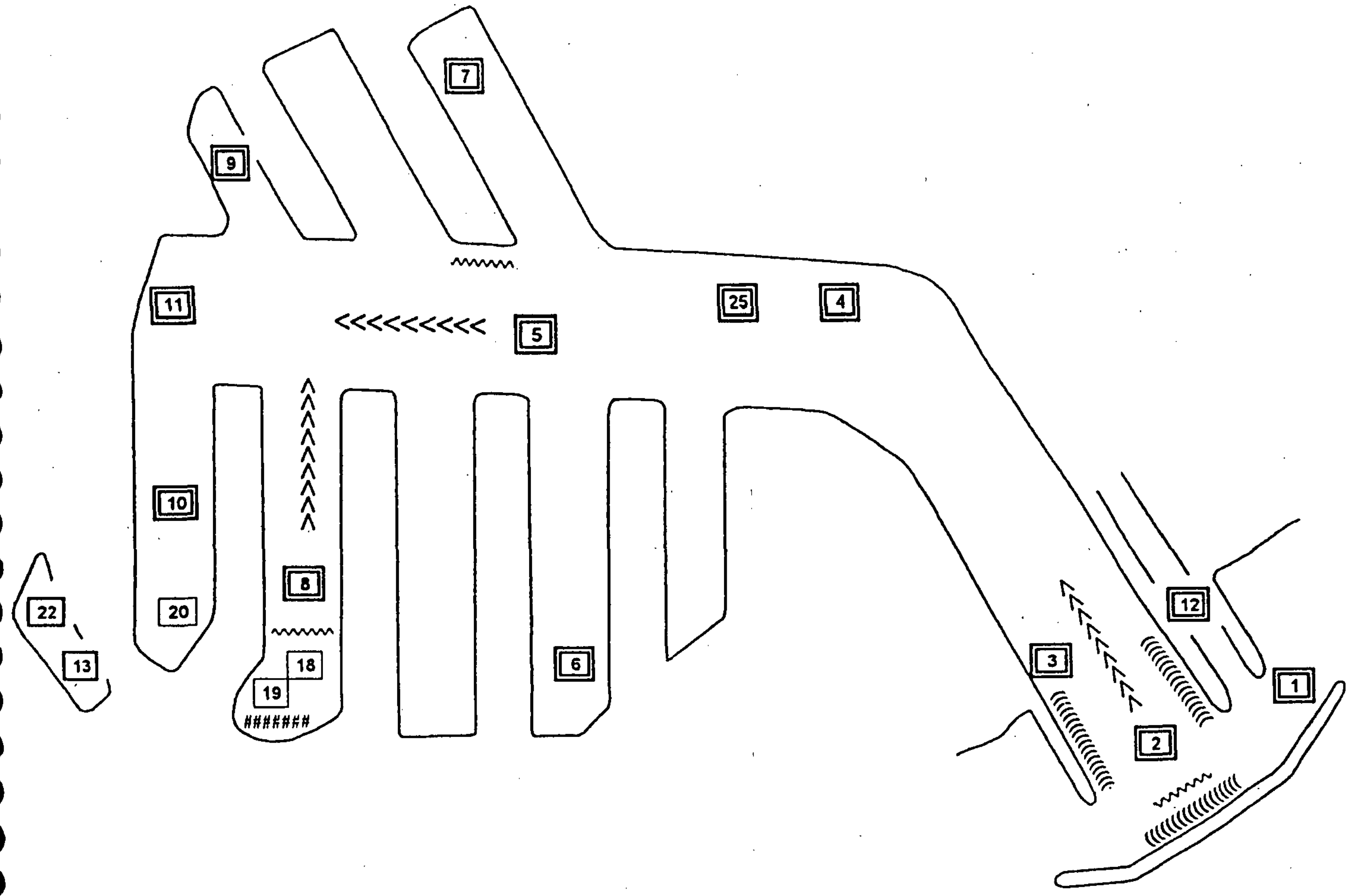
Based on each sampling methodology, each fish community was compared among stations by measures of population abundance and diversity. These included numbers of individuals, numbers of species, and species diversity. In addition, ranges of these variables were compared to surveys conducted in past years. Unlike infaunal data, fish collection data were not comparable to either SCCWRP or Los Angeles Harbor measurements, so no comparisons were made. Indices of biological community health are described above in Section 6.3.1. Table 7-1 lists all of the different fish species collected or observed since 1985 by various dive and net collection techniques (there was no spring 1985 survey). Among 115 different species collected since 1985, six were present in all 32 surveys: topsmelt (*Atherinops affinis*), black surfperch, (*Embiotoca jacksoni*), opaleye (*Girella nigricans*), blenny (*Hypsoblennius sp.*), kelp bass (*Paralabrax clathratus*) and barred sand bass (*Paralabrax nebulifer*). Fourteen other species have occurred frequently (25 or more times): sargo (*Anisotremus davidsoni*), blacksmith (*Chromis punctipinnis*), pile surfperch (*Damalichthys vacca*), northern anchovy (*Engraulis mordax*), a suite of larval gobies (Gobiedae A/C), rock wrasse (*Halochoeres semicinctus*), giant kelpfish (*Heterostichus rostratus*), diamond turbot (*Hypsopsetta guttulata*), garibaldi (*Hypsypops rubicundus*), dwarf surfperch (*Micrometrus minimus*), bat ray (*Myliobatis californica*), senorita (*Oxyjulis californica*), California halibut (*Paralichthys californicus*), and spotted turbot (*Pleuronichthys ritteri*). These fish are found in the Harbor during both spring and fall, are characteristic of a wide range of habitat types and represent a diverse group of fish families. Several fish species have not been found since 1985 they are a specie of croaker (Scaenidae) and brown rockfish (*Sebastes auriculatus*).

7.3.1. **Bottom Fish Abundance**

Spatial bottom fish abundance patterns. Numbers of bottom fish collected at the three sampling stations are listed in Table 7-2. The largest haul was in the spring at Station 2 at the Harbor entrance (406 individuals). Fewer individuals were collected at all other stations and seasons 12 to 29 individuals. The smallest catch was at Station 5 in mid channel during fall (12 individuals). The total count in spring (448 individuals) exceeded the fall count (65 individuals).

The most common fish collected in the fall was the California halibut (*Paralichthys californicus*) (22 individuals). Shiner surfperch (*Cyomatogaster aggregata*) was the most common fish collected in the spring (386 individuals at Station 2 at the Harbor entrance). Fall fish collection yielded 16 individuals of white croaker (*Genyonemus lineatus*) at Station 5 in mid channel, the highest single catch in the fall. The largest abundance for an individual fish was collected at Station 2 in the spring (386 shiner surfperch - *Cymatogaster aggregata*). The California halibut (*Paralichthys californicus*) was the only specie found at all stations in both the spring and fall.

FIGURE 7-1. LOCATION OF MARINA DEL REY HARBOR SAMPLING STATIONS.



Water Quality Stations only

Water Quality and Sediment Chemistry Stations

Water Quality, Sediment Chemistry, and Benthic Infauna Stations

>>>>>>>>>>>>> Bottom Fish by Otter Trawl and Ichthyoplankton by Plankton Net

Midwater Fish by Gill Net

Reef Fish by Diver Transect

######################## Inshore Fish by Beach Seine

TABLE 7-1. EGG, LARVAL, AND ADULT FISH TAXA COLLECTED DURING SPRING (Sp) AND FALL (Fl), 1985 TO PRESENT.

SCIENTIFIC NAME	COMMON NAME	85		86		87		88		89		90		91		92*		93		94		95		96		97		98		99		00			All	All	
		Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Fl	Sp	Sp	Fl	Tot.
Acanthogobius flavimanus	Yellowfin Goby				x		x	x	x	x								x	x	x				x		x	x								6	5	11
Albula vulpes	Bonefish							x								x	x		x								x	x	x	x	x	x	x	x	6	6	12
Anchoa compressa	Deepbody Anchovy		x	x		x			x									x		x		x	x	x	x	x	x	x				x		x	10	5	15
Anchoa delicatissima	Slough Anchovy						x																		x	x		x	x	x	x	x	x	x	5	5	10
Anchoa sp.	Anchovy																									x				x					2	0	2
Anisotremus davidsoni	Sargo		x	x	x	x				x	x		x		x	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	13	12	25
Atherinidae	Silverside																											x							1	0	1
Atherinops affinis	Topsmelt		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	16	32
Atherinopsis californiensis	Jacksmelt			x	x	x	x			x										x	x			x	x	x		x		x		x		x	10	4	14
Atractoscion nobilis	White Seabass			x	x	x									x												x		x						2	4	6
Brachyistius frenatus	Kelp Surfperch															x																			1	0	1
Bryx arctus	Snubnose Pipefish																								x										0	1	1
Cheilotrema saturnum	Black Croaker		x	x	x	x	x	x	x	x	x	x		x	x		x				x			x			x		x				x		7	11	18
Chitonotus pugetensis	Roughback Sculpin								x																										0	1	1
Chromis punctipinnis	Blacksmith		x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x	x	x	x	13	15	28
Citharichthys sp.	Sandab Egg																																	x	1	0	1
Citharichthys stigmaeus	Speckled Sandab					x					x												x	x	x	x	x			x				x	5	4	9
Citharichthys Type A	Sandab Larvae					x														x		x		x	x	x			x	x	x	x			7	3	10
Clevlandia ios	Arrow Goby			x	x	x		x			x		x									x		x		x	x	x							7	4	11
Clinocottus analis	Wooly Sculpin		x		x			x	x	x				x							x											x		x	5	4	9
Coryphopterus nichosii	Blackeye Goby					x				x								x																	3	0	3
Cymatogaster aggregata	Shiner Surfperch			x		x				x	x	x	x	x		x	x	x		x		x		x		x		x		x		x		x	15	3	18
Damalichthys vacca	Pile Surfperch		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x	x				x			x	x	x	x	13	12	25
Embiotoca jacksoni	Black Surfperch		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	16	32
Engraulidae	Anchovy																								x	x					x	x		x	3	2	5
Engraulis mordax	Northern Anchovy			x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x			x	x		x	15	11	26
Fundulus parvipinnis	California Killifish		x		x	x		x	x		x	x	x	x	x			x	x		x	x		x	x	x	x	x	x	x	x	x	x		11	13	24
Genyonemus lineatus	White Croaker		x	x		x	x		x	x		x		x	x			x		x		x		x	x	x	x	x		x	x	x	x	x	14	8	22
Gibbonsia elegans	Spotted Kelpfish		x		x		x			x	x	x	x	x	x		x			x	x		x	x					x	x					6	10	16
Gibbonsia spp.	Kelpfish																																	x	1	0	1
Gillichthys mirabilis	Longjaw Mudsucker				x									x			x			x								x							3	2	5
Girella nigricans	Opaleye		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	16	32
Gobiesox rhessodon	California Clingfish		x	x		x				x		x	x	x	x	x	x	x		x	x	x		x	x	x	x	x		x	x	x	x	x	15	9	24
Gobiidae	Goby																																		0	0	0
Gobiidae A/C	Goby		x		x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	12	15	27
Gobiidae D	Goby																												x	x					1	1	2
Gobiidae fragment	Goby																																		0	0	0
Gobiidae non A/C	Goby																				x								x	x					1	2	3
Halichoeres semicinctus	Rock Wrasse		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	15	15	30
Hermosilla azurea	Zebraperch		x		x				x	x			x			x		x	x	x	x			x	x	x	x	x	x	x	x	x		x	10	10	20
Heterodontus francisci	Horn Shark									x		x		x																				x	4	0	4
Heterostichus rostratus	Giant Kelpfish		x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x			x	x	x	x		x	x	x	x	x	x	14	14	28
Hippoglossina stomata	Bigmouth Sole			x													x																		1	1	2
Hyperprosopon argenteum	Walleye Surfperch			x											x																				1	1	2
Hypsoblennius spp.	Blenny		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	16	32
Hypsoblennius gentilis	Bay Blenny		x	x	x		x																												1	3	4
Hypsoblennius gilberti	Rockpool Blenny				x														x								x		x	x					1	4	5
Hypsoblennius jenkinsi	Mussel Blenny					x		x		x									x		x				x									x	4	3	7
Hypsopsetta guttulata	Diamond Turbot				x	x	x		x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	x	x	x	x	14	13	27
Hypsurus caryi	Rainbow Surfperch													x		x		x				x													4	0	4
Hypsypops rubicundus	Garibaldi		x		x	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15	14	29
Ilypnus gilberti	Cheekspot Goby			x	x	x		x				x	x	x												x								x	7	2	9
Kyphosidae	Zebraperch																				x														0	1	1
Lepidogobius lepidus	Bay Goby		x	x			x		x						x	x								x					x	x			x	x	5	6	11
Leptocottus armatus	Staghorn Sculpin			x	x	x		x		x	x	x		x	x	x	x				x			x	x	x					x		x	x	10	8	18
Leuresthes tenuis	California Grunion																									x		x							2	0	2
Medialuna californiensis	Halfmoon						x																				x	x	x				x		1	4	5
Menticirrhus undulatus	California Corbina			x	x		x	x		x				x						x		x				x		x	x	x		x	x	x	11	4	15
Micrometrus minimus	Dwarf Surfperch		x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			x	x	x	x		x	x	x	x	x	x	14	14	28
Mugil cephalis	Striped Mullet		x	x	x	x	x	x	x		x	x	x		x	x	x			x	x		x				x	x		x	x				8	12	20
Mustelus californicus	Gray Smoothound														x	x							x								x			x	2	3	5
Mustelus henlei	Brown Smoothound						x															x				x			x	x					3	2	5
Mustelus sp.	Smoothound															x																			1	0	1
Myliobatis californica	Bat Ray			x	x	x	x		x	x	x	x		x	x	x	x	x		x	x			x	x	x	x	x	x	x	x	x		x	14	11	25
Oligocottus/Clinocottus A	Sculpin										x				x																x				0	3	3
Oxyjulis californica	Senorita		x	x		x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	14	14	28
Oxylebius pictus	Painted Greenling		x									x																							1	1	2
Paraclinus integripinnis	Reef Finspot				x					x		x	x							x	x	x		x	x	x	x								6	5	11
Paralabrax clathratus	Kelp Bass		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	16	32

TABLE 7-1. (CONTINUED)

Paralabrax maculatofasciatus	Spotted Sand	x	x	x	x	x			x	x	x	x	x		x													x	x					7	6	13
Paralabrax nebulifer	Barred Sand Bass	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	16	32
Paralabrax sp.	Sea Bass																							x	x									1	1	2
Paralichthys californicus	California Halibut	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14	16	30
Perciformes	Perch																							x						x				0	2	2
Phanerodon furcatus	White Surfperch		x			x		x	x		x		x	x			x			x			x		x		x		x		x	x		10	5	15
Pleuronectidae**	Flatfish																	x		x			x		x	x								2	3	5
Pleuronichthys coenosus	C-O Turbot	x				x																												0	2	2
Pleuronichthys ritteri	Spotted Turbot	x		x	x	x	x	x	x	x		x	x		x		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	14	13	27
Pleuronichthys verticalis	Hornyhead Turbot		x			x					x		x											x	x			x	x	x	x		x	7	4	11
Porichthys myriaster	Specklefin Midshipman																												x		x		x	3	0	3
Quietula y-cauda	Shadow Goby		x	x	x		x		x	x	x		x												x	x						x	x	8	4	12
Raja binoculata	Big Skate																								x									1	0	1
Rhacochilus toxotes	Rubberlip Surfperch					x		x			x	x	x				x											x	x	x				4	5	9
Rhinobatos productus	Shovelnose Guitarfish																																x	1	0	1
Sarda chilensis	Pacific Bonito			x		x																												0	2	2
Sardinops sagax caeruleus	Pacific Sardine	x	x	x	x	x	x		x			x	x		x	x	x		x	x						x		x	x		x		x	11	8	19
Scaenidae	Croaker																																	0	0	0
Scaenidae complex 2	Croaker				x			x			x														x			x						3	2	5
Scomberomorus sierra	Pacific Sierra																										x	x						1	1	2
Scorpaena guttata	Spotted Scorpionfish		x						x						x			x	x								x	x						5	2	7
Scorpaenichthys marmoratus	Cabezon								x	x			x																	x	x			3	2	5
Sebastes auriculatus	Brown Rockfish																																	0	0	0
Sebastes dallii	Calico Rockfish																															x		0	1	1
Sebastes serranoides	Olive Rockfish	x	x			x	x	x		x			x																				x	4	4	8
Semicossyphus pulcher	California Sheepshead					x		x																										0	2	2
Seriphus politus	Queenfish	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x		x		x	x			x	x			x			13	9	22
Sphyraena argentea	California Barracuda	x	x			x	x				x	x					x							x				x			x			5	5	10
Squatina californica	Pacific Angel Shark	x																										x	x					1	2	3
Stenobrachius leucopsaura	Northern Lampfish		x									x																			x			2	1	3
Strongylura exilis	California Needlefish		x		x			x		x	x	x		x	x		x	x	x	x	x		x	x		x		x		x			x	9	10	19
Symphurus atricauda	California Tonguefish																							x		x			x	x				1	3	4
Sygnathus auliscus	Barred Pipefish	x									x		x															x			x	x		3	3	6
Sygnathus leptorhynchus	Bay Pipefish				x	x			x			x																x	x				x	4	3	7
Sygnathidae	Pipefish																															x		0	1	1
Synodus lucioceps	California Lizardfish							x																										0	1	1
Triakis semifaciata	Leopard Shark																								x							x	x	2	1	3
Type 32	Fish Larvae																								x	x	x			x	x			3	2	5
Type 71	Fish Larvae																									x	x	x	x				x	3	2	5
Typhlogobius californiensis	Blind Goby		x								x				x		x				x										x	x	x	7	1	8
Umbrina roncador	Yellowfin Croaker	x		x	x	x		x							x	x	x		x		x	x	x	x	x		x	x	x		x	x	x	11	9	20
Unidentified egg	Unidentified Egg																							x	x	x	x			x	x	x	x	4	4	8
Unidentified larvae	Unidentifed Larvae																								x			x	x	x	x	x	x	4	3	7
Urolophus halleri	Round Stingray			x	x		x		x				x	x	x		x				x		x		x		x		x	x	x	x		12	4	16
Xenistius californiensis	Salema					x				x		x						x		x				x		x		x	x			x	x	2	9	11
Xystreurys liolepis	Fantail Sole							x						x								x								x		x	x	1	5	6

* Diver survey and beach seine conducted on December 3 after completion of dredging.

** Unidentifiable turbot larvae.

<u>Bottom fish abundance patterns compared with past years.</u> Table 7-6 lists the ranges in numbers of bottom fish collected per station since October 1993. Fish collected during October ranged from 12 to 29 per station, which were typical of values for past fall surveys. Spring counts ranged between 21 and 406 which were higher than past spring counts.

7.3.2. Bottom Fish Species

<u>Spatial bottom fish species patterns.</u> Numbers of bottom fish species collected at the three trawl sampling stations are listed in Table 7-2. The greatest numbers of species were captured at Station 2 near the Harbor entrance in May (10 species). Station 5 had the lowest species count (5 species) in the fall. Total species counts in the fall (18 species) were lower than counts in the spring (33 species).

<u>Bottom fish species patterns compared with past years.</u> Table 7-6 lists the ranges of species of bottom fish collected per station since October 1993. Bottom fish collected during October ranged from five to seven species per station, which is characteristic of past ranges. The spring range of species counts (6 to 10) was also characteristic of past ranges.

7.3.3. Bottom Fish Diversity

<u>Spatial bottom fish diversity patterns.</u> Species diversity calculated from the three trawl sampling stations is listed in Table 7-2. Highest species diversity was at Station 8 in the Basin D May (1.70). Lowest diversity was found at Station 2 in mid channel, during spring (0.30) likely due to the high volume of shiner surfperch (*Cymatogaster aggregata*) caught at that location. Averaged among stations, diversity in the fall (1.33) was higher than in the spring (1.05).

<u>Bottom fish diversity patterns compared with past years.</u> Species diversity values ranged from 1.23 to 1.45 in the fall and from 0.30 to 1.70 in the spring (Table 7-6). Fall ranges fell within the range generated during the past five years (species diversity calculations were not performed prior to 1997) and were tighter, with the low value relatively high compared to past ranges. The spring diversity range tended to be lower compared past diversity ranges due to the high volume of shiner surfperch (*Cymatogaster aggregata*) caught at Station 2.

7.3.4. Midwater Fish Abundance

<u>Spatial midwater fish abundance patterns.</u> Numbers of midwater fish collected at the three gill net sampling stations are listed in Table 7-2. Fish collected in gill nets were greater than last year, since a large amount of topsmelt (*Atherinops affinis*) were caught in the spring (432 individuals). Additionally, eight individuals of five different species were collected at Station 8 in the spring gill net dispatch. No fish were caught in midwater in the fall.

The inherent passivity of gill net sampling for short periods of time makes it an inefficient method of catching fish. Catches may vary, as demonstrated this year. No fish were caught in the fall, but 441 individuals were caught in spring, mostly the schooling topsmelt.

<u>Midwater fish abundance patterns compared with past years.</u> Table 7-6 lists the ranges of individuals of midwater fish collected per station since October 1993. No fish were caught

TABLE 7-2. FISH COLLECTED BY OTTER TRAWL AND GILL NET AT THREE STATIONS.

