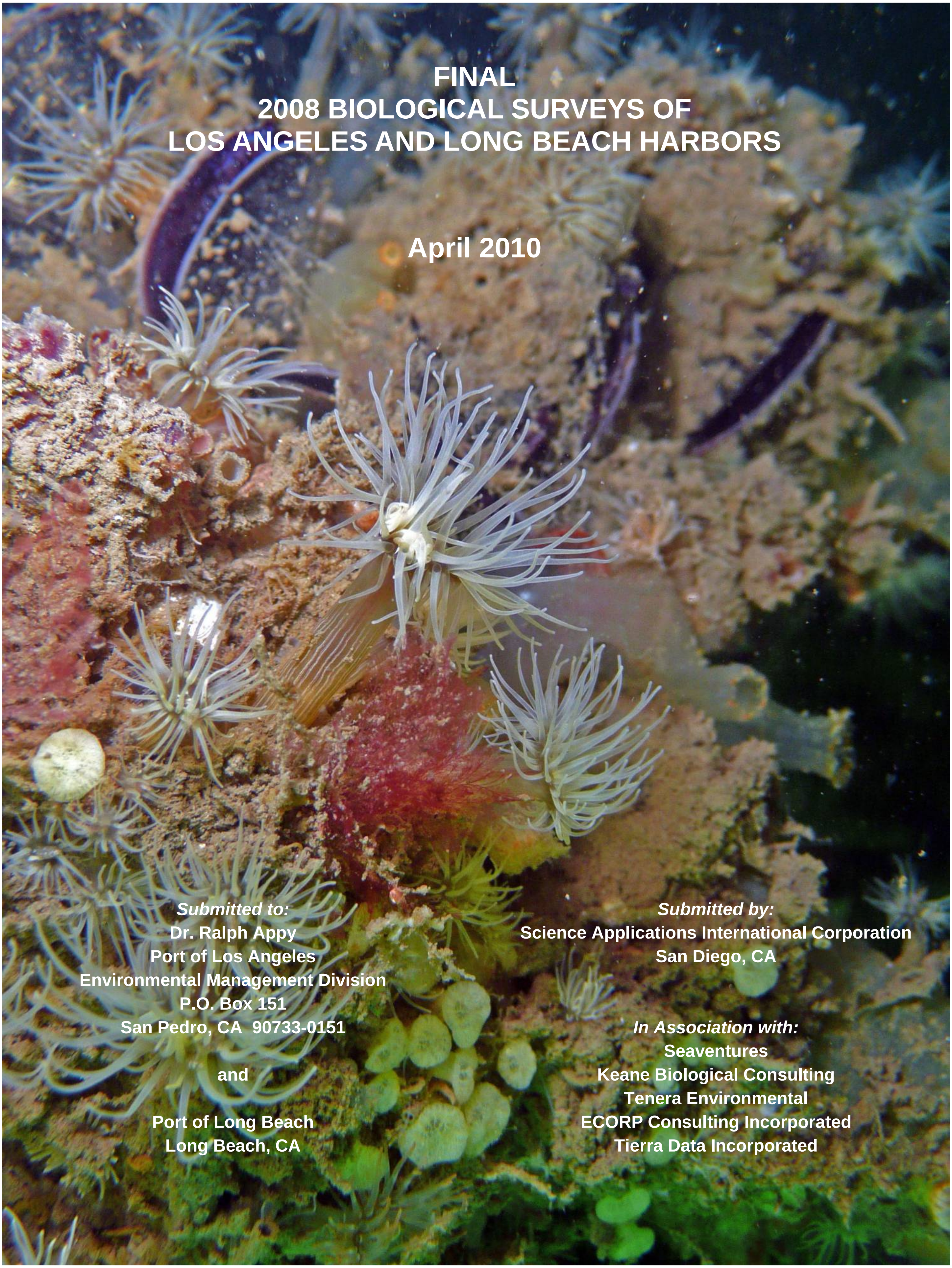

FINAL
2008 BIOLOGICAL SURVEYS OF LOS ANGELES AND LONG BEACH HARBORS

April 2010

Submitted to:
Dr. Ralph Appy
Port of Los Angeles
Environmental Management Division
P.O. Box 151
San Pedro, CA 90733-0151

and

Port of Long Beach
Long Beach, CA

Submitted by:
Science Applications International Corporation
San Diego, CA

In Association with:
Seaventures
Keane Biological Consulting
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EXECUTIVE SUMMARY

The Ports of Los Angeles and Long Beach (Ports) comprise a harbor complex that occupies almost 11,000 acres (43 square kilometers [km^2]) of land and water in western San Pedro Bay, located in southern Los Angeles County. The marine biological environment of the Ports has been periodically studied since the 1950s. As part of their long-term stewardship of marine biological communities in San Pedro Bay and scientific needs related to evaluation of potential effects from in-bay projects, the Ports have conducted periodic biological baseline studies to characterize marine communities over a range of representative habitats throughout the harbor complex.

In 2008, the Ports retained Science Applications International Corporation (SAIC) and its subcontractors to conduct environmental studies in Los Angeles and Long Beach Harbors. The goal was to provide an update of quantitative information from the previous biological baseline study conducted in 2000 (MEC 2002). Specific objectives were to:

- Provide physical/chemical characterization of environmental conditions during summer by measuring water quality and sediment grain size;
- Provide an update on the status of larval, juvenile, and adult fish populations;
- Provide an update on the status of the benthic invertebrate communities;
- Provide an updated description of biological communities attached to rocky riprap habitats;
- Provide an update of the harbor bird communities, including a summary of marine mammals observed during the surveys;
- Map kelp and eelgrass distributions and describe macroalgae communities;
- Identify the relative occurrence of non-indigenous (exotic) species among native populations;
- Provide a comparison of changes in current marine habitats with previous (historical) studies; and
- Provide a comparison of between benthic sampling methods.

Major findings of the 2008 study are summarized according to the survey element below.

PHYSICAL/CHEMICAL CONDITIONS

Water quality conditions measured during July 2008 generally were uniform throughout the harbor environments, with only minor differences that appeared to be unrelated to habitat type. Further, water quality conditions also were consistent with values reported previously for the Ports (e.g., MEC 2002), and indicative of well-mixed and well-oxygenated waters (e.g., DO greater than 5 mg/L) for almost all stations. Some localized differences, associated with comparatively warmer surface water temperatures, lower surface water salinities, and lower DO concentrations in near-bottom water, were observed, but the magnitude of the differences were small. Overall, the results of the July 2008 survey indicated water quality conditions that would be expected to promote healthy biological communities within the Ports.

ADULT AND JUVENILE FISH

Studies of adult and juvenile fish were conducted quarterly and employed three different sampling methods, including large lampara nets to sample pelagic fish in the water column, otter trawls to sample bottom-associated (demersal) species, and beach seines to sample shallow nearshore waters. A total of 62 taxa representing 59 unique species of fish were collected with the different sampling methods over all stations and sampling periods. Fish appeared healthy, with no obvious abnormalities or external parasites. Pelagic fish from lampara collections were dominated by four species (northern anchovy – *Engraulis mordax*, topsmelt – *Atherinops affinis*, California grunion – *Leuresthes tenuis*, and Pacific sardine – *Sardinops sagax*), which accounted for 98% of the total catch. All of these species are schooling fishes that spend most of their lives in the harbor environment. For otter trawl surveys, dominant species included northern anchovy, white croaker (*Genyonemus lineatus*), queenfish (*Seriphus politus*), shiner surfperch (*Cymatogaster aggregata*), and white surfperch (*Phanerodon furcatus*). Other species caught in high abundance were specklefin midshipman (*Porichthys myriaster*), California tonguefish (*Symphurus atricauda*), and yellowchin sculpin (*Symphurus atricaudus*).

Commercially and/or recreationally important species, including California halibut (*Paralichthys californica*) and barred sand bass (*Paralabrax nebulifer*), had moderate abundance. California halibut were collected with otter trawl nets and ranked tenth in total abundance and fourth in total biomass for that sampling gear. Barred sand bass also were caught with trawls, and ranked twelfth in total abundance using that gear.

Fish abundance was highly variable for pelagic species and seasonal trends were not evident. Otter trawl results showed more seasonal trends with generally higher catches during the summer compared to winter surveys. Similar to previous studies in which day and night samples were collected, a greater variety and more fish were collected at night. Day/night differences in catch are believed to result from a combination of fish behavior at night related to decreased visual avoidance of sampling gear, increased dispersal of schooling species, and increased foraging activity by several species (Horn and Allen 1981).

Few differences were observed for pelagic fish between inner and outer harbor areas, with inner harbor stations having between 4 and 12 species and outer harbor stations typified by between 3 and 11 species. This indicates that pelagic schooling species move throughout the harbor complex. In contrast, outer harbor areas generally were typified by a greater number, biomass, and variety of trawl-caught fish than inner harbor areas. For example, abundances of California tonguefish and speckled sanddab were higher based on studies of deepwater outer harbor sampling locations (MBC 1984, MEC 1988, CLA-EMD 1993-1999) than studies with more inner harbor and/or shallow-water stations (SAIC and MEC 1996, MEC 1999, MEC 2002, and the current study). Spatial and temporal trends were less distinct for the beach seine locations compared to the lampara and trawl stations, due mainly to the low species numbers, abundances, and biomass.

ICHTHYOPLANKTON

A total of 71 larval fish taxa were observed, with the most abundant being a complex of three goby species recorded as “CIQ gobies”. This complex represented 44.6% of the total catch. The second most abundant larvae were combtooth blennies (*Hypsoblennius* spp.; 34.0%), bay gobies (*Lepidogobius lepidus*; 8.6%), and clingfishes (Gobiesocidae; 2.9%). The abundances of most larval taxa differed between the three depths sampled. For example, all the gobies (CIQ, bay, and yellowfin) were least abundant in surface waters while combtooth blennies were in lowest abundance in the epibenthic layer. Clingfishes were in highest abundance in the epibenthic samples while silversides (California grunion, jacksmelt, and topsmelt) were most abundant in surface waters. When all station and survey data were combined, the total number of individuals/100 m^3 was similar for the midwater (139.2) and epibenthic (134.3) layers, but much lower in the neuston layer (38.9).

The three most abundant taxa of larvae (CIQ gobies, combtooth blennies, and bay gobies) were found at all nineteen stations. Outer harbor Station LA3 had the lowest abundance of larvae and was one of the lowest abundance stations for fish eggs. In contrast, outer harbor Station LA2 (next closest station to LA3) had more than triple the abundance of eggs and a much higher abundance of larval fish compared to LA3. Thus, egg and larval densities differed even at geographically similar stations.

Species composition varied among different areas and habitats in the harbor. However, dominant groups during the two most recent two studies (MEC 1998 and 2002) and the current study were gobies, representing small fish whose adults live in and on soft sediments that comprise the predominant habitat within the harbor complex. Larval combtooth blennies were also abundant in the recent studies; their adults occur on pier pilings that are common in the harbor complex. The average weighted mean abundance of larval fish was highest at shallow outer harbor stations (1,523/100m^2) compared to inner harbor (1,297/m^2) and deep outer harbor (1,157/100m^2) locations.

Some seasonal patterns of ichthyoplankton abundance were evident. For example, the total abundance of all larvae combined was similar during the winter and spring surveys, but much higher during the summer (July) survey. This pattern was due to large increases in abundance of three taxa (CIQ gobies, combtooth blennies, and clingfishes) during the summer survey. The differences among surveys are likely due to the seasonal reproductive patterns of these fish along the California coast (Moser 1996).

BENTHIC INVERTEBRATES

Over 250 species of benthic infauna (small organisms that live on and within the sediment) and larger macroinvertebrates were collected during the present study. The overall number of species was similar during summer (204) and winter (187).

The infaunal community was numerically dominated by polychaetes (48% of annual mean abundance), crustaceans (31%), and molluscs (20%), while echinoderms (2%) and other minor phyla (2%) were substantially less abundant. Molluscs and polychaetes accounted for most of the infaunal biomass. Polychaetes were the most diverse taxonomic group (123 species), followed by molluscs (64 species) and crustaceans (51 species). Species composition showed little change between the summer and winter surveys but differed among shallow and deepwater habitats in the outer harbor. In contrast to species composition, abundances were generally higher in summer than winter, and in shallow-water stations the values were approximately twice high as those at deepwater stations. There was little difference in species composition among deepwater stations located in basins, channels, or slips of the inner and outer harbors.

Species assemblages of benthic invertebrates can be indicative of habitat quality. Certain species are tolerant of adverse environmental conditions, such as low oxygen and high pollutant conditions, and others are found only in more pristine areas. In the present study, species assemblages indicated that stations in the outer harbor had the highest habitat quality as indicated by relatively greater abundance of species characteristic of areas having background to low organic enrichment (i.e., low pollution). The species assemblages found in the inner harbor, basins, and slips were indicative of low to moderate organic enrichment compared to the open-water outer harbor stations, suggesting that species composition is influenced by tidal circulation in the harbors, with outer harbor areas having greater circulation and higher habitat quality.

A special study was conducted to evaluate whether assessment of the benthic infauna community is substantially influenced by using different types of sampling gear (box corer vs

Van Veen) and analysis of samples that differ between 0.06 m^2 and 0.1 m^2 in surface area. Results of this comparison found no statistical differences in abundance or number of species between gear types.

For macroinvertebrates collected during trawl surveys, invertebrate catch varied among stations, and no distinct spatial patterns in species distribution or abundance was observed. Substantially more macroinvertebrates were collected at night than during the day and in winter and spring surveys compared to the summer survey. The most common species included black-spotted shrimp *(Crangon nigromaculata*), ridgeback prawn (*Sicyonia ingentis*), black-tailed bay shrimp (*Crangon nigricauda*), Xantus' swimming crab (*Portunus xantusii*), and *Heptacarpus* shrimps.

RIPRAP ASSOCIATED ORGANISMS

A total of 334 species of invertebrates were identified from three tidal zones within the riprap community. Distinct tidal zonation was observed with increasing numbers of species with increasing depth. Mean total abundance was highest in the lower intertidal, lowest in the upper intertidal, and intermediate in the subtidal zone. Across all tidal zones, crustaceans were numerically dominant, followed by polychaetes, echinoderms, molluscs, and other phyla.

Historical studies have noted relatively greater community development in outer harbor compared to inner harbor areas (MEC 1988, MEC 2002). However, the present study noted general similarities in these communities throughout the harbors. Exceptions were for diversity, which was somewhat greater at outer harbor breakwater stations compared to inner harbor locations, but these differences were mainly associated with the upper intertidal zone. Community summary measures did not show distinct trends among inner and outer harbor stations for the lower intertidal and subtidal zones, suggesting some improvement in environmental quality at inner harbor stations since the 2000 study.

KELP AND MACROALGAE

Within the Ports, the majority of kelp and macroalgae surface canopy is closely associated with the outer breakwaters and with riprap structures in the outer harbor and in locations facing the harbor entrances. While algal diversity in the Ports is considered relatively low, there is a general pattern of decreasing algal diversity from outer to inner harbor locations. In addition, seasonal patterns in the surface kelp canopy were evident during the present study, similar to those noted during the 2000 baseline study.

The previous baseline study in 2000 was the first systematic effort to quantify kelp surface canopy coverage throughout the Ports. Total mapped canopy cover of *Macrocysti*s in the spring was 24.8 acres, decreasing to 14.2 acres in fall (43% decrease). During the present baseline study, *Macrocystis* canopy totaled 77.8 acres in spring and decreased to 50.4 acres in the fall (35% decrease). Seasonal declines in kelp canopy cover for both studies are likely due to natural die-offs between winter and fall. Overall, the *Macrocystis* canopy extended greater distances along outer breakwaters and the kelp beds appeared broader and more contiguous during the present study compared to the 2000 survey.

Dominant macroalgal communities in the present study were similar to those described in MEC (2002) and included *Sargassum*, *Ulva*, *Colpomenia, Chondracnathus,* and *Halymenia*. Outer harbor stations had from 4 to 11 dominant groups during the present study compared to 2 to 11 groups during the 2000 survey. The present study reported substantially more species per station than the 2000 surveys (5 to 11 species in 2008, one to six species in 2000). The reasons for these inner harbor differences between surveys are unknown, but could be related to improved habitat conditions in the Ports.

EELGRASS

Eelgrass communities are spatially and temporally dynamic as influenced by physical and biological factors associated with site-specific characteristics and regional oceanographic conditions. Based on the rapid recruitment and growth tendencies of eelgrass coupled with the physical and biological requirements of these plants, eelgrass communities are relatively easy to locate but can be difficult to quantify. Eelgrass habitat is important to associated biological communities, water quality, and sediment stabilization and, where suitable habitat exists, can be a surrogate indicator of the relative health of Port waters. The ability to map and describe persistent and new eelgrass beds within the Ports provides important data for understanding the evolution and dynamics of eelgrass communities and their contributions to the environment.

Eelgrass communities delineated during the present surveys were consistent with previous investigations and established additional information on eelgrass density, morphology, and regional context. However, in contrast to the 2000 baseline study, little or no seasonal variability was evident between spring and fall 2008 surveys. Competition for habitat space by various marine algal species was more prevalent in 2008 than during the 2000 baseline survey. Additionally, there was less consistency and more patchiness of the majority of the eelgrass areas at both Cabrillo Beach and the Pier 300/Seaplane Anchorage area compared to results from MEC (2000) and Merkel & Associates (2008).

BIRDS

Los Angeles and Long Beach Harbors provide valuable habitat for foraging, resting, and breeding by numerous species and individuals of birds. Over 100 avian species use the various habitats within the Ports seasonally, year-round, or during migration. A total of 96 species representing 30 families were observed within the Ports during the current study. Of these species, 68 are dependent on marine habitats.

Species numbers varied seasonally, with a greater variety of birds present in fall and winter and fewer species during summer, consistent with large-scale migratory patterns. Bird abundance was more variable and was attributed to differences in bird migratory patterns and nesting activities. Bird abundance along the southern California coast typically follows a seasonal pattern, with the greatest numbers of individuals and species occurring during fall and winter.

Several special status species were commonly observed during the present study, including large numbers of the recently delisted California brown pelican which use the outer breakwaters as resting habitat. The endangered California least tern successfully nests at a designated site on Pier 400, and the endangered Peregrine falcon nests on bridges within the harbors. Non-listed special status species observed during the current study included black-crowned night heron, great blue heron, black oystercatcher, black skimmer, Caspian tern, elegant tern, double-crested cormorant, and burrowing owl. Several of those species, including the cormorant, herons, oystercatcher, and terns, were observed nesting at the Ports during the current study.

Similar to the previous baseline study (MEC 2002), birds observed during the current study were not equally distributed among survey zones. The highest numbers of birds were noted in the Long Beach West Basin and main shipping channel of Los Angeles Harbor, with counts being approximately an order of magnitude lower at small basin and channel zones at inner harbor locations.

EXOTIC SPECIES

Similar to the previous baseline study (MEC 2002), the only exotic (non-indigenous) fish species collected in the 2008 sampling surveys was the yellowfin goby (*Acanthogobius flavimanus*), which was collected at three Los Angeles stations (LA7, LA14, and LA15) and six Long Beach Harbor stations (LB1, LB3, LB5, LB7, LB12, and LB14).

Non-indigenous invertebrates comprise about 15% of the infauna and macroinvertebrate species occurring in the Ports, with some of these species representing numerical dominants. The relative abundance of these species has increased in the harbors since the 1970s.

A total of 10 non-indigenous (introduced) and 32 cryptogenic species (of unknown origin) were identified among the 313 species of infauna and macroinvertebrates collected during the present study. The overall percentage of introduced and cryptogenic species identified in the present study (14%) is similar to the 15% reported by MEC (2002) in 2000. However, some of these differences may be due to further distinction of introduced versus cryptogenic species since the 2000 study.

Occurrences of invasive exotic algae within the harbors include the brown algae *Sargassum muticum* and *Undaria pinnatifida*. While *Sargassum* has become a commonly observed component of the algal flora in southern California, including the Ports, *Undaria* was first reported in the United States in spring 2000 during the previous baseline study (MEC 2002). Notably, *Undaria* was documented during the present study at all eight inner harbor sites and at 7 of 12 outer harbor locations, indicating an expanded distribution since 2000. *Undaria* has also been reported at Port Hueneme, Santa Barbara Harbor, and Catalina Island (MEC 2002), and as far north as Monterey Bay and as far south as Ensenada, Mexico (Chapman 2005).

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

The Ports of Los Angeles and Long Beach (Ports) comprise a harbor complex that occupies almost 11,000 acres (43 square kilometers [km^2]) of land and water in western San Pedro Bay located in southern Los Angeles County (Figure 1.1-1). The Port of Los Angeles (POLA) is a department of the City of Los Angeles and is often referred to as the Los Angeles Harbor Department. Similarly, the Port of Long Beach (POLB) is governed by the City of Long Beach, with the City Charter creating the Long Beach Harbor Department to promote and develop the port. As part of their long-term stewardship of marine biological communities in San Pedro Bay and their scientific needs related to evaluation of potential effects from in-bay projects, the Ports have conducted periodic biological baseline studies to characterize marine communities over a range of representative habitats throughout the harbor complex. The most recent baseline biological study was conducted by MEC Analytical Systems, Inc (MEC) in 2000 (MEC 2002). The present Biological Study, conducted by Science Applications International Corporation (SAIC) is a continuation of this baseline series.

1.1 BACKGROUND

Habitat conditions and marine biological communities in the harbor complex have been documented since the early 1950s. The first comprehensive surveys of biological and physical/chemical conditions in the harbors were conducted by the Harbors Environmental Project of the University of Southern California between 1971 and 1978 (HEP 1980) to document existing conditions and evaluate impacts associated with dredging and planned expansion of the Ports. Several separate studies that were conducted during the 1980s and 1990s had limited focus on one port or the other in support of separate development projects (e.g., MBC Applied Environmental Sciences [MBC] 1984 and 1999, MEC 1988).

Since 2000, few major projects have occurred in the Ports that would have caused significant effects to marine habitats. However, as part of the Channel Deepening project conducted by the U.S. Army Corps of Engineers (USACE) (USACE and LAHD 2000), some changes in benthic habitat condition may have occurred in the Port of Los Angeles as a result of fills along Berths 103-106 (China Shipping) and Pier 300, deepening of the main channel to -53 feet Mean Lower Low Water (MLLW), creation of eelgrass habitat near Seaplane Lagoon, creation of the Pier 400 Submerged Material Storage Site, and extension of the Cabrillo Shallow Water Habitat.

The specific goal of the present Biological Study was to provide an update of quantitative information on biological and associated physical/chemical conditions within representative marine habitats of the Ports. Results and conclusions from the study will provide the Ports, as well as resource and regulatory agencies, with quantitative information to assist in characterizing the overall health of marine habitats within the Ports. This information can and has been used to define the boundaries of Inner Harbor and Outer Harbor habitats, classifications that have implications to the amount of mitigation required for port development projects that include fill of harbor waters.

This report provides an updated inventory and assessment of the marine biological environment of the inner and outer Los Angeles and Long Beach harbors. Survey elements from this study are consistent with the most recent previous biological baseline study (MEC 2002), including the physical/chemical environment (water quality and sediment grain size), adult and juvenile fish, larval fish (ichthyoplankton), benthic invertebrates, attached organisms on breakwaters and other rocky riprap, kelp and macroalgae, eelgrass, birds, marine mammals, and non-indigenous species. Other survey elements included for the present study, but not conducted by MEC (2002) were a special study to compare benthic sampling gear (box corer versus Van Veen grab) and an ichthyoplankton methods comparison study.

1.2 REPORT ORGANIZATION

This report is organized by technical area. Each of the nine technical sections (chapters) presents the methods and materials of the field, laboratory, and analytical efforts, a data summary, and a discussion of the results of the studies that were conducted. Figures and tables are provided at the end of each chapter. The Chapters are supported by technical appendices that present details of the data generated by the studies and the analyses that were conducted.

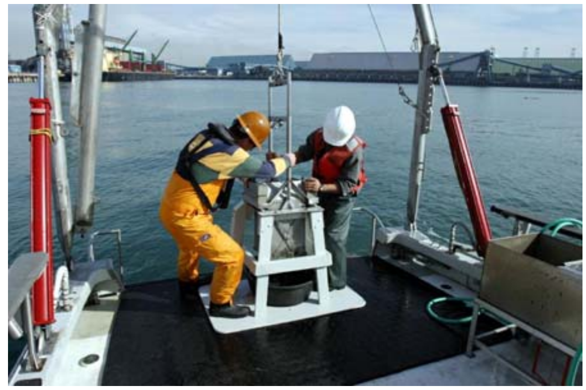
1.3 OVERVIEW OF THE STUDY SITE

A detailed discussion of the Ports and of the historical changes that have taken place since the early 1800s is presented in the 2000 biological baseline study (MEC 2002). Development of the harbors has changed much of the historic shallow estuarine habitats into mainly deepwater habitats through a series of dredge-and-fill operations that deepened and widened channels to accommodate deep draft vessels and provided fill for additional land areas of terminal development (HEP 1980, USACE 1992).

The current harbor complex consists of the Port of Los Angeles to the west and Port of Long Beach to the east (Figure 1.1-2) and is comprised of a wide variety of marine habitats. For example, just north of the breakwaters and channels, open water habitat leads to basins and slips in the middle and inner parts of the Ports. These habitats vary in size, length, width, and distance from the harbor entrance and generally have differences in physical characteristics including varying degrees of tidal circulation and exchange.

Angel’s Gate between the San Pedro and Middle Breakwaters and Queen’s Gate between the Middle and Long Beach Breakwaters are the two primary points of tidal exchange between western San Pedro Bay and the harbors. Tidal exchange also occurs near the east end of the Long Beach Breakwater. In addition, some of the watershed inflows to the Ports include the Los Angeles River, which empties into San Pedro Bay northeast of Pier J in Long Beach Harbor, and the Dominguez Channel, which drains into the north end of Los Angeles Harbor close to the Consolidated Slip. Other freshwater input to the Ports includes the Terminal Island Treatment Plant (TITP), which discharges near Pier 400, and major storm drains in both harbors.

1.4 STUDY OBJECTIVES



SAIC was contracted by the Ports to conduct the present Biological Study in Los Angeles and Long Beach Harbors. All sampling locations for the present study are presented in Figure 1.1-3. The goal was to provide an update of quantitative information from the previous biological baseline study conducted in 2000 (MEC 2002). Specific objectives were to:

- Provide physical/chemical characterization of environmental conditions during summer by measuring water quality and sediment grain size;
- Provide an update on the status of larval, juvenile, and adult fish populations;
- Provide an update on the status of the benthic invertebrate communities;
- Provide an updated description of biological communities attached to rocky riprap habitats;
- Provide an update of the harbor bird communities, including a summary of marine mammals observed during the surveys;
- Map kelp and eelgrass distributions and describe macroalgae communities;
- Identify the relative occurrence of non-indigenous (exotic) species among native populations;
- Provide a comparison of changes in current marine habitats with previous (historical) studies; and
- Provide a comparison of between benthic sampling methods.

The objectives listed above were accomplished by using the same study design followed by the Ports for previous baseline studies in consultation with various resource agencies, including California Department of Fish and Game, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. For most tasks conducted during this study, the survey station locations remained the same as those sampled during the 2000 biological baseline study (MEC, 2002). Details concerning the number of stations and frequency of sampling for each resource area are presented in their respective chapters. Generally, the study design allowed for similar numbers of stations to be sampled within each port and corresponded to the range of representative habitat types within each area.

MEC (2002) described the marine communities in the harbor complex by means of summary measures such as number of species, abundance, and biomass, and diversity indices that describe general community structure. Standardized mean community summary measures were used for comparisons with historical biological data. Species lists were reviewed for the presence of non-indigenous species by qualified taxonomists with specific expertise in the identification of Southern California Bight marine organisms. The current study utilized all of the community measures and historical comparisons described above.

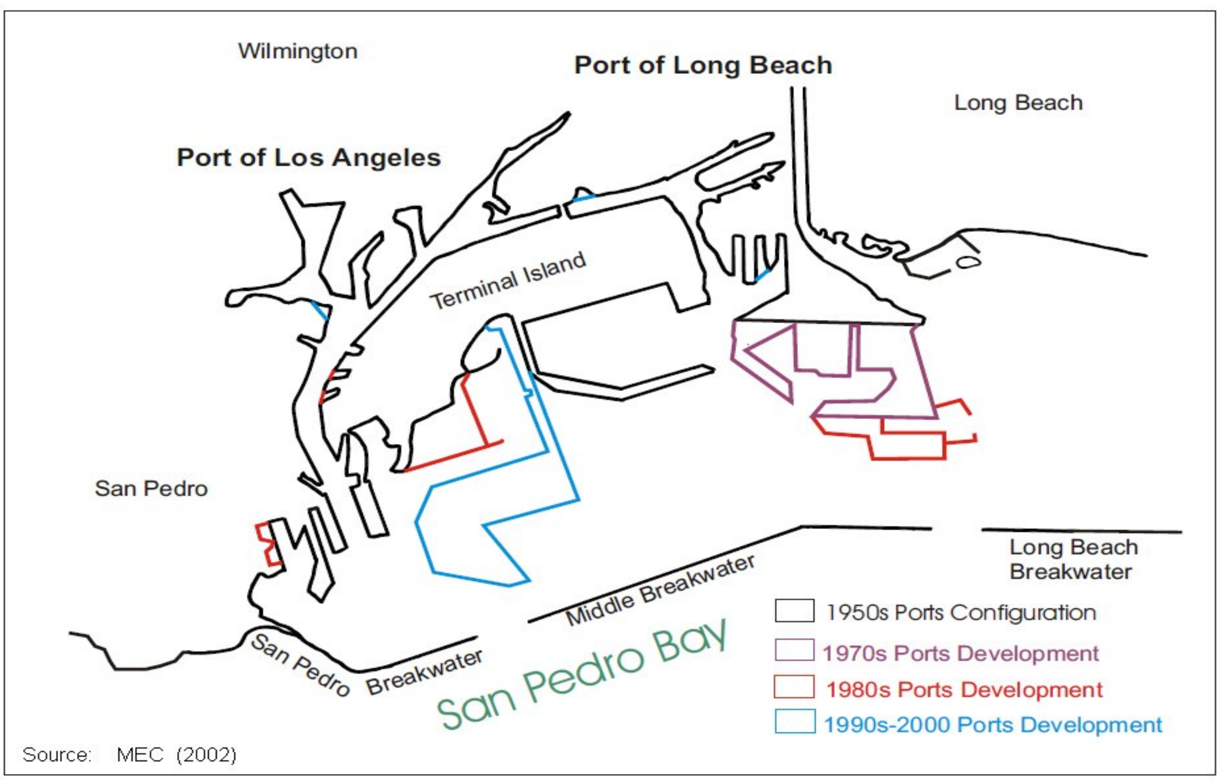
1.5 OVERVIEW OF PREVIOUS STUDIES AND COMPARISON OF METHODS

Marine studies of the Port complex in the 1950s reported severe pollution in many harbor areas (Reish 1959), resulting in the need for cleanup efforts in the 1960s (summarized in MEC 2002). During the 1970s, studies of the physical/chemical and biological conditions in the Ports were conducted by a number of research organizations for a variety of sponsors, including Pacific Lighting Service, NOAA Sea Grant Program, Los Angeles Board of Harbor Commissioners, and USACE (MEC 2002).

In the mid 1970s, studies in Long Beach harbor focused on potential thermal discharge effects from the Long Beach Generating Station (EQA-MBC 1978), the intake and discharge of which are located just north of the Gerald Desmond Bridge, opposite Pier C.

Over the past 30 years, port development plans have focused on accommodating anticipated increases in cargo. Numerous dredge and fill projects have been completed since the 1970s, when the first comprehensive baseline studies were conducted (MEC 2002). Other biological studies have focused on changes to the configuration of the Ports since the 1970s, including construction of Piers 300 and 400, expansion of Pier J (SAIC and MEC 1997), various slip fills, and construction of the west basin of the Cabrillo Marina complex (Jones & Stokes 2002). As stated above, few major projects have occurred in the Ports since 2000, with most being part of the Channel Deepening project (USACE and LAHD 2000).

Separate biological studies of Long Beach and Los Angeles harbors were conducted in the 1980s and 1990s. Several of these studies monitored effects of thermal discharges, while others focused on effects of discharges from the TITP outfall, and harbor developments (MBC 1984). In addition, MEC conducted biological baseline studies of Los Angeles Harbor in 1986-1987 (MEC 1988) and of Long Beach Harbor in 1994 and 1996 (MEC 1997), and MBC conducted a baseline study of Long Beach Harbor in 1983 (MBC 1984).