		OCTOBER 2001 SAMPLING STATIONS			MAY 2002 SAMPLING STATIONS		
SCIENTIFIC NAME	COMMON NAME	#2	#5	#8	#2	#5	#8
Bottom Fish							
Anisotremus davidsoni	Sargo		1	4			4
Albula vulpes	Bonefish		1				
Anchoa delicatissima	Slough Anchovy			2			
Citharichthys stigmaeus	Speckled Sandab				1		
Cymatogaster aggregata	Shiner Surfperch				386		
Genyonemus lineatus	White Croaker	16	2		2	1	
Gobiesox rhessodon	California Clingfish	2					
Heterodontus francisci	Horn Shark				2		
Hypsopsetta guttulata	Diamond Turbot	3			2		1
Leptocottus armatus	Staghorn Sculpin			1			
Myliobatis californica	Bat Ray				1	2	5
Paralabrax nebulifer	Barred Sand Bass	3		1	4	2	
Paralichthys califoricus	California Halibut	3	7	12	1	14	5
Phanerodon furcatus	White Surfperch						
Pleuronichthys ritteri	Spotted Turbot		1			1	
Porichthys myriaster	Specklefin Midshipman						1
Rhinobatos productus	Shovelnose Guitarfish						1
Sebastes dallii	Calico Rockfish	1					
Sygnathus leptorhynchus	Bay Pipefish		1				
Synodus lucioceps	California Lizardfish				4		
Umbrina roncador	Yellowfin Croaker			7			6
Urolophus halleri	Round Stingray			1		1	2
Xystreurys liolepis	Fantail Sole	1			3		
	Individuals	**29**	**12**	**24**	**406**	**21**	**21**
	Species	**7**	**5**	**6**	**10**	**6**	**7**
	Diversity	**1.45**	**1.23**	**1.31**	**0.30**	**1.15**	**1.70**
Midwater Fish							
Albula vulpes	Bonefish						2
Atherinops affinis	Topsmelt					432	2
Atherinopsis californiensis	Jacksmelt						2
Mustelus californicus	Gray Smoothound						
Paralabrax nebulifer	Barred Sand Bass				1		1
Sardinops sagax caeruleus	Pacific Sardine						
Strongylura exilis	California Needlefish						1
	Individuals	**0**	**0**	**0**	**1**	**432**	**8**
	Species	**0**	**0**	**0**	**1**	**1**	**5**
	Diversity	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.56**

TABLE 7-3. RESULTS OF DIVE SURVEY TRANSECTS AT THREE DIVE STATIONS.

		OCTOBER 2001 SAMPLING STATIONS			JUNE 2002 SAMPLING STATIONS		
SCIENTIFIC NAME	COMMON NAME	North Jetty	Breakwall	South Jetty	North Jetty	Breakwall	South Jetty
Reef Species							
Anisotremus davidsoni	Sargo		2		1		3
Atherinops affinis	Topsmelt	222	4				41
Cheilotrema saturnum	Black Croaker	3		1			
Chromis punctipinnis	Blacksmith		32				6
Cymatogaster aggregata	Shiner Surfperch				67		292
Damalichthys vacca	Pile Surfperch	7	2	6	1	1	6
Embiotoca jacksoni	Black Surfperch	12	16	19	18	8	66
Girella nigricans	Opaleye	172	61	79	104	78	74
Halichoeres semicinctus	Rock Wrasse		8	11		3	
Hermosilla azurea	Zebraperch				2	1	
Heterostichus rostratus	Giant Kelpfish			2		18	
Hypsypops rubicundus	Garibaldi		9			15	
Medialuna californiensis	Halfmoon		4				
Micrometrus minimus	Dwarf Surfperch	8		1	7		7
Oxyjulis californica	Senorita			33		3	3
Paralabrax clathratus	Kelp Bass	9	14	19		27	1
Paralabrax nebulifer	Barred Sand Bass		4			6	
Sebastes serranoides	Olive Rockfish				225		
Umbrina roncador	Yellowfin Croaker	3					
Urolophus halleri	Round Stingray		2			1	
Xenistius californiensis	Salema	1					
	Individuals	**437**	**168**	**171**	**425**	**161**	**499**
	Species	**9**	**12**	**9**	**8**	**11**	**10**
	Diversity	**1.11**	**1.90**	**1.57**	**1.23**	**1.63**	**1.31**

during the fall sampling which has been typical of past surveys. However, spring gill net fishing caught between one and 432 individuals, but, when compared to past surveys, is high though not unexpected.

7.3.5. **Midwater Fish Species**

Spatial midwater fish species patterns. Numbers of midwater fish species collected at the three gill net sampling stations are listed in Table 7-2. At most stations, only a single specie was collected or none at all. However, at Station 8 in Basin D, five discrete species were collected, bonefish (*Albula vulpes*), topsmelt (*Atherinops affinis*), jacksmelt (*Atherinops californiensis*) barred sand bass (*Paralabrax nebulifer*) and a California needlefish (*Strongylura exilis*). Station 5 in mid channel yielded 432 topsmelt (*Atherinops affinis*) and Station 2 at the Harbor entrance produced a single barred sand bass (*Paralabrax nebulifer*). No fish were caught in the other casts.

Midwater fish species patterns compared with past years. Table 7-6 lists the ranges of species of midwater fish collected per station since October 1993. Species counts for fall (zero) and spring (one to five species) were not unusual compared to past years.

7.3.6. **Midwater Fish Diversity**

Spatial midwater fish diversity patterns. Species diversity from the three gill net sampling stations is listed in Table 7-2. Diversity at Station 8 in the spring increased with five species caught producing a diversity value of 1.56. Species diversity values at all other stations were zero.

Midwater fish diversity patterns compared with past years. The species diversity value in the fall was zero which is not atypical (Table 7-6). However, in the spring (0.00 – 1.56), species diversity was higher due to the multiple species found at Station 8 in Basin D.

7.3.7. **Inshore Fish Abundance**

Spatial inshore fish abundance patterns. Numbers of inshore fish collected along the shoreline of Mother's Beach (Station 19) are listed in Table 7-5. More fish were captured in the fall (1855 individuals) than in the spring (426 individuals). Topsmelt (*Atheriops affinis*) dominated fall (1817 individuals) and spring counts (406 individuals). Other fish counts ranged from 1 to 14 individuals.

Inshore fish abundance patterns compared with past years. Table 7-6 lists the ranges of individuals of inshore fish collected per station since October 1993. The number of inshore fish collected during October (1855 individuals) was higher than last year (1515 individuals) and exceeded the range of past years. Spring counts (426 individuals), were relatively low compared to previous years.

7.3.8. **Inshore Fish Species**

Spatial inshore fish species patterns. Total inshore fish species collected at Mothers' Beach are listed in Table 7-5. More species of fish were collected in the fall (11 species) than in the spring (7 species).

Inshore fish species patterns compared with past years. Table 7-6 lists the range of species of inshore fish collected per station since October 1993. The number of inshore

TABLE 7-4. LARVAL FISH AND EGGS COLLECTED BY PLANKTON TOW AT THREE SURFACE AND BOTTOM STATIONS (INDIV/1000 M^3).

		OCT. 2001 SAMPLING STATIONS						MAY 2002 SAMPLING STATIONS					
		#2		#5		#8		#2		#5		#8	
SCIENTIFIC NAME	COMMON NAME	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Larval Fish													
Atherinopsis californiensis	Jacksmelt							9		8			
Citharichthys stigmaeus	Speckled Sandab								5				
Clinocottus analis	Wooly Sculpin								5				
Engraulidae	Anchovy							9	5		16		
Engraulis mordax	Northern Anchovy	10			5				16		5		
Genyonemus lineatus	White Croaker		5										
Gibbonsia spp.	Kelpfish								11				
Gobiesox rhessodon	California Clingfish										16		24
Gobiidae	Goby			64			40			110			
Gobiidae A/C	Goby	71	5	56	21	142	183	27	470	533	1728	102	801
Gobiidae fragment	Goby									8			
Heterostichus rostratus	Giant Kelpfish										5		
Hypsoblennius spp.	Blenny	71	213	542	683	125	280	9	694	839	2788	1047	730
Hypsoblennius jenkinsi	Mussel Blenny										26		
Hypsopsetta guttulata	Diamond Turbot		5		5								
Hypsypops rubicundus	Garibaldi								5		5		
Ilypnus gilberti	Cheekspot Goby										10		417
Lepidogobius lepidus	Bay Goby												
Paralichthys califoricus	California Halibut								5		5		5
Plueronichthys verticalis	Hornyhead Turbot								5				
Quietula y-cauda	Shadow Goby					74				63	207	19	9
Sygnathidae	Pipefish		5		11		6						
Typhlogobius californiensis	Blind Goby								5				
Unidentified larvae	Unidentifed Larvae	10	5					18	11	8	47		
	Individuals	**162**	**238**	**662**	**726**	**341**	**509**	**71**	**1238**	**1567**	**4857**	**1168**	**1985**
	Species	**4**	**6**	**3**	**5**	**3**	**4**	**5**	**12**	**7**	**12**	**3**	**6**
	Diversity	**1.07**	**0.49**	**0.60**	**0.30**	**1.06**	**0.95**	**1.49**	**0.99**	**1.10**	**0.97**	**0.38**	**1.15**
Fish Eggs													
Anchoa compressa	Deepbody Anchovy											139	213
Anchoa delicatissima	Slough Anchovy							18		16	16	120	175
Atherinops affinis	Topsmelt							9	43		21		
Citharichthys sp.	Sandab Egg								512				
Engraulis mordax	Northern Anchovy							62	96	24		130	33
Pleuronichthys ritteri	Spotted Turbot	10	15		5			98	16				
Pleuronichthys verticalis	Hornyhead Turbot								53				
Type 32	Fish egg	182	112	16				5755	1366		31		
Unidentified egg	Unidentified Egg	313	175	8	38				459	259	181	213	47
	Individuals	**505**	**301**	**24**	**43**	**0**	**0**	**5943**	**2546**	**298**	**248**	**602**	**469**
	Species	**3**	**3**	**2**	**2**	**0**	**0**	**5**	**7**	**3**	**4**	**4**	**4**
	Diversity	**0.74**	**0.83**	**0.64**	**0.38**	**0.00**	**0.00**	**0.17**	**1.27**	**0.48**	**0.87**	**1.02**	**0.79**

TABLE 7-5. INSHORE FISH COLLECTED BY BEACH SEINE AT MOTHERS BEACH (STATION 19).

SCIENTIFIC NAME	COMMON NAME	OCTOBER 2001	MAY 2002
Beach Seine Species			
Albula vulpes	Bonefish	1	
Anisotremus davidsoni	Sargo		9
Atherinops affinis	Topsmelt	1817	406
Clevlandia ios	Arrow Goby	1	
Fundulus parvipinnis	California Killifish		4
Ilypnus gilberti	Cheekspot Goby	2	
Hypsopsetta guttulata	Diamond Turbot	14	2
Lepidogobius lepidus	Bay Goby	1	
Leptocottus armatus	Staghorn Sculpin	9	1
Menticirrhus undulatus	California Corbina	2	2
Sardinops sagax caeruleus	Pacific Sardine	2	
Umbrina roncador	Yellowfin Croaker	5	2
Urolophus halleri	Round Stingray	1	
	Individuals	**1855**	**426**
	Species	**11**	**7**
	Diversity	**0.14**	**0.26**

fish species collected during October (11 species) was on the high end of the overall range (3 to 12 species). Spring counts (7 species) were typical of past collections.

7.3.9. Inshore Fish Diversity

Spatial inshore fish diversity patterns. Species diversity calculations for Mother's Beach are listed in Table 7-5. Species diversity values during fall (0.14) were slightly more than half of the spring diversity value (0.26). This is likely related to the overwhelming dominance of topsmelt in both seines. Topsmelt caught in spring were mostly juveniles.

Inshore fish diversity patterns compared with past years. Comparative past and present species diversity values are presented in Table 7-6. The species diversity value for fall (0.14) and spring (0.26) were lower than in past years. Species diversity values were not calculated prior to 1996.

7.3.10. Reef Fish Abundance

Spatial reef fish abundance patterns. Total counts in June (1085 individuals) were higher than those taken in October (766 individuals). Numbers of reef fish counted at the three dive survey stations are listed in Table 7-3. Greatest numbers were counted at the south jetty in June (499 individuals) but high numbers were also seen at the north jetty in October (437 individuals) and June (425 individuals). Lowest numbers were seen at the break wall in the fall (158 individuals).

Three species appeared in all sites and seasons, opaleye (*Girella nigricans* - 312 and 256 individuals in fall and spring, respectively), pile surfperch (*Damalichthys vacca* – 15 and 8 in fall and spring, respectively) and black surfperch (*Embiotoca jacksoni* - 47 and 92 individuals in fall and spring, respectively). High numbers of individual topsmelt (*Atherinops affinis* - 222 individuals) were seen at the north jetty in October. Numerous shiner surfperch (*Cymatogaster aggregata*) were observed at the south jetty in June (292 individuals). Also in June, 225 individuals of olive rockfish (*Sebastes serranoides*) were noticed at the north jetty.

Reef fish abundance patterns compared with past years. Table 7-6 lists the ranges in numbers of individuals of reef fish counted per station since October 1993. The numbers of reef fish enumerated during October ranged from 158 to 437 individuals per station, which falls within the range of autumn surveys. Similarly, the June range of individuals (161 to 499) compares well with past surveys.

7.3.11. Reef Fish Species

Spatial reef fish species patterns. Reef fish species counts at the three dive survey stations are listed in Table 7-3. Numbers of species were similar across the stations and seasons, greatest number of species was observed in October at the break wall (12 species), and the lowest species count appeared at the north jetty during the spring (8 species). Total fall and spring species counts (18 and 17 species, respectively) were quite similar.

Reef fish species patterns compared with past years. Table 7-6 lists the ranges in numbers of species of reef fish counted per station since October 1993. The range of species recorded during the fall, 9 to 12 species per station, and the spring, 8 to 11 species per station, coincided with ranges from past surveys.

TABLE 7-6. RANGES IN NUMBERS OF ALL INDIVIDUALS AND SPECIES OF FISH JUVENILES AND ADULTS COLLECTED: OCT 1993 - MAY 2002

	BOTTOM FISH			MIDWATER FISH			INSHORE FISH			REEF FISH		
DATE	Individuals	Species	Diversity	Individuals	Species	Diversity	Individuals	Species	Diversity	Individuals	Species	Diversity
Oct-93	3 - 6	3 - 4	—	2 - 28	1 - 1	—	1542	5	—	161 - 278	9 - 13	—
Oct-94	0 - 3	0 - 3	—	1 - 66	1 - 3	—	1016	6	—	110 - 304	11 - 19	—
Oct/Nov-95	1 - 8	1 - 5	—	0 - 31	0 - 1	—	416	6	—	6 - 48	2 - 8	—
Oct-96	3 - 53	2 - 10	0.64 - 2.15	0 - 26	0 - 1	0.00 - 0.00	1791	8	0.42	128 - 1862	9 - 12	0.57 - 1.93
Oct-97	13 - 69	4 - 9	0.80 - 1.80	0 - 2	0 - 2	0.00 - 0.69	646	8	0.56	165 - 5353	7 - 15	0.24 - 1.13
Sep-98	21 - 62	5 - 11	1.44 - 1.84	4 - 11	2 - 3	0.30 - 1.04	1091	12	0.35	145 - 512	10 - 14	1.24 - 1.95
Oct-99	24 - 58	5 - 6	0.41 - 1.32	0 - 1	0 - 1	0.00 - 0.00	234	7	0.31	57 - 243	7 - 14	0.96 - 1.88
Oct-00	2 - 229	2 -5	0.34 - 1.01	0 - 8	0 - 1	0.00 - 0.00	1515	3	0.50	46 - 325	5 - 7	0.48 - 1.59
Fall Range	**0 - 229**	**0 - 11**	**0.34 - 2.15**	**0 - 66**	**0 - 3**	**0.00 - 1.04**	**234 - 1791**	**3 - 12**	**0.31 - 0.56**	**6 - 5353**	**2 - 19**	**0.24 - 1.95**
Oct-01	12 - 29	5 - 7	1.23 - 1.45	0	0	0.00 - 0.00	1855	11	0.14	158 - 437	9 - 12	1.11 - 1.90
May-94	5 - 20	3 - 5	—	0 - 17	0 - 4	—	1418	6	—	15 - 130	2 - 12	—
May-95	4 - 13	4 - 5	—	0 - 44	0 - 5	—	8165	9	—	0 - 42	0 - 9	—
May-96	2 - 38	1 - 9	—	0 - 34	0 - 2	—	3321	9	—	30 - 320	8 - 16	—
May-97	35 - 69	8 - 9	1.48 - 1.91	0 - 6	0 - 3	0.00 - 0.60	1066	11	0.42	2169 - 7267	5 - 9	0.07 - 0.19
May-98	20 - 147	6 - 13	1.51 - 2.01	0 - 18	0 - 2	0.00 - 0.64	2145	9	0.42	24 - 150	2 - 10	0.56 - 1.88
May-99	18 - 75	6 - 8	0.68 - 1.89	11 - 373	1 - 6	0.00 - 0.37	1884	10	0.65	21 - 163	4 - 10	0.69 - 2.03
Jun-00	70 - 124	6 - 10	0.54 - 1.02	0 - 1	0 - 1	0.00 - 0.00	42	4	0.83	160 - 1077	9 - 15	1.12 - 1.56
May-01	20 - 103	4 - 6	0.59 - 0.90	0	0	0.00 - 0.00	546	7	0.44	118 - 696	9 - 10	1.05 - 1.72
Spring Range	**2 - 147**	**1 - 13**	**0.54 - 2.01**	**0 - 373**	**0 - 6**	**0.00 - 0.64**	**42 - 8165**	**4 - 11**	**0.42 - 0.83**	**0 - 7267**	**0 - 16**	**0.07 - 2.03**
May-02	21 - 406	6 - 10	0.30 - 1.70	1 - 432	1 - 5	0.00 - 1.56	426	7	0.26	161 - 499	8 - 11	1.23 - 1.63

TABLE 7-7. RANGES IN NUMBERS OF INDIVIDUALS AND SPECIES OF FISH LARVAE AND EGGS COLLECTED: OCT. 1993 - JUNE 2002

	LARVAL FISH			FISH EGGS		
DATE	Individuals	Species	Diversity	Individuals	Species	Diversity
Oct-93	309 - 3392	2 - 5	—	37 - 1219	1 - 1	—
Oct-94	720 - 1693	4 - 6	—	18 - 3127	1 - 2	—
Oct/Nov-95	311 - 1791	1 - 3	—	14 - 194	1 - 1	—
Oct-96	1193 - 3396	4 - 7	0.71 - 1.20	36 - 1052	1 - 5	0.00 - 0.81
Oct-97	56 - 2693	2 - 5	0.38 - 0.87	0 - 545	0 - 9	0.00 - 1.40
Sep-98	112 - 1680	2 - 9	0.50 - 0.76	89 - 3316	1 - 4	0.00 - 0.89
Oct-99	177 - 1730	3 - 6	0.61 - 1.11	112 - 4235	1 - 5	0.00 - 0.80
Oct-00	138 - 2472	2 - 5	0.12 - 0.81	81 - 1280	1 - 5	0.00 - 1.20
Fall Range	**56 - 3396**	**1 - 9**	**0.12 - 1.20**	**0 - 4235**	**0 - 9**	**0.00 - 1.40**
Oct-01	162 - 726	3 - 6	0.30 - 1.07	0 - 505	0 - 3	0.00 - 0.83
May-94	672 - 8803	2 - 11	—	17 - 477	2 - 2	—
May-95	1907 - 64,408	4 - 7	—	182 - 6782	1 - 2	—
May-96	1584 - 40,621	5 - 7	—	37 - 565	1 - 1	—
May-97	1563 - 7897	9 - 15	0.79 - 1.63	10,094 - 58,297	4 - 6	0.14 - 1.50
May-98	40 - 2820	2 - 5	0.42 - 0.91	16 - 1318	1 - 5	0.00 - 0.93
Jun-00	316 - 6520	2 - 15	0.69 - 1.70	239 - 4128	3 - 8	0.30 - 1.20
May-01	122 - 1376	2 - 8	0.63 - 0.99	7 - 569	1 - 6	0.00 - 1.38
Spring Range	**40 - 64,408**	**2 - 15**	**0.42 - 1.70**	**16 - 58,297**	**1 - 8**	**0.00 - 1.50**
Jun-02	71 - 4857	3 - 12	0.38 - 1.49	248 -5943	3 - 7	0.17 - 1.27

7.3.12. Reef Fish Diversity

Spatial reef fish diversity patterns. Species diversity calculated from the three dive survey stations are listed in Table 7-3. Highest species diversity was at the break wall in the fall (1.90), and the lowest diversity, like last year, was at the north jetty in the fall (1.11). Overall, average diversity in the fall (1.53) was higher than in the spring (1.39).

Reef fish diversity patterns compared with past years. The range of species diversity values this fall (1.11 to 1.90) and spring (1.23 to 1.63) were somewhat higher compared to recorded values over the last five years (Table 7-6). Additionally, the ranges this year were tighter. Diversity calculations were not performed prior to 1996.

7.3.13. Larval Fish Abundance

Spatial larval fish abundance patterns. Numbers of larval fish captured at the three plankton-sampling stations are listed in Table 7-4. The largest and smallest catches occurred in the spring at the bottom of mid channel (Station 5 - 4857 individuals) and at the surface at the Harbor entrance (Station 2 – 71 individuals). Total counts in the spring (10,886 individuals) greatly surpassed fall counts (2638 individuals). As in the past, total surface counts (3971 individuals) were lower than bottom counts (9553 individuals). Note that all counts are standardized to numbers per 1000 cubic meters.