Historical comparisons among studies can be difficult due to factors such as changes to the configuration of the harbors, creation of shallow water habitats, and differences in sampling methodologies among studies. For example, early studies by MBC (EQA-MBC 1978) provide data summaries across stations but do not include station-specific data, while more recent studies such as MBC (1984), MEC (1988, 1997, 2002), SAIC and MEC (1997), and City of Los Angeles (CLAEMD 2000) provide data tables by station that facilitate comparisons with data from the present study. This study is most comparable to the previous baseline study (MEC 2002) based on sampling site locations, methodologies, and data analyses. Comparisons to other previous biological studies are presented in each Chapter but are focused more on comparisons with the previous baseline study by MEC (2002) than with other earlier studies that may have limited overlap in methodologies and analyses. Historical comparisons are presented toward the end of each Chapter.

Because some of the historical ichthyoplankton studies have used non-standardized sampling methods, a special study was conducted to address differences between these non-standardized (most recent baseline methods) and more standardized methods being used by a wide variety of agencies and organizations. The non-standardized methods used in previous baseline studies differ somewhat from the standardized, common methods used by the California Cooperative Oceanic Fisheries Investigations (CalCOFI), an organization that collects quarterly hydrographic and biological data off southern and central California (Smith and Richardson 1977) and power plant entrainment studies conducted throughout California (Steinbeck et al. 2007). The methods used by CalCOFI and the power plant studies are approved by the State Water Resources Control Board (SWRCB), California Energy Commission (CEC), and the California Coastal Commission, and consist of using oblique tows (referred to as the "CalCOFI method") to evenly sample the entire water column as opposed to using different nets to discretely sample different parts of the water column. A detailed discussion of this methodology is presented in Chapter 4.

To evaluate whether the two methods resulted in comparable or different data, a special study was conducted to compare larval composition and density collected by the present method used for the Ports during previous baseline studies and the CalCOFI method. Detailed results of this special study, including method recommendations for subsequent baseline studies conducted by the Ports are presented in Chapter 4 (Ichthyoplankton) of this report.

Another special study was conducted, to compare results from benthic sampling using a box corer with sampling using a Van Veen grab. Generally, the Van Veen provides a sample with a greater surface area (0.1 square meters [$m^{2]}$) than a box core (0.06 m^2), as noted in the 2000 biological baseline study (MEC 2002) and several previous baseline studies. Other coring devices with a sampling area of 0.1 m^2 have been used for some historical harbor studies (MBC 1984) and City of Los Angeles monitoring. While species composition generally has been shown by these studies to be similar among box core and Van Veen samplers, the numbers of individuals per sample typically increase with increasing surface area sampled. Generally, that difference is adjusted by standardizing count data (e.g., to 0.1 m^2). There also may be some differences in species composition in habitats where species have a patchy distribution. This special study was designed to compare results from both sampling devices to evaluate any significant differences in abundance estimates, species number, and species composition. Method differences were also evaluated in the context of project effort (e.g., sample processing time). Detailed results of this special study are presented in Chapter 5 (Benthic and Epibenthic Invertebrates) of this report.

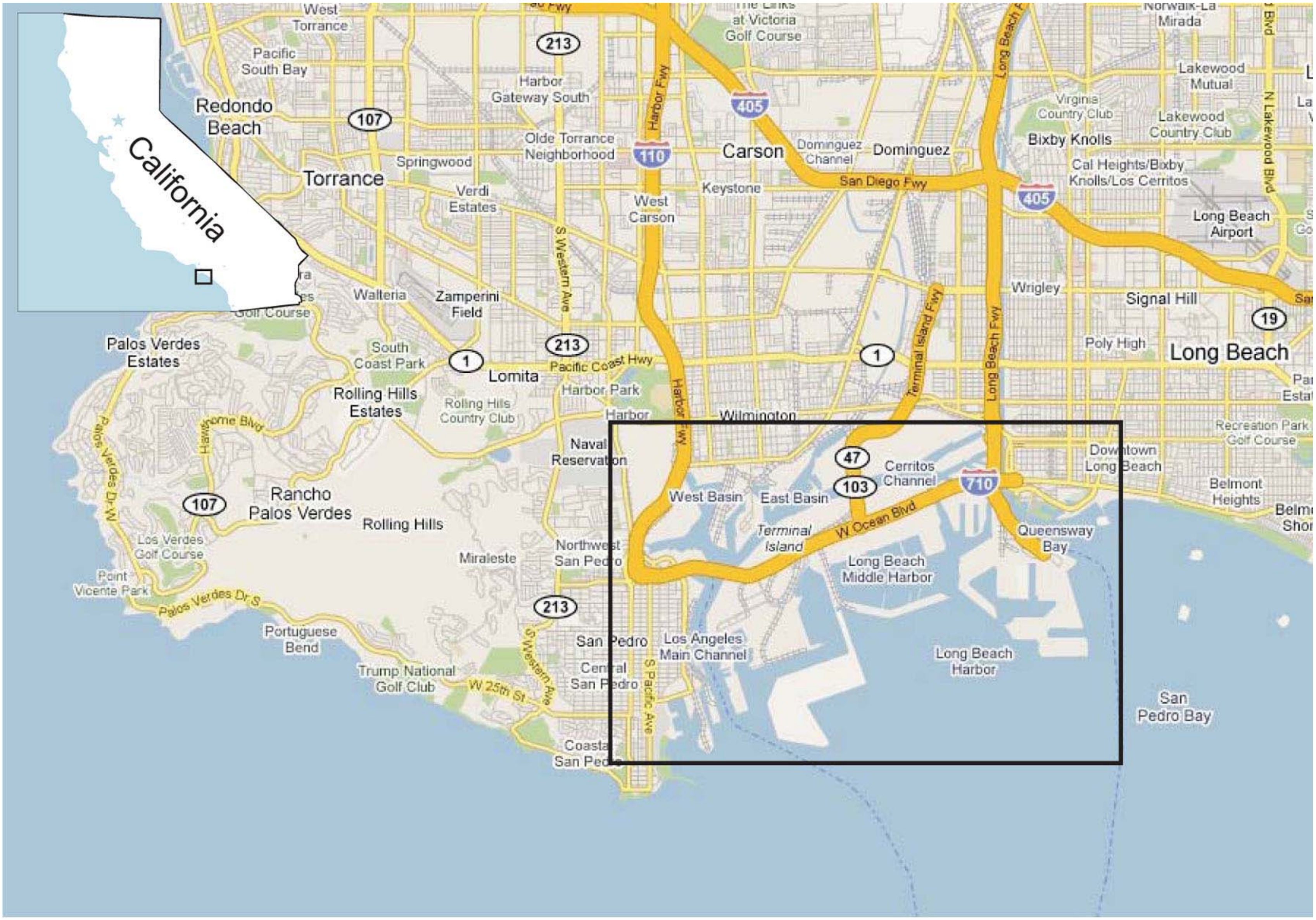


Figure 1.1-1. Study Area Location of Ports of Los Angeles and Long Beach within San Pedro Bay.

Figure 1.1-2. Map Identifying Features in Ports of Los Angeles (white) and Long Beach (yellow).

Figure 1.1-3. Map of Sampling Locations in Ports of Los Angeles and Long Beach.

CHAPTER 2

WATER QUALITY

2.0 WATER QUALITY

2.1 INTRODUCTION

This section presents the results and key findings of water quality measurements conducted within the Ports of Los Angeles and Long Beach during July 2008. Methods used for water quality measurements are described in Section 2.2. Results of water quality measurements are provided in Section 2.3. Discussions of spatial patterns and comparisons with historical conditions are provided in Sections 2.4 and 2.5, respectively.

The water quality parameters measured consisted of temperature, salinity, dissolved oxygen (DO), acidity/alkalinity (pH), and light transmittance/water clarity (transmissivity). Temperature and salinity are standard hydrographic measures used to characterize different water masses. These can be important in a port/harbor setting that receives freshwater flows from storm drains and other watershed input sources. DO, pH, and transmissivity are key water quality indicators for the protection of beneficial uses, as defined in the Basin Plan and California Ocean Plan. For example, human activities can result in reductions in DO concentrations and water clarity and/or alter pH, which causes adverse effects on biological resources. However, it is important to note that these water quality parameters also reflect natural physical, chemical, and biological processes that can result in changes at tidal, daily (diurnal), seasonal, and longer (decadal) time periods. Thus, water quality data typically are evaluated in the context of deviations from natural or background conditions.

2.2 METHODOLOGY

Water quality sampling was conducted during the July (summer) 2008 survey. Water quality characteristics were measured as continuous vertical profiles at each of 29 stations, 15 stations in the Port of Los Angeles and 14 in the Port of Long Beach (Figure 2.2-1). Sampling for Station LA14 was conducted at two locations (designated i and o), for inner and outer Consolidated Slip, to match historical sampling locations. Station coordinates and water depths are listed in Table 2.2-1. Water depths for the stations ranged from 4 to 25 meters [m] (13 to 82 feet [ft]).

Sampling was conducted during a one-day survey on July 30, 2008. The survey was conducted from a rigid hulled inflatable vessel. A Lowrance Model S-337C DF (Dual Frequency) differential GPS was used for navigation and vessel positioning. All stations were sampled while live-boating (i.e., vessel was not anchored during the casts).

Each of the water quality parameters was measured as continuous vertical profiles using a Seabird model SBE19 Conductivity Temperature Depth (CTD) instrument with additional pH and DO probes and a SeaTech CST-714PR, 0.25-centimeter (cm) pathlength transmissometer. All instruments were factory calibrated at SeaBird Electronics, Inc., in Bellevue, WA, prior to the survey.

The CTD was deployed and recovered from a bow-mounted davit and powered by an electric winch. The CTD was lowered to a depth of approximately 1 m, where it was allowed to soak (equilibrate) for a period of approximately 3 to 5 minutes (min). The CTD was then raised to a shallower depth and lowered to the bottom at a rate of approximately 10 m/min. The CTD was recovered at approximately the same rate (10 m/min).

After completing the water quality survey, the raw casts (data files) for both the down-casts and up-casts were copied electronically and saved for post-processing. The data were batch processed by first converting the raw (.hex) files to scientific units in conjunction with the updated calibration (.con) file provided during the factory instrument probe integration/calibration. Data were then processed through a low-pass filter based on the pressure signal to smooth out high frequency (rapidly changing) data. A loop edit algorithm was applied to the filtered data to remove data spikes typically caused by waves, ship heave, or unevenness of the winch motor. The resulting data files were then split into up-cast and down-cast for plotting and bin averaging routines. The up-cast records from each cast were used for bin averaging, with the exception that the down-cast data were used for Stations LB3 and LB5 due to instrument problems on the up-cast. Each cast was averaged at near-surface (i.e., 1 m) and at subsequent 1 m intervals to the bottom around whole-meter increments (i.e., +0.5 and -0.5 meters). The near-surface bin (i.e., 1 m) included measurements between 0.5 to 1.5 m. The 1 m bin-averaged results were then averaged at standard depth increments (surface [1 m]), 5 m increments, and 1 m above bottom [1 mab]) to provide a basis for inter-station comparisons that were not skewed by differences among stations in water depths.

2.3 RESULTS

Water quality data for the 29 monitoring stations sampled during the July 2008 survey are summarized in Table 2.3-1. Water quality profiles for individual stations are provided in Appendix B. Spatial patterns in the water quality parameters are discussed in Section 2.4 and comparisons to historical results are discussed in Section 2.5.

Minimum, maximum, and average values for water quality parameters by depth strata (surface, mid-depth, and bottom) were calculated by averaging surface, mid-water column and bottom bins over all stations, as summarized in Table 2.3-2. Surface measurements were averaged for the 1 m depth (e.g., below surface) bins and bottom measurements were averaged at the lowest bin for each station (i.e., 1 mab). Middle bins were averaged using the mid-water column bins from Table 2.3-1 that most closely represented the center of the water column based on overall depth.

2.3.1 Temperature

Water temperatures for surface, mid-depth, and bottom waters ranged from 19.7 to 22.7 degrees Celsius (°C), 16.8 to 20.2 °C and 15.2 to 20.4 °C, respectively (Table 2.3-2). Temperatures were consistently higher at the surface and decreased with depth. However, none of the temperature profiles, with the possible exception of Station LA8, showed rapid changes in temperature with depth (i.e., indicating thermoclines). Water temperature at LA8 (4 m maximum depth) remained around 23.5 °C to a depth of about 3 m, below which temperatures decreased sharply to 20.4 °C. The warm water temperatures at this location probably were influenced by a combination of shallow water (4 m maximum depth), solar heating, and reduced mixing with inner and outer harbor waters (see station location in Figure 2.2-1).

The Basin Plan does not specify water quality objectives for temperature. (Limitations on the temperatures of thermal discharges are covered under the Thermal Plan.)

2.3.2 Salinity

Salinity values for surface, mid-depth, and bottom waters ranged from 33.0 to 33.6 parts per thousand (ppt) or practical salinity unit (PSU), 33.4 to 33.6 ppt, and 33.3 to 33.5 ppt, respectively (Table 2.3-2). Salinity typically increased with water depth, although the range of salinities at individual stations was relatively small (e.g., less than 0.5 ppt). The vertical salinity profiles for individual stations did not show any rapid changes in salinity with depth (i.e., pycnocline) or other obvious stratification as would be expected in these relatively shallow depths.

The Basin Plan does not specify water quality objectives for salinity.

2.3.3 Density

Density values for surface, mid-depth, and bottom waters ranged from 22.5 to 23.7 kilograms/cubic-meter (kg/m^3), 23.6 to 24.4 kg/m^3 and 23.4 to 24.8 kg/m^3, respectively (Table 2.3-2). Density typically increased with water depth although the range of densities at individual stations was relatively small (e.g., approximately 0.5 kg/m^3), consistent with the salinity data which is a key component of density. Profiles for individual stations did not exhibit strong density stratification or other evidence of density layering.

The Basin Plan does not specify water quality objectives for density.

2.3.4 Acidity/Alkalinity (pH)

Average pH values for surface, mid-depth and bottom waters at individual stations were 7.37, 7.26 and 7.19 respectively (Table 2.3-2). Changes with depth in pH at individual stations typically were minimal, varying by 0.2 pH unit or less. However, differences between surface and bottom depths at some shallow and deep stations (e.g., 5 m and 20 m, respectively) were on the order of 0.2 pH units. There were no apparent gradients or consistent spatial patterns in pH conditions.

The Basin Plan established an acceptable range for pH in bays or estuaries of 6.5 to 8.5 with a change in tolerance level of no more than 0.2 due to discharges. All pH values measured during the July 2008 survey were within this range.

2.3.5 Dissolved Oxygen

DO concentrations ranged from 7.58 to 10.7 milligrams per liter (mg/L), 6.24 to 8.57 mg/L and 4.38 to 8.57 mg/L for surface, middle, and bottom depth waters, respectively (Table 2.3-2). DO concentrations were higher near the surface, decreasing with depth, with the lowest concentrations in the near-bottom waters. DO measurements at most stations indicated a well oxygenated water column (i.e., DO concentration above 5 mg/L). All surface water and mid-depth DO concentrations were above the 5 mg/L (Table 2.3-1). Near-bottom DO concentrations fell below 5 mg/L at three locations (LA8, 4.38 mg/L; LB1, 4.58 mg/L; and LB3, 4.94 mg/L).

The Basin Plan specifies that the mean annual DO concentration of waters shall be 7 mg/L or greater with no event less that 5 mg/L, except when natural conditions cause lesser concentrations. The Basin Plan also specifies that the mean annual DO concentration in the

Outer Harbor area shall be 6 mg/L or higher. Thus, some of the measured DO concentrations were below the water quality objective.

2.3.6 Transmissivity

Transmissivity (i.e., water clarity) in surface, mid-depth and bottom waters ranged from 37.5 to 76.5 percent transmittance (%), 45.1 to 78.1 %, and 14.4 to 75.0 %, respectively (Table 2.3-2). Generally, water clarity in mid-depth waters was relatively higher than surface and bottom waters. Water clarity at the surface (i.e., 1 m below the surface) was between 30% and 50% lower than mid-depth waters. Surface water clarity may have reflected the presence of plankton. The lower transmissivity values associated with bottom waters likely are attributable to resuspension of bottom sediments due to currents or turbulence from propeller wash. Station LA8 in the Seaplane Anchorage (4 m depth) had the lowest overall water clarity (i.e., 37.5 % [surface] and 14.4 % [bottom]), which likely reflected resuspension of bottom sediment by wave motions and natural turbulence at this shallow-water site.

The Basin Plan does not provide a numerical water quality objective for transmissivity. Instead, the Basin Plan states that waters shall be free of changes in turbidity that cause a nuisance or adversely affect beneficial uses. The magnitude of the transmissivity values measured during the July 2008 is not expected to cause a nuisance or adversely affect beneficial uses.

2.4 SPATIAL VARIATIONS

Water quality characteristics in the harbor complex did not exhibit pronounced spatial trends during the July 2008 survey. For example, the ranges in measured salinity, density, and pH values were small, indicating relatively uniform conditions across all of the water quality sampling locations. The ranges in measured temperature, transmissivity, and DO concentrations were comparatively larger than for salinity, density, and pH. Overall, there did not appear to be consistent patterns related to location (e.g., inner versus outer harbor) or water depth. However, a few examples of depth-related variations were noted and are discussed below.

Surface water temperatures at two of the shallow water sites (LA8 and LA7) were several degrees warmer (22.7 to 23.5 °C) than surface water temperatures in other portions of the harbor. The higher surface water temperatures at these sites were probably due to decreased vertical mixing and reduced circulation in inner harbor areas, and they are typical for this location and season.

Slightly lower salinity water (e.g., 32 ppt) occurred within the upper 2 m of the water column at stations along the Main Channel, including West Basin and Consolidated Slip (Stations LA14 and LA6). This lower salinity layer may reflect freshwater inputs from Dominguez Channel. Similar conditions were encountered during dry weather water quality sampling associated with the Dominguez Channel Estuary Modeling Study in 2004 (Everest International Consultants 2007). Additionally, reduced salinities were detected in surface waters at Station LB1 in the Long Beach Outer Harbor area (Figure 2.4-1). The lower salinity surface layer at these locations could reflect discharges from the Terminal Island Waste Treatment Plant discharge outfall, although similar profiles were not evident at Station LA1 that is considerably closer to the outfall terminus. An example of the salinity profile, showing lower salinity in the surface layer, for the Long Beach Outer Harbor area is provided in Figure 2.4-1. Receiving water quality data for the outfall show a similar seasonal reduced surface salinity trend for the outer harbor area, with the greatest decreases in surface salinity occurring in August (CLAEMD 2008).

As mentioned in Section 2.3.6, some depth-related patterns in transmissivity were observed that probably were related to higher plankton densities in surface waters and resuspended sediments in bottom waters. Water quality data from 2008 sampling was not sufficient to test for correlations between water quality and relative eelgrass distribution, even though the highest transmissivity was recorded at the seaplane lagoon/Pier 300 location (see Section 2.3.6). Thus, it appears that water clarity has not prevented a healthy eelgrass community from establishing (see Section 8.4). Depth-related patterns in pH were negligible.

As mentioned in Section 2.3.5, DO concentrations below 5 mg/L occurred in bottom waters at three sites (LB1, LB3, and LA8). Station LB1 is in an open area of the outer harbor with a water depth of 17 m, whereas LA8 is a shallow-water site (4 m) in an inner portion of the harbor, and LB3 is in the inner portion of the harbor with a water depth of 15 m. An example of the DO profile for a deepwater basin site is shown in Figure 2.4-2.

DO concentrations did not exhibit significant spatial patterns within the study area, although it is notable that near-bottom DO concentrations less than 5 mg/L occurred in the outer harbor only, whereas low DO concentrations normally would be expected in areas with relatively poor circulation (i.e., slip areas of the inner harbor). The lowest near-bottom DO concentration at an inner harbor area was 5.37 mg/L at station LA14o (outside Consolidated Slip).

The ranges in values, and the spatial and depth-related patterns, for the individual water quality parameters measured during the July 2008 survey are considered representative of summer conditions within the port complex. Water quality conditions during other seasons are expected to deviate from summer conditions due to the seasonal changes in water masses in adjacent offshore areas, magnitude and dispersion of freshwater inputs, and mixing processes.

2.5 HISTORICAL COMPARISONS

Water quality characteristics measured during the July 2008 survey generally were comparable to conditions during the August 2000 biological baseline survey (MEC 2002). While the pH and DO values during July 2008 were slightly higher (approximately 1.5 – 2.0 mg/L and 0.5 pH units) than those during the August 2000 survey, the differences were minor and probably due to normal variability in water quality conditions.

As recently as the late 1960s, DO levels at some locations in Los Angeles Harbor were so low that little or no marine life could survive. Since that time, regulations have reduced direct waste discharges into the harbor, resulting in improved DO levels throughout the harbor (MEC and Associates 2002).

Table 2.2-1. Water Quality Sampling Locations (Latitude and Longitude) and Depth (m) for the July 2008 Biological Baseline Survey

Station	*Latitude (N)*	*Longitude (W)*	*Depth (m)*
LA1	33° 43.045'	118° 14.431'	23
LA2	33° 42.440'	118° 16.231'	5
LA3	33° 42.484'	118° 16.435'	6
LA4	33° 44.279'	118° 16.600'	17
LA5	33° 45.883'	118° 16.483'	17
LA6	33° 45.554'	118° 15.647'	13
LA7	33° 44.446'	118° 14.783'	5
LA8	33° 44.884'	118° 15.053'	4
LA9	33° 43.892'	118° 15.157'	17
LA10	33° 43.719'	118° 15.909'	24
LA11	33° 43.051'	118° 16.160'	16
LA12	33° 43.261'	118° 16.738'	12
LA13	33° 45.300'	118° 16.931'	12
LA14i*	33° 46.499'	118° 14.729'	7
LA14o*	33° 46.170'	118° 15.054'	13
LA15	33° 45.285'	118° 16.496'	17
LB1	33° 43.924'	118° 13.353'	17
LB2	33° 44.122'	118° 14.352'	8
LB3	33° 44.635'	118° 13.924'	15
LB4	33° 46.455'	118° 12.862'	8
LB5	33° 44.604'	118° 11.813'	17
LB6	33° 44.242'	118° 11.305'	16
LB7	33° 44.950'	118° 13.015'	24
LB8	33° 44.332'	118° 11.028'	15
LB9	33° 43.703'	118° 11.530'	24
LB10	33° 44.822'	118° 12.640'	20
LB11	33° 44.750'	118° 13.386'	14
LB12	33° 45.342'	118° 12.683'	15
LB13	33° 46.178'	118° 13.385'	20
LB14	33° 46.040'	118° 13.954'	17

* - i=inner; o=outer

Table 2.3-1. Water Quality Values for Standard Depths at Individual Stations During July, 2008.

Depth (m)	*Temperature (°C)*	*Salinity (PSU)*	*Density (Kg/m^3)*	*pH*	*Oxygen (mg/L)*	*Transmissivity (%)*
			LA1			
1	20.6	33.4	23.4	7.47	9.98	61.0
5	19.5	33.4	23.7	7.37	8.12	71.4
10	18.7	33.5	23.9	7.30	7.54	74.4
15	17.6	33.5	24.2	7.26	7.56	63.5
20	15.5	33.5	24.7	7.25	7.96	70.5
23	15.2	33.5	24.8	7.25	7.94	66.0
			LA2			
1	19.7	33.4	23.6	7.38	9.11	60.1
5	18.8	33.5	23.9	7.30	7.16	38.8
			LA3			
1	19.8	33.5	23.7	7.39	9.30	60.7
5	18.8	33.5	23.9	7.30	6.96	45.1
6	18.5	33.5	24.0	7.22	5.68	23.7
			LA4			
1	19.9	33.3	23.5	7.34	8.87	60.7
5	19.1	33.4	23.8	7.31	8.25	69.5
10	18.4	33.5	24.0	7.27	7.73	71.7
15	16.5	33.5	24.5	7.26	7.72	68.9
17	16.2	33.5	24.6	7.24	7.62	59.2
			LA5			
1	20.3	33.4	23.5	7.39	9.76	62.1
5	19.4	33.4	23.7	7.37	9.53	69.2
10	19.0	33.4	23.8	7.28	8.28	78.1
15	18.7	33.5	23.9	7.25	7.83	73.6
17	18.3	33.5	24.0	7.20	7.11	66.8
			LA6			
1	20.3	33.2	23.3	7.31	8.70	67.2
5	19.3	33.4	23.7	7.29	8.02	75.5
10	18.9	33.5	23.9	7.25	7.67	75.9
12	18.4	33.5	24.0	7.21	7.15	75.0
			LA7			
1	22.7	33.5	22.9	7.48	9.38	44.3
5	18.9	33.5	23.9	7.19	5.73	39.5
			LA8			
1	23.5	33.3	22.5	7.41	8.14	37.5
4	20.4	33.3	23.4	7.19	4.38	14.4

Table 2.3-1. Water Quality Values for Standard Depths at Individual Stations During July, 2008 (continued).

Depth (m)	*Temperature (°C)*	*Salinity (PSU)*	*Density (Kg/m^3)*	*pH*	*Oxygen (mg/L)*	*Transmissivity (%)*
LA9						
1	20.2	33.4	23.5	7.44	9.69	60.9
5	19.5	33.5	23.7	7.41	8.96	65.9
10	18.4	33.5	24.0	7.27	7.22	72.3
15	17.0	33.5	24.4	7.17	6.18	71.1
18	15.8	33.5	24.6	7.19	6.83	32.2
LA10						
1	20.5	33.6	23.5	7.53	10.7	45.4
5	19.6	33.5	23.7	7.41	8.61	61.8
10	18.6	33.5	24.0	7.29	7.39	69.9
15	16.9	33.5	24.4	7.22	6.94	69.8
20	16.5	33.5	24.5	7.20	6.95	64.8
24	15.7	33.5	24.7	7.20	7.08	60.5
LA11						
1	20.2	33.4	23.5	7.42	9.47	57.3
5	19.8	33.5	23.7	7.43	9.53	66.3
10	18.7	33.5	23.9	7.32	8.14	70.3
15	17.3	33.5	24.3	7.26	7.39	62.0
17	16.1	33.4	24.5	7.25	7.51	58.2
LA12						
1	21.2	33.4	23.3	7.35	8.59	67.7
5	19.2	33.5	23.8	7.30	7.73	65.4
10	17.9	33.5	24.2	7.15	5.91	49.5
11	17.4	33.4	24.2	7.11	5.09	45.0
LA13						
1	20.1	33.5	23.6	7.31	9.52	63.5
5	19.0	33.4	23.8	7.29	8.21	60.2
10	18.8	33.4	23.9	7.25	7.53	58.6
12	18.7	33.4	23.9	7.23	7.40	53.6
LA14i (inner)						
1	20.6	33.0	23.1	7.22	7.58	72.9
5	19.3	33.4	23.7	7.30	7.90	71.0
7	19.0	33.4	23.8	7.26	7.53	66.5
LA14o (outer)						
1	21.0	33.1	23.0	7.23	7.75	66.6
5	19.5	33.5	23.7	7.32	8.21	71.1
10	18.9	33.5	23.9	7.23	7.28	62.1

Table 2.3-1. Water Quality Values for Standard Depths at Individual Stations During July, 2008 (continued).

Depth (m)	*Temperature (°C)*	*Salinity (PSU)*	*Density (Kg/m^3)*	*pH*	*Oxygen (mg/L)*	*Transmissivity (%)*
14	18.0	33.5	24.1	7.19	5.37	50.7
LA15						
1	20.0	33.4	23.6	7.34	9.01	59.5
5	19.0	33.4	23.8	7.29	8.28	72.6
10	18.8	33.4	23.9	7.26	7.90	74.0
15	18.4	33.5	24.0	7.22	7.32	58.9
17	18.2	33.5	24.0	7.21	7.06	62.9
LB1						
1	19.8	33.0	23.3	7.25	8.28	67.1
5	19.5	33.5	23.8	7.31	8.11	77.0
10	18.3	33.5	24.1	7.24	7.29	76.6
15	16.6	33.6	24.5	7.02	4.88	37.7
17	16.4	33.5	24.5	6.98	4.58	31.9
LB2						
1	20.4	33.5	23.5	7.39	8.73	62.7
5	20.2	33.5	23.6	7.38	8.43	70.6
8	19.7	33.5	23.7	7.29	7.38	55.1
*LB3**						
1	20.4	33.4	23.4	7.46	9.54	75.4
5	19.5	33.4	23.7	7.39	8.59	73.6
10	18.9	33.5	23.9	7.30	7.45	59.9
15	17.7	33.4	24.2	7.15	4.94	32.2
*LB5**						
1	20.4	33.4	23.4	7.39	8.40	74.7
5	19.6	33.4	23.6	7.31	7.51	79.9
10	18.7	33.4	23.9	7.27	7.20	76.3
15	17.0	33.5	24.3	7.15	5.98	58.7
17	16.8	33.5	24.4	7.11	5.70	43.4
LB6						
1	21.2	33.2	23.1	7.40	8.55	66.7
5	20.1	33.3	23.5	7.30	7.42	71.9
10	17.7	33.5	24.2	7.16	6.78	63.7
15	16.9	33.5	24.4	7.09	5.52	40.4
16	16.8	33.5	24.4	7.14	5.76	44.8
LB7						
1	20.2	33.5	23.6	7.41	9.00	68.1
5	19.8	33.5	23.7	7.37	8.28	74.3

Table 2.3-1. Water Quality Values for Standard Depths at Individual Stations During July, 2008 (continued).

Depth (m)	Temperature (°C)	Salinity (PSU)	Density (Kg/m^3)	pH	Oxygen (mg/L)	Transmissivity (%)
10	18.8	33.5	23.9	7.30	7.62	75.4
15	17.3	33.5	24.3	7.20	6.82	71.6
20	16.2	33.5	24.6	7.13	6.12	62.3
24	15.5	33.5	24.7	7.05	5.35	51.5
LB8						
1	20.8	33.3	23.2	7.37	8.40	69.7
5	19.8	33.5	23.7	7.28	7.24	76.9
10	18.0	33.5	24.1	7.15	6.24	66.8
15	16.8	33.5	24.4	7.20	7.30	50.5
LB9						
1	19.8	33.6	23.7	7.34	8.39	76.5
5	19.7	33.6	23.7	7.34	8.42	88.2
10	18.3	33.6	24.1	7.29	8.20	82.2
15	17.1	33.6	24.4	7.27	8.57	76.3
20	16.1	33.6	24.6	7.24	8.39	65.7
25	16.0	33.5	24.6	7.25	8.57	54.8
LB10						
1	19.9	33.4	23.6	7.35	8.61	65.4
5	19.3	33.5	23.8	7.30	8.10	75.9
10	17.9	33.5	24.2	7.23	7.02	78.3
15	16.8	33.5	24.4	7.16	6.41	77.9
20	16.0	33.5	24.6	7.10	5.70	57.2
LB11						
1	20.2	33.5	23.5	7.38	8.63	68.4
5	19.6	33.5	23.7	7.37	8.53	71.4
10	19.0	33.5	23.8	7.32	7.89	72.6
14	17.5	33.5	24.2	7.20	6.58	53.4
LB12						
1	20.4	33.3	23.4	7.37	8.50	65.1
5	19.8	33.5	23.7	7.37	8.24	72.2
10	18.8	33.5	23.9	7.28	7.17	45.1
14	17.2	33.4	24.3	7.16	5.90	17.6
LB13						
1	20.4	33.3	23.4	7.30	8.19	65.4
5	19.7	33.5	23.6	7.33	8.18	71.5
10	18.9	33.5	23.9	7.27	7.31	74.2
15	17.9	33.5	24.1	7.21	6.60	68.9

Table 2.3-1. Water Quality Values for Standard Depths at Individual Stations During July, 2008 (continued).

Depth (m)	*Temperature (°C)*	*Salinity (PSU)*	*Density (Kg/m^3)*	*pH*	*Oxygen (mg/L)*	*Transmissivity (%)*
18	17.7	33.5	24.2	7.18	6.34	64.2
LB14						
1	20.3	33.4	23.5	7.34	8.47	62.8
5	19.6	33.4	23.7	7.31	7.82	73.7
10	18.9	33.4	23.9	7.26	7.26	68.9
15	18.2	33.5	24.0	7.22	6.83	66.7
17	18.0	33.5	24.1	7.21	6.56	62.1

* - data based on downcast records.

Table 2.3-2. Average Water Quality Values at Surface, Middle and Bottom Depths Across all Stations During July, 2008.