Both fall and spring counts were dominated by larval blennies (*Hypsoblennius spp.*) and gobies (Gobiedae A/C, a combination of arrow goby (*Clevelandia ios*), cheekspot goby (*Ilypnus gilberti*), and shadow goby (*Quietula y-cauda*)).

Larval fish abundance patterns compared with past years. Table 7-7 lists the ranges of individuals of larval fish counted per station since October 1993. The fall range (162 to 726 individuals) fell below past ranges. The spring range (71 to 4857 individuals) compared well to past ranges.

7.3.14. Larval Fish Species

Spatial larval fish species patterns. Larval fish species collected at the three plankton-sampling stations are listed in Table 7-4. The highest species counts were at the bottom near the break wall and in mid channel in the spring (12 species, each). Only 3 species were found at the surface in mid channel (Station 5) and in Basin D (Station 8) in the fall and also at the surface of Basin D in the spring. Overall, species collected in the fall (9 species) were much lower than the number collected in the spring (21). As usual, average species counts at the surface (4) were much smaller than counts at the bottom (8).

Larval fish species patterns compared with past years. Table 7-7 lists the ranges of larval fish species counted per station since October 1993. The fall range (3 - 6) was typical of past surveys. The spring range (3 -12) was on the high side compared to past diversity ranges.

7.3.15. Larval Fish Diversity

Spatial larval fish diversity patterns. Species diversities calculated from the three plankton sampling stations are listed in Table 7-4. Lowest diversity was found near the bottom in mid channel October (0.30), and highest diversity was found at the surface near the break wall May (1.49). Average diversity among stations was higher in the spring (1.01) than in the fall (0.75). Average surface diversity across seasons (0.95) was higher than average bottom diversity (0.81), likely due to the high number of species found during the spring tows.

Larval fish diversity patterns compared with past years. The species diversity ranges in fall of 2001 (0.30 to 1.07) and spring, 2002 (0.38 to 1.49), were typical of measurements made during the past five years (Table 7-7). Species diversity calculations were not performed prior to 1996.

7.3.16. Fish Egg Abundance

Spatial fish egg abundance patterns. Numbers of fish eggs at three plankton-sampling stations are listed in Table 7-4. Note that all counts are standardized to numbers per 1000 cubic meters. The surface and bottom plankton tows of Station 2 near the Harbor entrance in the spring yielded the highest number of individual eggs (5943 and 2546, respectively). The majority of these were Type 32 eggs. No fish eggs were found at Station 8 in the fall in either the surface or bottom tows. Total counts in the fall (873 individuals) were much smaller than in the spring (10,106 individuals), and total counts at the surface from both seasons (7372 individuals) were larger than at the bottom (3605 individuals). The most abundant identified egg, *Citharichthys spp.* (Sandab egg) (512 individuals in spring) was found only at the bottom of Station 2 in the spring. The majority of eggs found in both seasons were identified as Type 32 (7462 total individuals) and Unidentified (1693 total individuals) with most of these caught in the spring tows.

Fish egg abundance patterns compared with past years. Table 7-7 lists the ranges of individuals of fish eggs counted per station since October 1993. Numbers of fish eggs found in October ranged from 0 to 505 individuals per station, and counts in the spring ranged from 248 to 5943 individuals. Numbers in the fall were low compared to past tows, but spring numbers were typical of past years.

7.3.17. Fish Egg Species

Spatial fish egg species patterns. Numbers of fish egg species collected at the three plankton sampling stations are listed in Table 7-4. The greatest numbers of species were captured at the surface near the breakwall in May (7 species). The lowest specie counts, where animals were found, were found in the fall at Station 5 in mid channel at the surface and bottom (2 species, either Type 32, Unidentified and *Pleuronichthys ritteri*). Species counts in the fall (3 species) were much lower than in the spring (9 species). The average number of species per sample at the surface (3) and bottom (3) were similar.

Fish egg species patterns compared with past years. Table 7-7 lists the ranges of species of fish eggs counted per station since October 1993. Fish egg species recorded during October ranged from 0 to 3 species per sample and 3 to 7 in the spring, which was typical.

7.3.18. Fish Egg Diversity

Spatial fish egg diversity patterns. Species diversity calculations from the three sampling stations are listed in Table 7-4. Highest diversity was near the bottom at the breakwall in May (1.27). The lowest diversity occurred at both surface and bottom in Basin D in October (0.00). Averaged among samples, spring diversity (0.77) exceeded fall diversity (0.50). Similar to last year, average surface diversity (0.53) was lower than bottom diversity (0.74).

Fish egg diversity patterns compared with past years. Both fall (0.00 to 0.83) and spring (0.17 to 1.27) diversity ranges were representative of surveys from the past four years (Table 7-7). Diversity values were not calculated prior to 1996.

7.4. DISCUSSION

Marina del Rey Harbor continues to serve as a viable habitat and nursery for many species of marine fish. To date, 115 different species of fish have been collected in the Harbor, representing most feeding and habitat niches found in the eastern Pacific Ocean. Since its inception, this sampling program has collected animals from different seasons (fall and spring), spatial strata (midwater, bottom, inshore), habitat type (soft bottom or rocky reef), and age group (eggs, larvae, juveniles, adults). This year's sampling yielded 29,148 total fish of all age groups (including larvae and eggs) representing 64 different species. By far, the majority of these were eggs, larvae, and juveniles, which attests to the Harbor's value as a nursery ground for adult Harbor species, as well as species for the Pacific Ocean as a whole.

Bottom fish were collected using a semi-balloon otter trawl at three locations in the Harbor: near the Harbor entrance, in mid channel, and along Basin D. Both fall and spring surveys were representative of past years. Diamond turbot, California halibut, and barred sand bass, prized by both commercial and sport fishermen, were present in several trawls with shiner surfperch dominating bottom trawls. This year, spring catches yielded larger individual and species counts, although average diversity was higher in the fall.

From the fall mid water gill net sampling data, it would appear that this method continues to be of limited use. Since the technique is passive, capture relies on chance that animals will swim into the net. The most species were caught at Station 8 in Basin D in the spring, however, when a school of topsmelt and several bonefish, jacksmelt, a barred sand bass and a California needlefish swam into the net.

Inshore fish were collected by beach seine at Mother's Beach. More individuals were caught in the fall than spring but topsmelt dominated both seines and most of these were juveniles. Additionally, more species were captured in the fall seine, but diversity was higher in the spring. Several species were found in both fall and spring seines; diamond turbot, staghorn sculpin, California corbina and yellowfin croaker.

Reef associated fish were enumerated and identified by diver-biologists along both jetties and the breakwall. Numbers of fish, numbers of species, and diversity values during this survey were characteristic of most past surveys. Opaleye, black surfperch, and pile surfperch were observed at all stations in both seasons and 18 other species were observed between the two seasons. Although more individuals were seen in June than in October, without the preponderance of shiner surfperch young of the year by the south jetty in the spring, the total number of individual fish would have been similar.

Larval fish and fish eggs were collected by plankton net near the surface and bottom at the three sampling stations used for trawl surveys. Larval fish and fish egg counts during both seasons were typical of past surveys. The majority of fish eggs were found near the breakwall in both bottom and surface tows in the spring. Basin D and the mid channel yielded the highest numbers of larval fish in the spring. Spring tows produced the greatest abundance of both larval fish and egg counts. Similar to last year, gobies and blennies dominated larval counts whereas, with the exception of an abundance of sandab eggs, the majority of eggs went unidentified. Spring tows contained the most species and also had higher average diversity compared to fall tows. Most eggs and larvae were found in the bottom tows although top tows still contained large amounts of individuals.

The sampling methods used in Marina del Rey differ somewhat from those of other southern California surveys (i.e. L.A. Harbor, SCCWRP), so fish population characteristics cannot be easily compared. However, it is obvious that the entire Marina continues to support a very abundant and diverse assemblage of fish fauna and serves as a nursery for many species important to local sport and commercial fisheries, as well as the whole coastal environment.

8. CONCLUSIONS

Marina del Rey Harbor continues to serve as an important commercial and recreational facility for southern California. Additionally, it continues to function as an important ecological habitat and nursery for a local community of fish, invertebrates, birds, and mammals. During this year, the quality of the water, sediment, infauna, and resident fish populations were measured and evaluated. This section provides the conclusions drawn from these evaluations.

The water quality of Marina del Rey Harbor remains impacted both temporally and spatially. Temporal impacts included both weather and oceanographic influences. This year, the Harbor experienced cooler water and low rainfall. Since rainfall fell far below normal, winter and spring rains exerted a much smaller influence on Harbor waters compared to rainier years. Regardless, winter and spring precipitation tended to lower water clarity and pH and increased ammonia, bacteria counts, and biochemical oxygen demand (BOD) throughout the Harbor. Salinity was not as variable except at stations in Ballona Creek and Oxford Lagoon, which is not unusual. The influence upon the phytoplankton community was generally limited to the spring. Phytoplankton blooms, in turn, can subsequently raise dissolved oxygen values, and their demise can increase biochemical oxygen demand later in the spring. Dissolved oxygen and BOD increased slightly in the spring and summer and may have been associated with observed red tides. As usual, seasonal temperature changes in the ocean impacted the Harbor, causing colder water in the winter and warmer water in the summer and fall.

The Harbor is spatially impacted by the discharges of Oxford Lagoon, Ballona Creek and the open ocean. The open ocean brought lower temperatures, high dissolved oxygen, salinity and pH primarily to stations located near the Harbor entrance. Ballona Creek highly influenced water quality at Station 1 producing decreased water clarity and increased ammonia, BOD and bacteria. Stations 2 and 3 felt more of the oceanic effect. Stations near Oxford Lagoon felt the influence more directly with decreased water clarity, dissolved oxygen and yellow brown coloration with high bacteria counts and temperature. Decreases in salinity at the surface were not as apparent this year. Similar to recent past surveys, Basin D which includes Mother's Beach, appeared less affected by surface runoff than in older surveys.

Stations in the lower main channel were most like the open ocean and were thus the most natural in the Harbor. These stations were characterized by high dissolved oxygen, pH, and water clarity and low values of BOD. As always, the areas further back into the Marina were warmer, more saline and moderate in dissolved oxygen, bacteria counts and water clarity.

Bacterial measurements were made monthly at 18 stations (648 measurements in the year). Total coliform limits were exceeded 33 times, fecal coliform limits 60 times, and enterococcus limits 42 times. The total exceedances (135) were almost two times last year's numbers. Among these 135 exceedances, 109 (81%) could be attributed to flows from either Ballona Creek or Oxford Lagoon. Enteroccocus exceedences were similar to last year, but the number of fecal coliform exceedances was at least three times higher in each season. Total coliform criteria were exceeded more in the fall and spring compared to past years.

Relative percent differences were calculated and only four stations differed more than 25% between 2000 and 2002. These changes did not seem to greatly affect the concentrations of chemical contaminants or biota health. In general, physical characteristics of Harbor sediments (median particle size and sorting) were influenced by energy of water flow that is influenced by Harbor configuration and rainfall intensity. The effect of current and wave action near the entrance and into the upper channel created sediments that were universally coarse and homogenous. Most stations experienced a settling out of finer sediment particles probably due to the low storm activity, although distribution did not change much. Stations near the Harbor entrance were sandy and the most homogenous of the marina. Finer sediments were found in the back Harbor and Basin areas.

Due to the historical and current land and water uses, the Harbor contains some contamination by heavy metals, DDT and derivatives, pesticides and PCBs, and organics. Oxford Lagoon and Ballona Creek appear to continue to supply chlorinated pesticides and organics. Only the DDT breakdown product, DDE was found at all stations but no DDT itself. Among chlorinated hydrocarbons listed as toxic by NOAA, all 15 Harbor stations exceeded at least one compound at levels "potentially" toxic to benthic organisms, and 12 out of 15 stations had chlorinated hydrocarbons at levels "probably" toxic to benthic organisms. More stations this year were found to have pesticide concentrations that were probably toxic than last year. However, most chlorinated compounds have continued to remain lower than historical values, and levels are much lower those of Los Angeles Harbor and are similar to those of reference samples collected offshore. Seven of 15 stations contained PCB concentrations at "potentially" toxic levels but, on average, concentrations were lower than those found in Los Angeles Harbor though higher than concentrations found offshore.

Heavy metals tended to be higher in the main channel and Basins F and E, likely originating from the resident boat population. All stations, except Station 22 in Oxford Lagoon, exceeded at least one metal limit of "possible" toxicity, and 6 out of 15 exceeded at least one metal limit of "probable" toxicity, which was higher than last year. Metal concentrations in Marina del Rey sediments do not appear to have greatly increased or decreased since 1989. Levels of about half the metals measured were about two to three times higher than Los Angeles Harbor. The remainder were about the same or lower. The configuration of Los Angeles Harbor allows for better flushing and offshore movement of contaminated suspended materials since it has two entrances rather than the one like Marina del Rey.

Tributyl tin continues to remain low but ubiquitous especially in the mid channel and Basins D and F. In the past, this compound was 100 times more concentrated in Harbor sediments. Nonspecific organic compounds, including nutrients and carbonaceous organics, tended to be within the Harbor and away from the Harbor entrance in lower disturbance areas with finer particles. Station 25 in mid channel was high in several metals, organics and chlorinated hydrocarbons.

The number of infaunal species (211) was somewhat lower compared to last year (248). As usual, areas associated with Oxford Lagoon, Ballona Creek, and possibly Venice Canal tended to show some evidence of community disturbance. More normal fauna through succession replace disturbance tolerant infauna if conditions stabilize. The soft, unconsolidated sediments and sometimes inhibitory levels of contamination favor populations of tolerant polychaete worms. These organisms provide important food for bottom feeding fish. Microcrustaceans are less nutritious by weight than polychaetes because of their indigestible exoskeletons. Infaunal community health did not appear to be strongly related to the stations' benthic grain size patterns but unexpectedly seem to coincide slightly with higher levels of chlorinated hydrocarbons and metals. This may be due to the fact that particles that tend to attract more contaminants usually tend to attract more organic nutrients. Overall, Nematode and oligochaete worms, that are known to be characteristic of highly disturbed benthic sediments, were found in relatively low numbers but had high counts at several locations this year. Despite contamination by various metals; mid-channel stations appeared to support the healthiest benthic populations in the Harbor.

Marina del Rey abundances and numbers of species were above Los Angeles Harbor averages possibly due to the protection an enclosed design provides. Infaunal index values and diversity values were slightly lower compared to Los Angeles Harbor. Overall infaunal values were higher than past results. All but one station had infaunal index values above normal (>60).

Like last year, fish enumerations this year included trawl net sampling for bottom fish, gill net sampling for midwater fish, beach seine sampling for inshore fish, plankton net sampling for larval fish and eggs, and diver transect enumeration for reef fish. 29,184 total fish of all age groups, representing 64 different species were recorded. The majority of these were eggs, larvae, or juveniles, which attest to the Harbor's importance as a nursery. Mid water gill net sampling caught many fish, mostly topsmelt, but occasionally a variety of different species. This year's data confirms Marina del Rey Harbor as an estuary supporting an abundant and diverse assemblage of fish fauna and as a nursery for many fish species important to local sport and commercial fisheries, as well as the whole coastal environment.

9. APPENDICES

9.1. REFERENCES

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9.2. WATER QUALITY DATA AND CRUISE LOGS

Physical Water Quality Data July 18, 2001

CRUISE:	MDR 01-04	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	907	3.2
RAIN:	None	S. Roush	Low	1338	2.8

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	838	0	19.67	33.51	8.57	8.29	68.07	90.8	9	4.2	0.02	4.3
1k ENE		1	19.64	33.51	9.08	8.32	65.85	90.1				
		2	19.58	33.53	9.60	8.34	64.67	89.7			0.02	4.4
		3	19.47	33.46	9.73	8.34	66.61	90.3				
		4	19.37	33.54	9.90	8.31	63.91	89.4			0.04	4.0
		5	19.34	33.53	10.01	8.29	63.94	89.4				
		6	19.29	33.45	9.79	8.28	63.02	89.1			0.03	4.9
2	830	0	19.78	32.96	8.53	8.24	61.46	88.5	9	4.5	< 0.01	3.9
1k ENE		1	19.51	33.16	9.02	8.28	61.40	88.5				
		2	18.96	33.31	9.25	8.30	63.58	89.3			0.01	4.0
		3	18.67	33.26	9.49	8.29	65.79	90.1				
		4	18.27	33.24	9.76	8.28	66.73	90.4			< 0.01	3.8
		5	17.94	33.50	9.93	8.26	67.07	90.5				
3	823	0	20.91	32.98	7.13	8.13	58.53	87.5	9	3.0	0.02	3.0
1k ENE		1	20.62	33.10	7.54	8.15	57.58	87.1				
		2	20.52	33.14	8.20	8.16	59.02	87.6			< 0.01	2.4
4	902	0	21.54	33.23	7.03	8.11	60.41	88.2	9	3.2	< 0.01	1.9
1k ENE		1	20.67	32.98	7.39	8.12	59.80	87.9				
		2	19.65	33.30	7.89	8.15	57.59	87.1			0.12	1.5
		3	19.36	33.44	8.09	8.17	56.15	86.6				
		4	19.22	33.51	8.20	8.18	55.35	86.3			0.03	1.7
5	755	0	21.67	33.40	7.23	8.06	60.82	88.3	10	3.0	< 0.01	1.9
1k ENE		1	21.76	33.28	7.61	8.06	55.06	86.1				
		2	21.64	32.54	7.75	8.05	51.80	84.8			0.02	1.6
		3	20.20	32.83	7.94	8.06	48.91	83.6				
		4	19.46	32.25	7.83	8.06	37.12	78.1			0.02	1.5
6	809	0	21.74	33.37	7.37	8.07	58.76	87.6	10	3.1	0.01	1.6
1k ENE		1	21.72	33.34	7.39	8.06	57.64	87.1				
		2	21.51	32.92	7.40	8.04	56.00	86.5			< 0.01	1.0
7	915	0	22.09	33.36	6.33	8.14	49.22	83.8	9	2.0	< 0.01	2.4
1k ENE		1	22.05	33.33	6.57	8.09	47.38	83.0				
		2	21.90	32.91	6.91	8.04	43.48	81.2			< 0.01	1.0
		3	21.06	32.77	7.08	8.04	39.19	79.1				
		4	20.21	32.72	6.92	8.05	35.09	77.0			< 0.01	1.0
8	705	0	22.11	33.34	7.91	8.01	54.72	86.0	10	2.2	< 0.01	2.3
1k ENE		1	22.09	33.31	8.05	8.01	52.43	85.1				
		2	21.98	33.23	8.06	7.99	44.80	81.8			< 0.01	2.5
		3	21.59	33.30	7.79	7.90	30.16	74.1				
											< 0.01	3.3

July 18, 2001 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	749	0	21.70	33.15	6.25	7.93	33.82	76.3	10	1.5	< 0.01	4.3
1k ENE		1	21.48	33.26	6.36	7.94	29.90	73.9				
		2	21.26	33.12	6.47	7.97	34.36	76.6			< 0.01	1.5
											< 0.01	1.3
10	730	0	22.51	33.22	6.28	7.88	16.66	63.9	11	0.8	< 0.01	4.4
1k ENE		1	22.45	33.07	6.58	7.90	22.67	69.0				
		2	22.02	33.12	6.71	7.90	30.38	74.2			< 0.01	5.5
		3	21.63	33.23	6.72	7.86	30.83	74.5				
											0.02	6.0
11	737	0	22.15	33.07	6.92	8.01	60.00	88.0	9	2.7	0.02	3.7
1k ENE		1	21.72	33.06	7.21	8.00	49.98	84.1				
		2	21.13	33.11	7.31	7.99	45.79	82.3			0.03	1.2
											0.02	1.4
12	845	0	19.76	32.86	8.61	8.24	56.41	86.7	9	3.0	0.03	6.1
1k ENE		1	19.66	33.49	8.48	8.29	55.24	86.2				
		2	19.61	33.53	8.50	8.30	63.95	89.4			0.03	5.6
13	616	0	22.02	33.25	6.71	8.09					0.03	5.5
18	700	0	21.99	33.37	8.49	8.08	45.66	82.2	10	3.0	0.03	5.1
1k ENE		1	21.94	33.35	8.78	8.08	44.43	81.6				
											0.03	3.4
19	633	0	19.96	33.27	7.40	8.11					0.03	5.6
20	721	0	22.46	31.78	6.43	7.91	33.16	75.9	10	1.2	0.04	9.8
1k ENE		1	22.41	32.63	7.14	7.91	33.16	75.1				
											0.04	7.3
22	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
25	907	0	21.33	33.19	4.12	8.09	62.35	88.9	9	3.3	0.05	2.3
1k ENE		1	20.97	33.13	5.00	8.09	60.67	88.3				
		2	20.46	33.07	6.32	8.09	58.15	87.3			0.05	1.1
		3	19.63	33.46	7.45	8.11	51.28	84.6				
		4	19.40	33.49	7.82	8.14	44.46	81.7			0.04	1.4
	Average		20.75	33.18	7.72	8.11	51.54	84.14	9.5	2.7	0.02	3.3
	Number		62	62	62	62	60	60	15	15	43	43
	St. Dev.		1.22	0.32	1.21	0.13	12.69	5.97	0.6	1.0	0.02	2.0
	Maximum		22.51	33.54	10.01	8.34	68.07	90.83	11	4.5	0.12	9.8
	Minimum		17.94	31.78	4.12	7.86	16.66	63.89	9	0.8	0.01	1.0

Surface Bacteriological Water Data and General Observations **July 18, 2001**

CRUISE:	MDR 01-04	Vessel:	Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.:	J. Gelsinger	High	907	3.2
RAIN:	None		S. Roush	Low	1338	2.8

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	838	20	70	5	High turbidity
2	830	120	50	2	High turbidity. Litter.
3	823	110	< 20	5	High turbidity.
4	902	40	20	2	High turbidity.
5	755	130	50	7	High turbidity. Surface scum, fuel oil, litter.
6	809	170	20	2	High turbidity.
7	915	80	50	4	High turbidity.
8	705	110	140	5	High turbidity. Plastic, fuel oil, jellyfish present.
9	749	9000	< 20	33	High turbidity. Litter.
10	730	2400	50	300	High turbidity. Fuel oil, mild red tide.
11	737	9000	20	17	High turbidity.
12	845	3000	270	8	High turbidity.
13	616	1400	20	20	Moderate turbidity. Jellyfish present.
18	700	40	< 20	2	High turbidity. Plastic, fuel oil, jellyfish present.
19	633	1300	20	50	Moderate turbidity.
20	721	2400	< 20	36	High turbidity. Fuel oil, mild red tide, jellyfish present.
22	n/a	n/a	n/a	n/a	n/a
25	907	300	< 20	14	High turbidity.
	Average	1742.4	51.8	30.1	
	Number	17	17	17	
	St. Dev.	2902.0	64.2	71.0	
	Maximum	9000	270	300	
	Minimum	20	20	2	

Physical Water Quality Data August 29, 2001

CRUISE:	MDR 01 - 08	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Overcast	Pers.: J. Gelsinger	High	844	3.2
RAIN:	None	S. Roush	Low	1329	2.9

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	859	0	21.35	33.50	6.49	7.29	68.06	90.8	8	5.9	0.10	2.2
3k SSE		1	21.30	33.52	7.02	7.30	67.08	90.5				
		2	21.24	33.52	7.68	7.30	67.54	90.7			0.11	2.3
		3	21.17	33.50	7.87	7.30	68.79	91.1				
		4	21.03	33.49	7.83	7.30	70.02	91.5			0.16	2.2
		5	20.94	33.53	7.75	7.30	70.96	91.8				
		6									0.11	2.5
2	854	0	21.37	33.48	7.26	7.29	63.08	89.1	8	5.8	0.14	1.9
3k SSE		1	21.37	33.43	7.71	7.29	63.85	89.4				
		2	21.34	33.46	7.69	7.29	64.30	89.5			0.09	1.8
		3	21.34	33.47	7.64	7.29	64.51	89.6				
		4	21.31	33.48	7.63	7.29	64.50	89.6			< 0.01	1.9
		5	21.27	33.45	7.62	7.29	64.42	89.6				
		6	21.11	33.40	7.66	7.29	65.10	89.8			0.04	2.0
3	847	0	21.72	33.22	7.08	7.26	54.41	85.9	9	3.8	0.03	2.0
3k SSE		1	21.70	33.24	7.22	7.26	54.26	85.8				
		2	21.69	33.28	7.20	7.26	54.45	85.9			< 0.01	1.8
		3										
		4									< 0.01	1.9
4	926	0	21.74	33.28	6.46	7.23	52.54	85.1	10	2.5	0.01	2.0
3k SSE		1	21.71	33.30	6.78	7.24	51.46	84.7				
		2	21.65	33.29	6.98	7.23	50.29	84.2			0.20	1.5
		3										
		4									0.27	1.3
5	819	0	22.23	33.28	5.92	7.13	48.77	83.6	10	2.2	0.24	1.6
3k SSE		1	22.18	33.29	6.24	7.14	46.70	82.7				
		2	22.15	33.30	6.42	7.15	45.11	82.0			0.15	1.6
		3	22.07	31.03	6.57	7.15	45.17	82.0				
		4									0.20	1.7
6	830	0	22.28	33.35	5.97	7.15	58.70	87.5	10	3.0	0.20	1.3
3k SSE		1	22.28	33.35	6.30	7.15	57.39	87.0				
		2	22.28	33.34	6.45	7.14	58.24	87.4			0.02	1.1
		3										
		4									0.02	1.2
7	942	0	22.46	33.33	5.62	7.12	42.21	80.6	11	1.7	0.01	1.6
3k SSE		1	22.40	33.23	5.90	7.11	40.78	79.9				
		2	22.21	33.17	6.05	7.09	37.76	78.4			0.03	1.6
		3	21.98	33.28	5.80	7.07	31.76	75.1				
		4									< 0.01	1.3
8	726	0	22.64	33.35	6.01	7.08	39.20	79.1	10	2.0	0.04	2.3
3k SSE		1	22.67	33.34	6.06	7.06	31.12	74.7				
		2	22.60	33.19	5.78	6.99	19.13	66.1			0.02	4.5
		3										
		4									0.03	5.3

August 29, 2001 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	810	0	22.53	33.20	4.09	6.99	34.59	76.7	10	1.6	0.09	1.4
3k SSE		1	22.45	33.09	4.56	7.01	35.63	77.3				
		2	22.31	31.49	4.88	7.04	34.02	76.4			0.04	1.6
		3										
		4									0.04	1.4
10	750	0	22.80	33.18	3.86	6.98	46.83	82.7	10	2.1	0.04	3.4
3k SSE		1	22.75	33.13	4.17	6.99	48.11	83.3				
		2	22.54	33.15	4.42	6.98	42.68	80.8			0.04	3.7
		3	22.37	33.20	4.38	6.94	28.94	73.3				
		4									0.04	2.9
11	800	0	22.58	33.22	5.31	7.05	43.91	81.4	10	2.1	0.03	2.0
3k SSE		1	22.49	33.22	5.39	7.06	38.69	78.9				
		2	22.34	33.23	5.29	7.08	39.11	79.1			0.04	1.4
		3										
		4									0.04	1.5
12	909	0	21.41	33.39	6.23	7.26	53.18	85.4	9	3.0	0.05	2.4
3k SSE		1	21.30	33.44	6.43	7.27	62.47	88.9				
		2									0.03	1.8
13	641	0	22.28	33.26	3.79	7.17					0.07	9.9
18	722	0	22.68	33.35	6.99	7.18	45.88	82.3	10	2.1	0.11	2.3
0k		1	22.66	33.31	7.30	7.19	45.60	82.2				
		2									0.08	3.4
19	700	0	21.78	33.38	6.85	7.45					0.19	2.6
0k												
20	744	0	22.77	33.15	4.08	6.95	47.52	83.0	10	1.9	0.06	3.2
3k SSE		1	22.72	33.16	4.35	6.97	39.34	75.9				
		2									0.02	3.6
22	635		22.28	33.22	3.79	6.94					0.03	8.3
25	933	0	21.87	33.25	6.07	7.15	49.17	83.7	10	2.1	0.02	2.1
3k SSE		1	21.82	33.24	6.36	7.15	46.98	82.8				
		2	21.70	33.27	6.17	7.16	41.91	80.5			0.02	1.6
		3	21.65	33.30	6.03	7.17	38.92	79.0				
		4	21.62	33.31	6.07	7.17	34.57	76.7			< 0.01	1.6
	Average		21.97	33.24	6.17	7.16	49.62	83.35				
	Number		57	57	57	57	54	54				
	St. Dev.		0.54	0.40	1.19	0.12	12.41	5.58				
	Maximum		22.80	33.53	7.87	7.45	70.96	91.78				
	Minimum		20.94	31.03	3.79	6.94	19.13	66.13				

Surface Bacteriological Water Data and General Observations **August 29, 2001**

CRUISE:	MDR 01 - 08	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Overcast	Pers.: J. Gelsinger	High	844	3.2
RAIN:	None	S. Roush	Low	1329	2.9

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	859	500	500	2	
2	854	< 20	< 20	< 2	
3	847	50	< 20	< 2	
4	926	< 20	< 20	< 2	
5	819	80	< 20	9	
6	830	50	< 20	7	
7	942	50	< 20	5	
8	726	80	< 20	11	
9	810	< 20	< 20	2	
10	750	2400	80	280	
11	800	40	< 20	14	fuel slick from boat bilge
12	909	3000	1100	14	litter
13	641	1400	50	17	jellyfish present
18	722	80	< 20	2	
19	700	20	20	13	
20	744	2400	170	280	fuel slick, jellyfish present
22	635	50	< 20	5	
25	933	< 20	< 20	2	fuel slick
	Average	571.1	120.0	37.2	
	Number	18	18	17	
	St. Dev.	996.8	270.5	88.5	
	Maximum	3000	1100	280	
	Minimum	20	20	2	

Physical Water Quality Data **September 13, 2001**

CRUISE:	MDR 01-09	Vessel:	Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.:	J. Gelsinger	High	754	3.2
RAIN:	None		S. Roush	Low	1240	2.8

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	837	0	19.87	33.37	7.61	7.99	57.31	87.0	9	3.9	0.07	1.9
1k SW		1	19.87	33.48	7.54	8.00	55.89	86.5				
		2	19.96	33.41	7.51	8.00	57.22	87.0			0.06	1.3
		3	19.92	33.45	7.57	8.01	60.24	88.1				
		4	19.89	33.47	7.65	8.00	62.08	88.8			0.07	1.5
		5	19.82	33.41	7.68	8.00	63.74	89.4				
		6	19.67	33.27	7.69	8.00	64.20	89.5			0.09	1.3
2	829	0	19.64	32.59	6.67	7.99	57.81	87.2	9	3.6	0.08	1.6
1k SW		1	19.64	32.84	6.87	7.99	57.16	87.0				
		2	19.28	33.13	7.43	7.99	57.28	87.0			0.07	1.3
		3	18.94	33.40	7.82	7.98	58.95	87.6				
		4	18.92	33.48	7.81	7.99	60.33	88.1			0.08	1.3
		5										
3	820	0	20.630	32.750	5.55	7.89	45.38	82.1	11	1.4	< 0.01	0.8
1k SW		1	20.63	33.01	5.72	7.92	45.96	82.3				
		2	20.42	33.13	6.19	7.95	47.57	83.0			< 0.01	1.0
		3	19.34	33.14	6.85	7.95	50.40	84.3				
		4									< 0.01	1.0
4	902	0	21.11	33.14	5.74	7.87	50.96	84.5	10	2.6	< 0.01	1.5
1k SW		1	20.97	33.15	5.91	7.88	51.53	84.7				
		2	20.73	33.19	6.11	7.89	50.47	84.3			< 0.01	0.9
		3	20.08	32.90	6.19	7.92	46.44	82.6				
		4									0.01	0.8
5	755	0	21.460	33.28	5.39	7.85	43.36	81.1	10	2.2	< 0.01	4.0
1k SW		1	21.45	33.21	5.69	7.86	42.36	80.7				
		2	21.33	33.14	6.18	7.86	42.53	80.8			0.02	1.2
		3	21.05	33.14	6.23	7.87	43.14	81.0				
		4	20.86	32.97	6.11	7.87	36.50	77.7			0.02	0.9
6	803	0	21.32	33.34	5.18	7.80	54.45	85.9	10	2.9	0.02	1.1
1k SW		1	21.31	33.35	5.45	7.80	53.23	85.4				
		2	21.31	33.34	5.49	7.80	53.31	85.4			0.03	0.6
7	921	0	21.83	33.25	4.68	7.80	37.88	78.5	11	1.2	0.03	1.5
1k SW		1	21.76	33.29	5.18	7.80	54.45	85.9				
		2	21.71	33.31	5.45	7.79	53.23	85.4			0.03	0.5
		3	21.69	33.31	5.49	7.78	53.31	85.4				
		4									0.02	0.7
8	702	0	21.67	33.35	4.32	7.63	43.86	81.4	11	1.6	0.03	1.0
1k SW		1	21.67	33.37	4.17	7.64	43.77	81.3				
		2	21.69	33.37	4.19	7.64	42.63	80.8			0.02	2.2
		3										
		4									0.02	1.2

September 13, 2001 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	742	0	21.780	33.23	4.16	7.66	40.41	79.7	11	1.6	0.02	2.0
1k SW		1	21.79	33.19	4.17	4.17	37.77	78.4				
		2	21.74	33.25	4.19	4.19	36.31	77.6			0.02	0.8
		3	21.71	33.26	4.37	4.37	36.86	77.9				
		4									< 0.01	0.7
10	723	0	21.96	33.19	3.27	7.60	47.34	82.9	11	2.0	< 0.01	1.5
1k SW		1	21.94	33.19	3.31	7.62	48.74	83.6				
		2	21.87	33.19	3.31	7.64	47.29	82.9			< 0.01	1.4
		3	21.75	33.19	3.53	7.65	39.90	79.5				
		4									0.02	0.9
11	732	0	21.74	33.23	4.45	7.70	48.17	83.3	11	2.0	0.01	2.0
1k SW		1	21.67	33.25	4.44	7.72	42.23	80.6				
		2	21.64	33.26	4.39	7.73	33.07	75.8			0.02	0.7
12	845	0	20.05	31.80	6.46	7.96	38.84	78.9	9	2.9	0.02	1.8
1k SW		1	19.77	33.02	6.49	7.97	37.17	78.1				
		2	19.67	33.25	6.71	7.98	55.01	86.1			0.06	2.4
13	628	0	21.96	33.11	3.02	7.83					0.03	22.0
18	653	0	21.65	33.38	4.37	7.63	36.55	77.8	11	1.9	0.04	2.9
1k SW		1	21.65	33.37	4.44	7.64	36.11	77.5				
		2	21.53	33.41	4.47	7.63	34.86	76.8			0.05	2.0
19	642	0	21.96	33.33	4.62	7.86					0.07	3.5
20	718	0	21.96	33.25	2.82	7.57	47.70	83.1	11	1.3	0.06	12.6
1k SW		1	21.96	33.24	2.82	7.56	47.70	83.1				
		2	21.99	33.20	2.75	7.56	33.12	75.9			0.07	1.5
22	615	1	22.77	32.93	2.24	7.79					0.03	13.9
25	910	0	21.09	33.18	5.12	7.83	53.73	85.6	10	2.6	0.03	1.7
1k SW		1	20.88	32.99	5.23	7.85	53.18	85.4				
		2	20.34	32.86	5.51	7.86	52.56	85.1			0.02	1.0
		3	19.58	33.20	5.79	7.91	49.42	83.8				
		4	19.21	30.25	6.04	7.97	40.03	79.5			0.01	0.9
	Average		20.95	33.14	5.36	7.65	47.72	82.88				
	Number		62	62	62	62	59	59				
	St. Dev.		0.97	0.45	1.45	0.79	8.30	3.66				
	Maximum		22.77	33.48	7.82	8.01	64.20	89.51				
	Minimum		18.92	30.25	2.24	4.17	33.07	75.83				

Surface Bacteriological Water Data and General Observations **September 13, 2001**

CRUISE:	MDR 01-09	Vessel:	Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.:	J. Gelsinger	High	754	3.2
RAIN:	None		S. Roush	Low	1240	2.8

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	837	20	220	110	
2	829	110	110	2	
3	820	290	20	< 2	
4	902	300	20	11	
5	755	300	< 20	< 2	fuel slick
6	803	80	20	8	
7	921	300	50	11	
8	702	300	50	50	
9	742	170	70	2	
10	723	9000	170	22	
11	732	230	20	5	
12	845	5000	2400	7	
13	628	2400	20	26	organic odor, jellyfish, blackcrown night herons
18	653	130	20	30	
19	642	50	< 20	9	
20	718	2200	70	50	
22	615	≥ 16000	170	80	
25	910	20	< 2	5	oil slick, litter
	Average	2050.0	192.9	24.0	
	Number	18	18	17	
	St. Dev.	4183.4	554.5	30.4	
	Maximum	16000	2400	110	
	Minimum	20	2	2	

Physical Water Quality Data — **October 31, 2001**

CRUISE:	MDR 01-10	Vessel: Aquatic Bioassay		TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger		High	810	6.0
RAIN:	None	S. Roush		Low	1425	0.0

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	854	0	17.30	33.21	4.26	7.92	42.27	80.6	12	1.7	0.11	10.3
1k NE		1	17.34	33.42	4.28	7.99	49.82	84.0				
		2	17.35	33.42	4.49	8.01	57.03	86.9			0.06	6.1
		3	17.21	33.34	4.92	8.02	61.92	88.7				
		4	16.93	33.30	5.35	8.02	66.00	90.1			0.07	4.4
		5	16.59	33.24	5.43	8.00	68.82	91.1				
		6	16.15	33.19	5.32	7.98	69.97	91.5			0.07	5.0
2	843	0	17.26	32.88	5.24	8.08	48.18	83.3	12	1.2	0.13	1.6
1k ENE		1	17.23	33.02	5.38	8.07	47.48	83.0				
		2	17.22	33.31	5.55	8.07	47.65	83.1			0.07	7.1
		3	17.15	33.42	5.60	8.05	53.98	85.7				
		4	17.02	33.33	5.55	8.04	60.44	88.2			0.09	5.1
		5	16.36	33.25	5.43	8.02	65.05	89.8				
		6	15.83	33.40	5.22	8.00	67.51	90.6			0.05	4.4
3	834	0	17.56	33.02	4.40	8.00	58.92	87.6	9	3.4	0.06	3.3
1k ENE		1	17.30	33.18	4.47	8.02	59.01	87.6				
		2	17.02	33.39	4.73	8.03	60.88	88.3			0.05	2.5
		3	16.95	33.39	5.01	8.02	61.64	88.6				
		4									0.05	1.9
4	918	0	18.08	33.18	4.25	8.07	60.24	88.1	9	2.9	0.07	2.2
1k NE		1	17.91	33.20	4.39	8.00	58.58	87.5				
		2	17.77	33.25	4.70	8.02	57.95	87.2			0.03	1.3
		3	17.70	33.29	4.88	8.04	57.12	86.9				
		4	17.67	33.29	4.98	8.04	55.70	86.4			0.05	1.2
5	804	0	17.97	33.20	4.41	7,94	56.50	86.7	11	2.5	0.03	2.6
1k ENE		1	18.09	33.38	4.53	7.93	55.58	86.3				
		2	18.20	33.30	4.72	7.92	51.35	84.7			0.04	2.0
		3	18.18	33.31	4.67	7.92	50.49	84.3				
		4	18.17	33.31	4.55	7.92	50.45	84.3			0.04	1.6
6	816	0	18.55	33.35	3.54	7.86	44.53	81.7	10	2.1	0.03	1.8
1k ENE		1	18.54	33.36	3.55	7.87	43.52	81.2				
		2	18.53	33.36	3.64	7.87	42.80	80.9			0.03	0.9
		3	18.51	33.36	3.72	7.87	42.42	80.7				
		4									0.03	1.7
7	936	0	18.60	33.31	3.65	7.91	46.30	82.5	9	2.3	0.03	1.1
1k ENE		1	18.54	33.28	3.68	7.91	45.35	82.1				
		2	18.48	33.31	3.82	7.91	44.14	81.5			0.04	0.8
		3	18.45	33.31	3.88	7.91	43.20	81.1				
		4	18.44	33.29	3.87	7.91	45.39	82.1			0.03	0.6
8	710	0	18.69	33.33	3.43	7.88	41.23	80.1	11	1.8	0.04	2.0
1k ENE		1	18.69	33.32	3.43	7.79	40.62	79.8				
		2	18.68	33.32	3.47	7.79	40.48	79.8			0.09	0.8
		3	18.64	33.25	3.49	7.79	40.08	79.6				
		4									0.08	0.8

October 31, 2001 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	754	0	18.67	33.31	3.54	7.83	43.84	81.4	11	1.6	0.07	1.9
1k ENE		1	18.73	33.28	3.63	7.86	32.44	75.5				
		2	18.68	33.27	3.77	7.88	31.48	74.9			0.07	1.3
		3	18.63	32.93	3.84	7.88	26.06	71.4				
		4									0.08	1.0
10	734	0	18.91	33.31	3.01	7.77	32.93	75.8	11	1.5	0.08	8.9
1k ENE		1	18.98	33.20	3.04	7.78	32.89	75.7				
		2	18.92	33.22	3.16	7.81	31.38	74.8			0.08	1.1
		3	18.85	33.26	3.31	7.82	30.86	74.5				
		4	18.83	33.28	3.48	7.83	26.96	72.1			0.22	0.9
11	744	0	18.62	33.33	3.66	7.84	52.86	85.3	11	2.0	0.08	1.8
1k ENE		1	18.67	33.28	3.72	7.84	49.74	84.0				
		2	18.62	33.27	3.80	7.86	38.90	79.0			0.17	0.8
		3	18.56	33.27	3.87	7.87	25.59	71.1				
		4									0.15	2.4
12	901	0	17.11	33.13	3.20	7.66	10.11	56.4	12	0.2	0.25	15.0
1k NE		1	17.16	33.35	3.24	7.89	30.11	74.1				
		2	16.96	33.34	3.68	7.97	52.54	85.1			0.11	6.2
13	650	0	17.00	32.32	3.02	7.60					0.11	13.0
18	705	0	18.63	33.34	3.51	7.77	44.37	81.6	11	1.8	0.02	5.1
1k ENE		1	18.49	33.29	3.54	7.78	43.50	81.2				
		2									0.03	1.3
19	700	0	17.99	33.60	3.91	7.60					0.03	2.9
20	727	0	18.96	33.22	2.56	7.74	42.51	80.7	11	1.9	0.02	5.0
1k ENE		1	18.97	33.22	2.64	7.75	41.56	80.3				
		2									0.02	3.0
22	645	0	16.50	22.88	2.05	7.60					0.11	15.0
25	924	0	18.14	33.25	4.03	7.92	52.48	85.1	9	1.9	< 0.01	1.3
1k ENE		1	18.06	33.24	4.00	7.93	48.81	83.6				
		2	17.98	33.26	4.30	7.95	46.53	82.6			< 0.01	0.9
		3	17.93	33.27	4.49	7.96	47.63	83.1				
		4	17.89	33.30	4.56	7.97	49.47	83.9			< 0.01	1.0
	Average		17.95	33.11	4.09	7.90	47.37	82.39				
	Number		69	69	69	68	66	66				
	St. Dev.		0.79	1.26	0.80	0.12	11.77	5.88				
	Maximum		18.98	33.60	5.60	8.08	69.97	91.46				
	Minimum		15.83	22.88	2.05	7.60	10.11	56.39				