Depth		*Temperature (°C)*	*Salinity (PSU)*	*Density (Kg/m^3)*	*pH*	*Oxygen (mg/L)*	*Transmissivity (%)*
Surface	Min	19.7	33.0	22.5	7.22	7.58	37.5
	Ave	20.5	33.4	23.4	7.37	8.87	63.3
	Max	23.5	33.6	23.7	7.53	10.7	76.5
Middle	Min	16.8	33.4	23.6	7.15	6.24	45.1
	Ave	18.5	33.5	24.0	7.26	7.49	69.4
	Max	20.2	33.6	24.4	7.38	8.57	78.1
Bottom	Min	15.2	33.3	23.4	6.98	4.38	14.4
	Ave	17.4	33.5	24.2	7.19	6.46	49.4
	Max	20.4	33.5	24.8	7.30	8.57	75.0

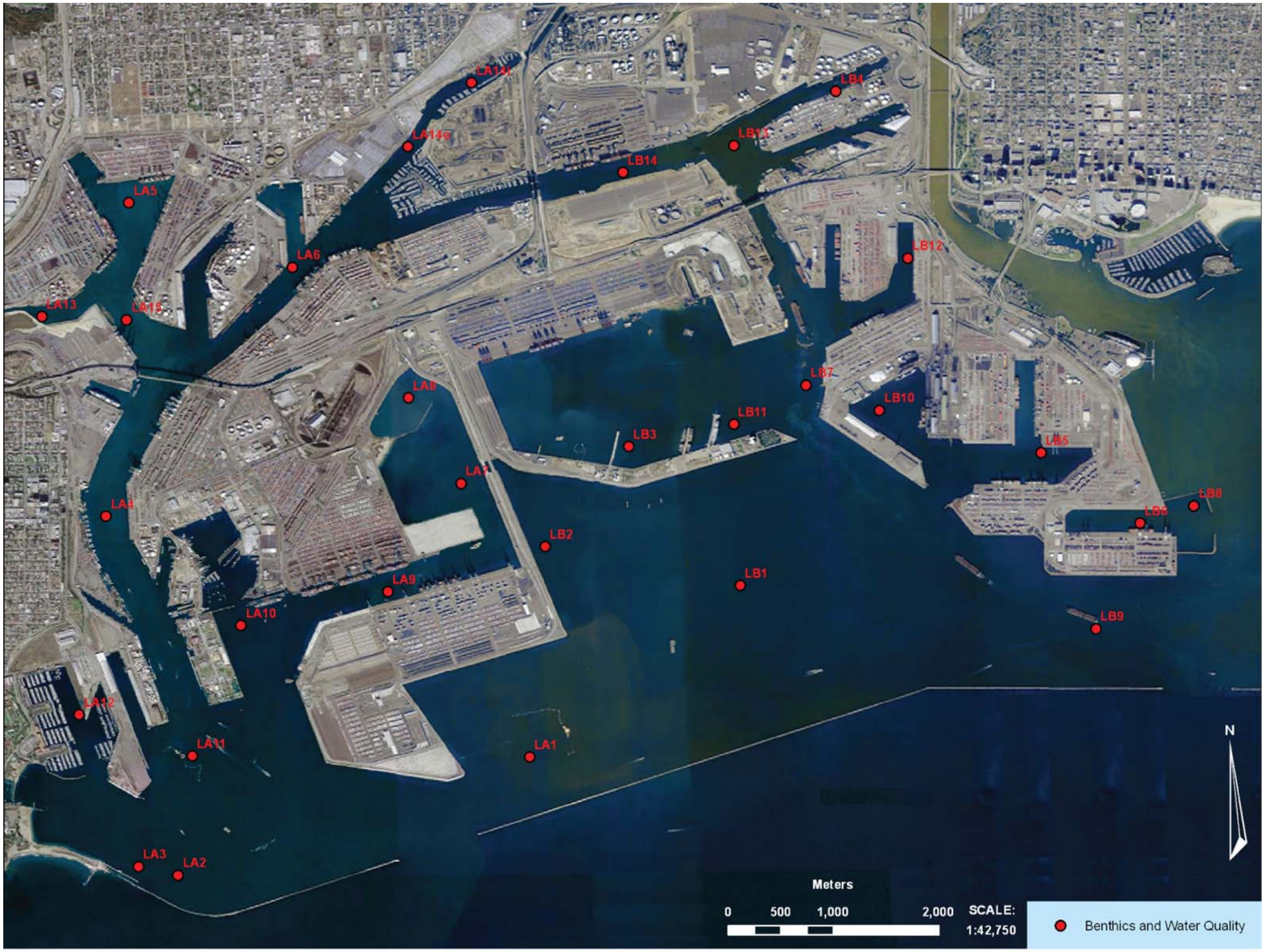


Figure 2.2-1. Water Quality Sampling Locations in Los Angeles and Long Beach Harbors, July 2008.

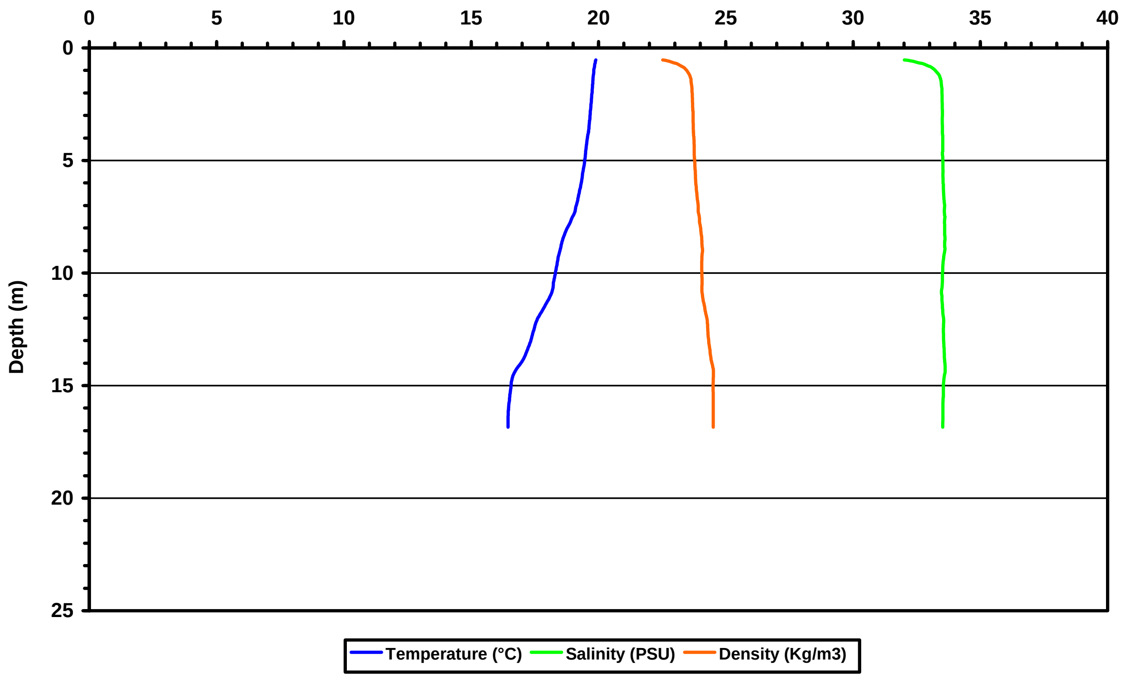


Figure 2.4-1. July 2008 Temperature (ºC), Salinity (PSU), and Density (Kg/m3) at Station LB1 Showing Decreased Salinity on Surface.

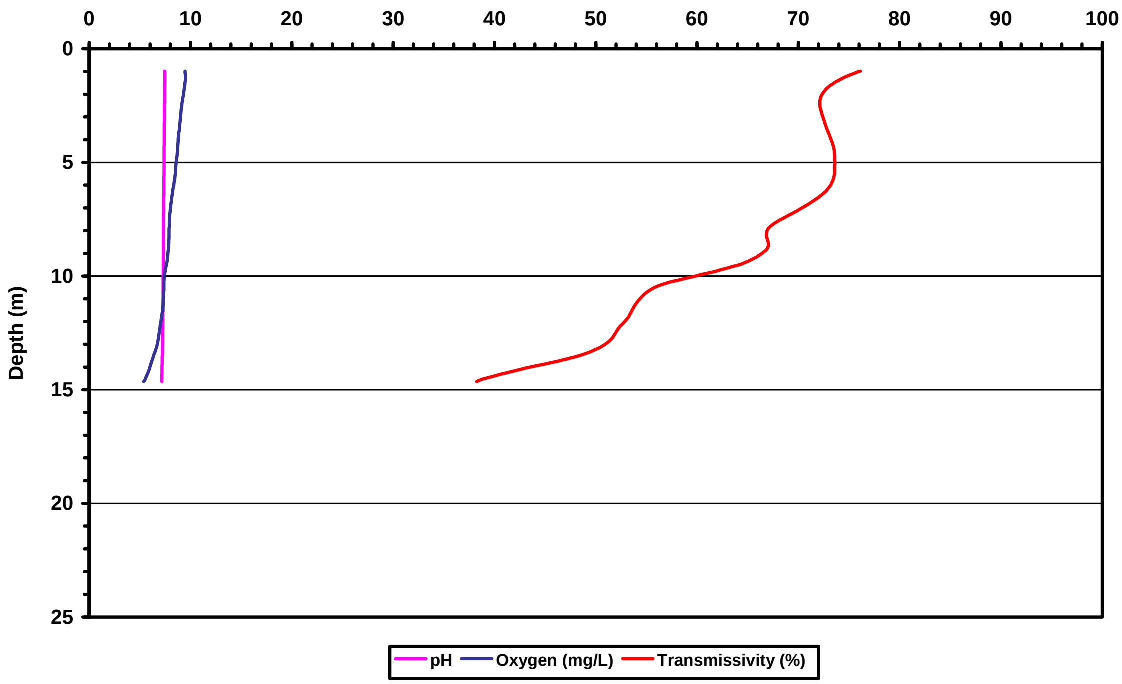


Figure 2.4-2. July 2008 Dissolved Oxygen (mg/L), pH, and Transmissivity (%) at Station LB3 Showing Decreased Dissolved Oxygen Concentrations in Near-Bottom Depths.

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CHAPTER 3

ADULT AND JUVENILE FISHES

3.0 ADULT AND JUVENILE FISHES

3.1 INTRODUCTION

Surveys of fish populations within POLA and POLB have been conducted since the early 1970s, with more than 100 species reported between 1971 and 1979 (Horn and Allen 1981). Studies during the 1970s, 1980, and 1990s primarily sampled fish communities using otter trawls, with other gear types such as lampara nets, gill nets, and beach seines used to a lesser extent (Horn and Allen 1981). While some earlier studies focused on characterizing fish assemblages within limited areas of one harbor (e.g., Horn and Hagner 1982, Allen et al. 1983, MEC 1999), a few studies sampled fish harbor-wide. For example, MEC (1988) conducted a large-scale study of Los Angeles outer harbor in 1986-1987 and utilized a number of gear types, including otter trawls, lampara nets, gill nets, minnow seines, and beach seines to describe fish populations. Similarly, MBC (1984) and SAIC and MEC (1996) completed surveys of inner and outer harbor areas in the Port of Long Beach for proposed development projects.

The goal of the current study was to describe the fish communities (pelagic and demersal) at 19 stations within the harbor complex using lampara and otter trawl gear. Shallow-water fish species were also sampled at two stations in the Port of Los Angeles using a beach seine. This study represents an update to the previous baseline survey conducted in 2000 by MEC Analytical Systems, Inc. (MEC 2002), and compares results with previous studies to address historical trends.

Detailed methods for each gear type are presented in Section 3.2. Sections 3.3, 3.4, and 3.5 provide the results from pelagic (lampara), demersal (otter trawl), and beach seine sampling, respectively. Community summary measures, species composition, size frequency distribution of catch, and historical comparisons are presented in each of these sections. Section 3.6 addresses the occurrence of exotic, non-indigenous, or uncommon species collected during the current study. Additional data for each gear type is presented in Appendix C, including a summary table of all the species collected using each gear type (Table C-1).

3.2 METHODOLOGY

Fish sampling using otter trawls and lampara nets was completed at 19 stations (10 in POLA and 9 in POLB) during both day and night surveys (Tables 3.2-1 and 3.2-2; Figure 3.2-1). Fish sampling using beach seines was completed at two stations in POLA (Table 3.2-3, Figure 3.2-1). Fish were sampled quarterly in winter (January), spring (April), and summer (July) 2008. All pelagic and demersal fish sampling over all quarters (day and night) was conducted from the *M/V Early Bird II*, owned and operated by Seaventures, Inc. The vessel was equipped with a differential Global Positioning System (dGPS) used to locate sampling stations accurately. In addition, a forward-facing sonar was used to verify that trawl locations were free of potential items that could snag the net (debris, large rocks, etc). A fathometer was used to record bottom/water depth at each station (± 0.5 ft accuracy).

3.2.1 Pelagic (Lampara) Fishes

Pelagic species were sampled using a lampara net, which generally extended from the surface to mid water depths. One haul during the day and one during the night was completed at each station. The lampara net utilized for this study included a 166 m corkline that was 22 m deep, similar to previous harbor studies (e.g., MEC 2002). The net had two 67.7 m wings with 15 cm mesh, a throat with 10 cm mesh, and a 0.6 cm mesh bag. Lampara sampling typically involves setting the net in a circle; however, in some areas where boat movement was restricted, the set was elliptical. As the net is hauled in, the catch is driven into the back of the net (bag end) where escape is unlikely. When hauls were sufficiently large, fish were scooped from the bag end of the net using a standard bait brailer (diameter = 40 cm, depth = 50 cm) and placed into containers (buckets and bins) where the catch was sorted by species. Small catches were transferred directly from the net into the sorting containers.

A maximum of six brailed scoops was processed, consistent with the previous baseline study (MEC 2002). This approach helped avoid impractical processing time that would have been associated with extremely large hauls and minimized incidental take from the sampling effort. Consequently, if a haul appeared to be greater than six scoops, the fishes to be processed (six scoops) were randomly withdrawn from the net. A count of the excess scoops returned to the water was recorded for later use in calculating the total catch for the sample. This procedure minimized the effects of being captured and significantly increased survival of most fishes.

All fishes were identified, measured (except in the case of abundant species – see below), and weighed. Abundant species (>30 individuals) were subsampled by first randomly selecting 30 individuals of each species, measuring (standard length to the nearest mm) and weighing each specimen (to 0.1 gm), then measuring the next 70 specimens (nearest 1 cm size class) and recording an aggregate weight for these 70 individuals. Next, a total of 400 individuals was counted and the aggregate weight determined along with the aggregate weight for any remaining specimens. Fish abnormalities, including fin erosion, lesions, pop-eye, tumors, and parasites were noted on pre-formatted data sheets set up for direct entry into the database. Macroinvertebrates collected from lampara hauls were not recorded since they were not the purpose of this sampling for pelagic fish.

3.2.2 Demersal and Epibenthic (Otter Trawl) Fishes

Demersal (bottom-oriented) fish and macroinvertebrates were collected using a 7.6 m semi-balloon otter trawl net constructed with 2.5 cm side mesh and fitted with a 1.3 cm mesh cod end that collects organisms as it is towed along the seafloor. For each haul, the trawl was towed at approximately 2 knots for 5 minutes, corresponding to a sample area of about 300 m^2. Trawl catches were processed immediately on deck to minimize fish mortality. Trawl-collected fish were identified, measured, and weighed using the same methods described above for pelagic fishes. Abundant species were subsampled using the same methods described above for lampara sampling. Macroinvertebrates collected from trawl surveys were identified to the lowest practicable taxon, counted, and an aggregate weight determined by species.

Identification of invertebrates was aided by a combination of photography and collection of voucher specimens for taxa that could not be identified in the field. Voucher specimens were preserved as noted for the benthic collections and final identifications, based on photographs and/or voucher specimens, were made by taxonomic specialists.

3.2.3 Shallow Subtidal (Beach Seine) Fishes

Fish sampling in shallow-water sandy habitats was conducted using a 15.2 m long by 1.8 m deep beach seine net. The net had 0.6 cm mesh wings with a bag end of 0.3 cm mesh. The fish catch was processed in the field. Every specimen was identified and counted, except when abundant species were encountered. If more than 30 individuals from one species was collected, the same protocols used for trawl and lampara sampling were followed (see Section 3.2.1). After field processing was completed, all specimens were immediately returned to the water to reduce potential mortality.

3.2.4 Data Analysis

All fish data were entered into a database which included unique species codes, count, length, and weight data. In addition, the fish database was subjected to standardized quality assurance routines. Consistent with the previous baseline survey analyses, abundance and biomass values in this report are presented as catch per unit effort (CPUE), that is, catch in one set of the lampara net, otter trawl, or beach seine. Fish length data were standardized to one-centimeter size classes.

Community measures of species richness and diversity were calculated using CPUE values and included number of species, Shannon-Wiener diversity, Margalef diversity, and Dominance. Diversity indices and Dominance were calculated using the following formulas:

- Number of species or unique taxa;
- Shannon-Wiener diversity: $-\Sigma p_i \times \ln(p_i)$, where p_i is the count for species i;
- Margalef diversity: $(S-1)/\ln(n)$, where S is the number of taxa, and n is the number of individuals; and
- Dominance: number of species comprising 75% of the total count of the sample.

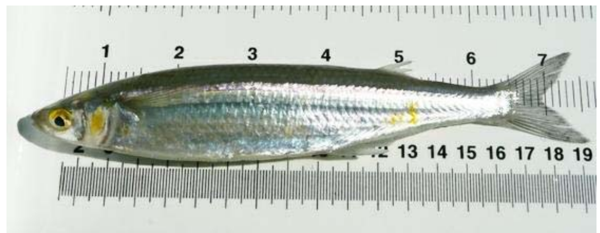
Analysis of variance (ANOVA) was performed on log-transformed (natural log = ln) abundance and biomass data to determine whether there were significant differences in catch between day and night and/or among seasons. ANOVA was also used to test for seasonal and diurnal differences in catches.

3.3 PELAGIC FISHES

3.3.1 Community Summary Measures

3.3.1.1 Abundance

A total of 81,084 fish were collected by lampara sampling during day and night surveys at all 19 stations combined (Table 3.3-1). Northern anchovy (*Engraulis mordax*) was the most abundant species collected and represented 87% of the total lampara catch. Other species with relatively high catch abundances included topsmelt (*Atherinops affinis*) with 7% of the total catch, California grunion (*Leuresthes tenuis*), and Pacific sardine (*Sardinops sagax*), each with nearly 2% of the total catch, and shiner surfperch (*Cymatogaster aggregata*) with almost 1% of the total catch (Table 3.3-1). No commercially important fish species were collected during lampara sampling.

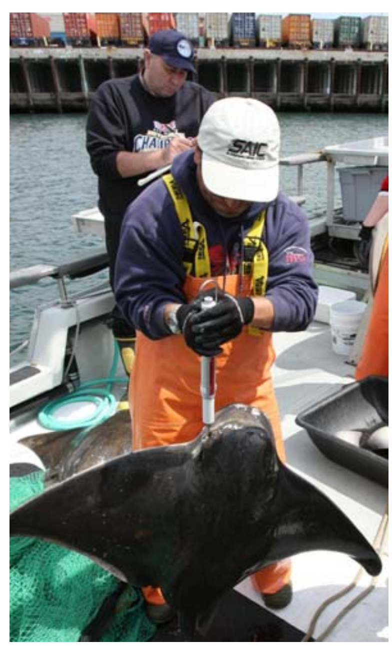


Significantly more fish (p<0.001) were collected during night sampling (73,041) compared to day (8,043) (Table 3.3-1). Although more northern anchovy and Pacific sardines were collected in night samples, the pattern was opposite for topsmelt and California grunion, with higher numbers of these species being collected in day samples.

Mean fish abundance by station is presented in Table 3.3-2. The highest mean abundance (day and night samples combined) was observed at outer harbor Stations LB7 (mean = 2298) and LB3 (mean = 1207). The lowest mean abundance was reported at outer harbor Station LA1 and inner harbor Station LB14 (mean = 18). With the exception of these few stations with either high or low mean abundances, most station means were similar and ranged from 100-200 (Table 3.3-2). Similar to the total number of individuals described above, mean abundance was statistically higher at night (p = 0.032) compared to day surveys.

Seasonal differences in lampara catch were not apparent. For example, even though more fish were collected during day surveys in summer (July) compared to all other surveys, fish abundances were highest in winter (January) surveys during night sampling (Figure 3.3-2). Spring (April) surveys had intermediate values for both day and night samples.

Additional lampara data, including raw data tables of abundance, biomass, and length distributions are presented in Appendix C.



3.3.1.2 Biomass

A total of 656.25 kg of fish were collected during day and night surveys at all 19 stations combined (Table 3.3-1). Northern anchovy (*Engraulis mordax*) had the highest total biomass (373.2 kg), representing nearly 57% of the total lampara biomass. Other species with relatively high total biomass included California bat ray (*Myliobatis californica*) (22%), topsmelt (9%), and Pacific sardine (3.7%) (Table 3.3-1).

Significantly more biomass (p<0.001) was collected during night sampling (570 kg) than during day sampling (85.8 kg) (Table 3.3-1). This was primarily due to large catches of northern anchovy and bat rays at night, representing nearly 85% of all fish biomass from the night surveys. Although more northern anchovy, bat rays, and Pacific sardines were collected in night samples compared to day, this pattern was primarily different for topsmelt, with higher numbers of this species being collected in day samples.

Mean fish biomass by station is presented in Table 3.3-2. The highest mean biomass (day and night samples combined) was observed at outer harbor Stations LB3 (mean = 9233) and LB7 (mean = 9231). The lowest mean biomass was reported at inner harbor Station LB14 (mean = 130). Mean biomass at most other stations was highly variable and ranged from 286 to 5,761 (Table 3.3-2). Mean biomass was not statistically higher at night compared to day surveys (all surveys combined). However, total biomass was significantly higher ($p = 0.006$) at night compared to day samples.

Seasonal differences in total biomass were also observed, with more fish biomass collected during night surveys in summer (July) compared to all other surveys (Figure 3.3-2), although these differences were not statistically significant. Total biomass was similar in winter (January) and spring (April).

3.3.1.3 Number of Species

A total of 20 species were collected with the lampara net during all surveys, night and day combined (Table 3.3-1). Slightly more total species (all surveys combined) were collected during night surveys (19) compared to day (12). In contrast, individual station means for number of species were generally two times higher at night compared to day (Table 3.3-2). The total number of species collected varied from a low of 1 species, collected only during day surveys at several stations, to a high of 15 species collected at Station LA7 at night (Table 3.3-2).

Seasonal differences in the number of species are presented in Figure 3.3-2. More species were collected at night during spring (April) and summer (July) surveys than any other sampling quarter. The lowest number of species (6) was observed in day samples during winter (January) and spring surveys.

3.3.1.4 Diversity and Dominance

Diversity indices provide information about community composition by combining species richness (i.e., the number of species present) and relative abundances of different species (equitability) into one measure. There are several methods to calculate diversity, but two commonly used indices, Shannon-Weiner and Margalef, were used in the current study (Table 3.3-3). In addition, Dominance values were calculated and are also presented in Table 3.3-3. For Shannon-Weiner indices, values vary from 0 for communities with only a single taxon to high values for communities with many taxa, each with few individuals. The Margalex Index incorporates the number of species and total number of individuals. The Dominance Index computes the number of species that account for 75% of the total abundance.

Shannon-Wiener values varied greatly among stations and between day and night surveys (Table 3.3-3). The values were generally higher during night surveys at most stations compared to day and at shallow-water stations. Shannon-Wiener values ranged from a low of 0.00 at several stations during the day to a high of 1.63 observed during the day at Station LA7. Margalef values followed similar trends, with night values being consistently higher than day. Margalef values ranged from a low of 0.00 to a high of 1.98 at Station LA7 (night survey). Station LA7 is a shallow-water station and had the highest Shannon-Wiener and Margalef values.

Dominance is defined as the number of species accounting for 75% of the total abundance at a specific station. Dominance values during all surveys ranged between 1 (one species accounted for 75% of the total abundance) and 3 (three species accounted for 75% of the total abundance), with most stations averaging 1 (Table 3.3-3). In general, higher dominance values (2 and 3) were found at shallow-water stations.

3.3.2 Dominant and Selected Species

Four of the 20 species collected over all surveys and stations in 2008 comprised over 98% of the total catch: northern anchovy, topsmelt, California grunion, and Pacific sardine (Table 3.3-1). All of these species are schooling fishes that spend most of their lives in the harbor environment.

As described above, northern anchovy was the most abundant species collected, and represented 87% of the total lampara catch and nearly 57% of the total biomass (Table 3.3-1). This species was collected at every sampling station and during every survey quarter (day and night samples). Average size for all measured northern anchovy ranged between 3 and 14 cm, with most individuals between 7 and 11 cm (Figure 3.3-3). No spatial trends in fish sizes were evident.

Topsmelt were the second most abundant fish species collected during lampara surveys and represented over 7% of the total catch and 9% of the total biomass (Table 3.3-1). Similar to northern anchovy, this species was collected during all survey quarters and at every sampling location (day and night samples). Sizes ranged between 4 and 32 cm, with most individuals between 6 and 12 cm (Figure 3.3-3). Average size for all measured topsmelt ranged between 8 and 13 cm, with most fishes falling into the 10 or 11 cm size class. No spatial trends in fish sizes were evident.

Other dominant pelagic species in terms of abundance included California grunion and Pacific sardine, each representing approximately 1.9% of the total lampara catch and 1.2% and 3% of the total biomass, respectively (Table 3.3-1). California grunion had a bimodal size distribution, with peaks at 6-7 cm and 13-14 cm (Figure 3.3-3). Although there was a peak in 10 cm size class Pacific sardine, their size distribution was also generally bimodal, with both small (4-8 cm) and large (9-15 cm) represented.

3.3.3 Summary of Spatial and Temporal Variations

A total of 20 species represented by 81,084 individuals, with a combined weight of 656 kg, was collected at 19 stations over 3 sampling quarters (seasons) in Los Angeles and Long Beach harbors.

In contrast to typical seasonal patterns for pelagic harbor fishes where summer is the peak of abundance (MEC 2002), the total number of individuals collected in this study using the lampara net was higher in winter (January) than in summer (August) (Figure 3.3-2). Significant differences were observed between night and day samples, with nearly ten times more fish collected at night.

Differences in diurnal catch were primarily due to large night catches of northern anchovy (Table 3.3-1). No spatial patterns of abundance were apparent. This is likely due to the mobile habits of most common pelagic fishes, which spend most of their lives moving in and around various locations in and outside the harbors.

Temporal biomass patterns were similar to the abundance trends described above, with significant day-night differences in biomass. Seasonal patterns in biomass were also observed, with values lowest in winter (January) and highest in summer (July) for both day and night samples (Figure 3.3-2). The significantly higher biomass during the summer was primarily due to large catches of northern anchovy and large-sized species such as bat rays.

Similar to the patterns for abundance and biomass, the number of species collected was greater at night (19 species) than during the day (12 species; Table 3.3-1). In addition, the number of species generally increased from fewer species collected in winter to the greatest number of species collected in spring and summer. More species were collected at Station LA7 (15) for day and night sampling combined than at any other station (Table 3.3-2). The fewest number of species (3) was collected at Stations LA1, LA4, and LB4. In general, more species were collected at the shallow-water stations than at the other stations.

3.3.4 Historical Comparisons

Although gear differences can account for differences in sampling results from study to study, overall patterns in common and abundant species collected in the harbors have remained similar. Fish studies in the 1970s primarily used gill nets, rather than lampara nets, to characterize pelagic fish communities. However, historic gill net catches were dominated by both pelagic and demersal species, including white croaker, northern anchovy, shiner surfperch, queenfish, white surfperch, and walleye surfperch (Horn and Allen 1981). Since the late 1980s, pelagic fish populations have been sampled occasionally using lampara nets, with periodic surveys in Los Angeles (MEC 1988, 1999) and Long Beach (MBC 1990; SAIC and MEC 1996) Harbors and Queensway Bay (MBC 1990).

Northern anchovy, Pacific sardine, white croaker, queenfish, and California grunion were most abundant in lampara samples during 1986-1987 (MEC 1988). Similarly, northern anchovy, Pacific sardine, white croaker, queenfish, and topsmelt or Pacific butterfish were most abundant in lampara samples during the 1990s (MBC 1990; SAIC and MEC 1996). The same fish species were most abundant in lampara samples during the previous baseline study in 2000 (MEC 2002), with lower abundances of Pacific sardine compared to the 1980s and 1990s.

In contrast to seasonal trends observed in previous studies (MEC 1988; SAIC and MEC 1996), specifically for abundance and number of species, no clear seasonal patterns in the pelagic fish community were evident during the current study. This is likely due to highly variable catches of the most dominant pelagic fishes during each survey and may also have been influenced by sampling conducted over three quarters compared to four.

Temporal patterns in biomass were observed. Similar to abundance and number of species, biomass values varied but were higher during the summer (July) survey. While some previous studies indicated shallow-water stations had generally lower abundances, but higher biomass and number of species compared to deepwater stations (MEC 2002), the current study found that shallow-water stations such as LA7 in the outer harbor had some of the highest abundances of any station sampled in 2008. As was the case in previous studies in which day and night samples were collected (MEC 1996; SAIC and MEC 1996; MEC 2002), more species in greater numbers were collected at night in the current study. Day/night differences in catch are likely due to a combination of fish behavior (decreased ability to detect and avoid sampling gear at night), increased dispersal of schooling species, and increased foraging activity at night (Horn and Allen 1981).

Inner and outer harbor differences in species composition of pelagic fish were documented during an earlier study of Los Angeles Harbor by MEC (1988). The MEC (2002) study also found outer harbor assemblages generally had relatively higher abundances that were distributed among more species (higher diversity) than those in the middle and inner harbor areas. In contrast, the current study did not find similar habitat associations or distributions of pelagic species. Most pelagic fish species in this study had more “harbor-wide” distributions and no evident preference for certain areas, similar to results of many historical studies (e.g., MEC 1996; SAIC and MEC 1996). Therefore, no consistent differences in species assemblages between outer, middle, and inner harbor areas were observed. It is likely that most dominant pelagic species such as northern anchovy, topsmelt, and Pacific sardines are distributed throughout the harbors and are not associated with any one habitat or area of the harbor. The MEC (2002) study used a slightly longer and deeper net to sample pelagic fishes but also collected demersal (habitat-associated) fishes which could have influenced the fish habitat association analyses. The current study used a net that was slightly smaller in length and less deep, so that incidental demersal species such as basses and halibut were not collected.

Studies conducted between 1988 and 2000 recorded no harbor-wide spatial trends in the number of species (MEC 2002). Lampara studies, including the present one, showed similar ranges in the number of species across the harbor regions, such as inner harbor stations having between 4 and 12 species and outer harbor stations typified by between 3 and 11 species.

Although results of the current study follow general trends observed by historical studies, some of the differences between the current study and previous harbor studies may be due to difference in sampling gear. For example, although the lampara net utilized for this study was similar in dimensions and mesh size to the lampara net used by MEC in previous baseline surveys, it was somewhat smaller. MEC's net had a 273 m corkline and a net depth of 36 m, which caused the net to rest on the bottom and often to snag objects on the bottom. In addition, that net often collected incidental demersal fish and macroinvertebrate species. Since this collection technique is intended to catch midwater pelagic fishes, it was evident that the net previously used fished too deep and collected non-pelagic (incidental) species. The net used in the current study was 22.3 m deep and rarely reached the bottom. Therefore, midwater pelagic species were primarily targeted and collected. Notwithstanding the net differences, the present baseline lampara results were similar (excluding incidental demersal catch), to historical lampara studies conducted in the ports.

3.4 DEMERSAL AND EPIBENTHIC (TRAWL) FISHES

3.4.1 Community Summary Measures

3.4.1.1 Abundance

A total of 20,318 fish were collected using otter trawl during day and night surveys at all 19 stations combined (Table 3.4-1). Northern anchovy (*Engraulis mordax*), the most abundant species collected, represented nearly 30% of the total trawl catch. Other species with relatively high catch abundances included white croaker (*Genyonemus lineatus*), 27% of the catch; queenfish (*Seriphus politus*), 19% of the catch; shiner surfperch (*Cymatogaster aggregata*), 6.7% of the catch; and white surfperch (*Phanerodon furcatus*), 3.6% of the total catch (Table 3.4-1). Commercially/recreationally important fish species collected during otter trawl sampling included California halibut (*Paralichthys californicus*) and barred sand bass (*Paralabrax nebulifer*).