Surface Bacteriological Water Data and General Observations **October 31, 2001**

CRUISE:	MDR 01-10	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	810	6.0
RAIN:	None	S. Roush	Low	1425	0.0

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	854	≥ 16000	≥ 16000	≥ 1600	brown discoloration, litter
2	843	≥ 16000	≥ 16000	8	
3	834	≥ 16000	≥ 16000	12	
4	918	≥ 16000	≥ 16000	59	
5	804	≥ 16000	≥ 16000	280	
6	816	5000	230	27	
7	936	9000	80	8	
8	710	500	< 20	36	jellyfish abundant, litter
9	754	300	< 20	5	
10	734	≥ 16000	1700	59	
11	744	800	80	110	
12	901	≥ 16000	≥ 16000	≥ 1600	strong odor, brown discoloration, litter
13	650	≥ 16000	2400	55	strong odor, brown discoloration litter
18	705	230	20	17	
19	700	300	20	34	
20	727	≥ 16000	1400	≥ 1600	
22	645	≥ 16000	≥ 16000	≥ 1600	
25	924	≥ 16000	300	20	
	Average	10673.9	6570.6	396.1	
	Number	18	18	17	
	St. Dev.	7163.4	7767.5	665.1	
	Maximum	16000	16000	1600	
	Minimum	230	20	5	

Physical Water Quality Data **28 November 2001**

CRUISE:	MDR 01-11	Vessel: Aquatic Bioassay		TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger		High	709	5.8
RAIN:	None	S. Roush		Low	1359	0.1

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	855	0	14.07	33.22	7.02	7.78	60.68	88.3	9	3.9	0.15	1.6
7k ENE		1	14.12	33.24	7.05	7.79	60.23	88.1				
		2	14.16	33.29	7.23	7.79	59.28	87.7			0.19	0.7
		3	14.17	33.29	7.40	7.79	57.45	87.1				
		4	14.18	33.31	7.51	7.80	56.64	86.8			0.20	0.8
		5	14.20	33.39	7.58	7.80	56.72	86.8				
		6									0.19	0.9
2	850	0	14.11	32.43	7.18	7.70	58.03	87.3	10	3.1	0.11	1.1
3k ENE		1	14.09	32.98	7.25	7.71	57.80	87.2				
		2	14.07	33.03	7.30	7.71	58.94	87.6			0.25	0.6
		3	14.07	33.11	7.32	7.72	59.38	87.8				
		4	14.11	33.24	7.34	7.73	59.61	87.9			0.09	0.6
		5	14.16	33.28	7.39	7.74	59.01	87.6				
		6	14.17	33.30	7.49	7.75	57.00	86.9			0.21	0.8
3	838	0	14.25	32.85	6.62	7.78	58.04	87.3	10	2.7	0.29	1.0
1k ENE		1	14.20	32.96	6.70	7.78	59.19	87.7				
		2	14.08	33.07	6.88	7.80	58.83	87.6			0.32	0.6
		3										
		4									0.23	0.5
4	918	0	14.56	32.76	6.59	7.75	60.82	88.3	9	3.9	0.28	0.9
1k ENE		1	14.55	32.75	6.80	7.75	60.40	88.2				
		2	14.35	32.90	7.01	7.75	60.63	88.2			0.25	0.7
		3	13.99	33.23	7.10	7.77	61.61	88.6				
		4									0.10	0.7
5	814	0	15.22	32.38	6.12	7.74	52.91	85.3	10	2.6	0.10	2.0
1k ENE		1	15.11	32.52	6.32	7.74	51.31	84.6				
		2	14.81	32.64	6.52	7.74	50.72	84.4			0.08	0.9
		3	14.35	32.85	6.61	7.76	51.56	84.7				
		4									0.04	0.8
6	822	0	14.74	34.04	5.95	7.71	62.10	88.8	10	2.8	0.05	1.1
1k ENE		1	15.60	33.18	5.94	7.73	54.64	86.0				
		2	15.54	33.08	6.11	7.77	40.23	79.6			0.30	0.5
		3										
		4									0.12	0.5
7	935	0	15.32	32.82	6.19	7.75	54.36	85.9	9	2.1	0.20	0.8
1k ENE		1	15.26	32.91	6.26	7.76	51.68	84.8				
		2	15.11	32.92	6.45	7.76	48.17	83.3			0.12	0.9
		3	14.66	32.99	6.65	7.76	46.89	82.8				
		4									0.16	0.6
8	716	0	15.28	33.20	5.92	7.70	58.73	87.5	10	2.8	0.28	2.2
1k ENE		1	15.86	33.01	5.91	7.71	52.92	85.3				
		2	15.91	33.10	6.02	7.74	42.69	80.8			0.18	0.9
		3										
		4									0.32	0.9

28 November 2001 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	802	0	15.61	32.91	5.92	7.77	44.59	81.7	10	2.1	0.27	1.3
1k ENE		1	15.54	32.84	6.04	7.78	42.17	80.6				
		2	15.31	33.00	6.29	7.80	39.92	79.5			0.14	0.7
		3	15.18	33.03	6.52	7.80	37.35	78.2				
		4									0.07	0.7
10	739	0	15.98	32.70	5.43	7.73	51.27	84.6	10	2.5	0.28	1.8
1k ENE		1	16.02	32.78	5.70	7.77	44.02	81.5				
		2	16.07	32.78	5.96	7.78	37.66	78.3			0.23	0.8
		3	16.10	32.90	6.15	7.78	34.80	76.8				
		4									0.07	0.7
11	750	0	15.66	32.81	6.00	7.85	50.26	84.2	10	2.7	0.16	1.3
1k ENE		1	15.57	32.74	6.13	7.87	44.05	81.5				
		2	15.30	32.92	6.37	7.89	43.58	81.2			0.20	0.5
		3	15.13	33.03	6.63	7.89	45.22	82.0				
		4									0.08	0.6
12	904	0	13.77	33.48	6.80	7.73	51.73	84.8	10	3.1	0.13	1.1
1k ENE		1	13.93	33.41	6.85	7.74	63.57	89.3				
		2	14.00	33.32	6.93	7.75	67.46	90.6			0.15	0.6
13	637	0	15.72	32.96	4.91	7.72					0.08	6.7
18	709	0	14.51	32.12	6.38	7.73	53.66	85.6	10	2.6	0.04	2.7
1k ENE		1	14.70	33.42	6.25	7.73	53.70	85.6				
		2									0.07	1.0
19	645	0	15.72	32.40	5.95	7.71					0.10	4.2
20	733	0	16.29	32.71	5.55	7.68	54.21	85.8	10	2.1	0.08	4.1
1k ENE		1	16.21	32.71	5.67	7.69	40.36	75.6				
		2									0.33	1.7
22	620		15.72	33.12	4.84	7.61					0.53	5.7
25	925	0	14.72	32.65	6.32	7.69	61.66	88.6	9	3.9	0.27	0.8
1k ENE		1	14.62	32.71	6.35	7.69	61.55	88.6				
		2	14.37	32.89	6.47	7.69	60.95	88.4			0.26	0.5
		3	14.08	33.13	6.62	7.71	59.42	87.8				
		4	13.94	33.27	6.76	7.72	56.51	86.7			0.21	1.2
	Average		14.86	32.98	6.48	7.75	53.43	85.24				
	Number		61	61	61	61	58	58				
	St. Dev.		0.74	0.31	0.62	0.05	7.79	3.44				
	Maximum		16.29	34.04	7.58	7.89	67.46	90.63				
	Minimum		13.77	32.12	4.84	7.61	34.80	75.63				

Surface Bacteriological Water Data and General Observations **28 November 2001**

CRUISE:	MDR 01-11	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	709	5.8
RAIN:	None	S. Roush	Low	1359	0.1

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	855	9000	2200	280	large amounts of litter
2	850	170	130	30	large amounts of litter
3	838	500	80	13	
4	918	300	130	30	
5	814	300	170	11	
6	822	110	50	5	
7	935	230	80	14	
8	716	230	130	50	
9	802	300	40	11	
10	739	800	500	33	
11	750	300	230	8	
12	904	≥ 16000	2800	220	large amounts of litter, surface scum
13	637	16000	5000	220	large amounts of litter
18	709	300	130	13	
19	645	300	300	17	litter
20	733	5000	300	170	litter, jellyfish
22	620	≥ 16000	16000	1600	
25	925	500	80	30	
	Average	3685.6	1575.0	153.1	
	Number ~	18	18	17	
	St. Dev.	6094.0	3832.0	371.8	
	Maximum	16000	16000	1600	
	Minimum	110	40	5	

Physical Water Quality Data **12 December 2001**

CRUISE:	MDR 01-12	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	656	6.5
RAIN:	None	S. Roush	Low	1357	-0.7

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	845	0	13.02	33.30	8.15	7.46	60.34	88.1	9	3.1	0.15	1.8
5k ENE		1	13.05	33.34	8.23	7.46	59.18	87.7				
		2	13.10	33.38	8.42	7.46	56.67	86.8			0.02	0.7
		3	13.10	33.41	8.59	7.46	54.75	86.0				
		4	13.10	33.42	8.65	7.46	53.49	85.5			0.09	0.9
		5	13.10	33.43	8.66	7.47	52.53	85.1				
		6	13.10	33.43	8.69	7.46	52.03	84.9			0.90	0.9
2	838	0	12.96	33.34	8.86	7.45	55.01	86.1	9	2.9	0.13	1.8
5k ENE		1	12.96	33.34	8.23	7.46	59.18	87.7				
		2	12.97	33.38	8.42	7.46	56.67	86.8			0.10	0.9
		3	13.02	33.41	8.59	7.46	54.75	86.0				
		4	13.03	33.42	8.65	7.46	53.49	85.5			0.16	1.0
		5	13.04	33.43	8.66	7.47	52.53	85.1				
		6	13.06	33.43	8.69	7.46	52.03	84.9			0.09	1.1
3	831	0	13.11	33.32	8.31	7.65	58.51	87.5	9	3.0	0.10	2.3
5k ENE		1	13.13	33.39	8.49	7.65	57.70	87.2				
		2	13.18	33.34	8.75	7.66	57.31	87.0			0.05	1.0
4	911	0	13.45	33.37	8.39	7.64	56.77	86.8	10	3.1	0.32	1.0
1k ENE		1	13.45	33.37	8.48	7.64	56.20	86.6				
		2	13.45	33.37	8.66	7.64	55.77	86.4			0.35	0.8
		3	13.44	33.37	8.70	7.65	55.71	86.4				
		4	13.44	33.37	8.71	7.64	55.87	86.5				
5	754	0	13.35	33.19	8.09	7.48	61.04	88.4	9	3.7	0.42	1.2
5k ENE		1	13.35	33.20	8.22	7.48	60.74	88.3				
		2	13.35	33.24	8.32	7.49	60.75	88.3			0.42	0.8
		3	13.35	33.34	8.35	7.50	59.97	88.0				
		4	13.46	33.37	8.36	7.51	58.95	87.6			0.30	0.7
6	803	0	13.470	33.110	8.17	7.520	62.15	88.8	9	3.2	0.44	1.3
5k ENE		1	13.47	33.10	7.30	7.56	61.22	88.5				
		2	13.46	33.11	7.55	7.55	59.41	87.8			0.20	0.6
		3	13.46	33.10	7.74	7.57	59.79	87.9				
		4									0.17	0.5
7	929	0	13.39	33.13	7.20	7.56	64.61	89.7	10	3.9	0.26	0.9
1k ENE		1	13.38	33.13	7.30	7.56	64.69	89.7				
		2	13.38	33.16	7.55	7.55	63.04	89.1			0.84	0.5
		3	13.45	33.28	7.74	7.57	61.98	88.7				
		4	13.52	33.27	7.73	7.60	60.56	88.2			0.20	0.5
8	702	0	13.19	33.01	8.58	7.56	64.20	89.5	9	4.2	0.08	0.7
5k ENE		1	13.21	33.01	8.66	7.56	63.36	89.2				
		2	13.20	32.99	8.76	7.56	62.57	88.9			0.13	1.0
		3	13.17	32.98	8.82	7.56	63.25	89.2				
		4	13.12	32.94	8.79	7.57	63.83	89.4			0.13	0.8

12 December 2001 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	745	0	13.70	33.12	8.01	7.37	54.43	85.9	10	2.7	0.17	1.3
5k ENE		1	13.70	33.11	8.07	7.37	54.34	85.9				
		2	13.70	33.09	8.17	7.38	54.97	86.1			0.07	0.8
		3	13.67	33.11	8.23	7.38	55.09	86.2				
		4									0.10	0.7
10	725	0	13.71	32.97	7.81	7.64	45.96	82.3	10	2.1	0.09	0.8
5k ENE		1	13.71	33.00	7.89	7.64	45.35	82.1				
		2	13.76	33.10	8.00	7.65	44.60	81.7			0.03	0.8
		3	13.83	33.00	8.07	7.65	49.26	83.8				
		4	13.80	33.09	8.09	7.65	52.98	85.3			2.15	0.9
11	735	0	13.48	33.12	8.00	7.41	60.34	88.1	10	3.2	0.50	1.8
5k ENE		1	13.60	33.19	8.04	7.42	59.18	87.7				
		2	13.65	33.05	8.14	7.42	56.52	86.7			1.17	0.6
		3	13.58	33.08	8.22	7.42	55.39	86.3				
		4									0.09	0.6
12	855	0	13.20	33.53	7.90	7.70	50.57	84.3	9	3.9	0.03	2.2
5k ENE		1	13.32	33.45	7.98	7.69	58.96	87.6				
		2	13.33	33.44	8.35	7.68	60.17	88.1			0.91	0.9
13	622	0	13.01	33.13	6.79	7.51					0.18	3.3
18	653	0	13.08	33.00	8.50	7.67	64.56	89.6	9	4.0	1.67	0.7
5k ENE		1	13.08	33.00	8.56	7.67	64.27	89.5				
		2	13.07	32.96	8.61	7.67	64.46	89.6			0.50	0.9
		3	12.99	32.81	8.65	7.67	64.46	89.6				
		4										
19	642	0	11.14	33.13	8.04	7.44					1.23	2.5
20	721	0	13.67	33.01	7.49	7.49	63.72	89.3	10	2.9	0.03	1.3
5k ENE		1	13.76	33.18	7.58	7.49	63.32	89.2				
											0.04	0.7
22	613		12.50	33.16	6.52	7.51					0.03	1.9
25	917	0	13.47	33.35	8.17	7.69	60.05	88.0	10	4.0	0.01	0.9
1k ENE		1	13.47	33.35	8.30	7.69	59.57	87.9				
		2	13.45	33.36	8.41	7.70	59.93	88.0			0.02	0.9
		3	13.45	33.35	8.40	7.69	60.75	88.3				
		4	13.44	33.33	8.34	7.69	61.53	88.6			0.20	1.0
	Average		13.30	33.22	8.21	7.55	58.01	87.23				
	Number		70	70	70	70	67	68				
	St. Dev.		0.37	0.17	0.48	0.10	4.83	1.86				
	Maximum		13.83	33.53	8.86	7.70	64.69	89.68				
	Minimum		11.14	32.81	6.52	7.37	44.60	81.72				

Surface Bacteriological Water Data and General Observations **12 December 2001**

CRUISE:	MDR 01-12		Vessel:	Aquatic Bioassay		TIDE	TIME	HT. (ft)
WEATHER:	Clear		Pers.:	J. Gelsinger		High	656	6.5
RAIN:	None			S. Roush		Low	1357	-0.7

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	845	≥ 16000	500	500	floating garbage
2	838	210	< 20	17	
3	831	700	< 20	11	
4	911	500	< 20	< 2	
5	754	130	20	< 2	
6	803	20	< 20	2	fuel slick
7	929	80	20	8	
8	702	500	20	14	
9	745	< 20	< 20	2	
10	725	5000	20	22	
11	735	500	< 20	< 2	jellyfish present
12	855	≥ 16000	300	220	
13	622	1300	80	300	
18	653	130	80	80	
19	642	130	20	26	
20	721	16000	< 20	50	
22	613	≥ 16000	70	300	
25	917	130	20	5	
	Average	4075.0	71.7	86.8	
	Number	18	18	17	
	St. Dev.	6656.0	126.1	144.2	
	Maximum	16000	500	500	
	Minimum	20	20	2	

Physical Water Quality Data **January, 24 2002**

CRUISE:	MDR 02-01	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	519	5.3
RAIN:	None	S. Roush	Low	1252	0.1

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	904	0	13.18	33.50	7.58	8.06	56.14	86.6	11	3.9	0.07	2.3
1k ENE		1	13.27	33.36	7.75	8.06	60.86	88.3				
		2	13.25	33.42	8.05	8.06	60.93	88.4			0.03	1.1
		3	13.21	33.46	8.17	8.06	60.37	88.1				
		4	13.17	33.43	8.22	8.06	59.74	87.9			0.05	0.9
		5	13.11	33.51	8.24	8.05	59.33	87.8				
		6									0.03	
2	900	0	12.68	33.19	8.17	8.04	58.87	87.6	10	3.1	0.02	1.9
1k ENE		1	12.82	33.14	8.19	8.03	59.29	87.7				
		2	12.90	33.37	8.26	8.02	59.36	87.8			0.06	1.0
		3	12.94	33.38	8.22	8.01	58.55	87.5				
		4	12.96	33.40	8.18	8.02	58.03	87.3			0.03	1.0
		5	12.97	33.41	8.16	8.01	57.76	87.2				
		6									0.05	
3	847	0	12.58	33.32	7.16	7.92	64.83	89.7	10	3.2	0.06	1.6
1k ENE		1	12.50	33.35	7.33	7.92	64.82	89.7				
		2	12.65	33.40	7.45	7.92	65.29	89.9			0.09	0.5
		3	12.81	33.29	7.43	7.93	63.94	89.4				
		4									0.11	
4	932	0	13.15	33.32	7.76	7.86	58.19	87.3	11	3.2	0.08	1.8
1k ENE		1	13.14	33.31	7.74	7.86	57.56	87.1				
		2	13.14	33.36	7.77	7.86	57.43	87.1			0.07	0.7
5	818	0	13.07	33.13	6.88	7.63	60.44	88.2	11	3.9	0.09	1.3
1k ENE		1	13.07	33.13	7.09	7.63	58.53	87.5				
		2	13.07	33.18	7.38	7.63	58.40	87.4			0.06	0.7
		3	13.15	33.40	7.43	7.64	58.31	87.4				
		4	13.37	33.45	7.34	7.67	55.54	86.3			0.06	0.7
6	828	0	13.04	33.20	7.32	7.76	59.69	87.9	11	3.8	0.07	3.2
1k ENE		1	13.04	33.19	7.29	7.76	56.78	86.8				
		2	13.03	33.19	7.26	7.76	57.70	87.2			0.07	0.7
7	949	0	13.14	33.22	7.10	7.82	58.34	87.4	10	3.9	0.10	0.9
1k ENE		1	13.14	33.22	7.06	7.82	58.32	87.4				
		2	13.12	33.18	7.12	7.82	57.69	87.2			0.06	1.3
		3	13.14	33.30	7.16	7.82	57.99	87.3				
8	720	0	12.75	33.10	7.87	7.79	64.20	89.5	9	4.4	0.06	2.4
1k ENE		1	12.75	33.08	7.91	7.80	64.20	89.5				
		2	12.72	33.02	8.02	7.80	64.31	89.6			0.02	1.0
		3	12.55	32.99	8.13	7.80	65.26	89.9				
		4									0.01	0.8

January, 24 2002 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	805	0	13.32	33.12	7.04	7.74	55.88	86.5	10	4.1	0.11	0.8
1k ENE		1	13.33	33.15	7.12	7.73	50.16	84.2				
		2	13.38	33.13	7.26	7.74	46.88	82.7			0.06	0.8
		3	13.39	28.09	7.50	7.74	51.90	84.9				
		4									0.06	
10	745	0	13.25	32.97	7.23	7.88	52.50	85.1	11	2.2	0.05	1.7
1k ENE		1	13.25	32.98	7.23	7.88	50.77	84.4				
		2	13.25	32.99	7.21	7.88	50.88	84.5			0.05	1.0
		3	13.27	32.98	7.18	7.88	51.94	84.9				
		4									0.08	
11	755	0	13.26	33.09	7.52	7.63	57.78	87.2	10	3.1	0.04	0.8
1k ENE		1	13.26	33.08	7.51	7.64	57.07	86.9				
		2	13.26	33.10	7.50	7.64	56.50	86.7			0.07	0.8
		3										
		4									0.05	1.4
12	913	0	13.35	33.66	6.96	7.75	45.05	81.9	11	2.6	< 0.01	1.3
1k ENE		1	13.68	33.33	6.97	7.72	49.43	83.8				
		2	13.62	33.31	6.58	7.74	66.10	90.2			0.09	1.2
13	638	0	13.16	33.07	6.20	7.67					*0.10*	*12.0*
18	710	0	12.54	33.06	7.65	8.01	64.97	89.8	9	2.5	0.13	1.3
1k ENE		1	12.51	33.01	7.69	8.00	65.33	89.9				
		2	12.52	33.09	7.79	8.00	65.87	90.1			0.05	0.9
19	650	0	13.16	33.03	7.35	7.93					0.08	2.0
20	739	0	13.43	33.01	6.91	7.83	57.62	87.1	11	2.2	0.10	3.6
1k ENE		1	13.42	33.02	7.00	7.84	53.39	75.8				
		2	13.42	33.01	7.09	7.84	55.42	75.8			0.09	1.5
22	621	0	13.16	33.11	6.11	8.28					0.16	3.0
25	939	0	13.16	33.26	7.55	7.88	63.26	89.2	10	4.7	0.06	8.0
1k ENE		1	13.14	33.29	7.54	7.89	64.23	89.5				
		2	13.13	33.31	7.51	7.89	63.96	89.4			0.07	0.8
		3	13.13	33.43	7.46	7.90	64.29	89.5				
		4	13.28	33.20	7.41	7.91	61.35	88.5			0.08	1.0
	Average		13.09	33.14	7.46	7.86	58.66	87.12				
	Number		63	63	63	63	60	60				
	St. Dev.		0.27	0.67	0.48	0.14	4.92	2.82				
	Maximum		13.68	33.66	8.26	8.28	66.10	90.17				
	Minimum		12.50	28.09	6.11	7.63	45.05	75.80				

Surface Bacteriological Water Data and General Observations

January, 24 2002

CRUISE:	MDR 02-01	Vessel:	Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.:	J. Gelsinger	High	519	5.3
RAIN:	None		S. Roush	Low	1252	0.1

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	904	800	800	80	fuel odor at surface
2	900	230	230	130	
3	847	700	700	5	
4	932	< 20	< 20	5	fuel slick
5	818	140	90	5	
6	828	≥ 16000	≥ 16000	21	surface scum
7	949	300	300	5	
8	720	300	300	27	
9	805	< 20	< 20	2	
10	745	700	500	5	
11	755	1300	1300	17	
12	913	2400	500	300	
13	638	1100	500	21	litter
18	710	230	230	50	
19	650	80	50	17	
20	739	80	80	11	fuel slick
22	621	≥ 16000	≥ 16000	46	
25	939	130	130	5	
	Average	2251.7	2097.2	41.8	
	Number	18	18	17	
	St. Dev.	5037.2	5068.5	72.3	
	Maximum	16000	16000	300	
	Minimum	20	20	2	

Physical Water Quality Data **February 22 2002**

CRUISE:	MDR 02-02	Vessel:	Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.:	J. Gelsinger	High	441	5.0
RAIN:	None		S. Roush	Low	1228	-0.1

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	856	0	15.13	32.27	8.56	7.99	58.22	87.4	10	3.5	0.11	2.3
2-3k NE		1	15.12	32.27	8.57	7.99	58.21	87.3				
		2	14.90	33.27	9.11	8.00	59.19	87.7			< 0.01	2.1
		3	14.71	33.45	9.42	8.02	58.12	87.3				
		4	14.69	33.48	9.60	8.03	58.59	87.5			< 0.01	3.5
		5	14.55	33.50	9.81	8.04	62.79	89.0				
		6									< 0.01	2.1
2	846	0	15.43	33.05	9.29	8.00	59.83	87.9	10	3.6	0.06	2.2
2-3k NE		1	15.43	33.06	9.29	8.02	59.85	88.0				
		2	15.33	33.15	9.70	7.99	57.79	87.2			0.05	2.0
		3	15.25	33.20	9.93	8.00	57.63	87.1				
		4	15.13	33.20	9.89	8.00	57.84	87.2			0.05	2.0
		5	14.68	33.51	10.01	7.99	56.37	86.6				
		6									0.06	1.8
3	839	0	15.31	33.05	8.25	7.98	62.65	89.0	10	3.2	0.08	3.3
2-3k NE		1	15.31	33.07	8.22	7.97	62.68	89.0				
		2	15.30	33.06	8.55	7.97	60.14	88.1			0.07	1.5
		3	15.24	33.14	8.61	7.97	59.46	87.8				
		4									0.06	1.2
4	918	0	15.43	32.90	8.80	8.00	61.32	88.5	10	3.8	0.05	2.1
2-3k NE		1	15.44	32.96	8.72	8.01	61.97	88.7				
		2	15.25	33.22	9.06	8.00	61.41	88.5			0.04	1.6
		3	15.03	33.36	8.90	8.01	56.22	86.6				
5	815	0	15.50	32.98	9.70	7.99	50.00	84.1	11	2.6	0.01	2.6
2-3k NE		1	15.48	32.96	9.69	7.99	50.25	84.2				
		2	15.35	33.21	9.88	7.99	48.85	83.6			0.13	2.1
		3	15.06	33.35	9.82	7.99	49.19	83.7				
											< 0.01	1.9
6	823	0	15.58	32.90	9.45	8.04	66.02	90.1	10	3.6	0.05	1.9
2-3k NE		1	15.55	32.85	9.44	8.04	66.01	90.1				
		2	15.08	33.26	10.08	7.99	47.94	83.2			0.06	1.4
7	935	0	15.73	32.98	8.83	7.95	58.70	87.5	10	3.0	0.05	1.4
2-5k NE		1	15.69	32.94	8.82	7.95	58.75	87.5				
		2	15.15	33.28	8.79	7.95	49.65	83.9			0.04	1.4
8	718	0	15.38	32.83	9.68	8.00	58.20	87.3	11	2.9	0.04	2.3
2-3k NE		1	15.37	32.84	9.67	8.01	58.04	87.3				
		2	15.28	33.10	9.92	7.97	38.17	78.6			0.04	1.4
		3										
		4									< 0.01	2.9

February 22 2002 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	803	0	15.50	33.01	9.25	7.95	40.01	79.5	11	1.8	0.03	1.7
2-3k NE		1	15.43	32.93	9.29	7.93	39.31	79.2				
		2	15.13	33.22	9.11	7.94	23.78	69.8			0.04	1.1
		3										
		4									0.02	1.8
10	743	0	15.35	32.87	10.27	8.00	54.13	85.8	12	2.3	0.06	2.4
0k		1	15.36	32.88	10.22	8.00	54.15	85.8				
		2	15.23	33.10	9.98	7.94	59.31	87.8			0.05	1.5
		3	15.20	33.10	8.48	7.91	55.92	86.5				
11	753	0	15.45	32.98	9.23	7.97	50.02	84.1	11	2.0	0.05	1.4
2-3k NE		1	15.48	32.93	9.22	7.96	48.99	83.7				
		2	15.09	32.67	9.54	7.93	40.90	80.0			0.04	0.6
		3										
		4									0.03	2.2
12	903	0	15.38	33.34	6.00	7.86	57.93	87.2	10	2.6	0.12	1.9
2-3k NE		1	15.36	33.31	5.95	7.84	57.89	87.2				
		2	15.38	33.33	7.82	7.91	63.30	89.2			0.07	1.9
13	628	0	15.52	32.95	6.10	7.81					0.54	3.5
0.5k NE												
18	711	0	15.31	32.78	9.20	8.02	57.52	87.1	11	2.9	0.04	2.4
2-3k NE		1	15.26	32.74	9.17	8.03	57.04	86.9				
		2	15.26	32.76	9.13	8.02	56.53	86.7			0.04	1.7
19	642	0	15.06	32.96	9.25	7.97					0.04	4.6
2-3k NE												
20	735	0	15.45	32.84	7.31	7.98	53.86	85.7	11	2.2	0.03	3.7
0k		1	15.43	32.73	7.28	7.94	53.85	85.7				
		2	15.44	33.00	7.74	7.95	55.42	86.3			0.01	1.6
22	615	0	15.39	30.85	6.81	7.97					0.33	5.8
0k												
25	924	0	15.51	33.02	8.72	7.92	61.32	88.5	10	3.2	0.01	1.5
2-5k NE		1	15.49	33.04	8.68	7.92	61.94	88.7				
		2	15.36	33.12	9.16	7.92	62.30	88.8			0.02	1.7
		3	15.07	33.33	9.13	7.92	55.20	86.2				
		4									0.03	1.7
		5										
	Average		15.28	33.01	8.95	7.97	55.55	86.15	10.5	2.9	0.06	2.1
	Number		59	59	59	59	56	56	15	15	43.00	43.0
	St. Dev.		0.24	0.38	1.00	0.05	7.64	3.41	0.6	0.6	0.09	1.0
	Maximum		15.73	33.51	10.27	8.04	66.02	90.14	12	3.8	0.54	5.8
	Minimum		14.55	30.85	5.95	7.81	23.78	69.83	10	1.8	0.01	0.6

Surface Bacteriological Water Data and General Observations **February 22 2002**

CRUISE:	MDR 97-98	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	441	5.0
RAIN:	None	S. Roush	Low	1228	-0.1

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	856	2800	2800	500	Fuel odor, surface debris
2	846	20	20	2	Fuel odor, surface debris
3	839	80	80	80	Strong current from gate
4	918	2200	2200	5	
5	815	< 20	< 20	14	
6	823	80	80	2	
7	935	< 20	< 20	2	
8	718	170	170	300	
9	803	20	20	2	
10	743	1400	1400	8	
11	753	50	50	< 2	
12	903	≥ 16000	≥ 16000	130	Plastic debris
13	628	≥ 16000	≥ 16000	900	Green surface scum, litter
18	711	9000	9000	30	
19	642	500	500	50	
20	735	800	800	50	Fuel slick, fuel odor
22	615	≥ 16000	≥ 16000	240	Litter, organic odor
25	924	300	300	< 2	
	Average	3636.7	3636.7	128.8	
	Number	18	18	18	
	St. Dev.	6071.2	6071.2	234.9	
	Maximum	16000	16000	900	
	Minimum	20	20	2	

Physical Water Quality Data **March 8, 2002**

CRUISE:	MDR 02-03	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear to Partly Cloudy	Pers.: J. Gelsinger	High	525	5.0
RAIN:	None	S. Roush	Low	1249	-0.4

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	832	0	15.69	33.11	7.03	7.91	43.68	81.3	12	0.3	0.19	3.98
3-6k NE		1	15.68	33.11	7.02	7.91	43.54	81.2				
		2	15.65	33.31	6.58	7.92	49.89	84.0			< 0.01	1.17
		3	15.58	33.33	7.06	7.94	50.21	84.2				
		4	15.39	33.27	7.97	7.95	49.08	83.7			< 0.01	1.10
		5	14.94	33.51	8.41	7.95	44.61	81.7				
		6	14.92	33.52	8.22	7.95	27.08	72.1			< 0.01	1.13
2	827	0	15.86	33.25	7.80	7.95	52.45	85.1	11	2.5	< 0.01	1.76
3-6k NE		1	15.85	33.21	7.76	7.95	52.39	85.1				
		2	15.72	33.28	8.15	7.96	51.81	84.8			< 0.01	1.61
		3	15.65	33.34	8.21	7.97	52.85	85.3				
		4	15.63	33.34	8.27	7.97	53.37	85.5			< 0.01	1.08
		5	15.57	33.38	8.36	7.97	52.96	85.3				
		6									< 0.01	1.15
3	819	0	15.74	33.28	7.31	7.91	52.01	84.9	11	2.7	< 0.01	1.60
3-4k NE		1	15.74	33.21	7.26	7.91	51.75	84.8				
		2	15.68	33.30	7.60	7.90	55.05	86.1			< 0.01	0.78
		3	15.82	33.25	7.38	7.90	52.54	85.1				
		4									< 0.01	0.70
4	901	0	16.14	33.12	7.51	7.91	48.72	83.5	11	2.1	< 0.01	0.81
5-6k NE		1	16.14	33.07	7.43	7.90	48.94	83.6				
		2	16.07	33.11	7.55	7.90	47.42	83.0			< 0.01	0.84
		3	16.02	33.03	7.67	7.91	46.64	82.6				
		4									< 0.01	0.77
5	756	0	16.61	32.99	7.15	7.91	43.67	81.3	11	2.1	< 0.01	1.78
3-4k NE		1	16.60	32.98	7.18	7.91	43.35	81.1				
		2	16.52	33.10	7.67	7.91	37.88	78.5			< 0.01	1.02
		3	16.32	33.04	7.71	7.91	35.28	77.1				
		4	16.10	31.50	7.69	7.92	37.83	78.4			< 0.01	0.91
		5										
6	804	0	16.43	33.24	7.10	7.91	38.85	78.9	11	1.6	< 0.01	0.75
3-4k NE		1	16.35	33.24	7.05	7.91	38.80	78.9				
		2	16.32	33.24	7.43	7.91	38.82	78.9			< 0.01	0.78
		3										
7	920	0	16.67	33.05	7.10	7.90	48.15	83.3	11	2.1	< 0.01	0.62
2-3k NE		1	16.65	33.06	7.06	7.90	48.12	83.3				
		2	16.58	33.09	7.55	7.91	40.90	80.0			< 0.01	0.72
8	701	0	16.60	33.18	7.13	7.90	30.68	74.4	12	1.2	< 0.01	1.11
0-1k NE		1	16.58	33.14	7.16	7.88	30.60	74.4				
		2	16.54	33.10	7.45	7.88	27.82	72.6			< 0.01	0.97
		3	16.38	33.18	7.38	7.87	22.94	69.2				
		4									< 0.01	1.23

March 8, 2002 **(Continued)**

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	743	0	16.86	33.05	6.99	7.88	31.67	75.0	11	1.3	< 0.01	0.88
4-5k NE		1	16.86	33.07	6.97	7.88	31.54	74.9				
		2	16.86	33.09	7.34	7.88	22.95	69.2			< 0.01	0.90
		3	16.82	33.09	7.14	7.86	13.54	60.7				
		4									< 0.01	0.82
10	725	0	16.67	33.01	6.87	7.89	35.33	77.1	11	1.3	< 0.01	2.40
4-5k NE		1	16.66	32.96	6.83	7.89	35.26	77.1				
		2	16.62	33.05	7.03	7.88	27.21	72.2			< 0.01	1.12
		3										
		4									< 0.01	0.95
11	730	0	16.74	33.15	7.10	7.88	33.98	76.3	11	1.3	0.05	1.14
4-5k NE		1	16.69	33.14	7.10	7.89	33.95	76.3				
		2	16.82	33.13	7.38	7.88	28.99	73.4			< 0.01	1.02
		3	16.81	33.01	7.13	7.86	6.79	51.0				
		4									< 0.01	1.02
12	844	0	15.91	32.78	3.55	7.43	17.01	64.2	14	0.3	0.19	1.58
2-3k NE		1	15.87	32.73	3.57	7.44	17.96	65.1				
		2	15.83	33.04	7.05	7.76	58.33	87.4			0.10	3.03
		3										
13	624	0	16.11	33.08	3.69	8.00					0.04	13.39
18	653	0	16.45	33.12	7.13	7.85	28.93	73.3	12	1.0	< 0.01	1.34
0-1k NE		1	16.45	33.15	7.13	7.85	28.85	73.3				
		2	16.44	33.16	6.91	7.85	28.81	73.3			< 0.01	1.10
19	638	0	16.22	33.08	5.02	6.25					< 0.01	1.09
20	718	0	16.83	32.97	6.41	7.80	45.01	81.9	11	1.9	0.02	1.73
0-1k NE		1	16.84	32.96	6.48	7.80	45.41	82.1				
		2	16.83	32.96	6.16	7.79	46.56	82.6			0.02	1.00
22	609	0	16.34	33.03	5.19	7.30					0.12	11.57
25	907	0	16.15	33.09	6.87	7.93	46.78	82.7	11	2.0	< 0.01	0.80
2-3k NE		1	16.17	33.09	6.84	7.93	46.55	82.6				
		2	16.13	33.08	6.97	7.93	45.33	82.1			< 0.01	0.83
		3	16.03	33.11	7.46	7.93	44.91	81.9				
		4	15.98	33.13	7.54	7.93	35.51	77.2			< 0.01	1.89
	Average		16.21	33.10	7.07	7.85	39.80	78.63	11.4	1.6	0.02	1.73
	Number		64	64	64	64	61	61	15	15	45.00	45.00
	St. Dev.		0.48	0.25	0.98	0.24	11.40	6.86	0.8	0.7	0.04	2.43
	Maximum		16.86	33.52	8.41	8.00	58.33	87.39	14	2.7	0.19	13.39
	Minimum		14.92	31.50	3.55	6.25	6.79	51.05	11	0.3	0.01	0.62

Surface Bacteriological Water Data and General Observations **March 8, 2002**

CRUISE:	MDR 97-98	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear to Partly Cloudy	Pers.: J. Gelsinger	High	525	5.0
RAIN:	None	S. Roush	Low	1249	-0.4

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	832	≥ 16000	≥ 16000	1600	Much plastic debris. Brown water color.
2	827	230	230	7	
3	819	130	130	2	Strong flow from gate.
4	901	≥ 16000	≤ 16000	23	
5	756	90	90	30	
6	804	1100	1100	11	
7	920	300	300	8	
8	701	300	300	8	
9	743	130	130	17	
10	725	≥ 16000	≥ 16000	500	Fuel slick. Surface debris.
11	730	1100	1100	130	
12	844	≥ 16000	≥ 16000	1600	Plastic debris. Dark brown water color.
13	624	≥ 16000	≥ 16000	≥ 16000	Litter. Surface scum.
18	653	300	300	22	
19	638	1400	1400	130	Surface foam. Strong surge.
20	718	220	220	21	Fuel slick.
22	609	16000	16000	900	Litter.
25*	907				Plastic debris. Drift kelp.
	Average	5959	5959	1236	
	Number	17	17	17	
	St. Dev.	7653	7653	3843	
	Maximum	16000	16000	16000	
	Minimum	90	90	2	

Physical Water Quality Data **April 22, 2002**

CRUISE:	MDR 04-02	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	556	5.0
RAIN:	None	S. Johnson	Low	1253	-0.4

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	924	0	16.08	33.44	8.06	7.96	57.69	87.2	6	3.0	< 0.01	2.49
3 SW		1	15.97	33.49	8.06	7.97	58.15	87.3				
		2	15.89	33.49	8.04	7.98	59.04	87.7			< 0.01	1.17
		3	15.78	33.51	8.05	7.98	59.55	87.8				
		4									< 0.01	1.11
		5										
		6									< 0.01	1.05
2	917	0	16.93	33.24	7.87	7.98	37.72	78.4	8	2.0	< 0.01	1.92
3 SW		1	16.68	33.21	7.84	7.98	40.60	79.8				
		2	16.12	33.30	7.90	7.98	45.74	82.2			< 0.01	1.48
		3	15.81	33.52	8.00	7.99	54.36	85.9				
		4	15.75	33.57	8.02	7.99	57.11	86.9			< 0.01	1.08
		5										
		6									< 0.01	1.14
3	908	0	16.87	33.49	7.24	7.91	42.27	80.6	6	2.3	< 0.01	1.09
3 SW		1	16.89	33.53	7.25	7.92	41.90	80.5				
		2									< 0.01	0.91
		3										
		4									< 0.01	0.99
4	948	0	17.67	33.23	7.35	7.95	39.32	79.2	8	1.3	< 0.01	1.25
4 SW		1	17.25	33.13	7.46	7.94	40.16	79.6				
		2									< 0.01	0.83
5	833	0	18.06	33.28	6.75	7.97	27.47	72.4	6	1.6	< 0.01	1.42
1 SW		1	17.82	33.09	6.43	7.96	27.64	72.5				
		2	17.15		6.35	7.97	31.69	75.0			< 0.01	1.49
		3										
		4									< 0.01	1.21
				27.02								
6	845	0	17.57	33.41	7.90	7.98	39.19	79.1	10	1.8	< 0.01	2.12
1 SW		1	17.55	33.41	7.89	7.98	38.72	78.9				
		2									< 0.01	1.00
7	1003	0	17.86	33.27	6.79	7.92	37.76	78.4	7	1.3	< 0.01	1.70
4 SW		1	17.55	33.25	6.88	7.91	35.38	77.1				
		2									< 0.01	0.96
8	740	0	18.18	33.40	7.54	7.93	27.66	72.5	6	1.3	< 0.01	1.32
1 SE		1	18.12	33.24	7.57	7.93	27.36	72.3				
		2									< 0.01	1.38
		3										
		4									< 0.01	1.42