No significant differences were found between total fish abundances during night sampling (10,216) compared to day (10,102) (Table 3.4-1). Although more northern anchovy were collected in day samples than in night samples, this pattern was opposite for most of the other commonly collected demersal species such white croaker, queenfish, shiner surfperch, and white surfperch, with higher numbers of those species being collected in night samples.

Mean fish abundance by station is presented in Table 3.4-2. The highest mean abundance (day and night samples combined) occurred at outer harbor Stations LA7 (mean = 498) and Station LA1 (mean = 367). The lowest mean abundances occurred at inner harbor Stations LA5 (mean = 37) and Station LA6 (mean = 57). Mean abundance over all stations was 178 individuals, with most station means (day and night combined) ranging between 100 and 200 (Table 3.4-2). As in the case of total abundance, no statistical difference was found between day and night samples for mean abundance.

Seasonal differences in trawl catch were not observed, and catches were highly variable over the seasons. For example, day abundances decreased from winter to spring and then increased to their highest levels in summer (July) (Figure 3.4-2). In contrast, night catches increased from winter (January) to their highest levels in spring (April) and then decreased in summer. Seasonal differences in trawl catch were observed during previous baseline surveys, with summer having the highest abundances and winter typically having the lowest catches (MEC 2002).

Additional otter trawl data, including raw data tables of abundance, biomass, and length distributions are presented in Appendix C.

3.4.1.2 Biomass

A total of 837.3 kg of fish were collected during day and night surveys at all 19 stations combined (Table 3.4-1). White croaker had the highest total biomass collected (317.9 kg), representing 38% of the total trawl biomass. Other species with high total biomass included California bat ray (*Myliobatis californica*) (21%), queenfish (10.6%), and California halibut (8.4%) (Table 3.4-1).

In contrast to abundance, significant differences were found between day and night biomass, with about twice as much total biomass being collected at night (561 kg) compared to day (276 kg) (Table 3.4-1). This was primarily due to large and highly variable night catches of northern anchovy and queenfish, and a wide variety of other species that had higher night catches as compared to day, such as California tonguefish (*Symphurus atricauda*), California lizardfish (*Synodus lucioceps*), California scorpionfish (*Scorpaena guttata*), and shovelnose guitarfish (*Rhinobatos productus*) (Table 3.4-1).

Mean fish biomass by station is presented in Table 3.4-2. The highest mean biomass (day and night samples combined) was observed at outer harbor Station LA2 (mean = 17.8 kg) and inner harbor Station LB12 (mean = 17.5 kg). The lowest mean biomass was reported at inner harbor Station LA15 (mean = 2,072 g) and outer harbor Station LB6 (mean = 2.2 kg). Mean biomass at most other stations was highly variable (Table 3.4-2). Mean biomass at night was statistically higher ($p<0.002$) compared to day (all surveys combined) and significant differences between total mean biomass in day and night samples were found.

Seasonal differences in total biomass were also observed, with spring biomass being significantly higher ($p<0.01$) than either of the other two sampling quarters (Figure 3.4-2).

3.4.1.3 Number of Species

A total of 62 species was collected with the otter trawl during all surveys (night and day combined) (Table 3.4-1). The total number of species was virtually the same during the two time periods (night = 52, day = 51), while comparisons among stations showed more species collected on average at night (18) compared to day (13) (Table 3.4-2). The average number of species collected per station varied from a low of 7 species during day surveys at inner harbor Station LB14 to a high of 28 species at shallow-water Station LB2 during night surveys (Table 3.4-2).

Seasonal differences in the number of species are presented in Figure 3.4-2. Slightly more species were collected at night during spring (April) and summer (July) surveys than winter (January). The lowest number of species (31) was observed in night samples during winter.

3.4.1.4 Diversity and Dominance

Shannon-Wiener values were fairly consistent among stations and between day and night surveys (Table 3.4-3). Values were generally higher during night surveys at most stations compared to day and ranged from a low of 0.10 at Station LB14 (day) to a high of 2.24 during day sampling at Station LA3. Margalef values followed similar trends, with night values being consistently higher than day. Margalef values ranged from a low of 0.82 at Station LB14 (day) to a high of 4.05 at Station LA3 (day survey). No depth-related or spatial patterns were observed for any of the diversity indices.

Dominance values during all surveys ranged between 1 and 5, with most stations averaging a 3 (Table 3.4-3). High dominance values (3, 4, or 5) were found at stations and depths throughout the harbors, and no spatial patterns were evident.

3.4.2 Dominant and Selected Species

Of the 62 species collected over all surveys and stations in 2008, nine comprised nearly 93% of the total catch. The dominant species in terms of abundance were northern anchovy, white croaker, queenfish, shiner surfperch, and white surfperch (Table 3.4-1). In addition, commercially/recreationally important fish species collected during otter trawl sampling included California halibut (*Paralichthys californicus*) and barred sand bass (*Paralabrax nebulifer*). Detailed information about some of the dominant species is presented below.

Northern anchovy was the most abundant species collected and represented nearly 30% of the total otter trawl catch, but only less than 2% of the total biomass (Table 3.4-1). This species was collected at every sampling station and during every survey quarter, with the highest numbers observed during day sampling. Sizes ranged between 3 and 18 cm, with most individuals between 4 and 8 cm (Figure 3.4-3). No spatial trends in sizes were evident and no significant differences were found for average northern anchovy size among stations.

White croaker had the second highest abundance and represented 27% of the total trawl catch and 38% of the biomass (Table 3.4-1). This species was collected during every sampling quarter and at every station, with the highest numbers noted from night sampling. White croaker had a bimodal size distribution, with the majority of fish between 2 and 12 cm and 16 to 22 cm (Figure 3.4-3). The small size classes (2-12 cm) likely represents young-of-year and new recruits while the larger size distribution (16-22 cm) represents adult fish. No significant spatial or temporal differences were found for average white croaker sizes.

Queenfish had the third highest abundance, representing 6.7% of the total trawl catch and 10.6% of the total biomass (Table 3.4-1). Similar to white croaker, this species was collected during every sampling quarter and at every station, with the highest numbers observed during night sampling. Queenfish also had a bimodal size distribution, with the majority of fish between 5 and 9 cm and 14 to 17 cm, representing distributions of juveniles (small sizes) and adults (larger sizes) (Figure 3.4-3). No significant spatial or temporal differences were found for average queenfish sizes.

Shiner surfperch accounted for 6.7% of the abundance and 1.4% of the trawl biomass (Table 3.4-1). This species was collected during every quarter, but was not caught at all stations. Shiner surfperch were generally collected more extensively at POLA stations compared to POLB. For example, this species was collected at 6 of 10 POLA stations and only 3 of 9 POLB stations during winter surveys. In April, shiner surfperch were collected at 7 of 10 POLA and 2 of 9 POLB stations. In summer, this species was captured at 8 of 10 POLA and 2 of 9 POLB stations. Shiner surfperch sizes ranged from 3 to 15 cm, with the greatest number of individuals in the 5 cm size class and likely represent new recruitment of young fish (Figure 3.4-3).

Commercially and/or recreationally important species, including California halibut and barred sand bass, had relatively low total abundance and biomass. California halibut ranked tenth in total abundance (192 individuals) and fourth in total biomass (nearly 70 kg) over all stations and surveys (Tables 3.4-1). Halibuts ranged in size from 4 to 74 cm, and had a bimodal distribution. The most abundant small individuals of this species ranged from 7 to 15 cm and the most abundant larger fish were from 24 to 34 cm. Since this species matures at relatively larger sizes (males at 23 to 33 cm and females at 48 to 58 cm; Emmett et al. 1991), most of the fish caught in the current study were likely juveniles and/or young adults.

Barred sand bass ranked twelfth in total abundance and fifteenth in biomass (Table 3.4-1), with only 130 individuals captured over all stations and surveys. The size class distribution for this species was bimodal, as shown in Figure 3.4-3. The most abundant small individuals ranged from 3 to 6 cm, while the larger individuals were from 15 to 19 cm. Although spatial patterns were generally not evident, barred sand bass were commonly collected at shallow-water stations such as Stations LA2, LA3, and LB2.

The size distributions of other species commonly collected by otter trawl are shown on Figure 3.4-3, including California tonguefish and speckled sanddab (*Citharichys stigmaeus*). California tonguefish ranged in size between 4 and 20 cm, with adults ranging upwards from 8 cm and the majority of the adults in the 8 to 11 cm range. Speckled sanddab were most abundant at 8 to 9 cm and mostly were comprised of adult fish.

3.4.3 Summary of Spatial and Temporal Variations

There were no statistically significant differences in trawl catch between day and night. Almost the same abundance was caught using trawls during the day (49.7% of total catch) compared to night (50.3% of total catch). Similarly, no significant seasonal differences in trawl catch were found, even though more fish were collected in the summer than all other seasons. In addition, no apparent spatial patterns were found in fish abundances.

Spatial and temporal patterns in biomass were generally similar to the patterns in abundance. However, substantially higher total biomass was observed in spring (April) compared to all other surveys. Seasonal differences in the number of species were not apparent, with only slightly more species collected at night during spring (April) and summer (July) surveys than in winter (January). In addition, significantly higher biomass was collected in night trawls compared to day. This is mainly due to somewhat larger fish being collected at night (i.e., croaker) than day trawls.

3.4.4 Historical Comparisons

Otter trawl sampling in the ports has been conducted on a fairly regular basis since the 1970s (MEC 2002), with similar species groups dominating the fish communities in the harbors over several decades. The most dominant (abundant) species from these otter trawl studies have generally been white croaker, northern anchovy, and queenfish. While total abundance of white croaker in historical studies has been variable, abundances in recent baseline studies have remained relatively high (MEC 2002 and the current study) compared to study results from the early 1980s and 1990s. Northern anchovy and queenfish abundances have been variable in previous studies in the 1990s (e.g., MEC 1996; SAIC and MEC 1996), but have remained dominant components of trawl catch in the harbors. Overall, otter trawl studies since the 1970s have produced similar results, with generally the same dominant species being reported. Therefore, it appears that based on otter trawl survey results, these demersal species have remained relatively stable over time.

Other species with relatively high abundance have included three species of flatfish (California tonguefish, speckled sanddabs, and California halibut) and two surfperches (shiner surfperch and white surfperch). The relative abundances of flatfish species have been highly variable and may be more related to sampling location differences in the various studies. For example, California tonguefish and speckled sanddab abundances were higher from studies with deepwater outer harbor sampling locations (MBC 1984, MEC 1988, CLA-EMD 1993-1999) than studies with more inner harbor and/or shallow-water stations (SAIC and MEC 1996, MEC 1999, MEC 2002, and the current study).

Results of most previous studies have shown seasonal patterns in trawl fish abundance, with higher numbers reported in summer compared to all other seasons. However, similar seasonal trends in biomass have been less apparent (except for night data) or number of species. For example, larger fish catches were reported from summer compared to winter by numerous studies, including Allen et al. (1983), SAIC and MEC (1996), CLA-EMD (1998), and MEC (2002).

No temporal trends in the number of species were evident among studies conducted since 1986 (MEC 2002), including the current study, even when considering differences in sampling methodologies. However, a few examples of higher numbers of species collected have been reported. For example, higher mean numbers of species were collected in shallow waters near the San Pedro Breakwater in 2000, even though deeper water that was sampled in the vicinity of the same area yielded fewer species during previous surveys (MEC 2002).

3.5 SHALLOW SUBTIDAL (BEACH SEINE) FISHES

3.5.1 Community Summary Measures

3.5.1.1 Abundance

A total of 1,938 fishes representing seven distinct species and one species group (gobies) were collected by beach seine at two sampling locations (Cabrillo Beach and Pier 300) over all surveys (Table 3.5-1). Topsmelt was by far the most abundant species collected, followed by gobies (unspecified) and diamond turbot. These three taxa comprised 99% of the total catch. Abundances at the two beach seine locations were variable over all sampling quarters.

Mean total abundance by station is presented in Table 3.5-2. Pier 300 had the highest annual mean abundance (579), while an annual average of 67 fish per haul was collected at Cabrillo Beach (Table 3.5-2). Mean abundances were highest in April for Pier 300 (949), while Cabrillo Beach had the lowest total mean catch (8) during the same quarter. Summer (July) mean abundances followed the same trend, with higher numbers collected at Pier 300 (774) compared to Cabrillo Beach (24).

3.5.1.2 Biomass

As with abundance, biomass values were variable over all three sampling events. Mean biomass was lowest during April at Cabrillo Beach (0.001 kg) and highest in January (0.70 kg) at the same station (Table 3.5-2). The highest biomass occurred in April at Pier 300. No significant difference was found in mean total biomass between stations over all sampling quarters combined, due to the very high variability between sampling events.

3.5.1.3 Number of Species

A total of seven species and unidentified individuals from one family (Gobiidae; gobies) were collected at all beach seine locations. While three species were collected at Cabrillo Beach, three species and the gobies group were collected at Pier 300 (Table 3.5-1). The greatest number of species (4) was collected at Cabrillo Beach during January sampling and at Pier 300 during July sampling, while only one species was collected at Cabrillo Beach during April (Table 3.5-2). No significant differences were found for the mean number of species between stations.

3.5.1.4 Diversity and Dominance

Community measures for the beach seines are presented in Table 3.5-2. The annual mean Shannon-Weiner diversity index was higher at Pier 300 (0.45) than at Cabrillo Beach (0.11). Shannon-Weiner diversity values at both stations were variable across the sampling periods. For Margalef values, the lowest annual mean occurred at Cabrillo Beach and the highest value at Pier 300. A dominance value of 1 was calculated at Cabrillo Beach during all sampling periods. Dominance values at Pier 300 were 1 in April and 2 in the other seasons.

3.5.2 Dominant and Selected Species

Of the 7 species collected at both beach seine stations during all sampling quarters, one species (topsmelt) and one species group (gobies) comprised 99% of the total catch, with topsmelt as the most abundant species collected at both stations (Table 3.5-1). Topsmelt sizes ranged between 2 and 13 cm at Cabrillo between 1 and 7 cm at Pier 300 (Figure 3.5-1), indicating that most topsmelt collected during beach seine surveys were juveniles. The taxonomic group “gobies” was likely comprised of two species, arrow goby and shadow goby, and ranged in size between 2 and 4 cm. Diamond turbot were only collected at Pier 300 and were in the 1 to 6 cm size classes.

No commercially and/or recreationally important species were collected at either beach seine location.

3.5.3 Summary of Spatial and Temporal Variations

Spatial and temporal trends were less distinct for the beach seine locations compared to the lampara and trawl stations, due mainly to the low species numbers, abundances, and biomass. Seasonal patterns in abundance were variable, with average total abundances being highest in

April at Pier 300 and highest in January at Cabrillo. Abundances were lowest in spring (April) at Cabrillo and lowest in winter (January) at Pier 300 (Table 3.5-2). The same temporal patterns were observed for biomass. In addition, no distinct pattern in the number of species was evident, although the number of species increased slightly at Pier 300 from a low in winter of 2 to a high in summer of 4. The number of species collected at Cabrillo was highest in January (4). The main difference between the two locations was larger catches of topsmelt at Pier 300. Because eelgrass occurs at both beach seine locations, the variability in topsmelt catch most likely reflects natural variability rather than a habitat-associated difference between locations.

3.5.4 Historical Comparisons

Characterization of shallow-water fishes in the harbors using beach seines has occurred infrequently since the 1980s (MEC 2002). Generally, fish abundances (pelagic and demersal species) have been spatially and temporally variable, sometimes due primarily to differences in sampling methodologies. However, general patterns in fish species composition collected in otter trawl and lampara (or gill net) surveys have been relatively stable, with the same dominant species being collected throughout the harbors. Beach seine collections have tended to be variable in abundance, biomass, and species composition. However, few studies have consistently sampled the same locations over time. For example, 9 species were caught at the Seaplane Anchorage during beach seine sampling, queenfish and California grunion being the most abundant (Horn and Hagner 1982). In 1999, MEC sampled a beach near the Seaplane Anchorage and collected gobies, topsmelt, California halibut, diamond turbot, and pipefish (MEC 2002). Allen et al. (1983) reported a total of 37 fish species collected over a 12-month period at Cabrillo Beach, with northern anchovy comprising 73% of the catch. MBC (1999) sampled fish at two stations at the Southwest Slip in inner Los Angeles harbor and collected topsmelt, slough anchovy, deepbody anchovy, and the yellowfin goby. The previous baseline survey (MEC 2002) collected a total of 20 fish species at the same two beach seine locations as sampled during the current study. The current study collected similar species to most of the previous studies, with a total of 7 species collected at both beach seine stations during all sampling quarters. Although this number is relatively low compared to other historical studies, sampling gear and station differences likely account for the differences in the number of species.

3.6 NONINDIGENOUS SPECIES

The only non-indigenous or exotic species collected in the 2008 sampling surveys was the yellowfin goby (*Acanthogobius flavimanus*). This species is native to Japan, Korea, and northern China (Miller and Lea 1972, Eschmeyer et al. 1983) and was accidentally introduced into the Sacramento-San Joaquin estuary in the 1950s, through ship ballast systems (Brittan et al. 1963). A second population has been reported in Los Angeles, Long Beach Harbor, and Newport Bay (Haaker 1979), and was likely established in the same manner as described above.

A total of 53 yellowfin goby were collected in otter trawls at a total of 10 locations (5 in POLA and 5 in POLB) during the current study. This species is also commonly collected in many of the southern California bays and lagoons (MEC 1993, MEC 1999, Merkel and Associates 2001). The previous baseline survey (MEC 2002) collected 19 individuals in beach seine sampling at the Pier 300 site.

Table 3.2-1. Survey Schedule and Conditions for Lampara Sampling in Los Angeles and Long Beach Harbors, January – July 2008.

Date	*Season*	*Sampling Time*	*Weather Conditions*	*Notable Observations*
19-Jan-08	Winter	0630-1600	Clear	Large offshore swell last 2-3 days. California sea lion at LB5. Four sea lions at LA6.
20-Jan-08	Winter	0630-1600	Clear	
22-Jan-08	Winter	1630-0130	Cloudy, drizzling	Rain in region last 24 hours. Large offshore swell offshore last 4-5 days. Net gets tangled in boat rudder during LB3 deployment. Net retrieved and repaired.
24-Jan-08	Winter	1700-2130	Windy, 20-25 mph	23-Jan-08 sampling postponed due to heavy rains and strong winds (30-35 mph). After successfully completing 3 stations, boat tied up to visitor dock near LA14 to wait for better wind conditions. At 2100 hrs, decision made to postpone survey and wait for better weather.
4-Feb-08	Winter	1700-2230	Windy, 15-20 mph	Moderate-heavy rains in region over the last 7-10 days. Strong offshore swell still present.
11-Apr-08	Spring	0700-1430	Sunny, warm	Light red tide and 4 sea lions on buoy near LB6.
12-Apr-08	Spring	0700-1230	Sunny, calm	
14-Apr-08	Spring	1900-0130	Clear	
15-Apr-08	Spring	1930-0015	Clear	LA2 sampling effort repeated due to net twist during first deployment.
16-Apr-08	Spring	1945-2200	Clear	
18-Jul-08	Summer	0700-1600	Overcast	
19-Jul-08	Summer	0700-1600	Overcast, cool	
21-Jul-08	Summer	2015-0200	Clear, calm	South swell running offshore over the last 72 hours.
22-Jul-08	Summer	1945-0015	Clear, calm	South swell still present. Red tide visible within Port waters. Bottlenose dolphin spotted at LA4.
23-Jul-08	Summer	2015-0045	Clear, light winds	South swell still present. LA2 sampling effort repeated due to net twist during first deployment. Sea lion at LA2.

Table 3.2-2. Survey Schedule and Conditions for Otter Trawl Sampling in Los Angeles and Long Beach and Harbors, January – July 2008.

Date	*Season*	*Sampling Time*	*Weather Conditions*	*Notable Observations*
11-Jan-08	Winter	0630-1600	Fair	Several (10-12) California sea lions on and around buoy near LB2. Harbor seal at LA1.
12-Jan-08	Winter	0630-1600	Fair	Many (20-25) seal lions and harbor seals within Fish Harbor.
14-Jan-08	Winter	1630-0300	Fair, light winds	Net snagged in clay-like mud at LB6. Retrieved and redeployed.
15-Jan-08	Winter	1630-0100	Clear	
16-Jan-08	Winter	1630-2015	Clear, light winds	Sea lions and harbor seals on buoy near LA1.
3-Apr-08	Spring	0700-1600	Clear, slight overcast	Three sea lions at LB6 basin. First haul at LB6 rejected due to snagged metal fencing. First haul at LB14 rejected due to snagged wooden debris.
4-Apr-08	Spring	0700-1500	Clear, marine layer	Sea lion at LA10. Pulled up large tire at LA10. Pulled up 50-gallon plastic garbage can at LA6. Hauled in large clay mud ball at LA6. Retrieved and redeployed.
6-Apr-08	Spring	1830-0230	Clear	
7-Apr-08	Spring	1900-0230	Clear	Sea lion at LA1. Large clay mud ball collected in net at LA6 dragged through water to disperse sediment before retrieval.
8-Apr-08	Spring	1930-2350	Clear, cold	Sea lions at LA3.
11-Jul-08	Summer	0700-1530	Clear, calm	Sea lion at LA1.
12-Jul-08	Summer	0700-1530	Clear, calm	Two seal lions in front of Coast Guard buildings. Net snagged on soft bottom at LA15. Net recovered, repaired, and successfully redeployed.
14-Jul-08	Summer	2030-0230	Clear, calm	
15-Jul-08	Summer	2015-0200	Clear, calm	
16-Jul-08	Summer	2015-0030	Clear, calm	

Table 3.2-3. Survey Schedule and Conditions for Beach Seine Sampling in Los Angeles and Long Beach Harbors, January – July 2008.

Date	*Season*	*Sampling Time*	*Weather Conditions*	*Notable Observations*
31-Jan-08	Winter	0950-1230	Sunny, light winds	
5-Apr-08	Spring	0900-1200	Sunny	
13-Jul-08	Summer	0830-1200	Clear, calm	Large numbers of topsmelt and shadow goby collected at LA02.

Table 3.3-1. Total Abundance and Biomass of Fish Species Caught by Lampara in Los Angeles and Long Beach Harbors, January – July 2008.

		Total Abundance				*Total Biomass (g)*			
Common Name	*Scientific Name*	*Day*	*Night*	*Total*	*% of Total*	*Day*	*Night*	*Total*	*% of Total*
Northern anchovy	*Engraulis mordax*	2,762	67,896	70,658	87	32,740	340,459	373,199	56.9
Topsmelt	*Atherinops affinis*	4,083	2,123	6,205	8	42,666	19,341	62,007	9.4
California grunion	*Leuresthes tenuis*	1,157	374	1,531	2	3,832	3,869	7,701	1.2
Pacific sardine	*Sardinops sagax*	18	1,491	1,509	2	93	24,431	24,524	3.7
Shiner surfperch	*Cymatogaster aggregata*		759	759	1		3,307	3,307	0.5
Queenfish	*Seriphus politus*	3	156	159	0	190	5,524	5,714	0.9
Jack mackerel	*Trachurus symmetricus*	7	99	106	0	683	6,483	7,166	1.1
White surfperch	*Phanerodon furcatus*	2	56	58	0	153	765	918	0.1
Bat ray	*Myliobatis californica*	5	23	28	0	4,350	141,545	145,895	22.2
White croaker	*Genyonemus lineatus*		25	25	0		3,787	3,787	0.6
Pacific barracuda	*Sphyraena argentea*		19	19	0		6,942	6,942	1.1
Jacksmelt	*Atherinopsis californiensis*		7	7	0		922	922	0.1
Deepbody anchovy	*Anchoa compressa*		4	4	0		20	20	0.0
Giant kelpfish	*Heterostichus rostratus*	3	1	4	0	7	3	10	0.0
Spotfin croaker	*Roncador stearnsii*	1	2	3	0	645	1,310	1,955	0.3
White seabass	*Atractoscion nobilis*	1	2	3	0	500	1,135	1,635	0.2
Pacific mackerel	*Scomber japonicus*		2	2	0		435	435	0.1
Brown smoothhound shark	*Mustelus henlei*		1	1	0		10,100	10,100	1.5
Kelp pipefish	*Syngnathus californiensis*	1		1	0	15		15	0.0
Ocean whitefish	*Caulolatilus princeps*		1	1	0		1	1	0.0
	Total Abundance/Biomass	*8,043*	*73,041*	*81,084*	*100*	*85,873*	*570,378*	*656,251*	*100*
	Total Number of Species	*12*	*19*	*20*					

Table 3.3-2. Mean Abundance, Biomass, and Number of Species of Fish Caught by Lampara in Los Angeles and Long Beach Harbors, January – July 2008.

		Mean Abundance			*Mean Biomass (g)*			*Total Number of Species*		
Habitat/Station	*Depth (m)*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*
LA1 –Outer Harbor	22	10	26	18	182	390	286	2	2	3
LA2 –Outer Harbor	5	336	81	189	4,014	562	2,023	7	9	9
LA3 –Outer Harbor	6	137	106	118	839	838	839	6	8	11
LA4 –Outer Harbor	17	128	175	167	4,433	1,289	1,813	1	3	3
LA5 –Inner Harbor	17	95	261	226	711	1,615	1,422	2	8	8
LA6 –Inner Harbor	17	249	37	108	822	208	413	4	4	4
LA7 –Outer Harbor	5	3	44	34	237	919	748	7	15	15
LA10 –Inner Harbor	25	8	414	292	118	8,166	5,761	2	4	5
LA14 –Inner Harbor	13	87	60	64	4,136	457	1,070	1	6	6
LA15 –Inner Harbor	16	8	99	72	38	557	404	4	7	7
LB1 –Outer Harbor	13	222	22	99	1,184	277	625	3	5	7
LB2 –Outer Harbor	8	86	64	70	1,373	608	812	3	7	8
LB3 –Outer Harbor	14	9	1,447	1,207	287	11,022	9,233	1	7	7
LB4 –Inner Harbor	14	20	60	47	523	359	413	1	3	3
LB5 –Outer Harbor	16	4	48	43	28	329	296	1	4	4
LB6 –Outer Harbor	15	3	325	305	84	1,227	1,156	1	9	9
LB7 –Outer Harbor	24	27	2,623	2,298	463	10,483	9,231	1	6	6
LB12 –Inner Harbor	12	53	198	180	110	10,133	8,881	2	9	9
LB14 –Inner Harbor	17	5	25	18	54	169	130	2	5	6
	Station Mean	*113*	*358*	*295*	*1,209*	*2,796*	*2,386*	*3*	*6*	*7*

Table 3.3-3. Mean Diversity (*) and Dominance of Fish Caught by Lampara in Los Angeles and Long Beach Harbors, January – July 2008.

	*Shannon-Weiner **			*Margalef **			*Dominance*		
Habitat/Station	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*
Deepwater Open									
LA1 –Outer Harbor	0.15	0.12	0.14	0.29	0.23	0.43	1	1	1
LA2 –Outer Harbor	0.76	1.15	0.98	0.73	1.13	0.94	2	2	2
LA3 –Outer Harbor	0.74	1.39	1.38	0.73	0.98	1.30	2	2	2
LA4 –Outer Harbor	0.00	0.23	0.52	0.00	0.30	0.29	1	1	1
LA5 –Inner Harbor	0.09	0.40	0.64	0.18	0.88	0.87	1	1	1
LA6 –Inner Harbor	0.28	0.78	0.66	0.43	0.53	0.42	1	2	2
LA7 –Outer Harbor	1.63	0.56	0.65	1.82	1.98	1.97	3	1	2
LA10 –Inner Harbor	0.46	0.40	0.43	0.32	0.50	0.50	1	1	1
LA14 –Inner Harbor	0.00	0.40	0.73	0.00	0.78	0.75	1	1	1
LA15 –Inner Harbor	0.62	0.37	0.44	0.82	0.85	0.84	1	1	1
LB1 –Outer Harbor	0.51	0.97	0.81	0.29	0.77	0.84	1	2	2
LB2 –Outer Harbor	0.70	1.09	1.11	0.34	0.92	1.01	2	2	2
LB3 –Outer Harbor	0.00	0.22	0.23	0.00	0.63	0.63	1	1	1
LB4 –Inner Harbor	0.00	0.59	0.55	0.00	0.36	0.36	1	1	1
LB5 –Outer Harbor	0.00	0.55	0.55	0.00	0.50	0.50	1	1	1
LB6 –Outer Harbor	0.00	0.50	0.50	0.00	0.94	0.94	1	1	1
LB7 –Outer Harbor	0.00	0.05	0.06	0.00	0.48	0.48	1	1	1
LB12 –Inner Harbor	0.22	0.19	0.34	0.21	1.01	1.00	2	1	2
LB14 –Inner Harbor	0.68	0.34	0.62	0.34	0.75	0.93	2	1	2

Table 3.3-4. Mean and Total Abundance of Fish Species Caught by Lampara (Day and Night) in Los Angeles and Long Beach Harbors, January – July 2008.

	Mean Abundance																			*Total Catch*
	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Engraulis mordax	0	139	5	2,286	10	11	689	6,071	487	158	177	98	428	32	435	90	182	448	31	70,658
Atherinops affinis	18	25	57	6	37	53	110	15	253	111	8	47	54	170	9	34	18	8	2	6,205
Leuresthes tenuis	0	0	148	1	0	0	6	1	14	18	3	21	1	14	9	0	2	17	2	1,531
Sardinops sagax	0	3	0	116	0	0	5	41	4	0	0	0	42	0	33	0	2	4	1	1,509
Cymatogaster aggregata	0	0	0	0	0	0	0	0	56	68	1	0	1	0	0	0	0	0	0	759
Seriphus politus	0	0	1	1	0	0	1	0	1	5	9	7	0	0	0	1	1	0	0	159
Trachurus symmetricus	0	0	3	5	0	1	1	1	0	1	2	0	0	0	0	2	0	1	1	106
Phanerodon furcatus	0	0	0	0	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	58
Myliobatis californica	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	28
Genyonemus lineatus	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	25
Sphyraena argentea	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	19
Atherinopsis californiensis	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7
Anchoa compressa	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4
Heterostichus rostratus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4
Roncador stearnsii	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Atractoscion nobilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Scomber japonicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Mustelus henlei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Syngnathus californiensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Caulolatilus princeps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Catch Across Surveys	*109*	*1,004*	*1,288*	*14,487*	*279*	*390*	*4,877*	*36,774*	*4,908*	*2,233*	*1,223*	*1,043*	*3,160*	*1,293*	*2,913*	*769*	*1,230*	*2,883*	*221*	*81,084*

Table 3.3-5. Mean and Total Biomass of Fish Species Caught by Lampara (Day and Night) in Los Angeles and Long Beach Harbors, January – July 2008.

	Mean Biomass (g)																			*Total Biomass (g)*
	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Engraulis mordax	1	967	28	14,648	18	35	2,075	23,589	5,387	901	350	288	2,339	178	8,912	359	881	1,114	129	373,199
Myliobatis californica	0	0	0	1,333	0	0	0	0	492	0	0	374	0	0	0	0	0	22,117	0	145,895
Atherinops affinis	276	788	714	123	392	345	753	209	2,396	464	100	764	477	617	76	1,485	178	133	45	62,007
Sardinops sagax	0	57	2	2,156	0	8	37	746	11	7	0	0	425	3	570	0	24	37	3	24,524
Mustelus henlei	0	0	0	0	0	0	0	0	0	0	1,683	0	0	0	0	0	0	0	0	10,100
Leuresthes tenuis	9	0	438	11	3	0	11	8	165	111	2	406	3	28	34	2	12	37	3	7,701
Trachurus symmetricus	0	0	124	180	0	55	89	62	20	65	216	28	27	0	0	215	18	25	70	7,166
Sphyraena argentea	0	0	0	0	0	0	30	0	0	0	942	0	0	0	0	58	0	127	0	6,942
Seriphus politus	0	0	30	14	0	0	85	2	50	177	490	38	5	0	0	21	31	0	11	5,714
Genyonemus lineatus	0	0	0	0	0	0	0	0	0	502	116	13	0	0	0	0	0	0	0	3,787
Cymatogaster aggregata	0	0	0	0	0	0	1	0	209	332	3	0	6	0	0	0	2	0	0	3,307
Roncador stearnsii	0	0	0	0	0	0	0	0	0	0	326	0	0	0	0	0	0	0	0	1,955
Atractoscion nobilis	0	0	0	0	0	0	0	0	0	0	217	0	0	0	0	0	0	56	0	1,635
Atherinopsis californiensis	0	0	18	0	0	0	0	0	0	0	19	118	0	0	0	0	0	0	0	922
Phanerodon furcatus	0	0	0	0	0	0	1	0	35	95	22	0	0	0	0	0	0	0	0	918
Scomber japonicus	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	38	0	435
Anchoa compressa	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	20
Syngnathus californiensis	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	15
Heterostichus rostratus	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	10
Caulolatilus princeps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Biomass Across Surveys	*1,714*	*15,933*	*52,585*	*6,875*	*110,793*	*8,131*	*2,480*	*10,877*	*18,493*	*147,694*	*142,088*	*1,565*	*4,950*	*26,938*	*57,552*	*12,175*	*12,841*	*2,661*	*19,905*	*656,251*

Table 3.4-1. Total Abundance and Biomass of Fish Species Caught by Otter Trawl in Los Angeles and Long Beach Harbors, January – July 2008.