April 22, 2002 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	823	0	18.09	33.27	6.19	7.98	23.43	69.6	8	1.3	< 0.01	1.30
1 SW		1	17.84	33.27	6.06	7.98	24.35	70.2				
		2									< 0.01	1.22
10	802	0	16.67	33.01	6.87	7.89	35.33	77.1	6	1.0	< 0.01	1.70
1 SW		1	18.35	33.38	6.05	7.95	23.82	69.9				
		2	18.33	33.34	5.92	7.94	21.14	67.8			< 0.01	1.47
		3										
		4									< 0.01	1.88
11	813	0	16.74	33.15	7.10	7.88	33.98	76.3	8	1.0	< 0.01	1.31
1 SW		1	18.28	33.25	6.42	7.95	24.45	70.3				
		2	17.94	31.38	6.82	7.94	22.66	69.0			< 0.01	1.19
12	932	0	15.91	32.78	8.90	7.43	17.01	64.2	6	2.5	< 0.01	2.65
3 SW		1	16.66	33.25	6.89	7.91	56.93	86.9				
		2	16.75	33.13	6.75	7.91	58.41	87.4			< 0.01	1.23
13	659	0	16.74	4.21	13.50	7.52					< 0.01	15.16
1 NE												
18	732	0	16.45	33.12	7.13	7.85	28.93	73.3	6	1.3	< 0.01	1.65
1 NE		1	18.07	33.37	7.49	7.89	24.48	70.3				
		2	18.02	33.40	6.91	7.89	23.86	69.9			< 0.01	1.61
19	709	0	16.78	33.16	6.73	7.93					0.02	1.52
1 NE												
20	757	0	18.40	33.30	7.68	7.87	27.23	72.2	7	1.6	< 0.01	2.29
1 NE		1										
		2									0.02	1.50
22	645	0	16.78	4.57	1.20	7.41					< 0.01	4.27
1 NE												
25	953	0	16.15	33.09	6.87	7.93	46.78	82.7	8	2.0	< 0.01	1.55
4 SW		1	17.67	33.32	6.62	7.93	46.85	82.7				
		2	17.48	33.23	6.51	7.92	45.41	82.1			< 0.01	0.76
		3	17.17	33.15	6.55	7.91	44.38	81.6				
		4									< 0.01	1.84
	Average		17.16	31.79	7.19	7.91	37.95	77.69	7.1	1.7	0.01	1.82
	Number		44	44	44	44	41	41	15	15	42.00	42.00
	St. Dev.		0.83	6.13	1.49	0.13	12.55	6.57	1.2	0.6	0.00	2.19
	Maximum		18.40	33.57	13.50	7.99	59.55	87.85	10	3.0	0.02	15.16
	Minimum		15.75	4.21	1.20	7.41	17.01	64.22	6	1.0	0.01	0.76

Surface Bacteriological Water Data and General Observations **April 22, 2002**

CRUISE:	MDR 04-02	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger	High	556	5.0
RAIN:	None	S. Johnson	Low	1253	-0.4

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	924	110	≥ 70	< 2	
2	917	< 20	< 20	5	
3	908	110	70	14	
4	948	< 20	< 20	2	
5	833	80	80	< 2	
6	845	110	50	< 2	Light particulate
7	1003	80	50	< 2	
8	740	20	20	< 2	Light oil
9	823	20	20	80	
10	802	220	110	9	
11	813	170	110	< 2	
12	932	260	70	4	
13	659	230	20	50	Heavy algal mat, heavy particulate, trash
18	732	80	20	< 2	
19	709	50	20	14	Organic floating material
20	757	< 20	< 20	2	
22	645	20	20	13	Algal mat
25	953	50	< 20	7	Trash
	Average	93	45	12	
	Number	18	18	18	
	St. Dev.	79	32	20	
	Maximum	260	110	80	
	Minimum	20	20	2	

Physical Water Quality Data **May 23, 2002**

CRUISE:	MDR 05-02	Vessel: Aquatic Bioassay		TIDE	TIME	HT. (ft)
WEATHER:	Clear	Pers.: J. Gelsinger		High	748	4.3
RAIN:	None	S. Johnson		Low	1331	0.6

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	1012	0	15.92	33.40	8.46	7.92	54.27	85.8	8	3.7	< 0.01	2.18
10 NW		1	15.80	33.49	8.48	7.92	53.66	85.6				
		2	15.72	33.51	8.61	7.93	53.56	85.5			< 0.01	2.10
		3	15.60	33.52	8.82	7.94	53.07	85.4				
		4									< 0.01	2.30
		5										
		6									< 0.01	2.02
2	1000	0	17.17	32.69	8.15	7.93	44.82	81.8	8	2.4	< 0.01	2.37
10 NW		1	16.20	33.22	8.53	7.94	43.99	81.4				
		2	15.74	33.41	8.77	7.94	46.50	82.6			< 0.01	1.86
		3	15.53	33.57	8.81	7.93	47.34	82.9				
		4									< 0.01	2.13
		5										
		6										
3	953	0	18.10	33.50	7.50	7.85	57.77	87.2	6	2.2	< 0.01	1.58
10 NW		1	18.08	33.26	7.63	7.85	57.14	86.9				
		2									< 0.01	1.49
		3										
		4										
4	1037	0	18.72	33.47	7.85	7.89	48.19	83.3	7	2.6	< 0.01	1.69
10 NW		1	18.67	33.33	7.83	7.89	48.24	83.3				
		2									< 0.01	1.60
5	924	0	18.73	33.31	7.45	7.88	43.55	81.2	7	2.0	< 0.01	1.56
6 NW		1	18.15	33.04	7.86	7.89	42.69	80.8				
		2	17.02	33.22	8.09	7.90	43.17	81.1			< 0.01	1.99
		3										
		4									< 0.01	2.11
6	937	0	18.70	33.43	7.50	7.90	55.87	86.5	8	3.6	< 0.01	1.49
4 NW		1	18.42	33.15	7.70	7.88	56.04	86.5				
		2									< 0.01	1.25
		3										
		4									< 0.01	1.78
7	1054	0	19.03	33.36	7.09	7.86	50.59	84.3	8	2.8	< 0.01	1.61
10 NW		1	18.65	32.79	7.37	7.86	49.30	83.8				
		2									< 0.01	1.23
8	827	0	19.16	33.45	7.53	7.87	37.98	78.5	10	1.5	< 0.01	1.80
2 SE		1	19.10	33.45	7.57	7.87	35.02	76.9				
		2									< 0.01	1.94
		3										
		4									< 0.01	2.20

May 23, 2002 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	915	0	18.58	33.13	6.91	7.87	25.27	70.9	7	1.7	< 0.01	1.39
2 NW		1	18.00	33.26	7.20	7.87	29.13	73.5				
		2									< 0.01	1.53
10	855	0	19.05	33.26	6.57	7.83	30.50	74.3	10	1.6	< 0.01	1.91
2 SE		1	18.80	33.39	6.51	7.82	25.00	70.7				
		2	18.68	33.42	6.42	7.82	20.42	67.2			< 0.01	1.92
		3										
		4									< 0.01	1.47
11	904	0	19.05	33.02	7.02	7.86	41.89	80.5	10	2.1	< 0.01	1.44
2 NW		1	18.27	32.94	7.32	7.87	40.39	79.7				
		2									< 0.01	1.48
12	1023	0	16.55	33.06	7.20	7.84	52.26	85.0	6	2.6	< 0.01	2.93
10 NW		1										
		2									< 0.01	2.14
13	745	0	17.48	33.14	6.98	7.88					< 0.01	3.29
2 SE												
18	817	0	19.18	33.47	7.87	7.56	37.91	78.5	8	2.2	< 0.01	1.92
4 SE		1										
		2									< 0.01	2.21
19	751	0	17.58	33.13	6.69	7.87					< 0.01	2.22
4 SE												
20	645	0	19.17	33.38	7.80	7.80	25.13	70.8	10	1.6	< 0.01	2.43
2 SE		1										
		2									< 0.01	2.14
22	730	0	17.38	33.20	4.00	7.85					< 0.01	2.67
2 SE												
25	1044	0	18.83	33.46	7.12	7.86	53.60	85.6	7	0.9	< 0.01	1.63
10 NW		1	18.76	33.43	7.28	7.86	52.78	85.2				
		2	18.33	32.96	7.50	7.85	53.51	85.5			< 0.01	1.51
		3	16.69	33.22	7.73	7.84	46.22	82.5				
		4									< 0.01	2.30
	Average		17.86	33.27	7.52	7.87	44.48	81.18	8.0	2.2	0.01	1.92
	Number		38	38	38	38	35	35	15	15	41.00	41.00
	St. Dev.		1.21	0.21	0.87	0.06	10.39	5.33	1.4	0.8	0.00	0.44
	Maximum		19.18	33.57	8.82	7.94	57.77	87.18	10	3.7	0.01	3.29
	Minimum		15.53	32.69	4.00	7.56	20.42	67.22	6	0.9	0.01	1.23

Surface Bacteriological Water Data and General Observations **May 23, 2002**

CRUISE: MDR 05-02 | Vessel: Aquatic Bioassay
WEATHER: Clear | Pers.: J. Gelsinger
RAIN: None | S. Johnson

TIDE	TIME	HT. (ft)
High	748	4.3
Low	1331	0.6

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	1012	16000	16000	5	Plastic bags
2	1000	1300	1300	< 2	Plastic bags
3	953	500	500	2	Plastic bags; Venice Canal gate open
4	1037	800	800	2	Numerous plastic bags, leaves
5	924	300	300	2	Plastic bags
6	937	20	20	< 2	Floating plastic bags
7	1054	170	170	< 2	Plastic bags
8	827	< 20	< 20	7	
9	915	90	90	< 2	
10	855	1700	1700	4	Plastic bags
11	904	300	300	< 2	
12	1023	2400	2400	4	Numerous plastic bags
13	745	1300	1300	240	Scum film at funnel entrance
18	817	130	130	2	
19	751	< 20	< 20	2	Plastic bags
20	645	9000	9000	8	
22	730	16000	16000	130	Large algal mat covering one quarter of pond
25	1044	110	110	< 2	
	Average	2787	2787	23	
	Number	18	18	18	
	St. Dev.	5238	5238	62	
	Maximum	16000	16000	240	
	Minimum	20	20	2	

Physical Water Quality Data

June 20, 2002

CRUISE:	MDR 06-02	Vessel: Aquatic Bioassay	TIDE	TIME	HT. (ft)
WEATHER:	Overcast	Pers.: J. Gelsinger	High	645	3.7
RAIN:	None	S. Johnson	Low	1210	1.2

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 mg/l	BOD mg/l
1	919	0	20.66	33.37	8.09	8.03	59.21	87.7	7	3.6	< 0.01	1.51
5 S		1	20.54	33.43	8.10	8.03	58.38	87.4				
		2	20.36	33.53	8.05	8.02	56.22	86.6			< 0.01	1.23
		3	20.24	33.61	8.10	8.03	54.57	85.9				
		4	20.18	33.45	8.22	8.03	54.06	85.7			< 0.01	1.24
		5	19.50		8.46	8.04	54.98	86.1				
		6									< 0.01	1.28
2	911	0	20.81	33.51	8.03	7.99	54.38	85.9	7	2.7	< 0.01	1.39
5 S		1	20.68	33.50	7.98	8.00	54.57	85.9				
		2	20.51	33.54	7.97	8.01	54.86	86.1			< 0.01	1.24
		3	20.39	33.58	8.00	8.02	54.28	85.8				
		4	20.33	33.62	8.00	8.01	53.89	85.7			< 0.01	1.13
		5										
		6										
3	905	0	21.68	33.50	6.47	7.85	53.20	85.4	8	3.1	< 0.01	0.87
5 S		1	21.63	33.43	6.47	7.86	52.49	85.1				
		2									< 0.01	0.95
		3										
		4										
4	943	0	21.80	33.31	6.61	7.88	51.30	84.6	6	2.9	< 0.01	1.43
2 S		1	21.39	33.36	6.67	7.88	50.23	84.2				
		2	21.16	33.29	6.70	7.89	48.48	83.4			< 0.01	1.37
		3										
		4									< 0.01	1.15
5	837	0	22.54	33.46	5.84	7.86	54.81	86.0	7	2.7	< 0.01	1.51
2 S		1	22.47	33.36	5.75	7.86	53.49	85.5				
		2	22.10	32.86	5.90	7.87	52.46	85.1			< 0.01	1.40
		3	20.92	33.24	6.56	7.91	49.97	84.1				
		4									< 0.01	1.45
6	857	0	22.29	33.54	5.45	7.89	58.88	87.6	8	2.6	< 0.01	1.17
2 S		1	22.28	33.17	5.32	7.89	57.62	87.1				
		2	21.70	33.06	4.90	7.86	54.47	85.9			< 0.01	1.12
		3	20.97	32.90	3.94	7.79	42.53	80.8				
		4									< 0.01	1.71
7	951	0	22.39	33.47	4.91	7.84	47.93	83.2	6	2.1	< 0.01	1.38
2 S		1	22.09	33.10	4.96	7.83	45.62	82.2				
		2	21.38	33.27	5.24	7.80	38.48	78.8			< 0.01	1.25
8	715	0	22.82	33.54	4.75	7.86	56.22	86.6	5	2.8	< 0.01	1.26
2 S		1	22.79	33.32	4.57	7.86	56.06	86.5				
		2	22.33	33.19	4.81	7.82	48.01	83.2			< 0.01	1.09
		3										
		4									< 0.01	1.48

June 20, 2002 (Continued)

Station/ Wind	Time	Depth m	Temp. C	Sal. 0/00	DO mg/l	pH	Trans %T-.25m	Trans %T-.1m	FU	Secchi m	NH3+NH4 u-at/l	BOD mg/l
9	828	0	22.23	33.30	4.56	7.74	34.36	76.6	7	2.5	< 0.01	1.16
2 S		1	21.96	33.29	4.40	7.79	27.71	72.6				
		2	21.60	33.08	4.34	7.78	26.31	71.6			< 0.01	1.55
10	735	0	23.02	33.30	4.93	7.86	43.31	81.1	8	2.0	< 0.01	1.91
2 S		1	22.67	33.17	2.82	7.83	34.94	76.9				
		2	21.96	33.35	2.56	7.80	32.09	75.3			< 0.01	2.15
		3	21.68	33.50	2.89	7.71	21.62	68.2				
		4									< 0.01	2.22
11	823	0	22.77	33.37	5.57	7.81	64.38	89.6	7	2.7	< 0.01	0.80
2 S		1	22.53	33.08	5.56	7.82	57.02	86.9				
		2	21.79	33.08	5.88	7.85	48.03	83.2			< 0.01	0.89
		3										
		4									< 0.01	1.25
12	926	0	21.20	33.11	6.42	7.94	59.98	88.0	6	2.6	< 0.01	2.44
7 S		1	20.86	33.46	6.45	7.94	60.91	88.3				
		2									< 0.01	1.11
13	630	0	29.97	33.17	7.42	7.98					< 0.01	6.59
1 S												
18	710	0	22.76	33.58	6.48	7.85	56.15	86.6	5	2.3	< 0.01	1.30
2 S		1										
		2									< 0.01	1.50
19	640	0	21.91	33.47	6.86	7.74					< 0.01	2.18
2 S												
20	730	0	22.90	33.40	3.87	7.72	45.24	82.0	8	2.1	< 0.01	4.52
2 S		1										
		2									< 0.01	1.86
22	620	0	29.80	33.08	7.57	7.74					< 0.01	4.60
1 S												
25	946	0	21.90	33.50	6.00	7.84	53.27	85.4	6	2.9	< 0.01	1.52
2 S		1	21.83	33.38	5.97	7.83	54.35	85.9				
		2	21.59	32.96	5.98	7.82	54.14	85.8			< 0.01	1.38
		3	20.82	33.13	6.12	7.84	50.12	84.1				
		4									< 0.01	1.66
	Average		21.93	33.33	6.03	7.88	50.12	83.80	6.7	2.6	0.01	1.68
	Number		51	50	51	51	48	48	15	15	43.00	43.00
	St. Dev.		1.83	0.19	1.52	0.09	9.40	4.55	1.0	0.4	0.00	1.08
	Maximum		29.97	33.62	8.46	8.04	64.38	89.58	8	3.6	0.01	6.59
	Minimum		19.50	32.86	2.56	7.71	21.62	68.19	5	2.0	0.01	0.80

Surface Bacteriological Water Data and General Observations **June 20, 2002**

CRUISE:	MDR 06-02	Vessel: Aquatic Bioassay		TIDE	TIME	HT. (ft)
WEATHER:	Overcast	Pers.: J. Gelsinger		High	645	3.7
RAIN:	None	S. Johnson		Low	1210	1.2

Station	Time	Total Coliform (MPN /100ml)	Fecal Coliform (MPN /100ml)	Entero coccus (Col.'s /100ml)	Comments
1	919	700	700	17	Plastic bags.
2	911	50	50	< 2	
3	905	< 20	< 20	6	
4	943	< 20	< 20	< 2	
5	837	230	230	14	
6	857	50	50	2	
7	951	300	300	9	
8	715	110	110	130	
9	828	70	70	50	
10	735	5000	5000	500	
11	823	70	70	2	Slight oil slick.
12	926	130	130	22	Plastic bags.
13	630	700	700	500	
18	710	50	50	11	
19	640	800	220	130	
20	730	5000	5000	220	Slight oil slick.
22	620	≥ 16000	≥ 16000	300	
25	946	70	70	11	
	Average	1632	1599	107	
	Number	18	18	18	
	St. Dev.	3910	3920	166	
	Maximum	16000	16000	500	
	Minimum	20	20	2	

9.3. INFAUNAL SPECIES ABUNDANCE LIST

MDR - October 2001		1	2	3	4	5	6	7	8	9	10	11	12	25
SCAMIT #4														
88	PHYLUM CNIDARIA													
89	Class Hydrozoa													
99.5	Corymorpha sp.						1	3						
106	Tubularia crocea		1			5								
180	Class Anthozoa													
180.5	Anthozoa, unid.			5		1			1		1			
244	Ceriantharia											1		
274	Edwardsiidae			2	1	19	3				1	3		
282	Scolanthus sp. A											1		12
340	PHYLUM PLATYHELMINTHES													
342	Polycladida sp.				1								1	
363	Stylochus franciscanus				2									
364.5	Stylochus sp.				1									
374	Parviplana californica				1									
428	PHYLUM NEMERTEA													
433	Paleonemertea	2	2	17	1	12					2		12	19
435	Carinoma mutabilis	1		9		3					1		2	
439	Carinomella lactea	1	1											
450	Tubulanus polymorphus	4		26									2	2
460	Lineidae, unid.	9	2	7	1	1		2		3	1	3	4	4
465.5	Cerebratulus sp.		1											
483	Zygeupolia rubens												2	2
494	Hoplonemertea	3		2	2									
502	Paranemertes californica		1	9	7			1	1	1	1		6	16
508	Oerstedia dorsalis	1												
516	Amphiporus bimaculatus													1
518	Amphiporus cruentatus	1												
523	Amphiporus rubellus													1
527.5	Amphiporus sp	1			9									
539.5	Tetrastemma sp.	1												
	PHYLUM NEMATODA													
	Nematode	912	5200	450							1130		5000	572
573	PHYLUM MOLLUSCA													
679	Class Gastropoda													
861	Caecum californicum			1										
880	Caecum occidentale			1										

927.5	Crepidula sp., juv.	1		1										
1468	Rictaxis punctocaelatus				1	2								2
1510.5	Odostomia (Euala) sp.	1												
1528.5	*Turbonilla* sp.	1												
1569	Haminoea vesicula												8	
1594	Acteocina harpa	1												
1601	Acteocina inculta	3		1				2	1			1	1	
1617	Melanochalmys diomedea			1										
1826	Class Bivalvia													
1826.5	Bivalve (shell dissolved)	8		9									12	
1909	Mytilidae		9											
1938	Modiolus rectus	2												
1944	Musculista senhousei					1								
2034	Leptopecten latiauratus	1												
2068	Lucinisca nuttalli	2												
2086	Diplodonta orbella			3										
2191	Rochefortia coani			17										2
2225	Laevicardium substriatum	1		8	2									
2277	Pitar newcombianus			1										
2286	Protothaca staminea							1					6	
2325	Leporimetis obesa			5	5									1
2344	Macoma nastua	24	8		4	1					3		14	3
2352	Macoma yoldiformis												8	
2357	Tellina cadieni				1									3
2371	Tellina modesta	12	4		3								7	
2384	Tellina sp. B	1												
2384.5	Tellina sp. (no shell)			4	1								55	1
2405	Cumingia californica			1										
2419	Theora lubrica													1
2426	Tagelus subteres	7		12	9	1		3			1	1	39	10
2430	Solen rostriformis	1												
2451	Mactrotoma californica	1		1							1			
2572	Lyonsia californica			1										
2588	Thracia trapezoides				1									
2691	PHYLUM SIPUNCULA													
2691	Sipuncula, unid.	1												
2749	Apionosoma misakiana	1	3	21										
2770	PHYLUM ANNELIDA													
2771	Class Polychaeta													