		Total Abundance				*Total Biomass (g)*			
Common Name	*Scientific Name*	*Day*	*Night*	*Total*	*% of Total*	*Day*	*Night*	*Total*	*% of Total*
Northern anchovy	*Engraulis mordax*	5,825	212	6,037	30	14,641	1,552	16,192	2
White croaker	*Genyonemus lineatus*	1,168	4,359	5,527	27	55,525	262,329	317,854	38
Queenfish	*Seriphus politus*	1,158	2,764	3,922	19	13,641	74,877	88,518	11
Shiner surfperch	*Cymatogaster aggregata*	801	553	1,354	7	8,460	3,621	12,081	1
White surfperch	*Phanerodon furcatus*	512	217	729	4	23,165	3,775	26,940	3
Specklefin midshipman	*Porichthys myriaster*	33	484	517	3	863	3,310	4,173	0
California tonguefish	*Symphurus atricaudus*	46	245	291	1	409	2,840	3,249	0
Yellowchin sculpin	*Icelinus quadriseriatus*	41	221	262	1	448	924	1,372	0
Bay goby	*Lepidogobius lepidus*	9	244	253	1	18	155	174	0
California halibut	*Paralichthys californicus*	78	114	192	1	31,486	38,507	69,993	8
Pacific sanddab	*Citharichthys sordidus*	48	123	171	1	328	945	1,273	0
Barred sand bass	*Paralabrax nebulifer*	33	97	130	1	2,755	3,639	6,394	1
Speckled sanddab	*Citharichthys stigmaeus*	63	58	121	1	532	513	1,045	0
California lizardfish	*Synodus lucioceps*	35	81	116	1	4,213	13,051	17,264	2
Longspine combfish	*Zaniolepis latipinnis*	43	56	99	0	1,277	1,608	2,885	0
Hornyhead turbot	*Pleuronichthys verticalis*	29	64	93	0	3,345	5,363	8,708	1
Yellowfin goby	*Acanthogobius flavimanus*	6	47	53	0	35	128	163	0
Eelpouts	*Zoarcidae unid.*		48	48	0		456	456	0
Fantail sole	*Xystreurys liolepis*	19	27	46	0	3,304	6,840	10,144	1
Bat ray	*Myliobatis californica*	9	28	37	0	81,945	94,755	176,700	21
Spotted turbot	*Pleuronichthys ritteri*	16	18	34	0	1,866	1,620	3,486	0
Round stingray	*Urobatis halleri*	11	15	26	0	5,580	7,655	13,235	2
Walleye surfperch	*Hyperprosopon argenteum*	22	4	26	0	1,143	55	1,198	0
English sole	*Parophrys vetulus*	10	14	24	0	686	679	1,365	0

Table 3.4-1. Total Abundance and Biomass of Fish Species Caught by Otter Trawl in Los Angeles and Long Beach Harbors, January – July 2008 (continued).

		Total Abundance				*Total Biomass (g)*			
Common Name	*Scientific Name*	*Day*	*Night*	*Total*	*% of Total*	*Day*	*Night*	*Total*	*% of Total*
California skate	*Raja inornata*	9	14	23	0	3,696	7,863	11,559	1
Vermilion rockfish	*Sebastes miniatus*	5	15	20	0	263	61	324	0
Rockfishes (juvenile)	*Sebastes spp. (juv.)*	15		15	0	69		69	0
Salema	*Xenistius californiensis*	1	14	15	0	3	630	633	0
California scorpionfish	*Scorpaena guttata*	1	10	11	0	330	2,011	2,341	0
Diamond turbot	*Pleuronichthys guttulatus*	6	5	11	0	1,268	1,720	2,988	0
Bay pipefish	*Syngnathus leptorhynchus*	5	4	9	0	26	8	33	0
Kelp bass	*Paralabrax clathratus*	2	7	9	0	3	12	15	0
Shovelnose guitarfish	*Rhinobatos productus*		9	9	0		9,290	9,290	1
Giant kelpfish	*Heterostichus rostratus*	5	2	7	0	25	14	39	0
Pacific staghorn sculpin	*Leptocottus armatus*	1	6	7	0	39	156	195	0
Blackbelly eelpout	*Lycodes pacificus*		6	6	0		257	257	0
Plainfin midshipman	*Porichthys notatus*	3	3	6	0	72	36	108	0
Basketweave cusk-eel	*Ophidion scrippsae*		5	5	0		148	148	0
Black surfperch	*Embiotoca jacksoni*	3	2	5	0	195	36	231	0
Shadow goby	*Quietula y-cauda*	5		5	0	1		1	0
Pacific sardine	*Sardinops sagax*	2	2	4	0	38	62	100	0
Pipefishes	*Syngnathus spp.*	4		4	0	10		10	0
Spotted cusk-eel	*Chilara taylori*		4	4	0		142	142	0
Thornback	*Platyrhinoidis triseriata*	1	3	4	0	245	467	712	0
Bigmouth sole	*Hippoglossina stomata*	2	1	3	0	133	5	138	0
Brown smoothhound shark	*Mustelus henlei*	3		3	0	10		10	0
Roughback sculpin	*Chitonotus pugetensis*	3		3	0	3,190		3,190	0
Barred surfperch	*Amphistichus argenteus*	2	1	3	0	20	9	29	0

Table 3.4-1. Total Abundance and Biomass of Fish Species Caught by Otter Trawl in Los Angeles and Long Beach Harbors, January – July 2008 (continued).

		Total Abundance				*Total Biomass (g)*			
Common Name	*Scientific Name*	*Day*	*Night*	*Total*	*% of Total*	*Day*	*Night*	*Total*	*% of Total*
C-O turbot	*Pleuronichthys coenosus*		2	2	0		9	9	0
Deepbody anchovy	*Anchoa compressa*	2		2	0	20		20	0
Pacific electric ray	*Torpedo californica*	1	1	2	0	5,500	8,000	13,500	2
Rockfishes	*Sebastes spp.*	1	1	2	0	1	1	2	0
Topsmelt	*Atherinops affinis*		2	2	0		39	39	0
Brown rockfish	*Sebastes auriculatus*	1		1	0	420		420	0
California corbina	*Menticirrhus undulatus*		1	1	0		220	220	0
Gobies	*Gobioidei unid.*	1		1	0	0		0	0
Pacific butterfish	*Peprilus simillimus*		1	1	0		37	37	0
Pacific mackerel	*Scomber japonicus*		1	1	0		220	220	0
Pile surfperch	*Rhacochilus vacca*	1		1	0	12		12	0
Slough anchovy	*Anchoa delicatissima*	1		1	0	0		0	0
Spiny dogfish shark	*Squalus acanthias*	1		1	0	5,000		5,000	1
Spotfin croaker	*Roncador stearnsii*		1	1	0		410	410	0
	Total Abundance and Biomass	*10,102*	*10,216*	*20,318*	*100*	*276,253*	*561,061*	*837,314*	*100*
	Total Number of Species	*51*	*52*	*62*					

Table 3.4-2. Mean Abundance, Biomass, and Number of Species of Fish Caught by Otter Trawl in Los Angeles and Long Beach Harbors, January - July 2008.

		Mean Abundance			*Mean Biomass (kg)*			*Total Number of Species*		
Habitat/Station	*Depth (m)*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*
LA1 –Outer Harbor	22	424	310	367	13.0	15,725.9	14.3	11	14	19
LA2 –Outer Harbor	5	168	213	191	10,147.6	25,531.2	17,839.4	14	20	24
LA3 –Outer Harbor	6	124	259	192	7,013.5	13,298.4	10,155.9	21	20	25
LA4 –Outer Harbor	17	30	155	93	1,602.3	5,214.2	3,408.2	12	20	22
LA5 –Inner Harbor	17	15	59	37	1,132.4	4,277.1	2,704.8	13	17	20
LA6 –Inner Harbor	17	32	81	57	398.3	4,797.4	2,597.8	13	18	20
LA7 –Outer Harbor	5	834	161	498	5,464.9	18,550.2	12,007.6	12	19	20
LA10 –Inner Harbor	25	340	255	298	6,069.8	18,394.9	12,232.3	18	15	20
LA14 –Inner Harbor	13	107	94	101	2,075.6	4,209.6	3,142.6	14	16	18
LA15 –Inner Harbor	16	12	132	72	888.9	3,254.2	2,071.6	12	26	28
LB1 –Outer Harbor	13	60	109	85	2,333.8	4,229.2	3,281.5	14	16	19
LB2 –Outer Harbor	8	371	163	267	4,773.4	11,913.5	8,343.4	20	28	31
LB3 –Outer Harbor	14	6	153	80	2,624.0	10,248.3	6,436.2	11	16	21
LB4 –Inner Harbor	14	35	115	75	1,037.2	3,407.6	2,222.4	8	13	14
LB5 –Outer Harbor	16	128	181	154	783.7	6,301.8	3,542.8	14	21	22
LB6 –Outer Harbor	15	49	79	64	2,541.8	5,106.6	3,824.2	12	14	20
LB7 –Outer Harbor	24	81	343	212	1,345.6	19,496.0	10,420.8	12	14	16
LB12 –Inner Harbor	12	62	359	211	27,212.6	7,821.9	17,517.3	15	15	19
LB14 –Inner Harbor	17	487	183	335	1,620.4	5,242.3	3,431.4	7	17	19
Station Mean		*177*	*179*	*178*	*4,846.5*	*9,843.2*	*7,344.9*	*13*	*18*	*21*
Total Survey Mean		*3,367*	*3,405*	*3,386*	*92,084.3*	*187,020*	*139,552*	*17*	*17*	*21*

Table 3.4-3. Mean Diversity (*) and Dominance of Fish Caught by Otter Trawl in Los Angeles and Long Beach Harbors, January – July 2008.

	*Shannon-Weiner **			*Margalef **			*Dominance*		
Habitat/Station	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*
LA1 –Outer Harbor	1.34	1.16	1.43	1.40	2.05	2.34	3	2	3
LA2 –Outer Harbor	1.07	1.66	1.61	2.09	2.79	3.12	2	3	3
LA3 –Outer Harbor	2.24	1.74	2.11	4.05	3.16	4.12	5	3	4
LA4 –Outer Harbor	2.05	1.86	2.07	2.44	3.26	3.32	5	4	5
LA5 –Inner Harbor	1.77	2.09	2.25	2.87	2.89	3.33	4	4	5
LA6 –Inner Harbor	1.21	1.98	2.12	2.63	3.09	3.60	2	5	5
LA7 –Outer Harbor	0.57	1.84	1.03	1.41	3.24	2.50	1	3	2
LA10 –Inner Harbor	0.88	1.34	1.36	2.60	2.26	3.07	2	4	2
LA14 –Inner Harbor	1.24	2.05	2.00	2.43	2.66	3.12	2	5	5
LA15 –Inner Harbor	2.11	2.00	2.13	3.05	3.51	3.79	4	4	5
LB1 –Outer Harbor	1.56	1.24	1.68	2.12	2.59	3.05	3	2	3
LB2 –Outer Harbor	1.00	2.02	1.69	2.85	4.52	4.20	1	4	3
LB3 –Outer Harbor	2.20	1.39	1.49	3.40	2.94	3.73	5	2	3
LB4 –Inner Harbor	0.87	1.30	1.67	1.50	2.22	2.29	1	3	4
LB5 –Outer Harbor	0.60	1.62	1.77	2.19	3.49	3.37	1	2	3
LB6 –Outer Harbor	0.68	1.07	1.03	2.20	2.01	2.69	2	2	2
LB7 –Outer Harbor	1.42	1.15	1.33	2.00	2.02	2.24	3	2	2
LB12 –Inner Harbor	1.61	1.10	1.35	2.68	2.00	2.66	3	2	2
LB14 –Inner Harbor	0.10	1.84	1.12	0.82	2.70	2.50	1	4	2

Table 3.4-4. Mean and Total Abundance of Fish Species Caught by Otter Trawl (Day and Night) in Los Angeles and Long Beach Harbors, January - July 2008.

	Mean Abundance																			
	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							*Total Catch*
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Engraulis mordax	79	5	17	5	14	57	0	18	5	9	361	143	0	0	4	34	2	11	241	6,037
Genyonemus lineatus	168	38	33	46	5	32	48	133	17	36	9	45	9	7	121	8	27	126	16	5,527
Seriphus politus	83	12	22	15	37	41	9	33	44	58	21	26	6	16	131	11	17	47	26	3,922
Cymatogaster aggregata	0	1	1	0	0	0	0	0	77	38	73	15	0	14	0	3	3	0	0	1,354
Phanerodon furcatus	0	3	1	0	2	2	0	1	38	21	12	4	6	1	1	22	3	4	1	729
Porichthys myriaster	1	1	0	5	9	2	1	7	0	3	0	4	7	4	6	11	4	4	18	517
Symphurus atricaudus	15	5	1	2	0	2	1	6	0	4	1	1	1	0	10	0	1	0	0	291
Icelinus quadriseriatus	0	4	0	1	3	6	0	1	0	0	0	0	2	4	7	1	5	1	8	262
Lepidogobius lepidus	0	0	0	0	1	2	1	0	0	0	2	0	2	2	0	1	1	10	19	253
Paralichthys californicus	1	1	0	1	1	1	1	1	1	4	9	5	1	1	1	1	1	2	1	192
Citharichthys sordidus	6	6	2	0	0	2	0	6	0	0	0	0	0	0	6	0	0	0	0	171
Paralabrax nebulifer	0	1	0	0	2	1	0	0	1	2	2	2	1	4	0	3	2	0	0	130
Citharichthys stigmaeus	4	10	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	121
Synodus lucioceps	0	1	1	1	1	2	1	1	1	2	0	3	1	0	0	1	1	2	2	116
Zaniolepis latipinnis	8	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	99
Pleuronichthys verticalis	1	1	2	1	1	1	1	2	0	2	0	3	0	0	1	0	1	1	0	93
Acanthogobius flavimanus	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	3	2	1	1	53
Zoarcidae unid.	0	1	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	48
Xystreurys liolepis	0	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	0	1	0	46
Myliobatis californica	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	37
Pleuronichthys ritteri	0	0	0	0	0	0	0	0	1	1	2	1	0	0	0	0	0	0	0	34
Urobatis halleri	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	26
Hyperprosopon argenteum	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	1	0	0	26
Parophrys vetulus	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	24
Raja inornata	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	23
Sebastes miniatus	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	20

Table 3.4-4. Mean and Total Abundance of Fish Species Caught by Otter Trawl (Day and Night) in Los Angeles and Long Beach Harbors, January - July 2008 (continued).

	Mean Abundance																			*Total Catch*
	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Sebastes spp. (juv.)	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	15
Xenistius californiensis	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	15
Scorpaena guttata	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	11
Pleuronichthys guttulatus	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	11
Syngnathus leptorhynchus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	9
Paralabrax clathratus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Rhinobatos productus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	9
Heterostichus rostratus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	7
Leptocottus armatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Lycodes pacificus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
Porichthys notatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Ophidion scrippsae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Embiotoca jacksoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Quietula y-cauda	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5
Sardinops sagax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Syngnathus spp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4
Chilara taylori	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4
Platyrhinoidis triseriata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Hippoglossina stomata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Mustelus henlei	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Chitonotus pugetensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Amphistichus argenteus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Pleuronichthys coenosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Anchoa compressa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Torpedo californica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Sebastes spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

Table 3.4-4. Mean and Total Abundance of Fish Species Caught by Otter Trawl (Day and Night) in Los Angeles and Long Beach Harbors, January - July 2008 (continued).

	Mean Abundance																			
	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							*Total Catch*
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Atherinops affinis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Sebastes auriculatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Menticirrhus undulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Gobioidei unid.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Peprilus simillimus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Scomber japonicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhacochilus vacca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Anchoa delicatissima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Squalus acanthias	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Roncador stearnsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Catch Across Surveys	*2,203*	*556*	*508*	*477*	*451*	*926*	*386*	*1,272*	*1,143*	*1,149*	*2,987*	*1,602*	*224*	*339*	*1,785*	*603*	*432*	*1,265*	*2,010*	*20,318*

Table 3.4-5. Mean and Total Biomass of Fish Species Caught by Otter Trawl (Day and Night) in Los Angeles and Long Beach Harbors, January - July, 2008.

	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							*Total Biomass*
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Genyonemus lineatus	61,154	7,922	7,070	20,167	3,091	8,244	14,921	49,057	12,035	22,760	4,739	19,042	4,963	2,580		8,268	5,910	9,646	6,379	317,854
Myliobatis californica			770	2,800					70,035	545	30,450	4,100			0			68,000		176,700
Seriphus politus	11,744	1,553	4,475	4,515	3,695	4,058	3,479	7,542	4,998	10,557	5,759	3,227	979	1,852	6,330	1,760	1,887	7,257	2,851	88,518
Paralichthys californicus	2,162	3,615	825	1,783	1,570	2,317	2,618	993	1,303	11,987	8,072	3,067	7,025	323	5,800	2,117	922	10,785	2,709	69,993
Phanerodon furcatus	235	763	346	209	1,138	995	120	645	7,603	3,503	4,461	726	1,263	133	369	2,168	574	1,009	681	26,940
Synodus lucioceps	130	409	328	382	1,679	896	751	615	517	1,952	142	2,280	135	435	134	1,466	331	2,655	2,028	17,264
Engraulis mordax	6,253	326	243	222	333	411	12	352	257	121	2,194	1,131	11	17	137	142	111	221	3,698	16,192
Torpedo californica														8,000	5,500					13,500
Urobatis halleri			208	555					745	2,890	4,887	3,405			0			545		13,235
Cymatogaster aggregata		112	110			29	9		5,225	936	1,641	2,452	59	977	0	160	371			12,081
Raja inornata	1,010	3,486	2,433	28		580						2,000			140	350	565	67	900	11,559
Xystreurys liolepis	380	310	544	785		595	360	898	455	1,948		842	655	184	0	405	575	913	295	10,144
Rhinobatos productus			700						1,445		6,245	900			0					9,290
Pleuronichthys verticalis	428	437	1,231	433	588	835	157	651		1,073	245	685	305	300	268	83	165	825		8,708
Paralabrax nebulifer	205	119		56	691	955	88	344	625	57	445	467	253	309	0	1,214	567		1	6,394
Squalus acanthias				5,000											0					5,000
Porichthys myriaster	90	27		263	84	149	123	603		95	47	610	171	170	622	349	86	218	468	4,173
Pleuronichthys ritteri			90		320				1,010	264	1,177	496		45	0				84	3,486
Symphurus atricaudus	754	287	23	153	25	46	42	523	30	475	93	194	38	20	420	22	30	30	45	3,249
Mustelus henlei				900											0			2,290		3,190
Pleuronichthys guttulatus									293		1,015	1,680			0					2,988
Zaniolepis latipinnis	1,479						27		26	45					1,282	26				2,885
Scorpaena guttata						329						1,420			592					2,341
Icelinus quadriseriatus	1	98		13	56	441		40					66	103	175	36	108	38	197	1,372

Table 3.4-5. Mean and Total Biomass of Fish Species Caught by Otter Trawl (Day and Night) in Los Angeles and Long Beach Harbors, January - July, 2008 (continued).

	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							*Total Biomass*
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Parophrys vetulus		70	14			4				10			129		720		74	345		1,365
Citharichthys sordidus	147	274	128	2		100		198		39		95			223	26	32			1,273
Hyperprosopon argenteum							218			912		13			0		55			1,198
Citharichthys stigmaeus	55	600	135			48		37		56		88		12	0				14	1,045
Platyrhinoidis triseriata									245	155		312			0					712
Xenistius californiensis							3		90	261			85		0			194		633
Zoarcidae unid.		27	9	47								368			0			6		456
Sebastes auriculatus															420					420
Roncador stearnsii											410				0					410
Sebastes miniatus	4	5		2		6	13	6		26					263					324
Lycodes pacificus		2			62								72		0				121	257
Embiotoca jacksoni									36					53	0	142				231
Scomber japonicus												220			0					220
Menticirrhus undulatus				220											0					220
Leptocottus armatus										39		55		46	0	15			40	195
Lepidogobius lepidus	2			3	2	7	4	6			7		8	12	1	5	9	58	51	174
Acanthogobius flavimanus			8	0		1		16			10			13	0	100	8	3	5	163
Ophidion scrippsae						148									0					148
Chilara taylori												118			0		24			142
Amphistichus argenteus										130	5				0	3				138
Porichthys notatus		6		68		1						30		3	0					108
Sardinops sagax						62									25				13	100
Sebastes spp. (juv.)										69					0					69
Atherinops affinis									13	13					13					39

Table 3.4-5. Mean and Total Biomass of Fish Species Caught by Otter Trawl (Day and Night) in Los Angeles and Long Beach Harbors, January - July, 2008 (continued).

	Deep Outer Harbor								*Shallow Outer Harbor*				*Inner Harbor*							*Total Biomass*
Scientific Name	*LA1*	*LA4*	*LB1*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LA2*	*LA3*	*LA7*	*LB2*	*LA5*	*LA6*	*LA10*	*LA14*	*LA15*	*LB12*	*LB14*	*All Stations*
Heterostichus rostratus									35			4			0					39
Peprilus simillimus															37					37
Syngnathus leptorhynchus									4	8		10			11					33
Chitonotus pugetensis													12		0		17			29
Anchoa compressa												14			6					20
Paralabrax clathratus					2					3	1				0		1		8	15
Rhacochilus vacca									12						0					12
Syngnathus spp.												10			0					10
Hippoglossina stomata										10					0					10
Pleuronichthys coenosus															0		9			9
Sebastes spp.	1	1													0					2
Quietula y-cauda														1	0					1
Anchoa delicatissima															0		0			0
Gobioidei unid.													0		0					0
Total Catch Across Surveys	*86,233*	*20,449*	*19,689*	*38,617*	*13,334*	*21,257*	*22,945*	*62,525*	*107,036*	*60,935*	*72,045*	*50,061*	*16,229*	*15,587*	*73,394*	*18,856*	*12,429*	*105,104*	*20,588*	*837,314*

Table 3.5-1. Mean and Total Abundance of Fish Species Caught by Beach Seine in Los Angeles Harbor, January - July, 2008.

		Mean Abundance		
Common Name	*Species*	*Cabrillo Beach*	*Pier 300*	*Total Catch*
Topsmelt	*Atherinops affinis*	65	371	1,308
Gobies	*Gobiidae unid.*	0	203	611
Diamond turbot	*Pleuronichthys guttulatus*	0	4	11
Bay pipefish	*Syngnathus leptorhynchus*	1	0	2
Giant kelpfish	*Heterostichus rostratus*	1	0	2
Pacific staghorn sculpin	*Leptocottus armatus*	0	1	2
Dwarf surfperch	*Micrometrus minimus*	0	0	1
Shiner surfperch	*Cymatogaster aggregata*	0	0	1
	Total	*202*	*1,736*	*1,938*

Table 3.5-2. Mean Abundance, Biomass, Number of Species, Diversity, and Dominance of Fish Caught by Beach Seine in Los Angeles Harbor, January - July 2008.

	January 2008	*April 2008*	*July 2008*	*Annual Mean*	*Annual Total*
Abundance					
Cabrillo Beach	170	8	24	67	202
Pier 300	13	949	774	579	1,736
Weight (grams)					
Cabrillo Beach	700	1	8	236	709
Pier 300	7	176	135	106	318
Number of Species					
Cabrillo Beach	4	1	2	2	5
Pier 300	2	3	4	3	5
Shannon-Wiener Diversity					
Cabrillo Beach	0	0	0	0	
Pier 300	1	0	1	0	
Margalef Diversity					
Cabrillo Beach	1	0	0	0	
Pier 300	0	0	0	0	
Dominance					
Cabrillo Beach	1	1	1	1	
Pier 300	2	1	2	2	

Figure 3.2-1. Fish Sampling Locations in Los Angeles and Long Beach Harbors, January – July 2008.

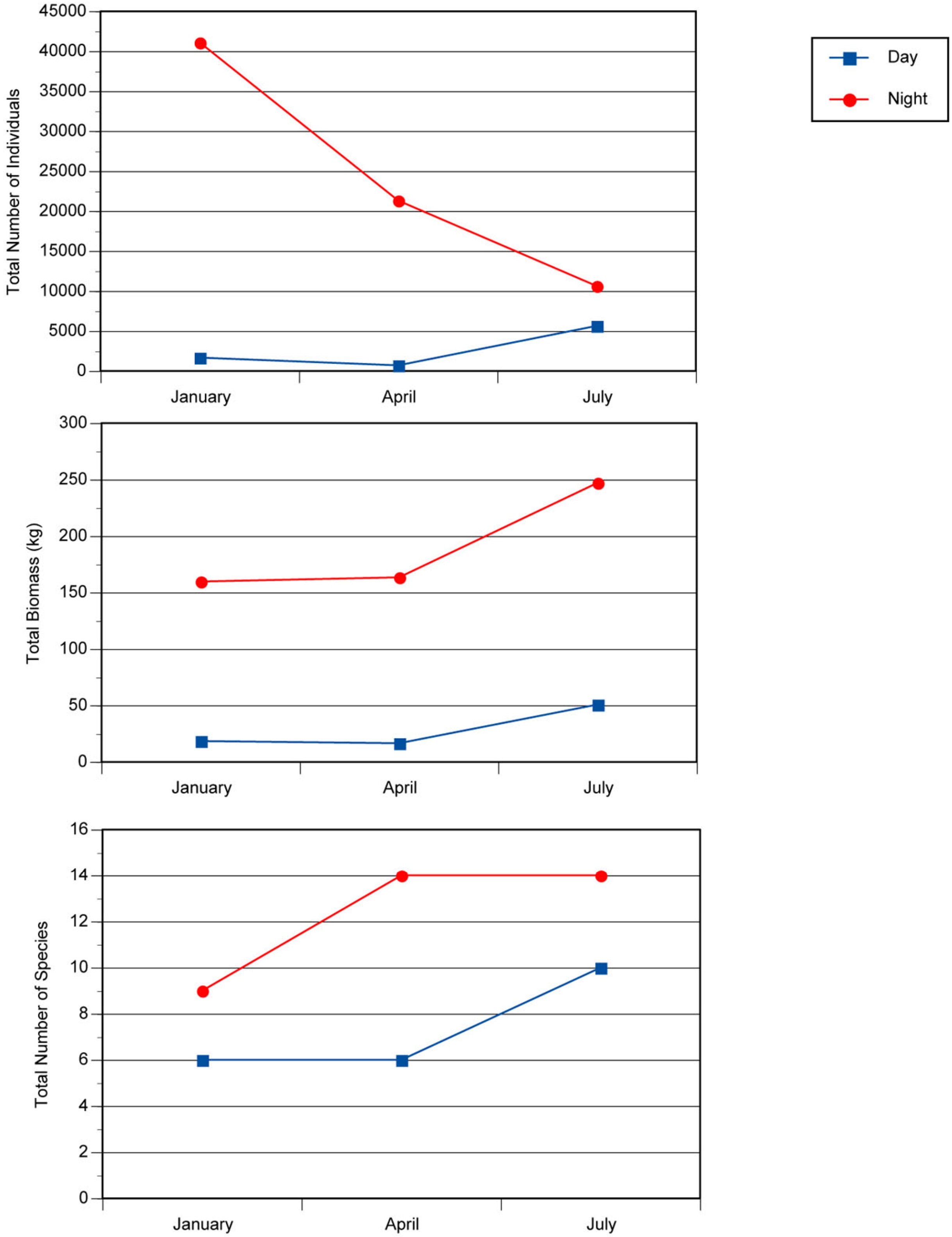


Figure 3.3-1. Total Abundance, Biomass, and Number of Species for Fish Collected by Lampara in Los Angeles and Long Beach Harbors, January through July, 2008.

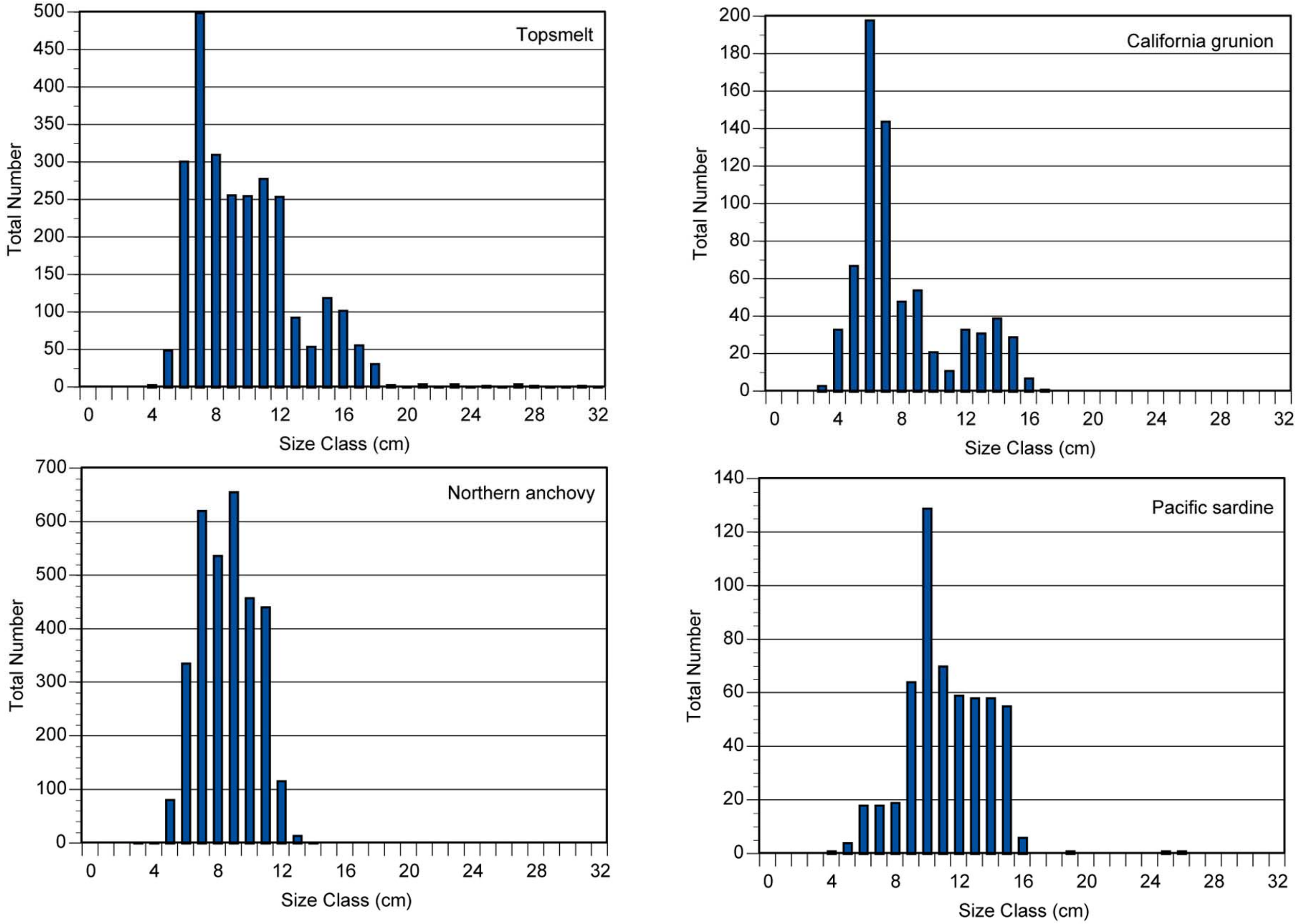


Figure 3.3-2. Size Class Distributions for Dominant and Selected Fish Species Collected by Lampara in Los Angeles and Long Beach Harbors, January through July, 2008.

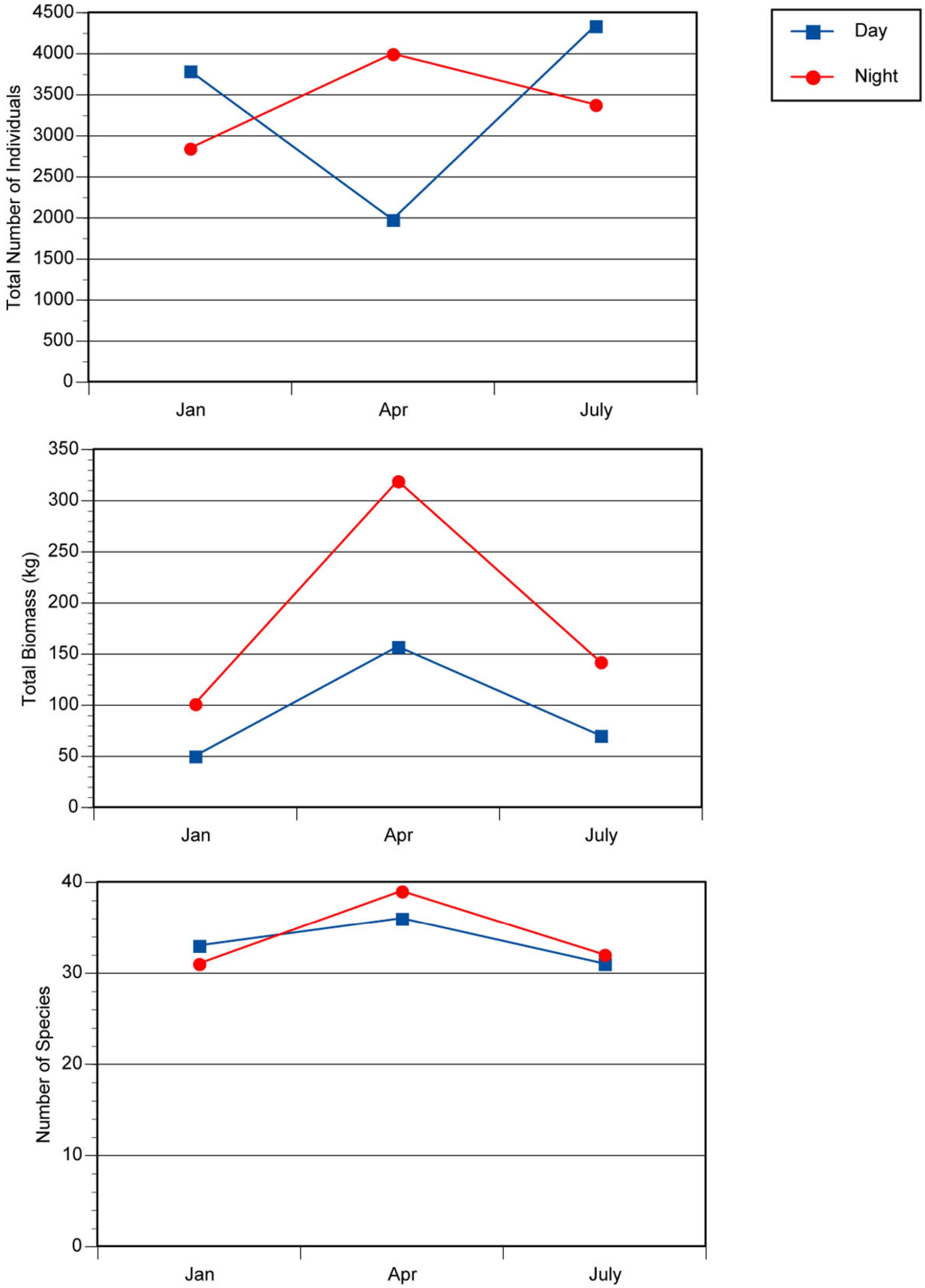


Figure 3.4-1. Total Abundance, Biomass, and Number of Species for Fish Collected by Lampara in Los Angeles and Long Beach Harbors, January through July, 2008.

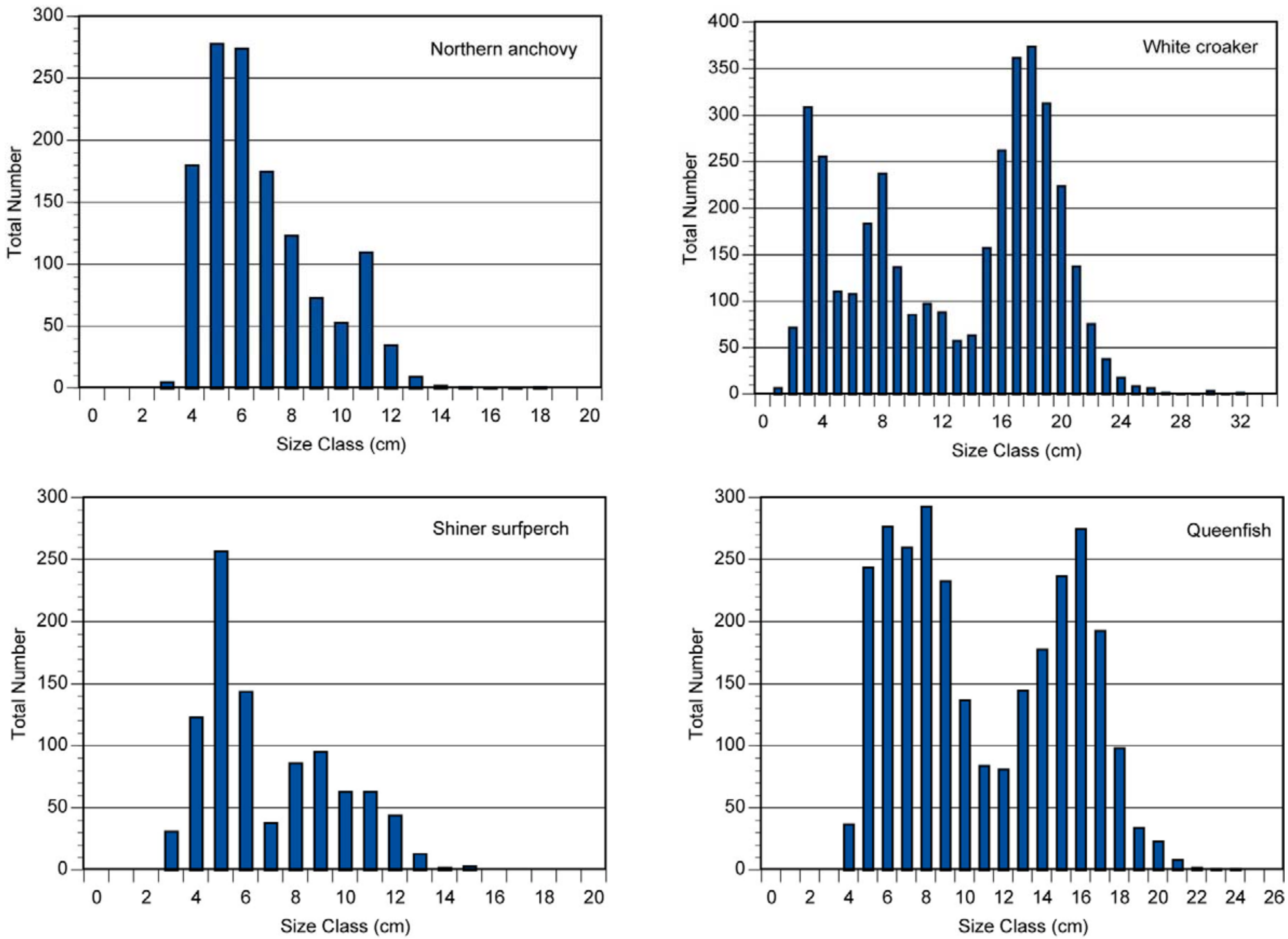


Figure 3.4-2. Size Class Distributions for Dominant and Selected Fish Species Collected by Otter Trawl in Los Angeles and Long Beach Harbors, January through July, 2008.

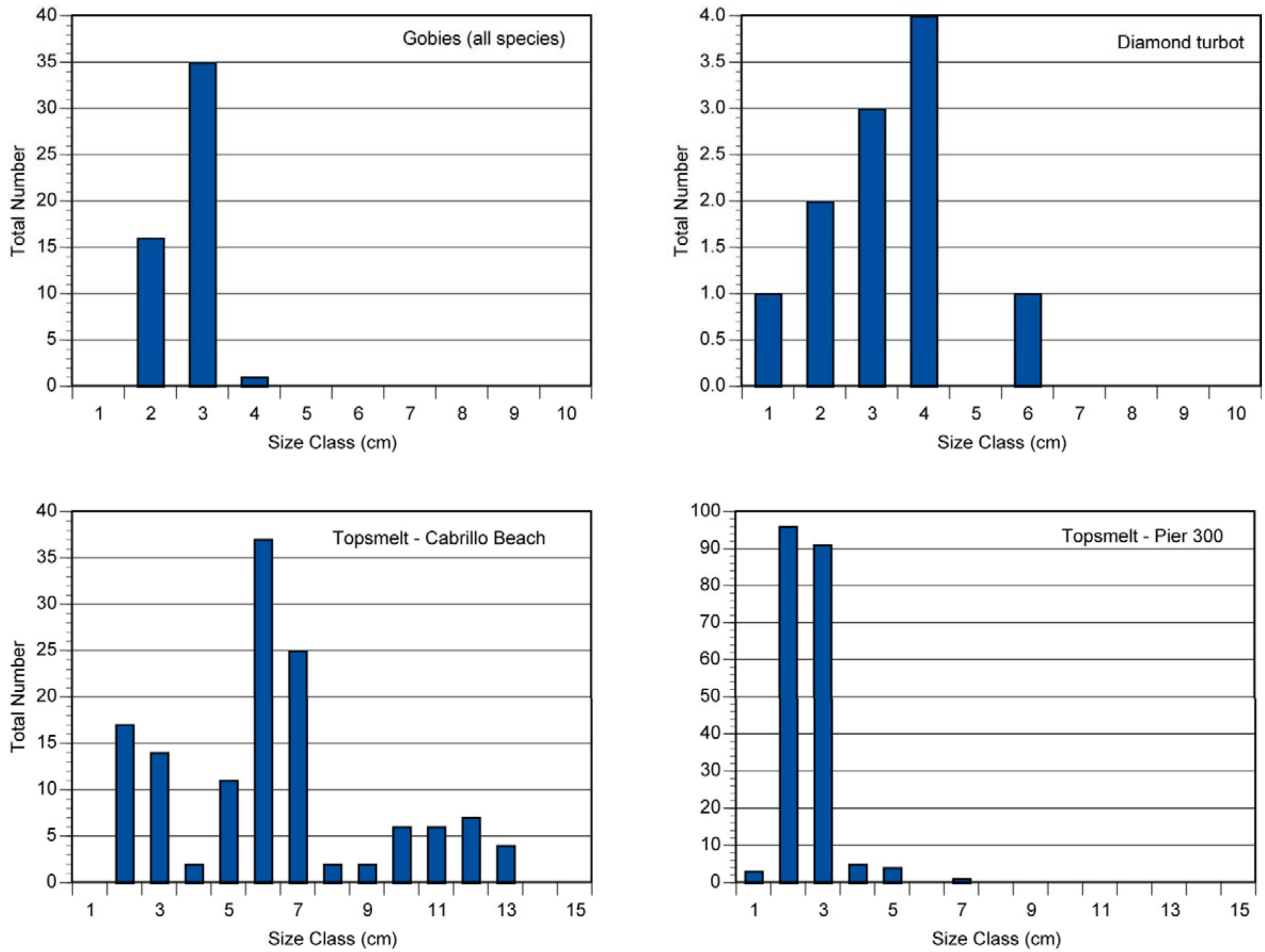


Figure 3.5-1. Size Class Distributions for Dominant and Selected Fish Species Collected by Beach Seine in Los Angeles and Long Beach Harbors, January through July, 2008.

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CHAPTER 4

ICHTHYOPLANKTON

4.0 ICHTHYOPLANKTON

4.1 INTRODUCTION

A large number of different fish species live and spawn in the various habitats in the Los Angeles and Long Beach Harbor complex (MEC 1988 and 2002). The eggs and larval stages of many fish (ichthyoplankton) stay in the water column for a period of time after being released by the female and/or after hatching. The ichthyoplankton are typically sampled by pulling a plankton net through the water column.

The first studies of the ichthyoplankton within Los Angeles and Long Beach Harbors were conducted in 1972. Larger studies were conducted by the Harbors Environmental Project (HEP 1976, 1979), Brewer (1983), MBC (1984), MEC (1988 and 2002). The studies conducted through 1988 generally had fewer stations but more frequent sampling than the MEC 2002 study and the current study. A variety of collection techniques were used during the earlier studies, but recent studies have been more standardized.

4.2 METHODOLOGY

4.2.1 Sample Collection

Quarterly ichthyoplankton surveys were conducted at night during February, April, and July 2008, at the same nineteen stations (ten in the Port of Los Angeles and nine in the Port of Long Beach) sampled for adult fish (Figure 4.2-1). The water column was sampled using three techniques and equipment types: a manta net was used to sample the surface water (neuston), stepped-oblique bongo net tows sampled the midwater (from near the bottom to the surface), and a wheeled bongo net sampled the near bottom (epibenthic) level. During the stepped-oblique sample collection, the net was lowered to the bottom and during retrieval to the surface it was kept at two midwater depths ('steps') for a longer period of time that at the rest of the depths. This equipment and these methods were the same as those used during the 2000 biological baseline study (MEC 2002). The neuston samples were collected using a manta net that had an 85-cm-wide, 17-cm-high rectangular opening. The midwater and epibenthic samples were collected using a wheeled bongo frame and nets. The bongo frame has two 0.6-meter diameter openings, each with an attached net. All nets and codends (sample collecting chamber on the end of each net) were made from 0.335 mm mesh. A calibrated flowmeter was attached in the mouth of each net to calculate the volume of water filtered during each deployment. Nets were towed for 10 minutes at a speed of about 1 knot at each location. Samples were placed in labeled jars and fixed in either 70-80% ethanol or 4-5% buffered formalin in the field. Samples that were preserved in formalin were transferred to ethanol prior to laboratory processing. All collections were completed during the night because previous studies (Horn and Hagner 1982) showed that higher densities of ichthyoplankton were collected then than during daytime collections.

Additional samples were collected for a special methods comparison study, described in Section 4.2.4, below. These samples were collected using more recent and widely employed gear and methods developed by the California Cooperative Fisheries Investigations (CalCOFI) for their coastal ichthyoplankton studies.

4.2.2 Laboratory Sample Processing

In the laboratory, eggs and fish larvae were removed from each sample, and identified to the lowest practicable taxon and counted. During the start of sample sorting, if the sorter estimated that there were more than 500 fish eggs in the sample, eggs were not removed during the initial sample sorting for larval fish. After the removal of the fish larvae, 10 percent of the sample was removed from the sample using an aliquot transfer pipette (Hensen Stempel pipette) and the eggs in this aliquot (subsample) were counted. When aliquot sampling was required, an estimate of the number of eggs in the entire sample was determined by multiplying the number in the subsample by the fraction that was sorted. For example, if 10% of the sample was sorted for eggs, the number of eggs of each taxon in the subsample was multiplied by 10 to estimate the total number in the entire sample. All laboratory data was recorded on sequenced datasheets and then entered into a computer database and reviewed for completeness prior to data analysis.

Myomere counts and pigmentation patterns were used to identify larval fishes to the lowest taxonomic classification possible. Generally, individuals that could not be identified to the species level were identified to either the genus or family level. For example, many species of the family Gobiidae have the same pigment pattern during early life stages (Moser et al. 1996), making accurate identifications to the species level questionable. Accordingly, early larvae of the arrow goby (*Clevelandia ios)*, cheekspot goby (*Ilypnus gilberti)*, and shadow goby (*Quietula y-cauda)* were combined into an unidentified goby category referred to as "CIQ gobies".

The identification of fish eggs is even more difficult than the identification of larvae. Egg identification is generally based on a number of characters including egg size and shape, number and size of oil globules, presence and type of ornamentation on the chorion (outer egg membrane), and characteristics of the developing embryo, if present (Ahlstrom and Moser 1980, E. Sandknop, CalCOFI pers. comm.). In many instances, some of these measurements can overlap between taxa, making positive identification problematic; in those cases the individual egg was recorded as belonging to a 'slash' category (one of two or more fish families). Many of the eggs were left in the category "undeveloped egg" because there was no embryo inside the egg, possibly due to the short period of time between release from the female and capture in the net. Eggs with a visible embryo that could not be identified were recorded as unidentified fish egg.

4.2.3 Data Analysis

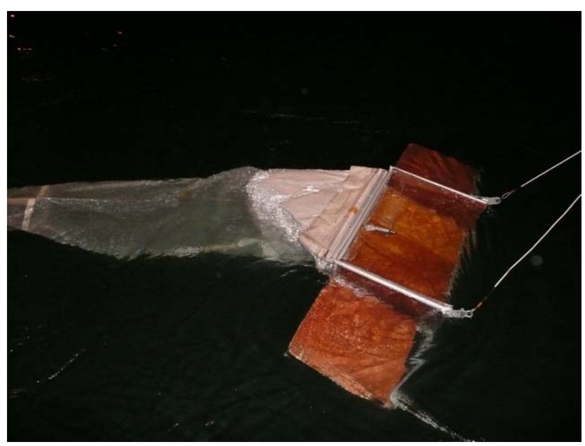
The ichthyoplankton catch was standardized to number of eggs or fish larvae per 100 m^3 using information from the calibrated flowmeter mounted in the net mouth during sample collection.

The numbers were adjusted to the number of each taxon per 100 m^2 (referred to in this report as weighted mean abundance) by multiplying the number of each taxa per 100 m^3 by the depth of water that the net sampled. It was estimated that the manta net sampled the upper 0.16 meters of the water column, the epibenthic net sampled the lower 0.70 meters of the water column, and the stepped oblique net sampled the rest of the water column (station water depth – [0.16 + 0.70]). For example, if there were 2.5 individuals of Taxon A per 100 m^3 in a stepped oblique sample that was collected in 12.2 meters water depth, the total density would equal 28.35 per 100 m^2 [2.5 times (12.2 minus 0.86)]. If this same density of fish was found in the neuston net there would be 0.4 per 100 m^2 (2.5 times 0.16). This process of weighting the strata allowed the three sample types from each station to be added together to generate an estimate of the number of eggs and larvae in the entire water. Diversity at each station was calculated as the number of taxa, Shannon-Weiner index, Margalef index, and dominance (see Section 3.2.4 for a description of these measures of diversity).

The data on larval fishes collected by the three sampling methods during the three surveys were combined and compared among the nineteen stations using multivariate non-metric multidimensional scaling (MDS). The analysis was completed by first transforming the data to the 4^{th} root to correct for the large-scale differences among densities, and then computing Bray-Curtis distances among each set of data. The Bray-Curtis distance is a commonly used measure of the degree of similarity between sets of data based on differences in species and their abundances (Clarke and Warwick 2001). The Bray-Curtis distances were then analyzed using MDS that optimizes the spatial differences into two-dimensions. The MDS analysis was completed using the PRIMER analysis package (Clarke and Gorley 2001).

The relationship between larval fish composition and sediment grain size was investigated using the RELATE analysis procedure in the PRIMER statistical package (Clarke and Gorley 2001). The RELATE procedure computes a rank correlation between the rank order of Bray-Curtis distances among stations based on the biological data and the rank order based on the Euclidean distances among the stations based on the grain size data.

4.2.4 Method Comparison Study



A comparison of larval species composition and abundance collected during the current study (referred to below as “three nets”) and the modified CalCOFI-type net deployment method was undertaken during Surveys 2 (April) and 3 (July). The objective of this special study was to determine if more recent and widely accepted sampling methods could produce comparable data and decrease the overall field and laboratory effort for future baseline surveys. During this special study the bongo nets were deployed at ten of nineteen ichthyoplankton stations (LA1, LA2, LA4, LA5, LA6, LB1, LB2, LB3, LB5, and LB6; Figure 4.2-1) to collect a sample throughout the entire water column following similar methods to those employed by CalCOFI. In general, the bongo nets were fished from the surface to the bottom and then back to the surface, with the nets collecting a similar volume of water at all depth strata. The deeper stations (depths between 40-50’) were selected for the comparison study because (1) these stations are relatively easy to sample (fewer deployment and retrieval cycles to filter a target volume) and (2) if there is stratification of the larvae, such as between the surface and bottom, differences are more likely to be evident at deeper stations compared to shallower stations. Post-collection handling and processing methods were identical to those described above. These additional samples were used to compare abundance and densities of ichthyoplankton between the different collection methods. After sample processing, analysis of the larval composition and density between the sample types, including manta surface tows, stepped-oblique tows, benthic tows, and CalCOFI-type (oblique tow only) was completed.

4.3 RESULTS

Summaries of the abundance of fish eggs and larvae per 100 m^3 of water for each of the three techniques (net types) are presented in Tables 4.3-1 and 4.3-2; the data for each station, survey, and net type are presented in Appendix D. Eggs were approximately twice as abundant (#/100 m^3) in the neuston than in either the midwater or epibenthic layers when all station and survey data were combined (Table 4.3-1). The majority of the individual eggs (92.4%) were identified as "undeveloped".

A total of 71 different larval fish taxa were observed during this study (Table 4.3-2). The most abundant taxon was a complex of three goby species recorded as "CIQ gobies" (see Section 4.2.2), representing 44.6% of the total catch. The next most abundant larvae were combtooth blennies (*Hypsoblennius* spp.; 34.0%), bay gobies (*Lepidogobius lepidus;* 8.6%), and clingfishes (Gobiesocidae; 2.9%). The abundances of most larval taxa differed between the three depths sampled. For example, all the gobies (CIQ, bay, and yellowfin) were least abundant in the surface water while combtooth blennies were in lowest abundance in the epibenthic layer. Clingfishes were in highest abundance in the epibenthic samples while silversides (California grunion, jacksmelt, and topsmelt) were in highest abundance in the surface waters. When all station and survey data were combined, the total number of individuals/100 m^3 was similar for the midwater (139.2) and epibenthic (134.3) layers but much lower in the neuston (38.9).

The weighted mean abundances (number of individuals/100 m^2) of eggs and larvae in the entire water column at each station are presented in Table 4.3-3. Harbor-wide, the abundance of fish eggs and larvae averaged 1,294 per 100 m^2. On a per-station basis, the highest weighted mean abundance was observed at Station LA7 (4,381/100 m^2), followed by stations LB7 (2,726/100 m^2), LB6 (2,550/100 m^2), and LB12 (2,541/100 m^2) (Table 4.3-3). These high abundances were due to large number of either CIQ gobies or combtooth blennies. Station LA7 was dominated by CIQ gobies (almost 93%), while LB7 and LB12 were dominated by combtooth blennies (80% and 60%, respectively). The larval fish at station LB6 were composed of about 39% CIQ gobies and 25% combtooth blennies. The lowest mean abundances were observed at stations LA3 (257/100 m^2) and LA15 (316/100 m^2). The mean number of larval taxa per station over all surveys varied from a low of 12/100 m^2 at Station LA15 to a high of 34/100 m^2 at Station LA10.

Shannon-Weiner diversity values varied from a low of 0.34 at Station LA7 to a high of 2.21 at Station LA1 (Table 4.3-3). The lowest Shannon-Wiener value was due to dominance by a single taxon (CIQ gobies). Margalef diversity values varied from a low of 1.49 at Station LA14 to a high of 3.91 at Station LA10 (Table 4.3-3). Stations with the highest Margalef values had the highest number of taxa.

At the majority of the stations, the dominance values were either two or three (Table 4.3-3). This means that at most stations at least 75% of the total larvae collected at that station over the study belonged to only two or three taxa. Stations LA1 and LA3 had a value of four (4) while stations LA7 and LB7 had values of only one (1). The stations with the lowest dominance generally had low Shannon-Weiner values, with the larval abundance generally being dominated by CIQ gobies.

Annual mean abundance of fish eggs per station (all three surveys combined) is presented in Table 4.3-4. As noted above, the vast majority of eggs was categorized as undeveloped and could not be identified to a lower taxonomic level. The highest weighted mean abundance of eggs at any station over all survey data was combined was Station LA4 (13,797/100m^2), followed by stations LA10 (12,071/100m^2) and LB7 (10,217/100m^2). Stations LB2 (1,362/100m^2) and LA3 (1,737/100m^2) had the lowest weighted mean abundance of eggs.

Abundances of the most common taxa at each station varied (Table 4.3-5) For gobies, CIQ gobies were most abundant at Station LA7 followed by Station LA14, while bay gobies were most abundant at stations LB4 and LA14, and yellowfin gobies were most abundant at stations LA14 and LA7. Combtooth blennies were most abundant at stations LB7 and LB12, while clingfish were most abundant at stations LB6 and LB12. The abundance of clingfish at all other stations was generally very low.

The three most abundant taxa of larvae (CIQ gobies, combtooth blennies and bay gobies) were found at all nineteen stations (Table 4.3-5). It is interesting to note that during the current study, Station LA3 had the lowest abundance of larvae and one of the lowest abundance of fish eggs compared to the other stations. Station LA3 is geographically close to LA2, yet during the current study, LA2 had more than triple the abundance of eggs and a much higher abundance of larval fish. Thus, egg and larval densities can differ even at geographically similar station.

Table 4.3-6 presents the weighted mean abundance (#/100 m^2) per survey of the ten overall most abundant larval fishes. The total abundance of all larvae combined was similar during the first two surveys but much higher during the July survey. This pattern was due to dramatic increases in the abundance of three taxa (CIQ gobies, combtooth blennies, and clingfishes) during the summer (July) survey. Three taxa, yellowfin goby, white croaker, and roughcheek sculpin, were found during the first two surveys but not during the third, while northern anchovy was only found during the last two surveys. The differences among surveys are due to the seasonal reproductive patterns of these fish along the California coast (Moser 1996).

Results of the multidimensional scaling (MDS) analysis of the Bray-Curtis distances among stations (Figure 4.3-1) show that similarities among the Long Beach Harbor stations are higher (stations are closer together) than the similarities among Los Angeles Harbor stations, which are more scattered in the figure. The distances among the LA stations almost mirrors the physical locations of the stations. For example, Stations LA14, LA6, LA05, and LA15 at the top of the figure represent an inner harbor grouping and the locations of Stations LA4, LA3, LA2, and LA1 represent an outer harbor grouping. The relationship of the LB stations to their physical locations is not as clear, which is due to the greater similarity in the larval data among those stations. PRIMER SIMPER tests confirmed that the average similarity among the Long Beach Harbor stations (65 %) was greater than the average similarity among the Los Angeles Harbor stations (52%).

Although the MDS analysis suggests potential relationships and similarities among stations based on larval fish, the differences that were observed could be due to differences in adult fish composition among sites. The adult fish assemblages, in turn, are dependent to some extent on the habitats available at each site. Sediment grain size data were used to determine if a significant relationship exists between sediment grain size and larval fish composition. Although sediment grain size would not be expected to affect larval fish composition directly, it might be indicative of habitat differences that could affect adult fish composition. For example, California halibut and other flatfishes might be more abundant in sandy areas with larger grain size than in areas with higher percentages of clay that might support higher numbers of gobies that dwell in burrows in the mud.

The results of the RELATE analysis showed that the rank correlation for all nineteen stations had a calculated probability level of 63 percent (i.e., the value exceeded 63 percent of the correlations calculated from the random permutations of the data). The probability level increased to 89.5 percent when the analysis was conducted only on the data from the ten Los Angeles Harbor stations. Although not significant at the 95 percent level usually employed in statistical testing, the results are consistent with the MDS depiction of the relationships among those stations showing a relationship between the location of the stations and the associated suite of larval taxa.

4.4 HISTORICAL COMPARISON

A comparison between the 2000 (MEC 2002) and current study results shows a generally similar composition of the larval fish. The six most abundant larval fish taxa did differ between the two studies in terms of their percent abundance (Table 4.4-1). Some of the differences might be due to the current study only sampling three quarters while the 2000 study sampled during all four quarters of the year. However, more larval taxa were reported in the current study than in the previous baseline study (MEC 2002), which was due to the presence of only one or two individuals of a number of taxa in the current study. The percent of CIQ gobies and combtooth blennies was greater in the 2008 study than in the previous baseline study while the percent of northern anchovies, clingfish, and queenfish was lower during the current study than found in the previous study (MEC 2002). These differences are not particularly dramatic: it is not unusual to observe differences in larval abundance between years due to variations in the annual reproductive output of adult fish as a result of variations in local environmental and biological conditions.

A direct comparison of the numerical abundance of the total larvae in the current study with the 2000 study is difficult because of discrepancies in data presentation in the earlier study. But in general, their reported summary values are higher than both the numbers observed in the current study and values reported in recent ichthyoplankton studies conducted in or near the LA/LB Harbor complex (Harbor Generating Station [MBC et al 2007a], Haynes Generating Station [MBC et al 2007b] and Alamitos Generating Station [MBC and Tenera 2007]).

Even though there were differences observed between the current study and the 2000 study, the overall larval fish composition of both is similar to the earlier studies in the Ports (HEP 1976 and 1979, Brewer 1983, MBC 1984, MEC 1988 and 2002) and in recent entrainment studies in the nearby vicinity (MBC et al. 2007a, MBC et al. 2007b and MBC and Tenera 2007). The actual abundance of each larval taxon will vary based on the reproductive success of the adults that live in or near the Port waters. The dominant groups during the most recent two studies (MEC 1998 and 2002) and the current study were gobies, small fish whose adults live in and on soft sediments that are present in large amounts in the harbor complex. Larval combtooth blennies were also abundant in the recent studies; their adults are found living on pier pilings that are abundant in the harbor complex.

The ichthyoplankton stations were designated as being in one of three general areas (Table 4.4-2): deep outer harbor (seven stations), shallow outer harbor (four stations), and inner harbor (eight stations). The average weighted mean abundance of larval fish in each of these three areas was: shallow outer harbor 1,523/100m^2, inner harbor 1,297/m^2, and deep outer harbor 1,157/100m^2. The range of values in each area was variable; for example, the value for the shallow outer area was the highest based on the large number of larvae found at station LA7 (4,381/100m^2 in Tables 4.3-3 and 4.3-5). The other three stations designated shallow outer were much lower ranging from 257 to 588 larvae/100m^2.

4.5 METHOD COMPARISON STUDY RESULTS

The comparison of the two sampling approaches was based on two analyses. First, total larval abundance (#/100m^2) in paired samples (three-net sampling vs. CalCOFI-type sampling - Table 4.5-1) was compared by calculating the difference between the two samples and testing the hypothesis that the average difference was zero. Since the differences were not normally distributed, abundance data were transformed ($\log_{10}$) prior to calculating differences. As Table 4.5-1 shows, the three-net method overall yielded somewhat higher abundances than the CalCOFI method, although in five of the twenty sample pairs abundances were lower in the three-net samples. The statistical analysis showed that the average difference was not significantly different from zero, but a power analysis showed that due to the small sample size and variation in the data, there was only a 7 percent chance that a difference from zero could have been detected. Since acceptable levels of power for such tests are 70 percent or greater, the results of this analysis do not support a comparison of the two methods.

The second analysis compared the Bray-Curtis similarity between the paired samples collected using the two methods. The average similarity between the paired samples at the ten stations was 56.8 percent (Table 4.5-1). The average Bray-Curtis similarity among the 171 possible sample pairs based on the average abundances for the three surveys at all 19 stations was slightly higher, at 57.3 percent. The average similarity between paired samples at the ten stations would be expected to be much greater than the average based on a random sample of all of the samples if the CalCOFI-type sampling was effective at replicating the sampling done with the three nets. Although the result of the statistical comparison was unable to detect a statistically significant difference between the two methods, the overall results were inconclusive.

Due to the patchiness of plankton, filtering larger volumes of water increases the chance of collecting a more representative cross section of the ichthyoplankton composition, but will also increase the sample processing time and cost. It is recommended that for future studies in the Port complex the current three-net method be continued with a modification to the midwater collection. It is suggested that the surface and epibenthic sampling continue without change. These techniques allow more water in these two strata to be filtered than does the CalCOFI technique. This increases the chance of collecting rare taxa that might be in higher concentrations in these two strata than in the midwater. However, it is recommended that the 'steps' in the current midwater sampling be eliminated. These 'steps' introduce potential biases into the data by oversampling the depth strata where the net was during its 'steps'. It is also impossible to replicate the exact depth strata used at each station or between surveys at a particular station due to factors such as vessel, wind, current speeds, and length of tow cable. Therefore, it is recommended that during any future midwater collection the net be deployed in a similar fashion to that used during the CalCOFI-type tows in this study, where the nets deployment and retrieval speeds through the water column be constant so that all depths are evenly sampled.