2777		Leitoscoloplos pugettensis	8		29	44	54	307	42	136	47	33	46	2	104
2797		Scoloplos acmeceps			1										16
2801		Aricidea (Acmira) catherinae	3												
2812		Aricidea (Acmira) horikoshii	3												
2867		Levinsenia gracilis									2				
2903		Cossura candida					11				2	6	1		3
2912		Spionidae	3			4	1			1				9	15
2914		Apoprionospio pygmaea	47		3	3	2								
2974		Polydora cirrosa						4							2
2975		Polydora cornuta	9								1	2			17
2985		Prionospio lighti	66		13	10							1	45	19
2999		Prionospio heterobranchia	54	21	147	41	29	16		3	1	12	4	184	40
3006		Pseudopolydora paucibranchiata	1	2	9	402	295	749	33	35	1	30	2	18	654
3015		Scolelepis occidentalis													2
3017		Scolelepis squamata	1											1	
3024		Scolelepis sp. SD 1				2		1						3	
3025.5		Scolelepis sp.			5	1				1	1			19	3
3037		Spiophanes duplex	1		14		3		1			3	2	3	18
3043		Streblospio benedicti						17		124	3	383	1		50
3072		Spiochaetopterus costarum	1										1		
3077		Cirratulidae	1					1				40	2	1	
3086		Aphelochaeta multifilis			6		54	53	410	283	23	48	113		31
3090.5		Aphelochaeta spp.	1			4						30	2	2	1
3101		Caulleriella pacifica	1												
3113		Chaetozone setosa Cmplx	6												
3114.5		Chaetozone sp.	1												
3126.5		Cirriformia sp. MDR 1					19	17	2	5	2	28	15		
3126.6		Cirriformia sp.			1			7		1	9	23	13		1
3128		Monticellina cryptica	33												
3135		Monticellina siblina	1												
3152		Capitellidae		1	5									48	
3154		Anotomastus gordiodes	1				2								
3157		Capitella capitata		1						2	1	7	1	16	7
3161		Heteromastus filiformis					15								
3168.5		Mediomastus spp.	1316	640	1084	710	168	95	71	83	72	109	54	4240	3914
3169		Notomastus hemipodus	1	2		1								34	3
3169.5		Notomastus sp.							2					21	
3199		Metasychis disparidentatus													1
3218		Armandia brevis	30	2	18	8								81	

3230	Polyophthalmus pictus			2	5			2					61	6
3243	Phylodocidae	1												
3250.5	Eteone pacifica			1										
3258	Eulalia quadrioculata												1	
3259	Eumida longicornuta	2												
3278	Phyllodoce hartmanae		1											
3281	Phylodoce longipes		1											
3288.5	Phylodoce sp.				3									
3405.5	Sthenelais sp.					1								
3409	Paleonotus bellis				5									
3423	Micropodarke dubia			1										
3430	Podarkeopsis glabrus	4			1									
3459.5	Brania brevipharyngea				1									
3460	Brania californiensis	2		9									127	
3473	Exogone lourei				2						8	4		
3480	Exogone uniformis	3	3	461	608	276	5	29	5	7	57	13	32	486
3480.5	Exogone sp.			21	10						9		7	
3504	Syllides mikeli										1			
3518	Syllis (Typosyllis) nipponica					1				1				
3522	Nereididae												1	
3528	Neanthes acuminata Cmplx						2	1			7	2	1	17
3530	Nereis latescens	10												
3531	Nereis procera	10				1								
3536	Platynereis bicanaliculata	6												
3545.5	Microphthalmus sp.	1											1	
3548	Glycera americana			4				1				1		2
3557	Glycera macrobranchia				1									
3560	Glycera nana	5											1	
3574	Glycinde armigera	1								1				
3581	Goniada littorea	36	16	4	4	2				1			5	
3599	Nephtys caecoides	3	1		6	2		2					7	1
3643	Diopatra ornata	21	5	1									11	2
3643.5	Diopatra sp.			4										
3665	Onuphis elegans			1										
3692	Lumbrineridae									1			1	
3715	Lumbrineris limicola	9	3	10	2					3				
3720.5	Scoletoma erecta		2	3										
3721	Scoletoma sp. A	2			1	4								
3725	Scoletoma sp. C	1		2	1	47	23	7	22	77	12	5		132

3725.5	Scoletoma spp.	9	2	3	7	15	9	10	1	12		6		
3726.5	Lumbrineris sp.	3		5										
3746	Dorvillea (Schistomeringos) annula	2												
3752	Dorvillea (Schistomeringos) longicc	2		91		3		6	5	4	38	14	86	126
3797	Pherusa capulata			1										11
3825	Pectinaria californica	1												
3837	Ampharete labrops	12											2	
3858	Melinna oculata			1										
3878	Amaeana occidentalis			4										2
3900	Pista alata			1										1
3904	Pista disjuncta			1		1								
3941	Chone minuta											1		
3943	Chone mollis												1	
3956	Euchone limnicola	1		18	13	230	193	14	209	46	68	22	1	31
3989	Hydroides pacificus			1						1	1			
4004	Class Oligochaeta													
4004.5	Oligochaeta	13	65	270	11		11	9	6	1	45	12	10	340
4014	PHYLUM ARTHROPODA													
4016	Pycnogonida												3	
4016	Class Pycnogonida													
4035	Anoropallene palpida	3	1										4	5
4055	Anoplodactylus erectus												31	2
4073	Class Ostracoda													
4082	Euphilomedes carcharodonta					3			2					
4099.5	Bathyleberis sp.					28								25
4129	Calss Copepoda													
4129.5	Calaniod copepod				7								3	
4130	Harpactiocoida, unid.	7	1	3	12						1		7	6
4177	Class Malacostraca													
4202	Order Mysidacea													
4213.5	Deltamysis sp A									4		2		
4244	Order Cumacea													
4323	Oxyurostylis pacifica	1	338										20	
4325	Order Tanaidacea													
4332	Leptochelia dubia		5	10	2	3							1	
4339	Paratanais sp.					1								
4372	Synaptotanais notabilis			1		23	263			1			6	
4376	Order Isopoda													
4388.5	Anthuridae						1							

4397	Paranthura elegans					6	6							2
4410	Rocinela belliceps		1											
4453	Paracerceis sculpta										1			
4463	Edotia sublittoralis	2											5	
4508	Uromunna ubiquita	5												
4523	Order Amphipoda													
4559	Deflexilodes norvegicus		1											
4563	Hartmanodes hartmanae		1											
4577	Pleustidae	1												
4794	Atylus tridens												2	
4801	Ampelisca agassizi									1				
4904	Amphideutopus oculatus		1	12								1		8
4919	Gammaropsis thompsoni	5	2											
4925	Photis brevipes		1											
4947	Cerapus tubularis Cmplx		1											
4949	Ericthonius brasiliensis	6	2											
4965	Microjassa litotes		1											
4967	Neoischyrocerus claustris	10												
4970	Aoroidae	8			1			1						
4974	Aoroides exilis	24	1				2							
4976	Aoroides inermis	6											2	
4984.5	Aoroides sp.	8					15							
4992	Grandidierella japonica								3	5				
4995	Rudilemboides stenopropodus		8			14				1		1	25	1
4995.5	Rudilemboides sp. HYP1												1	
5000	Monocorophium acherusium		1				23				1	5	1	
5008	Podocerus brasiliensis		4				2							
5027	Mayerella banksia	0	18		51	8	13	15	23		8	1	1	100
5032	Caprella californica		7										2	
5056	Order Decapoda													
5109	Alpheus clamator													4
5119.5	Alpheus sp.						1							
5153.5	Heptacarpus sp.									1				
5420.5	Cancer sp.	2												
5457	Hemigrapsus oregonensis					1								
5498	PHYLUM ECHINODERMATA													
5635	Amphiodia urtica			39	9									2
5652	Amphipholis squamata			2		2								
5724	Dendraster excentricus	2											1	

5807		Leptosynapta sp.	1		1	9									2
5826	PHYLUM PHORONA														
5829		Phoronis sp.			41	131		6	13	23	11	2	10	1	35
6034	PHYLUM CHORDATA														
6076		Agnesia septentrionalis	1												
		Fish Larvae					9								
goby		Ilypnus gilberti		2		1									1
		Number of Species per station	89	48	73	57	45	29	26	24	34	39	37	70	63
		Abundance per station	2832	6397	2980	2187	1380	1846	683	976	348	2155	368	10378	6903
		* = sample split and fraction sorted and counted, then total abundance calculated by multiplication of split fraction.													
		Entire sample inspected for rare, specific species.													

9.4. FISH SPECIES ABUNDANCE LIST

TABLE 9-1. AGE AND FREQUENCY OF FISH OBSERVED DURING DIVE TRANSECTS AT THREE HARBOR STATIONS.

		Oct. 2001 SAMPLING STATIONS											
SCIENTIFIC NAME	COMMON NAME	North Jetty				Break wall				South Jetty			
Reef Species		Ad.	Sub.	Juv.	YOY	Ad.	Sub.	Juv.	YOY	Ad.	Sub.	Juv.	YOY
Anisotremus davidsoni	Sargo					2							
Atherinops affinis	Topsmelt			222				4					
Cheilotrema saturnum	Black Croaker				3							1	
Chromis punctipinnis	Blacksmith								32				
Damalichthys vacca	Pile Surfperch		1	5	1		2				2	4	
Embiotoca jacksoni	Black Surfperch	3	5	4		5	8	3		1	9	9	
Girella nigricans	Opaleye		20	113	39	4	57			1	37	39	2
Halichoeres semicinctus	Rock Wrasse					8				4	7		
Heterostichus rostratus	Giant Kelpfish									1	1		
Hypsypops rubicundus	Garibaldi					6	3						
Medialuna californiensis	Halfmoon					4							
Micrometrus minimus	Dwarf Surfperch	4	2	2						1			
Oxyjulis californica	Senorita									27	4	2	
Paralabrax clathratus	Kelp Bass		2	7		2	7	5			11	8	
Paralabrax nebulifer	Barred Sand Bass					4							
Umbrina roncador	Yellowfin Croaker			3									
Urolophus halleri	Round Stingray					2							
Xenistius californiensis	Salema				1								

		June 2002 SAMPLING STATIONS											
SCIENTIFIC NAME	COMMON NAME	North Jetty				Break wall				South Jetty			
Reef Species		Ad.	Sub.	Juv.	YOY	Ad.	Sub.	Juv.	YOY	Ad.	Sub.	Juv.	YOY
Anisotremus davidsoni	Sargo			1								3	
Atherinops affinis	Topsmelt												41
Chromis punctipinnis	Blacksmith											6	
Cymatogaster aggregata	Shiner Surfperch	6			61								292
Damalichthys vacca	Pile Surfperch				1	1							6
Embiotoca jacksoni	Black Surfperch	1	2	8	7	4	3	1		1		55	10
Girella nigricans	Opaleye	1	4	99		16	46	6			2	72	
Halichoeres semicinctus	Rock Wrasse					3							
Hermosilla azurea	Zebraperch		2			1							
Heterostichus rostratus	Giant Kelpfish								18				
Hypsypops rubicundus	Garibaldi					15							
Micrometrus minimus	Dwarf Surfperch	2			5					2			5
Oxyjulis californica	Senorita					3				3			
Paralabrax clathratus	Kelp Bass					4	16	7			1		
Paralabrax nebulifer	Barred Sand Bass					6							
Sebastes serranoides	Olive Rockfish				225								
Urolophus halleri	Round Stingray					1							

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

01-Oct-01

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
2S	**10.10**	**Total Larvae**		**16**	**1171.40**	
		Engraulis mordax	FL	1	10.10	2.9mm
		Gobiidae Type A/C	NL	7	70.69	7 @ 2.0-2.5mm
		Hysoblennius	NL	7	70.69	7 @ 2.0-2.5mm
		Unidentifiable	FR	1	10.10	
	10.10	**Total Eggs**		**50**	**504.91**	
		Plueronichthys ritteri	EG	1	10.10	Stage II
		Egg Type 32	EG	18	181.77	Stage II, VI, VII
		Unidentified	EG	31	313.05	

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

01-Oct-01

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
2B	**4.85**	**Total Larvae**		**49**	**237.73**	
		Genyonemus lineatus	NL	1	4.85	1.5mm
		Gobiidae Type A/C	NL	1	4.85	2.1mm
		Hypsopsetta guttulata	NL	1	4.85	2.3mm
		Hysoblennius	NL	44	213.47	39 @ 2.0-2.5mm 4 @ 2.6-3.0mm 1 @ 3.1-3.5mm
		Syngnathidae	SL	1	4.85	7.6mm
		Unidentifiable	FR	1	4.85	
	4.85	**Total Eggs**		**62**	**300.80**	
		Plueronichthys ritteri	EG	3	14.55	Stage VII, VIII
		Egg Type 32	EG	23	111.59	Stage II, IV, VI, VII
		Unidentified		36	174.66	

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

01-Oct-01

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
5S	7.97	**Total Larvae**		**83**	**661.49**	
		Gobiidae	NL	8	63.76	5 @ 2.0-2.5mm 3 @ 2.6-3.0mm
		Gobiidae Type A/C	NL	7	55.79	3 @ 2.0-2.5mm 4 @ 2.6-3.0mm
		Hysoblennius	NL	68	541.95	68 @ 2.0-2.5mm
	7.97	**Total Eggs**		**3**	**23.91**	
		Egg Type 32		2	15.94	Stage II
		Unidentified		1	7.97	

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

01-Oct-01

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
5B	**5.37**	**Total Larvae**		**135**	**725.51**	
		Engraulis mordax	FL	1	5.37	9.4mm
		Gobiidae Type A/C	YS	1	5.37	2.5mm
			NL	3	16.12	3 @ 2.5mm (1 damaged)
		Hypsopsetta guttulata	YS	1	5.37	2.5mm
		Hysoblennius		127	682.52	122 @ 2.0-2.5mm 5 @ 2.6-3.0mm
		Syngnathidae (syngnathus/cosmocamp	SL	2	10.75	7.0 & 7.8mm
	5.37	**Total Eggs**		**8**	**42.99**	
		Plueronichthys ritteri	EG	1	5.37	Stage VII
		Unidentified	EG	7	37.62	

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

01-Oct-01

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
8S	**5.68**	**Total Larvae**		**60**	**340.69**	
		Gobiidae Type A/C	YS	1	5.68	1 @ 2.6-3.0mm
			NL	3	17.03	3 @ 2.0-2.5mm
			NL	21	119.24	21 @ 2.6-3.0mm
		Hysoblennius	NL	22	124.92	22 @ 2.0-2.5mm
		Quietula y-cauda	NL	1	5.68	1 @ 2.0-2.5mm
				11	62.46	11 @ 2.6-3.0mm
				1	5.68	1 @ 3.1-3.5mm
		Total Eggs		**0**		

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

01-Oct-01

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
8B	**5.72**	**Total Larvae**		**89**	**508.78**	
		Gobiidae	NL	7	40.02	7 @ 2.0-2.5mm
		Gobiidae Type A/C	NL	32	182.93	30 @ 2.0-2.5mm 2 @ 2.6-3.0mm
		Hysoblennius	NL	49	280.11	48 @ 2.0-2.5mm 1 @ 2.6-3.0mm
		Sygnathidae	SL	1	5.72	7.2mm
		Total Eggs		**0**		

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

15-May-02

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
2B	**5.34**	**Total Larvae**		**232**	**1238.12**	
		Citharichthys stigmaeus	YS	1	5.34	1.0mm
		Clinocottus analis	NL	1	5.34	3.3mm
		Engraulis mordax	YS	3	16.01	2 @ 2.0-2.5mm 1 @ 2.6-3.0mm
		Engraulidae	YS	1	5.34	1 @ 1.5-2.0mm
		Gibbonsia	NL	2	10.67	1 @ 5.0mm, 1 @ 6.5mm
		Gobiidae Type A/C	NL	88	469.63	77 @ 2.0-2.5mm 11 @ 2.6-3.0mm
		Hypsoblennius	NL	130	693.77	110 @ 2.0-2.5mm 14 @ 2.6-3.0mm # 6 @ 3.1-3.5mm
		Hypsypops rubicundus	NL	1	5.34	2.8mm
		Paralichthys californicus	YS	1	5.34	1.4mm
		Plueronichthys verticalis	YS	1	5.34	2.2mm
		Typhlogobius californiensis	NL	1	5.34	2.6mm
		Unidentified	YS	2	10.67	1.5mm

Sample	**5.34 Total Eggs**		**477**	**2545.62**	
Code	Atherinops affinis	EG	8	42.69	Stage V, XI Damaged
2B	Citharichthys	EG	96	512.33	Stage VII, Tail pigmernt
15-May-02	Engraulis mordax	EG	18	96.06	Stage VII, Damaged (1 small)
	Egg Type 32	EG	256	1366.20	Stage IV
	Plueronichthys ritteri	EG	3	16.01	Stage III, VII
	Plueronichthys verticalis	EG	10	53.37	Stage Stage III, VII
	Unidentified	EG	86	458.96	(2 damaged)

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples
15-May-02

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
5S	**7.84**	**Total Larvae**		**200**	**1567.29**	
		Atherinopsis californiensis	NL	1	7.84	9.2mm
		Gobiidae	NL	14	109.71	1 @ 2.0-2.5mm 13 @ 2.6-3.0mm
		Gobiidae fragment	FR	1	7.84	
		Gobiidae Type A/C	NL	68	532.88	31 @ 2.0-2.5mm 37 @ 2.6-3.0mm
		Hypsoblennius	NL	107	838.50	59 @ 2.0-2.5mm 37 @ 2.6-3.0mm 9 @ 3.6-4.0mm 2 @ 4.1-4.5mm
		Quietula y-cauda	NL	8	62.69	3 @ 2.0-2.5mm 4 @ 2.6-3.0mm 1 @ 3.1mm
		Unidentified	YS	1	7.84	
	7.84	**Total Eggs**		**38**	**297.79**	
		Anchoa delicatissima	EG	2	15.67	Stage VI, X
		Engraulis mordax	EG	3	23.51	Stage VI
		Unidentified	EG	33	258.60	

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples
15-May-02

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
5B	**5.17**	**Total Larvae**		**939**	**4857.47**	
		Engraulidae	YS	3	15.52	2.0-2.5mm
		Engraulis mordax	NL	1	5.17	3.1mm
		Gobiesox rhessodon	NL	3	15.52	2 @ 2.6-3.0mm 1 @ 4.1-4.5mm
		Gobiidae Type A/C	NL	322	1665.71	151 @ 2.0-2.5mm 103 @ 2.6-3.0mm 36 @ 3.1-3.5mm 21 @ 3.6-4.0mm 11 @ 4.1-4.5mm
			FL	2	10.35	4.6-5.0mm
			SL	10	51.73	5.1-5.5mm
		Heterostichus rostratus	SL	1	5.17	9.2mm
		Hypsoblennius	NL	539	2788.26	285 @ 2.0-2.5mm 173 @ 2.6-3.0mm 47 @ 3.1-3.5mm 26 @ 3.6-4.0mm 8 @ 4.1-4.5mm
		Hypsoblennius jenkinsi	FL	4	20.69	3 @ 4.6-5.0mm 1 @ 5.6mm
			SL	1	5.17	5.8mm
		Hypsypops rubicundus	NL	1	5.17	2.8mm
		Lepidogobius lepidus	SL	2	10.35	10.2 -12.0mm

5B 15-May-02	Quietula y-cauda	NL	40	206.92	10 @ 2.0-2.5mm 22 @ 2.6-3.0mm 5 @ 3.1-3.5mm 3 @ 3.6-4.0mm
	Paralichthys californicus	YS	1	5.17	1.7mm
	Unidentified	YS	2	10.35	
	Unidentifiable	FR	7	36.21	
5.17	**Total Eggs**		**48**	**248.31**	
	Atherinops affinis	EG	4	20.69	Stage V, VII
	Anchoa delicatissima	EG	3	15.52	Stage VI
	Egg Type 32	EG	6	31.04	Stage VII
	Unidentified	EG	35	181.06	

Ichthyoplankton Data Sheet

Marina Del Rey Ichthyoplankton Samples

15-May-02

Sample Code	Stand. Factor	Taxon	Stage	No. ID	Stan. Abundance (Standardized to n/1000m^3)	Larval Size(mm) or Egg Stage
8S	**9.27**	**Total Larvae**		**126**	**1167.51**	
		Gobiidae Type A/C	YS	2	18.53	2 @ 2.0-2.5mm
			NL	8	74.13	8 @ 2.0-2.5mm
			FL	1	9.27	1 @ 5.1-5.5mm
		Hysoblennius	NL	113	1047.05	88 @ 2.0-2.5mm 18 @ 2.6-3.0mm 5 @ 3.1-3.5mm 2 @ 3.6-4.0mm 1 @ 4.1-4.5mm
		Quietula y-cauda	NL	1	9.27	1 @ 2.0-2.5mm
			YS	1	9.27	1 @ 2.0-2.5mm
	9.27	**Total Eggs**	EG	**65**	**602.29**	
		Engraulis Mordax	EG	14	129.72	Stage V, VII
		Anchoa compressa	EG	15	138.99	Stage V, VIII
		Anchoa delicatissima	EG	13	120.46	Stage VI
		Unidentified	EG	23	213.12	

8B 15-May-02		Ilypnus gilberti	SL	88	416.86	3 @ 6.1-6.5mm 2 @ 6.6-7.0mm 20 @ 7.1-7.5mm 13 @ 7.6-8.0mm 19 @ 8.1-8.5mm 14 @ 8.6-9.0mm 4 @ 9.1-9.5mm 4 @ 9.6-10.0mm 3 @ 10.1-10.5mm 1 @ 10.6-11.0mm 4 @ 11.1-11.5mm 1 @ 12.6mm
		Quietula y-cauda	YS	2	9.47	2.2mm
		Paralichthys californicus	NL	1	4.74	2.2mm
	4.74	**Total Eggs**		**99**	**468.97**	
		Engraulis Mordax		7	33.16	Stage IV (1 damaged)
		Anchoa compressa		45	213.17	Stage V, VI, X
		Anchoa delicatissima		37	175.27	Stage IV, VII
		Unidentified		10	47.37	