Table 4.3-1. Total (#/100 m^3) and weighted mean abundance (#/100 m^2) of fish eggs collected during the three 2008 surveys (all surveys and stations combined).

Taxonomic Name	*Common Name*	*Neuston (#/100 m^3)*	*Midwater (#/100 m^3)*	*Epibenthic (#/100 m^3)*	*Weighted Mean Abundance (#/100 m^2)*	*% of total*
fish eggs (undeveloped)	undeveloped fish eggs	772.07	425.22	409.02	4,991.08	92.39
Sciaenidae/Paralichthyidae unid.	croaker/flatfish fish eggs	30.87	7.47	5.36	88.51	1.64
Sciaenidae/Paralichthyidae/ Labridae unid.	croaker/flatfish/w rasse fish eggs	9.57	4.37	4.07	75.23	1.39
Citharichthys spp.	sanddab eggs	12.52	6.05	2.57	68.41	1.27
Pleuronichthys spp.	turbot eggs	6.38	2.39	4.39	43.47	0.80
Paralichthyidae unid.	sand flounder eggs	2.32	2.61	3.79	37.32	0.69
Sciaenidae unid.	croaker eggs	5.37	2.99	1.48	36.27	0.67
Engraulis mordax	northern anchovy eggs	1.93	1.41	0.91	20.85	0.39
fish eggs unid.	unidentified fish eggs	2.86	1.09	0.69	12.95	0.24
poss. Sciaenidae unid.	possible croaker eggs	0.77	0.94	0.23	11.57	0.21
Engraulidae unid.	anchovy eggs	0.07	0.42	0.06	8.11	0.15
Labridae/Paralichthyidae	wrasse /flatfish fish eggs	1.63	0.47	0.35	6.98	0.13
Labridae unid.	wrasse eggs		0.04		0.53	0.01
Atherinops affinis	topsmelt eggs		0.02	0.03	0.23	0.00
poss. *Xystreurys liolepis*	poss. fantail sole eggs		0.02		0.22	0.00
Pleuronectiformes unid.	flatfish eggs		0.02		0.21	0.00
Labridae/Serranidae unid.	wrasse eggs	0.53			0.09	0.00
Paralichthys californicus	California halibut eggs	0.25		0.04	0.07	0.00
poss. Paralichthys californicus	poss. California halibut eggs	0.15			0.03	0.00
Genyonemus lineatus	white croaker eggs			0.02	0.01	0.00
	Total	*847.30*	*455.51*	*433.01*	*5,402.12*	

"poss" = possible

Table 4.3-2. Total density (#/100 m^3) and weighted mean abundance (#/100 m^2) of larval fish collected during the three 2008 surveys (all surveys and stations combined).

Taxonomic Name	*Common Name*	*Neuston (#/100 m^3)*	*Midwater (#/100 m^3)*	*Epibenthic (#/100 m^3)*	*Weighted Mean Abundance (#/100 m^2)*	*% of total*
CIQ gobies	gobies	2.23	84.60	86.19	577.14	44.62
Hypsoblennius spp.	combtooth blennies	25.47	33.12	11.85	440.10	34.02
Lepidogobius lepidus	bay goby	0.84	7.78	11.69	111.87	8.65
Gobiesocidae unid.	clingfishes		2.39	9.22	37.48	2.90
unidentified larval fish	unidentified larval	0.78	2.20	3.20	18.92	1.46
Acanthogobius flavimanus	yellowfin goby		1.86	2.09	16.48	1.27
Genyonemus lineatus	white croaker	0.35	0.96	0.55	14.41	1.11
Ruscarius creaseri	roughcheek sculpin	0.21	0.30	0.71	6.03	0.47
Orthonopias triacis	snubnose sculpin	0.06	0.53	1.09	6.01	0.46
larval fish fragment	unidentified larval	0.21	0.48	1.21	5.82	0.45
Cottidae unid.	sculpins	0.16	0.41	0.36	5.45	0.42
Engraulis mordax	northern anchovy		0.41	0.45	5.13	0.40
Zaniolepis frenata	shortspine combfish	0.03	0.22	0.24	4.56	0.35
Stenobrachius leucopsarus	northern lampfish	0.08	0.30	0.37	4.39	0.34
Gobiesox spp.	clingfishes	0.03	0.53	1.10	3.67	0.28
Paraclinus integripinnis	reef finspot	0.08	0.22	0.10	3.65	0.28
Bathymasteridae unid.	ronquils	0.13	0.17	0.37	2.99	0.23
Clinocottus analis	wooly sculpin	0.17	0.25	0.33	2.48	0.19
Gibbonsia spp.	kelpfishes	0.03	0.41	0.55	2.42	0.19
Gillichthys mirabilis	longjaw mudsucker		0.11	0.32	1.98	0.15
Leuresthes tenuis	California grunion	3.98	0.26	0.36	1.95	0.15
Rhinogobiops nicholsi	blackeye goby	0.16	0.09	0.10	1.67	0.13
Typhlogobius californiensis	blind goby	0.20	0.13	0.17	1.59	0.12
Icelinus spp.	sculpins		0.08	0.06	1.16	0.09
Pomacentridae unid.	damselfishes	0.28	0.05		1.13	0.09
Artedius lateralis	smoothhead sculpin		0.07	0.13	0.93	0.07
Gobiesox rhessodon	California clingfish		0.22		0.92	0.07
Sebastes spp.	rockfishes	0.03	0.04	0.05	0.90	0.07
Icelinus quadriseriatus	yellowchin sculpin		0.04	0.30	0.84	0.06
Neoclinus spp.	fringeheads		0.04	0.02	0.83	0.06
Sciaenidae unid.	croakers	0.17	0.09	0.11	0.79	0.06
Atherinopsis californiensis	jacksmelt	0.58	0.03		0.76	0.06
Pleuronichthys guttulatus	diamond turbot		0.03	0.06	0.68	0.05
Blennioidei unid.	blennies		0.04	0.07	0.67	0.05
Engraulidae unid.	anchovies	0.03	0.04	0.04	0.60	0.05
Lythrypnus spp.	gobies	0.03	0.04	0.03	0.48	0.04
Oligocottus/*Clinocottus*	sculpins		0.02	0.04	0.45	0.03
Paralichthyidae unid.	sand flounders		0.10	0.02	0.43	0.03
Syngnathus spp.	pipefishes	0.02	0.05		0.42	0.03
Oxylebius pictus	painted greenling		0.02		0.35	0.03
Leptocottus armatus	Pacific staghorn		0.04	0.08	0.34	0.03

Table 4.3-2. Total Density (#/100 m^3) and Weighted Mean Abundance (#/100 m^2) of Larval Fish Collected During the Three 2008 Surveys (all surveys and stations combined) (continued).

Taxonomic Name	*Common Name*	*Neuston (#/100 m^3)*	*Midwater (#/100 m^3)*	*Epibenthic (#/100 m^3)*	*Weighted Mean Abundance (#/100 m^2)*	*% of total*
Hypsypops rubicundus	garibaldi	0.12	0.02	0.03	0.32	0.02
Rathbunella spp.	ronquils		0.02	0.05	0.31	0.02
Chitonotus/Icelinus	sculpins		0.02	0.00	0.30	0.02
Heterostichus rostratus	giant kelpfish	0.05	0.02	0.10	0.28	0.02
Ilypnus gilberti	cheekspot goby		0.07		0.27	0.02
Porichthys notatus	plainfin midshipman		0.02	0.02	0.27	0.02
Porichthys myriaster	specklefin		0.02		0.26	0.02
Perciformes unid.	order Perciformes		0.02	0.02	0.26	0.02
Labrisomidae unid.	labrisomid blennies		0.02	0.07	0.26	0.02
Paralichthys californicus	California halibut	0.14	0.02		0.25	0.02
Atherinops affinis	topsmelt	0.70	0.02	0.02	0.23	0.02
Pleuronectoidei unid.	flatfishes		0.02		0.22	0.02
Syngnathidae unid.	pipefishes		0.02		0.22	0.02
Pleuronectiformes unid.	flatfishes		0.02		0.20	0.02
Atherinopsidae unid.	silversides	1.07		0.04	0.20	0.02
Pleuronichthys spp.	turbots		0.02	0.04	0.17	0.01
Clinidae unid.	kelp blennies		0.02	0.06	0.12	0.01
Clupeiformes unid.	herrings and	0.11	0.02	0.02	0.11	0.01
Hexagrammidae unid.	greenlings		0.02		0.10	0.01
Paralabrax spp.	sea basses		0.02		0.06	0.00
Citharichthys stigmaeus	speckled sanddab	0.30			0.05	0.00
Chaenopsidae unid.	tube blennies			0.05	0.03	0.00
Artedius spp.	sculpins			0.02	0.02	0.00
Parophrys vetulus	English sole			0.03	0.02	0.00
Myctophidae unid.	lanternfishes			0.02	0.01	0.00
Anchoa spp.	bay anchovies			0.02	0.01	0.00
Alloclinus holderi	island kelpfish			0.02	0.01	0.00
Pleuronichthys verticalis	hornyhead turbot			0.02	0.01	0.00
Pleuronectidae unid.	righteye flounders			0.02	0.01	0.00
Liparis spp.	snailfishes			0.02	0.01	0.00
Lyopsetta exilis	slender sole			0.02	0.01	0.00
Sphyraena argentea	Pacific barracuda	0.05			0.01	0.00
	Total	*38.92*	*139.17*	*134.31*	*1,293.48*	

Table 4.3-3. Mean Abundance, Number of Taxa, Diversity, and Dominance of Ichthyoplankton (all stages combined) Collected During the Three 2008 Surveys (all surveys combined).

Habitat/Station	*Average Depth (m)*	*Weighted Mean Abundance (#/100 m^2)*	*Mean Number of Larval Taxa*	*Shannon-Weiner Diversity*	*Margalef Diversity*	*Dominance*
LA1	22	421.2	23	2.21	3.09	4
LA2	4	419.5	25	1.16	3.37	2
LA3	4.5	256.8	25	1.87	3.63	4
LA4	18	535.0	20	1.21	2.58	2
LA5	16	583.1	13	1.01	1.61	2
LA6	16	773.2	19	1.39	2.33	3
LA7	4.5	4,830.8	24	0.34	2.40	1
LA10	25	1,576.3	34	1.71	3.91	3
LA14	13	2,057.7	14	0.86	1.49	2
LA15	17	316.2	12	1.43	1.61	3
LB1	12	586.7	27	1.48	3.48	3
LB2	5	587.8	24	1.22	3.08	2
LB3	14	578.7	17	1.53	2.15	3
LB4	14	1,269.1	23	1.26	2.67	3
LB5	16	702.2	25	1.69	3.14	3
LB6	14.5	2,549.8	30	1.54	3.25	3
LB7	23	2,725.7	26	0.90	2.78	1
LB12	14	2,540.7	27	1.16	2.91	2
LB14	16	1,265.5	17	1.29	1.94	2
Station Mean		*1,293.5*				

Table 4.3-4. Weighted Mean Abundance (#/100 m^2) of Ichthyoplankton Eggs Collected During the Three 2008 Surveys (February, April, and July).

Taxonomic Name	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA10	LA14	LA15	LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB12	LB14	Avg.
fish eggs (undeveloped)	6,943.31	6,209.90	1,616.27	13,330.54	3,591.78	3,073.79	7,188.14	10,392.60	2,533.78	3,397.83	3,898.46	999.66	7,566.24	1,417.04	4,584.79	3,026.57	9,486.25	1,957.14	3,616.47	4,991.08
Sciaenidae/ Paralichthyidae unid. (eggs)	57.33	90.52	4.92	102.47	39.20	153.33	71.26	155.26	102.62	178.33	82.84	127.41	113.80	14.62	137.14	26.07	157.82	35.17	31.59	88.51
Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	0.21	16.71	21.31	82.49	20.84	151.67	0.20	602.74	26.19	38.07	80.65		13.76	38.80	34.10	4.81	126.94	66.78	103.02	75.23
Citharichthys spp. (eggs)	120.95	103.61	33.97	71.40	0.32	0.42	4.92	523.83		2.26	47.10	118.00	2.18	4.20	92.47	6.37	109.93	15.21	42.69	68.41
Pleuronichthys spp. (eggs)	103.83	2.99	1.39	168.81	21.91	55.60		147.70	31.85	94.35	14.47	2.84	9.13	16.86	57.79		56.36	0.29	39.67	43.47
Paralichthyidae unid. (eggs)	8.38	6.39	46.57	26.88	0.37	4.74	17.98	204.29	0.58	8.16		11.82	234.09	0.61	61.95		76.19			37.32
Sciaenidae unid. (eggs)	67.19			0.20	21.37	0.00	21.11	0.87		41.92	33.39	55.86	119.93	46.69	29.41	83.57	96.93	20.25	50.41	36.27
Engraulis mordax (eggs)	205.93	29.84	2.17	0.31	2.09	0.42		25.38		24.92	15.41	1.48	0.44		1.18	31.80	54.88			20.85
fish eggs unid.		1.81	9.21	13.35	0.21	33.19	2.07	17.66		10.37	8.73	42.40	19.87	29.15	29.22	1.06	15.08	0.76	11.85	12.95
poss. Sciaenidae unid. (eggs)		2.95					6.71					2.46			0.15	133.95		62.95	10.65	11.57
Engraulidae unid. (eggs)	149.91							0.35			3.86									8.11
Labridae/Paralichthyidae (eggs)	0.49	2.76	1.74	0.12	9.40	0.39	0.20	0.63	0.21	0.28	24.56	0.17	5.62	0.32	27.84	9.96	37.03	4.61	6.27	6.98
Labridae unid. (eggs)											3.92				6.13					0.53
Atherinops affinis (eggs)														4.31						0.23
poss. Xystreurys liolepis (eggs)																4.19				0.22
Pleuronectiformes unid. (eggs)											3.92									0.21
Labridae/Serranidae unid. (eggs)													1.67							0.09
Paralichthys californicus (eggs)											0.48		0.80							0.07
poss. Paralichthys californicus (eggs)																		0.49		0.03
Genyonemus lineatus (eggs)																			0.21	0.01
	7,657.52	6,467.48	1,737.54	13,796.57	3,707.48	3,473.57	7,312.57	12,071.32	2,695.23	3,796.49	4,217.78	1,362.12	8,087.53	1,572.60	5,062.15	3,328.35	10,217.41	2,163.65	3,912.82	

Table 4.3-5. Weighted Mean Abundance (#/100 m^2) of Ichthyoplankton Larvae (all stages combined) Collected During the Three 2008 Surveys.

Taxonomic Name	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*	*Average*
CIQ gobies	38.78	157.15	111.90	91.08	407.28	321.31	4,471.53	714.91	1,518.59	84.13	77.15	176.09	158.62	286.95	239.65	996.65	142.23	638.92	332.65	577.14
Hypsoblennius spp.	139.03	199.17	36.35	336.00	28.81	237.21	47.00	433.12	57.75	135.92	344.11	335.69	243.56	592.69	244.23	636.85	2,159.28	1,516.91	638.30	440.10
Lepidogobius lepidus	85.36	0.44	3.37	6.68	72.31	127.60	29.81	32.32	291.41	41.65	74.93	15.96	73.58	345.57	110.80	214.96	210.34	175.43	212.96	111.87
Gobiesocidae unid.	13.38	1.67						26.01			23.05	16.38	14.96	0.57	0.91	478.65	7.59	128.35	0.62	37.48
larvae, unidentified	7.77	23.93	10.21	7.37	17.43	22.12	80.29	49.71	8.55	0.68	6.63	6.30	4.61	0.19	6.79	71.11	15.29	14.69	5.72	18.92
Acanthogobius flavimanus					1.46	23.70	81.68		133.29		8.08	0.21	24.37	5.83	0.91		15.19	0.60	17.83	16.48
Genyonemus lineatus	20.07	1.69	1.83	28.80	11.34	4.95	1.45	8.54	0.39	26.36	13.05	5.67	33.70	0.60	17.89	20.96	43.66	11.54	21.30	14.41
Ruscarius creaseri	14.63	1.92	3.36	7.35				59.72			5.22	0.21	0.83		5.44	0.22	15.28		0.43	6.03
Orthonopias triacis	6.69	2.15	18.37	18.94	6.29	0.60	3.18	10.62	0.19	5.39	0.24	2.93		1.81	6.48	6.40	8.03	4.98	10.84	6.01
larval fish fragment		4.55	3.12	11.57	10.62	5.41	10.22	0.18	18.29	11.14	0.24		8.71	0.19		19.92		6.24	0.21	5.82
Cottidae unid.	14.64	0.84	14.75			4.94	0.22	26.87			3.92		9.60	0.64	11.56	0.44	15.20			5.45
Engraulis mordax	6.88			0.15	4.70	4.80	12.07	17.46	4.30		4.61	0.51	0.20	0.19	0.55	4.98	30.68	4.74	0.60	5.13
Zaniolepis frenata	6.87	0.10	1.69	0.43			0.22	66.62			5.94				0.19		0.24	4.38		4.56
Stenobrachius leucopsarus	20.58	1.57	1.69	18.36	11.19	0.40		0.36		0.21	0.24	3.18			0.19	24.73	0.48	0.20		4.39
Gobiesox spp.	0.38		11.63				29.51	0.18		0.22	0.72	0.51		1.66	5.83	6.85	0.48	6.42	5.33	3.67
Paraclinus integripinnis	0.38					4.99			0.27					4.44	5.29	19.92	29.63	4.36		3.65
Bathymasteridae unid.	6.87	0.52	1.89	0.21				25.83			0.73		0.20	4.14	5.55	5.86	0.20	3.98	0.84	2.99
Clinocottus analis		4.66	0.22	0.41			3.53	8.54	3.66			4.20	0.41	4.14	5.44	4.71	0.68	1.00	5.53	2.48
Gibbonsia spp.	6.69	0.71	1.67	0.43			30.92			0.21	0.25	0.72			0.23		0.20	3.89		2.42
Gillichthys mirabilis						0.41		9.16	9.13	0.22			0.20	0.42	6.58		7.20	3.98	0.41	1.98
Leuresthes tenuis	0.63	6.30	26.26		0.11	0.16	0.21	0.29			0.47			0.64		0.84	0.56		0.51	1.95
Rhinogobiops nicholsi		1.58				0.20	0.20	25.33	3.86							0.19	0.18			1.67
Typhlogobius californiensis		3.14		0.21			0.22	16.41			0.11	4.73			5.44					1.59
Icelinus spp.					5.88	4.27										6.40		0.20	5.33	1.16
Pomacentridae unid.								16.71			4.04			0.13		0.56				1.13
Artedius lateralis						4.48	0.22	0.21			3.92	0.26		4.14		0.22	0.40	3.78		0.93
Gobiesox rhessodon							17.44													0.92
Sebastes spp.		0.10		0.21				16.50					0.20							0.90
Icelinus quadriseriatus					0.20	0.39			0.41					0.97		4.98	7.79	0.36	0.65	0.83

Table 4.3-5. Weighted Mean Abundance (#/100 m^2) of Ichthyoplankton Larvae (all stages combined) Collected During the Three 2008 Surveys (continued).

Taxonomic Name	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*	*Average*
Neoclinus spp.	15.55							0.18												0.83
Sciaenidae unid.		3.91				4.74		0.09			0.24	0.77	0.20			4.98				0.79
Atherinopsis californiensis		0.79	0.20					0.29		0.14		0.27			5.59		7.20			0.76
Pleuronichthys guttulatus										5.18		0.00	0.20		0.23		7.20	0.20		0.68
Blennioidei unid.	7.77													4.35				0.60		0.67
Engraulidae unid.			0.10									0.26			10.88			0.18		0.60
Lythrypnus spp.						0.20		0.27	3.66							4.98				0.48
Oligocottus/Clinocottus		0.22	0.22					8.16												0.45
Paralichthyidae unid.												8.00				0.19				0.43
Syngnathus spp.			2.46												0.07				5.48	0.42
Oxylebius pictus	6.69																			0.35
Leptocottus armatus			2.55								3.92									0.34
Hypsypops rubicundus								0.10			0.19				5.29	0.37	0.11			0.32
Rathbunella spp.				0.20	5.31									0.42						0.31
Chitonotus/Icelinus				5.78																0.30
Heterostichus rostratus		0.73	0.42						3.97			0.17								0.28
Ilypnus gilberti							5.22													0.27
Porichthys notatus								0.17								4.98				0.27
Porichthys myriaster																4.98				0.26
Perciformes unid.										4.74		0.22								0.26
Labrisomidae unid.											0.25			4.06		0.56				0.26
Paralichthys californicus												0.17	4.26			0.28				0.25
Atherinops affinis	0.42	0.11	0.20			0.33	2.16	0.41			0.09			0.19			0.45			0.23
Pleuronectoidei unid.																		4.18		0.22
Syngnathidae unid.														4.14						0.22
Pleuronectiformes unid.											3.86									0.20
Atherinopsidae unid.	0.82		0.10		0.11		0.89				0.19					1.57		0.14		0.20
Pleuronichthys spp.											0.25	2.94								0.17
Clinidae unid.		0.24	1.89				0.25													0.12

Table 4.3-5. Weighted Mean Abundance (#/100 m^2) of Ichthyoplankton Larvae (all stages combined) Collected During the Three 2008 Surveys (continued).

Taxonomic Name	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*	*Average*
Clupeiformes unid.								0.36				1.48						0.18		0.11
Hexagrammidae unid.							1.94													0.10
Paralabrax spp.		1.15																		0.06
Citharichthys stigmaeus	0.15												0.23			0.56				0.05
Chaenopsidae unid.								0.17							0.23			0.18		0.03
Artedius spp.				0.21																0.02
Parophrys vetulus				0.21				0.18												0.02
Myctophidae unid.							0.25													0.01
Anchoa spp.							0.22													0.01
Alloclinus holderi			0.22																	0.01
Pleuronichthys verticalis				0.21																0.01
Pleuronectidae unid.				0.20																0.01
Ronquilus jordani	0.19																			0.01
Liparis spp.								0.18												0.01
Lyopsetta exilis								0.18												0.01
Sphyraena argentea																		0.14		0.01
	421.23	*419.53*	*256.75*	*535.02*	*583.07*	*773.21*	*4,830.81*	*1,576.35*	*2,057.72*	*316.19*	*586.65*	*587.82*	*578.67*	*1,269.08*	*702.24*	*2,549.84*	*2,725.73*	*2,540.74*	*1,265.54*	

Table 4.3-6. Seasonal Weighted Mean Abundance (#/100 m^2) of the Top Ten Ichthyoplankton Larvae (all stages combined) Collected During the Three Surveys.

Taxonomic Name	*Common Name*	*Feb 2008*	*April 2008*	*Jul 2008*	*Mean for three surveys*
CIQ gobies	gobies	347.30	151.13	1,232.98	577.14
Hypsoblennius spp.	combtooth blennies	0.00	71.79	1,248.52	440.10
Lepidogobius lepidus	bay goby	85.46	51.03	199.11	111.87
Gobiesocidae unid.	clingfishes	0.16	2.18	110.10	37.48
Acanthogobius flavimanus	yellowfin goby	45.15	4.30	0.00	16.48
Genyonemus lineatus	white croaker	31.65	11.58	0.00	14.41
Ruscarius creaseri	roughcheek sculpin	3.64	14.45	0.00	6.03
Orthonopias triacis	snubnose sculpin	6.07	9.48	2.47	6.01
Cottidae unid.	sculpins	7.78	7.35	1.23	5.45
Engraulis mordax	northern anchovy	0.00	4.35	11.02	5.13
	Survey Total	*565.70*	*426.12*	*2,888.64*	

Table 4.4-1. Percent of the Total Larvae of the Dominant Taxa Found in the 2000 and 2008 Studies (based on # larvae/100 m^2).

	2000	*2008*
CIQ goby	32.0	44.6
bay goby	16.3	8.7
northern anchovy	13.9	5.1
California clingfish/Gobiesocidae	13.0	2.9
queenfish	9.6	0
combtooth blenny	5.1	34.0

Table 4.4-2. Ichthyoplankton Station Area Designations.

Station	*Designation*
LA1	Deep Outer harbor
LA2	Shallow Outer harbor
LA3	Shallow Outer harbor
LA4	Deep Outer harbor
LA5	Inner harbor
LA6	Inner harbor
LA7	Shallow Outer harbor
LA10	Inner harbor
LA14	Inner harbor
LA15	Inner harbor
LB1	Deep Outer harbor
LB2	Shallow Outer harbor
LB3	Deep Outer harbor
LB4	Inner harbor
LB5	Deep Outer harbor
LB6	Deep Outer harbor
LB7	Deep Outer harbor
LB12	Inner harbor
LB14	Inner harbor

Table 4.5-1. Areal Abundance (#/100 m^2) and Differences of Total Fish Larvae Between Samples Collected Using Three Nets (neuston, midwater, and epibenthic) and Single Oblique CalCOFI-type Tow.

Survey	*Station*	*Area Abundance - Three Nets*	*Area Abundance – CalCOFI-type Sampling*	*Difference Three Nets - CalCOFI*	*Bray-Curtis Distance Between Samples*
April 2008	LA01	410.6	147.9	262.7	39.842
April 2008	LA02	67.0	77.9	-10.9	51.862
April 2008	LA04	230.8	284.6	-53.8	32.838
April 2008	LA05	100.6	143.3	-42.7	53.172
April 2008	LA06	239.5	236.5	3.0	59.648
April 2008	LB01	082.1	259.0	-176.9	49.789
April 2008	LB02	307.4	149.9	157.5	60.361
April 2008	LB03	22.9	62.8	-39.8	50.759
April 2008	LB05	485.2	261.2	224.1	34.590
April 2008	LB06	754.4	739.5	14.9	56.272
July 2008	LA01	8.491	599.9	249.2	60.380
July 2008	LA02	1,133.0	744.4	388.5	51.167
July 2008	LA04	1,194.0	1,738.9	-544.9	72.564
July 2008	LA05	820.6	1,970.6	-1,150.0	70.565
July 2008	LA06	1,642.8	1,145.4	497.4	75.107
July 2008	LB01	1,370.3	451.5	918.9	29.200
July 2008	LB02	1,213.2	570.1	643.1	75.837
July 2008	LB03	1,145.1	1,374.7	-229.6	75.754
July 2008	LB05	868.8	1,256.9	-388.1	73.716
July 2008	LB06	6,630.2	3,644.3	2,985.9	63.393
Averages		*978.4*	*793.0*	*185.4*	*56.841*

Note: The Bray-Curtis distance between the paired samples is also presented, which was calculated using the abundances of all the fish taxa.

Figure 4.2-1. Ichthyoplankton Sampling Locations in Los Angeles and Long Beach Harbors, January – July 2008.

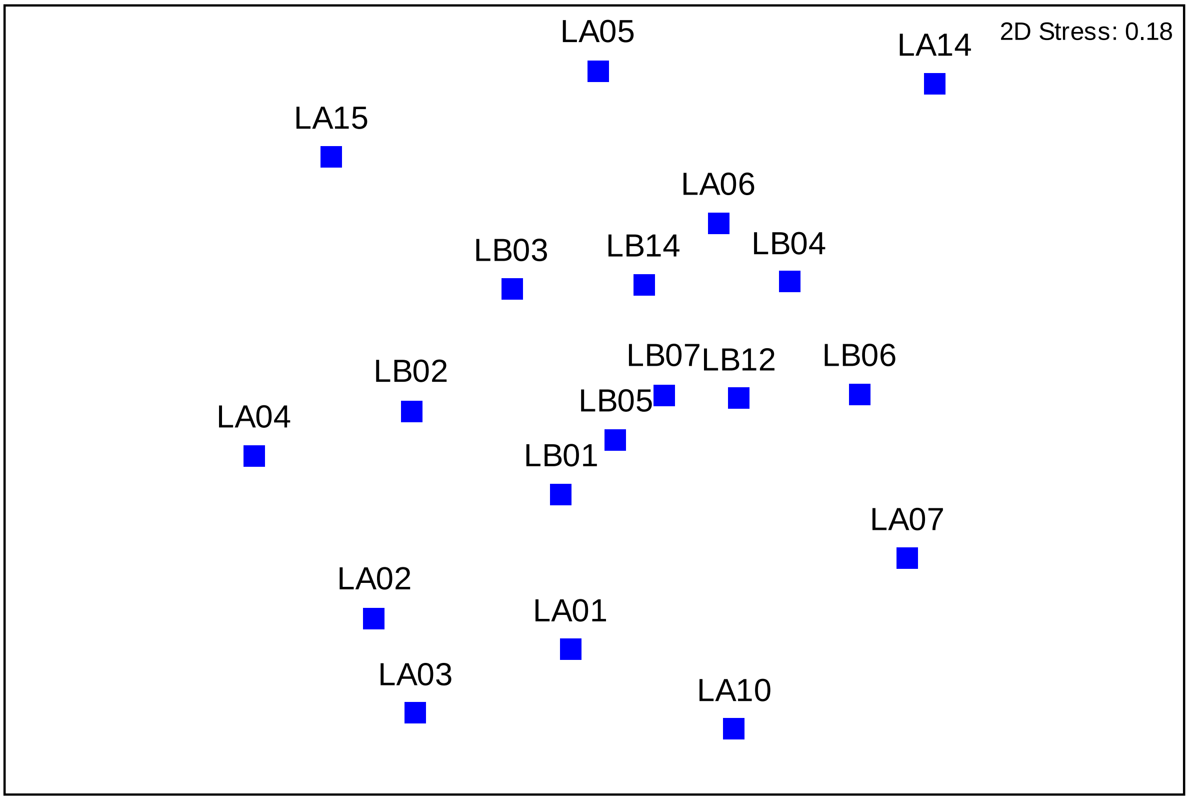


Figure 4.3-1. Two-Dimensional MDS Configuration of Bray-Curtis Distances among Los Angeles/ Long Beach Harbor Stations Based on Average Abundances of Larval Fishes from the Three Surveys.

The stress value represents the relative fit based on the rank correlation between the distances in the MDS plot and the original Bray-Curtis distances.

CHAPTER 5

BENTHIC AND EPIBENTHIC INVERTEBRATES

5.0 BENTHIC AND EPIBENTHIC INVERTEBRATES

5.1 INTRODUCTION

Invertebrate organisms (e.g., worms, shrimps, crabs, clams, snails, starfish) live within, on, or associated with the sediment that comprises the benthos. Small invertebrates that burrow within, or anchor to the bottom, and feed in the sediments or at the sediment-water interface are termed infauna. Larger invertebrates that reside at or above the sediment surface are termed epibenthic macroinvertebrates.

Invertebrates are important community members because:

- Their burrowing and feeding activities alter the physical and chemical nature of the sediments and create habitat heterogeneity, which can lead to greater biodiversity and a more productive community.
- Many of them live in direct contact with the sediments and therefore can be good indicators of sediment and habitat quality.
- They tend to be an intermediate trophic link between primary producers (e.g., plankton, algae) and higher trophic levels (e.g., fish, birds, mammals) by converting detritus and organic material from the sediments and sediment-water interface into animal biomass.
- Some are commercially important for food and bait (e.g., lobster, crabs, mussels, clams, ghost shrimp, and worms).

Because of their fundamental importance to the marine ecosystem, benthic invertebrates have been sampled as part of nearly every survey of the Los Angeles-Long Beach harbors and nearby waters that has been conducted for the past 35 years. As part of the present study, infaunal and epibenthic macroinvertebrates were sampled from a range of habitats in Long Beach and Los Angeles Harbors. Infaunal invertebrates were collected by boxcore, and epibenthic macroinvertebrates by otter trawl, as described below. A special study also was conducted to evaluate the comparability of invertebrate data collected by box core with data collected by a different sampler, the Van Veen grab, which has been used in other studies in the harbors and in regional Bight programs.

Methods used to survey infaunal invertebrates and epibenthic macroinvertebrates are described in Section 5.2. Survey results for infauna are presented in Section 5.3, and results for epibenthic macroinvertebrates are presented in Section 5.4. Species considered to be non-indigenous to the harbors are discussed in Section 5.5. A summary of spatial and temporal patterns observed in 2008 and how they compare to historical studies within the harbors is provided in Section 5.6.

5.2 METHODOLOGY

Benthic invertebrates were collected twice during the 2008 baseline study, in January (winter) and July (summer). Infauna were collected at a total of 29 stations, 15 in Los Angeles Harbor and 14 in Long Beach Harbor (Figure 5.2-1), using a 0.1m^2-surface-area box core sampler.

Epibenthic macroinvertebrates were collected at the same 19 stations sampled for fish. Methods specific to the infaunal and macroinvertebrate surveys are described below.

5.2.1 Infauna

As in previous studies of the harbors, the box core samples were separated into 0.06 and 0.04 m^2 sections using an acrylic divider (MEC 1988, 1997, 1999; SAIC 1996). The larger section was used for the infaunal sample. The infaunal sample size is similar to historical studies, which collected benthic infauna with 0.06 to 0.0625 m^2 coring devices (e.g., HEP 1976, 1980), although a 0.1 m^2 coring device also has been used (e.g., MBC 1984, City of Los Angeles 1999).

Recovery of at least 10 cm of the upper sediment layer with a relatively undisturbed surface layer was considered sufficient for analysis. Rejected cores were discarded and re-sampled. Each sample was processed through a 1.0-mm mesh screen and placed in a labeled sample jar(s); 7% magnesium sulfate ($MgSO_4$) seawater solution was then added to relax the collected animals. After approximately 30 minutes, the sample was fixed with buffered formalin to yield a 10% formalin-seawater solution. Samples were uniquely labeled by station.

Some of the stations were also sampled with a Van Veen grab sampler. The Van Veen sampler is routinely used to monitor the Terminal Island Waster Reclamation Plant in Los Angeles Harbor and is used in the Southern California Bight Regional Monitoring Program. Because a box core device has been used for most collections in the harbors, a comparison study was conducted to determine the comparability of the data obtained with the two sampling techniques. Van Veen samples were processed in the same way as box core samples.

In the laboratory, infauna samples were transferred from formalin to 70% ethanol within 7 days of sampling for long-term preservation. Infaunal samples were sorted into major taxonomic categories (annelids, crustaceans, echinoderms, molluscs, other minor phyla) using a stereoscopic microscope. Samples with extremely high abundance by a few species were split to yield smaller samples for analysis; count data were scaled-up to the whole sample depending on the fraction sorted. Whole samples were analyzed for all but a few of the collected samples. Sorted organisms were placed into vials containing 70% ethanol for long-term storage. Qualified taxonomists identified and counted the organisms to the lowest practicable taxon (usually species). Wet weight biomass (to nearest 0.01gram) was quantified for each taxonomic group after the species were identified.

5.2.2 Epibenthic Macroinvertebrates

Epibenthic macroinvertebrates were collected during the day and night along with fish during the three otter trawl surveys (see Section 3.2.2 for a description of methods). Collected invertebrates were identified to the lowest practicable taxon (usually species) and weighed (wet weight biomass in grams [g]) in the field. Organisms not identified in the field were preserved in buffered formalin and returned to the laboratory for identification and weighing.

5.2.3 Data Analysis

Infauna data were entered into a database from the taxonomic laboratory sheets. Macroinvertebrate data were coded from the field data sheets and entered into a separate database. Data were subjected to quality assurance review.

Infaunal data from box core and Van Veen samples were standardized to number per 0.1 m^2 for comparison with each other and historical data. Abundance and biomass of the trawl collected invertebrates is presented as catch per unit effort (CPUE), which represents the number of individuals captured standardized to the amount of the effort (total time or area sampled) exerted. Averages were calculated for each station across surveys and for the total mean for all stations and surveys combined.

Diversity was calculated with three different indices, which are derived measures based upon the number of species (species richness) and their abundances (equitability). The Shannon-Wiener diversity index tends to emphasize the equitability of the species distribution in a community. The Margalex Index incorporates the number of species and total number of individuals. The Dominance Index computes the number of species that account for 75% of the total abundance.

Cluster analysis was performed for the infauna data for both the winter and summer surveys. This analysis was used to identify groups of stations that were biologically similar. Species composition and relative abundance of the species defined the groups. Rare species (i.e., occurring at fewer than three stations) were excluded from the analysis. Figures of station and species dendrograms were prepared from the cluster analysis.

5.3 INFAUNA

This section presents discussions of community summary measures (Section 5.3.1), a detailed description and evaluation of species composition (Section 5.3.2) and dominant species (Section 5.3.3), summary of spatial and temporal patterns (Section 5.3.4), and a comparison of the 2008 Biological Survey results with historical studies (Section 5.3.5). The box core and Van Veen comparison is discussed in Section 5.3.6. Raw summary data and a complete listing of abundance by species and stations and of biomass data are provided in Appendix E.

5.3.1 Community Summary Measures

5.3.1.1 Abundance

A total of 10,772 infaunal invertebrates weighing 704 grams and comprising 258 species was collected across the 29 stations (Table 5.3-1). Total infaunal abundance was nearly double during the summer (7,017) compared to winter (3,755) surveys.

Mean abundances ranged from 80 to 488 individuals/0.1 m^2 (Table 5.3-1). Abundance varied with depth and location in the harbors. Abundances were similar between the inner harbor stations (80-488 individuals/0.1 m^2) and outer harbor stations (93-413 individuals/0.1 m^2), but were markedly higher in shallow water (126-488 individuals/0.1 m^2) than in deep water (80-289 individuals/0.1 m^2).

In the outer harbor, mean abundance in shallow water was nearly two times higher (mean of 249 individuals/0.1 m^2) compared to deep water (mean of 142 individuals/0.1 m^2, Table 5.3-1). In the inner harbor, mean abundance at the shallow water station (488 individuals/0.1 m^2) was approximately 3 times greater than at deepwater stations (173 individuals/0.1 m^2).

The highest mean abundances (mean > 400 individuals/0.1 m^2) were found at the Pier 300 Shallow Water Habitat and Consolidated Slip of inner Los Angeles Harbor (Stations LA7 and

LA14). The lowest mean abundances (<100 individuals/0.1 m^2) occurred in the Long Beach Southeast Basin (Station LB4), Pier J Basin (Station LB6) and inner harbor deep water (Stations LB12, LB14).

5.3.1.2 Biomass

Mean biomass values ranged from 3.4 to 89.5 g/0.1 m^2 with an overall mean of 12.4 g/0.1 m^2 (Table 5.3-1). Overall mean values across stations in the outer harbor were similar between deep (11 g/0.1 m^2) and shallow (10 g/0.1 m^2) water stations. Values in the inner harbor were more variable, with overall mean biomass across stations four times higher in deep (16 g/0.1 m^2) than in shallow water (4 g/0.1 m^2). The highest average biomass values (>20 g/0.1 m^2) were in Los Angeles outer harbor (Station LA13), Long Beach Shallow Water Habitat (Station LB2), and outer Long Beach Harbor (Station LB9). The lowest (<5 g/0.1 m^2) mean biomass values were in the Cabrillo Shallow Water Habitat (Stations LA2 and LA3), Cabrillo Basin (Station LA12), Seaplane Anchorage (Station LA8), Los Angeles West Basin (Station LA5), and Consolidated Slip of inner Los Angeles Harbor (Station LA 14).

5.3.1.3 Number of Species

A total of 258 unique species were collected over the two surveys (Table 5.3-1). The overall number of species was similar during summer (204) and winter (187) (Appendix E).

The mean number of species per station ranged from 12 to 51 (Table 5.3-1). Stations with the highest numbers of species (> 35 unique species) were located at the Pier 300 Shallow Water Habitat (Station LA7), the channel between Piers 300 and 400 (Station LA9), the deepwater outer harbor (Station LB9), the main channel of Los Angeles Harbor (Station LA4), Long Beach Shallow Water Habitat (Station LB2), and Long Beach deep outer harbor (Station LB7).

The fewest mean numbers of species (< 25 species) were found at the Cabrillo Marina (Station LA12), Los Angeles West Basin (Station LA5), Seaplane Anchorage (Station LA8), Consolidated Slip of inner Los Angeles Harbor (Station LA14), Long Beach inner harbor (Station LB14), and Slip 1 of the East Basin in Long Beach Harbor (Station LB12).

5.3.1.4 Diversity and Dominance

Shannon-Wiener diversity, which considers the equitability of abundance among species, was highest at stations in the channel between Piers 300 and 400 (Station LA9), Long Beach outer harbor (Station LB9), and Long Beach deep outer harbor (Station LB7) (Table 5.3-1). The Margalef Index, which considers the total number of individuals in all species, was highest at these stations, as well. Three stations had relatively high Shannon-Wiener diversity (Stations LA4 and LB5) or Margalef Index (Station LA6), but moderate numbers of species.

Dominance values generally were highest at stations with the highest species diversity and generally lower where diversity values were less (Table 5.3-1). Stations where 19 or more species accounted for 75% of the abundance were in Long Beach and Los Angeles outer harbor (Stations LB7, LB9, LA11). Station LA11 in outer Los Angeles Harbor also had relatively high dominance, but had moderate numbers of species and diversity.

Species diversity (Shannon-Wiener and Margalef) and dominance generally were lowest at the stations with the fewest number of species; i.e., Cabrillo Marina (Station LA12), Consolidated Slip of inner Los Angeles Harbor (Station LA14), and Seaplane Anchorage (Station LA8). Dominance also was relatively low in the Turning Basin of inner Los Angeles Harbor (Station LA15).

5.3.2 Taxonomic Composition and Dominant Taxa

The infaunal community was numerically dominated by polychaetes (48% of annual mean abundance), crustaceans (31%), and molluscs (20%) (Table 5.3-2). Echinoderms (2%) and other minor phyla (2%) were substantially less abundant. Molluscs and polychaetes accounted for most of the infaunal biomass (Table 5.3-3). Polychaetes were the most diverse taxonomic group (123 species), followed by molluscs (64 species) and crustaceans (51 species) (Table 5.3-4). The substantial decline in abundance between summer and winter, a pattern noted in Section 5.3.1, was primarily associated with a decline in crustacean abundance (Appendix E).

The non-indigenous semele clam (*Theora lubrica*) was the most abundant species in the Los Angeles-Long Beach harbor complex, accounting for approximately 10% of the total abundance of infauna collected in the harbors (Table 5.3-5). Other dominant species, each accounting for approximately 2.5 to 6% of the total abundance, included a leptostracan crustacean (*Nebalia pugettensis*-complex), an amphipod crustacean (*Amphideutopus oculatus*), a pea crab (*Scleroplax granulata*), and polychaete worms (*Cossura* sp. A, *Monticellina siblina* [reported as *Tharyx* sp. in previous studies], *Pisa agassizi, Pseudopolydora paucibranchiata, Streblosoma sp. B*). Most of these species have been numerical dominants in previous studies of the harbors (HEP 1976, 1980; MBC 1984, MEC 1988, MEC 2002).

Several of these species were relatively widely distributed, although abundance levels varied among stations (e.g., *Aphelochaeta petersenae*, *Cossura* sp. A, *Monticellina siblina*, *Pista agassizi*, *Streblosoma* sp. B, *Scleroplax granulata*, and *Theora lubrica*) (Appendix E). Other dominant species with relatively widespread distribution included the amphipod *Eochelidium* sp. A and the polychaete *Pista wui*.

In contrast, a few species were more restricted in distribution by depth or location within the harbors. For example, *Amphideutopus oculata* and *Pseudopolydora paucibranchiata* were most abundant in shallow water (Stations LA2, LA3, LA7, LB2). *Nebalia pugettensis*-complex was most abundant in the Consolidated Slip in inner Los Angeles Harbor (Station LA14).

5.3.3 Spatial Patterns of Abundance

Results of cluster analysis investigating spatial patterns in species composition and abundance are summarized below according to survey.

5.3.3.1 Summer Survey

Four station cluster groups and nine species cluster groups were identified for the summer survey (Figure 5.3-1). Station cluster groups for the most part consisted of a mix of outer and inner harbor stations without a clear distinction between inner and outer harbor habitats. One exception was the separation of outer harbor shallow-water habitats (Stations LA2, LA3, LB2, LA7, LA8) from open-water, deepwater habitats (Stations LA1, LB1, LB9, LA11, LA12).

Outer harbor open-water habitats in deep water were characterized by relatively higher abundances of ophiuroid echinoderms (*Amphiodia urtica*), amphipod (*Eochelidium* sp. A) and ostracod (*Euphilomedes carcarodonta*) crustaceans, bulloid gastropods (*Volvulella panamica*), bivalve molluscs (*Nuculana taphria*), and polychaete worms (*Laonice cirrata*, *Nereis* sp. *A, Streblosoma* sp. B). Shallow-water outer harbor stations were characterized by relatively higher abundances of amphipod crustaceans (*Amphideutopus oculatus*, *Corophium heteroceratum*), California surf clam (*Mactrotoma californica*), and polychaete worms (*Pseudopolydora paucibranchiata*, *Cossura candida*). Several of these outer harbor species have been associated with background or low enrichment environments associated with open-water coastal areas (MEC 2002).

The other two station cluster groups consisted of outer and inner harbor basins, channels, and slips. Species assemblages within these groups were similar between Long Beach and Los Angeles Harbors. One of the cluster groups had relatively higher abundance of *T. lubrica*. Within these two cluster groups, outer and inner harbor basins and slips generally had relatively higher abundances of polychaete worms such as *Aphelochaeta petersenae*, *Cossura candida*, *Monticellina siblina*, *Pista wui*; scaphapod molluscs (*Gadila aberrans*), and pea crabs (*Scleroplax granulata*). Inner harbor channel stations had higher relative abundances of several polychaete worms such as *Euchone limnicola*, *Paramage scutata*, *Pista agassizi*, *Spiophanes dupex*, and *Streblosoma* sp. B. A few of these species, including *Aphelochaeta*, *Euchone*, and *Monticellina* have been associated with low to moderate organic enrichment (MEC 2002). This is not unexpected in areas with relatively lower tidal circulation.

5.3.3.2 Winter Survey

The cluster analysis indicates that species composition was similar throughout the harbors during the winter (Figure 5.3-2). There were three major station cluster groups; however, only one included stations that were aligned by either location or depth. That group consisted of stations in the western side of outer Los Angeles Harbor, including shallow and deepwater habitats and the Cabrillo Basin (Stations LA3, LA7, LA10, LA11, and LA12). The other two cluster groups each included a mix of inner and outer harbor stations covering both shallow and deep water, including open water, basins, channels, and slips.

5.3.4 Summary of Spatial and Temporal Variations

Species composition showed little change between the summer and winter surveys. However, abundances were generally higher in summer than winter. Species composition differed among shallow and deepwater habitats in the outer harbor with both being relatively diverse in terms of number of species, but abundances at shallow-water stations were approximately twice those at deepwater stations. There was little difference in species composition among deepwater stations located in basins, channels, or slips of the inner and outer harbors.

Species assemblages of benthic invertebrates can be indicative of habitat quality. Certain species are tolerant of adverse environmental conditions, such as low oxygen and high pollutant levels, and others are found only in more pristine conditions. Accordingly, the patterns of occurrence of those indicator species can be used to deduce habitat quality, and past studies have evaluated habitat quality in that manner (MEC 1988, MEC 2002). In the present study, species assemblages indicated that stations in the outer harbor had the highest habitat quality as indicated by relatively greater abundance by species characteristic of areas of background to low organic enrichment, i.e., pollution. The species assemblages found in the inner harbor, basins, and slips were indicative of low to moderate organic enrichment compared to the open-water outer harbor stations. This result suggests that species composition is influenced by tidal circulation in the harbors.

5.3.5 Historical Comparisons

The benthic community of the harbors was first studied in the 1950s by Reish (1959). The harbor environment was quite different then, with several inner harbor and slip areas severely polluted and either devoid of marine life or dominated by the polychaete *Capitella capitata*, which is considered an indicator of pollution or disturbance (Reish 1959, Pearson and Rosenberg 1978). Areas considered “healthy” occurred in the outer harbor and were dominated by the polychaetes *Cossura candida, Nereis procera,* and “*Tharyx* ? *parvus*.”

Similar species have been collected in the harbors over the last 30 years (Table 5.3-6). However, the relative abundances of the species have varied, and there has been a shift in the dominance of several species. Ciratulid polychaetes (*Monticellina*, *Tharyx)* have been numerical dominants since the 1950s. The pollution-tolerant polychaete *Capitella capitata*-complex ranked as one of the top five dominants in the 1970s and 1983. However, it was not a numerical dominant in 1986-1987, 1994, 1996, 2000, or 2008. A decrease in the occurrence of this species complex indicates a trend of benthic habitat improvement over time. Also suggestive of habitat quality improvement was the similarity in species assemblages between inner and outer harbor basins, slips, and channels with the present study.

Similar to the 2000 study, the present study showed a substantial increase in abundance from the winter to the summer survey. During 2000, the number of species also showed a similar seasonal difference; however, the numbers of species were similar among winter and summer surveys in 2008. MEC (2002) speculated that the seasonal difference in species number in 2000 may have been related to large-scale oceanographic conditions because the study following a strong El Niño-La Niña period. The similarity in species composition throughout the year during the 2008 study was similar to other historical studies.

5.3.6 Box Core and Van Veen Comparison

Both box core and Van Veen samplers have been used to survey the benthic infauna community in the harbors. Historical and current baseline studies in the harbors have generally used a box corer. The same box core sampler and methodology was used for the present study as with the 2000 study. Both the box core and Van Veen sampler collect samples with a surface area of 0.1 m^2. However, historical studies using a box corer have subdivided the sample into 0.06 m^2 and 0.04 m^2 fractions with analysis of the infauna from the larger fraction (MEC 1988, 1997, 1999; SAIC 1996, MEC 2002). This was done to provide a comparable sample to early historical studies that used 0.06 to 0.0625 m^2 coring devices (e.g., HEP 1976, 1980). In contrast, the Van Veen sampler has been adopted for use with sanitation district outfall monitoring, including the Terminal Island Water Reclamation Plant monitoring program in Los Angeles Harbor, and has been used in recent regional Bight monitoring programs.

A special study was conducted to evaluate whether assessment of the benthic infauna community is substantially influenced by choice of these two types of sampling gear and analysis of samples that differ between 0.06 m^2 and 0.1 m^2 in surface area. During the summer survey, ten benthic stations were sampled with a Van Veen grab sampler in addition to the box core sampler. Count data were standardized to 0.1 m^2 for the comparison.

No statistical differences in abundance or number of species were detected among gear types with *t*-tests ($p>0.2$) or Kruskal-Wallis one-way analysis of variance on ranks ($P>0.9$). A total of 2,677 invertebrates were collected by Van Veen and 2,160 were collected by box core (Table 5.3-7). The overall mean abundance across stations also was similar with box core (216) and Van Veen (267) samplers. A similar result was seen for number of species: 378 species were collected by Van Veen and 355 species were collected by box core and overall means across stations were 37.8 and 32.4, respectively (Table 5.3-8). Although results were more variable at some stations when taxonomic categories were compared, there was no consistent trend of higher or lower values associated with either gear type. This suggests that variability among samples related more to small-scale differences in organism abundance (e.g., patchiness) at a station level rather than to a broader trend related to gear type. Results of the special study indicate that historical and more recent assessments of the infauna community in the harbors using coring devices with surface areas ranging from 0.06 to 0.1 m^2 should be comparable.

5.4 EPIBENTHIC MACROINVERTEBRATES

This section presents a discussion of summary community measures (Section 5.4.1), descriptions and evaluation of species composition (Section 5.3.2), and dominant species (Section 5.3.3), a summary of spatial and temporal patterns Section 5.3.4, and a comparison of the 2008 baseline study results with historical studies (Section 5.4.5). Exotic species are addressed together with infauna in Section 5.5. Raw summary data are provided in Appendix E.

5.4.1 Community Summary Measures

5.4.1.1 Abundance

A total of 7,035 macroinvertebrates representing 61 taxa was collected over the three surveys (Table 5.4-1). Five species accounted for 86% of the catch: black-spotted shrimp *(Crangon nigromaculata* 38.4%), ridgeback prawn (*Sicyonia ingentis* 16%), black-tailed bay shrimp (*Crangon nigricauda*), Xantus' swimming crab (*Portunus xantusii* 10.6%), and *Heptacarpus* shrimps (8.3%).

Mean catch for day sampling ranged from 2 to 93 individuals at the various stations (Table 5.4-2), with the greatest catch in the Los Angeles main channel (Station LA4) and least at the Pier 300 shallow-water habitat (Station LA7) and Los Angeles inner harbor West Basin (Station LA 15). The overall mean catch per station during the day was 21 individuals.

Mean catch per station at night was five times greater than during the day, ranging from 9 to 230 individuals (Table 5.4-2). The highest values at night were at Stations LA2, LA6, LA15, and LB3. The overall mean catch per station for night sampling was 103 individuals, nearly five times the day sampling value. The greatest difference in catch between day and night was in the Turning Basin of inner Los Angeles Harbor (Station LA15), with 10 times more invertebrates caught at night than during the day. There was no obvious pattern in macroinvertebrate abundance with depth or location. The mean combined day-night abundances ranged from 9 to 127 individuals and were greatest at Station LB3 and least at Station LA3.

Total combined catch across day and night trawls was relatively higher during winter (3619) and spring (2254) surveys compared to the summer survey (878) (Appendix E).

5.4.1.2 Biomass

Total wet-weight biomass of macroinvertebrates across all stations was 59.1 kg (Table 5.4-2). Mean biomass by station ranged from 0.01 to 4.49 kg for day sampling and 0.06 to 1.1 kg for night sampling. Mean biomass values were generally similar between day and night. Station LB1 in Long Beach outer harbor had the highest mean biomass values for both day and night collections. Relatively high mean biomass was collected during both day and night collections in outer harbor shallow water (Stations LA7 and LB2). There were no other obvious patterns in macroinvertebrate biomass with depth or location.

5.4.1.3 Number of Species

A total of 61 unique species were collected from the 19 stations sampled over the three surveys (Table 5.4-2; Appendix E). The average number of species caught per trawl ranged from 2 to 9. The number of species caught during day and night combined ranged from 6 to 15. Generally, twice as many species were collected at night than during the day. The stations with the greatest variety of species across day-night sampling were in the outer harbor (Stations LA1, LA3, LA4, LA6, LB3). The fewest species were caught in outer harbor shallow water (Stations LA2, LA7, and LB2). There were no other obvious patterns in macroinvertebrate biomass with depth or location.

5.4.1.4 Diversity Indices and Dominance

In general, the diversity of macroinvertebrates in trawl catches was low (Table 5.4-3). Mean Shannon-Wiener diversity ranged from 0 to 1.03 in day samples, 0.34 to 1.02 in night samples, and 0.57 to 1.37 combined across sampling periods. Margalef diversity ranged from 0 to 0.8 in day samples, 0.31 to 0.51 in night samples, and 0.47 to 1.19 combined across day-night sampling. Dominance values also were relatively low, with 1 to 5 species accounting for 75% of the trawl catch at all stations for day, night, and combined samples.

5.4.2 Species Composition

The most abundant species tended to be found at all stations, although in varying abundances (Table 5.4-4). The black-spotted shrimp, Xantus' swimming crab, and *Heptacarpus* shrimp were caught at all stations, the ridgeback prawn and black-tailed bay shrimp were caught at most stations, and the tuberculate pear crab was collected at more than half the stations. Other species were caught in low numbers and contributed unequally to species composition. The Xantus' swimming crab generally was more abundant in shallow-water habitats, but patterns for other taxa were not evident.

5.4.3 Dominant and Special Interest Species

Crustaceans (prawns, shrimps, and crabs) dominated the trawl catches. Over 6,000 individuals representing 87% of the total catch over the three surveys was accounted for by the five most abundant species (black-spotted shrimp, black-tailed bay shrimp, ridgeback prawn, *Heptocarpus* shrimps, and Xantus' swimming crab) (Table 5.4-1).

Other relatively abundant taxa, with 82 to 236 individuals caught in all samples, were also crustaceans: tuberculate pear crab (*Pyromaia tuberculata*), Northern crangon shrimp (*Crangon alaskensis*), and spotted ridgeback prawn (*Sicyonia penicillata*).

Several of the invertebrates found in the harbors have economic importance for the commercial and sport fishing industry, although commercial fishing does not occur within the Ports. The harbors provide nursery and adult habitat for many species, which contributes to the maintenance of these resources within and offshore San Pedro Bay. Species of commercial or recreational importance that were collected in the harbors included prawns, brown shrimp (*Penaeus californiensis* - a total of 48) and California spiny lobster (*Panulirus interruptus* – a total of 43).

5.4.4 Summary of Spatial and Temporal Variations

Trawl invertebrate catch varied among stations, but there were no distinct spatial patterns in species distribution or abundance. Substantially more macroinvertebrates were collected at night than during the day. There also were more individuals caught during each of the winter and spring surveys than the summer survey.

5.4.5 Historical Comparisons

The first comprehensive study of epibenthic macroinvertebrates caught during trawl collections was conducted in outer Los Angeles Harbor (MEC 1988). Trawls in inner and outer Long Beach Harbor were collected in 1994 and 1996 (MEC 1996; SAIC and MEC 1996, 1997). Since 1993, the City of Los Angeles has reported trawl invertebrate catch in the vicinity of the TITP outfall as part of their annual NPDES monitoring program (e.g., CLAEMD 2000, 2008). The 2000 biological baseline study reported macroinvertebrate catch from trawls for both inner and outer harbors for both Ports (MEC 2002).

Table 5.4-5 compares the ten most abundant species collected by trawls during this 2008 Biological Survey with other relevant historical studies. Similar species have dominated the catch since the 1980s: black-spotted shrimp, ridgeback prawn, tuberculate pear crab, Xantus' swimming crab, and, in earlier studies, the non-indigenous New Zealand bubble snail (*Philine auriformis*). *Philine auriformis* was caught in higher abundance in the 1990s and 2000 than in the 1980s, but relatively few were collected during the present study (*Philine* spp.). *P. auriformis* was collected at seven of the twelve stations in outer Los Angeles Harbor surveyed as part of the TITP monitoring, but in relatively low numbers (CLAEMD 2008).

A notable difference in trawl catch among surveys was the occurrence of several fouling organisms in the trawls from Los Angeles Harbor in the 1980s (*Balanus*, *Corynactis, Crepidula, Mytilus*), whereas these taxa have been rarely caught in trawls since then. It is possible that differences in methods may relate to that result. On the other hand, the ophiuroid *Ophiothrix spiculata* was one of the numerically dominant organisms in the 1980s, whereas in subsequent surveys it has been a minor component of the catch.

5.5 EXOTIC SPECIES

A total of 10 non-indigenous (introduced) and 32 cryptogenic species (of unknown origin) were identified among the 313 species represented by the collected infauna and macroinvertebrates (Appendix E). The overall percentage of introduced and cryptogenic species identified with the present study (14%) is similar to the 15% reported for the 2000 study (MEC 2002); however, the proportion of introduced species was substantially less in the present study compared to the 25 reported in 2000. This was due in part to more species being collected in 2000 (409). However, there also has been further distinction of introduced versus cryptogenic species since the 2000 study (e.g., Ranasinghe et al. 2005, Foss 2008).

Approximately 12% of the infaunal abundance was comprised of non-indigenous taxa, including relatively dominant taxa such as *Theora lubrica* (10%) and *Eochelidium* sp. A (1.8). The non-indigenous New Zealand bubble snail, *Philine auriformis*, accounted for less than 1% of the macroinvertebrate abundance (Appendix E), which is less than noted during the 2000 study (MEC 2002).

The relative abundance of *Theora lubrica* has increased in the harbors since the 1970s as well as since 2000 (refer to Tables 5.3-6 and 5.4-5). For example, *T. lubrica* had higher abundance in areas with finer sediments and at adjacent stations during the 2000 study (MEC 2002). In contrast, this species occurred at 25 of the 29 stations surveyed during the present study, although abundance was highest in Los Angeles Harbor.

Other non-native species collected in relatively low abundance included amphipods (*Caprella simia, Corophium heteroceratum*, *Grandidierella japonica, Monocorophium insidiosum*), clam (*Venerupis phillipinarium*), mussels (*Mytilus galloprovincialis*), and polychaete worms (*Nicolea* sp. A).

One cryptogenic species dramatically decreased in relative abundance since the 2000 study. The polychaete *Pseudopolydora paucibranchiata* represented approximately 22% of the total infaunal abundance in 2000, but accounted for less than 3% of the abundance in 2008. In contrast, *Nebalia pugettensis*-complex accounted for a relatively higher percentage of abundance in 2008 (6%) compared to 2000 (<1%). Several cryptogenic species accounted for a similar proportion of total abundance between 2000 and 2008 such as *Cossura candida* (1%), and *Scoletoma* sp. A (<1%).

Table 5.3-1. Mean Benthic Infauna Abundance, Biomass, Number of Species, Diversity, and Dominance in Los Angeles and Long Beach Harbors, 2008.

Station	*Description*	*Depth (m)*	*Mean Abundance*	*Mean Biomass (g)*	*Mean # spp*	*Mean Shannon-Wiener Diversity*	*Mean Margalef Diversity*	*Mean Dominance*
LA1	Deep Outer harbor	22.9	132	14.4	32	2.2	5.7	15
LA10	Inner harbor	15.8	115	7.6	31	2.2	5.6	15
LA11	Deep Outer harbor	16.5	108	7.7	34	2.3	6.3	27
LA12	Inner harbor	11.9	143	4.7	20	1.9	3.6	6
LA13	Inner harbor	14.3	289	89.5	32	2.0	5.1	9
LA14	Shallow Inner harbor	7.3	488	4.1	12	1.3	1.9	5
LA15	Inner harbor	17.1	228	8.5	28	1.9	4.5	6
LA2	Shallow Outer harbor	6.1	249	3.4	33	1.9	5.2	8
LA3	Shallow Outer harbor	6.4	231	4.3	29	2.4	5.0	10
LA4	Deep Outer harbor	17.1	179	8.2	38	2.8	6.8	14
LA5	Inner harbor	18.3	185	3.8	24	2.2	4.3	7
LA6	Inner harbor	16.2	255	14.2	43	2.7	7.3	13
LA7	Shallow Outer harbor	5.5	413	7.7	38	2.4	6.0	7
LA8	Shallow Outer harbor	4.9	202	3.4	17	1.9	3.0	4
LA9	Shallow Outer harbor	18.3	126	15.3	38	2.8	7.3	19
LB1	Deep Outer harbor	12.5	110	6.3	34	2.7	6.4	18
LB10	Deep Outer harbor	20.4	134	8.5	28	2.5	5.2	12
LB11	Deep Outer harbor	13.4	165	5.0	34	2.6	6.2	15
LB12	Inner harbor	13.7	80	5.7	23	2.4	4.7	11
LB13	Deep Outer harbor	14.3	133	14.2	35	2.7	6.5	18
LB14	Inner harbor	18.3	83	5.8	22	2.3	4.4	11
LB2	Shallow Outer harbor	5.2	276	26.9	39	2.7	6.5	15
LB3	Deep Outer harbor	13.7	177	11.4	28	2.5	5.0	12
LB4	Inner harbor	16.5	180	7.2	32	2.6	5.7	15
LB5	Deep Outer harbor	17.7	134	8.8	34	2.8	6.3	17
LB6	Deep Outer harbor	16.5	93	9.4	31	2.7	6.2	18
LB7	Deep Outer harbor	23.2	155	14.2	40	2.8	7.2	20
LB8	Deep Outer harbor	14.0	120	11.3	34	2.7	6.6	16
LB9	Deep Outer harbor	24.4	204	20.4	51	3.0	8.9	24
		Station Mean	186	12.1	31.2	2.4	5.6	13
		Grand Total Across Surveys	*10,772*	*704*	*258*			

Table 5.3-2. Mean and Total Benthic Infauna Abundance by Taxonomic Groups in Los Angeles and Long Beach Harbors, 2008.

Station	Description	Depth (m)	Crustaceans	Echinoderms	Molluscs	Polychaetes	Other	Annual Mean	Grand Total
LA1	Deep Outer harbor	23	18	17	107	125	10	138	263
LA10	Deep Outer harbor	16	45	7	73	103	18	123	230
LA11	Deep Outer harbor	16	43	10	35	117	20	113	217
LA12	Inner harbor	12	92	2	105	85	5	144	285
LA13	Inner harbor	14	30		208	327	20	293	578
LA14	Inner harbor	7	858			113	3	488	975
LA15	Inner harbor	17	83	3	105	277	7	238	457
LA2	Shallow Outer harbor	6	193	3	127	185	2	255	498
LA3	Shallow Outer harbor	6	185	8	160	115	10	239	462
LA4	Deep Outer harbor	17	92		23	217	33	183	358
LA5	Inner harbor	18	78		43	247	3	186	370
LA6	Inner harbor	16	50	3	90	370	8	261	510
LA7	Shallow Outer harbor	5	345	15	200	272	3	418	825
LA8	Shallow Outer harbor	5	220	2	15	167		202	403
LA9	Shallow Outer harbor	18	25	8	105	135		137	252
LB1	Deep Outer harbor	12	72	5	37	113		113	220
LB10	Deep Outer harbor	20	80		45	143	7	138	268
LB11	Deep Outer harbor	13	67		62	207	5	170	330
LB12	Inner harbor	14	45		48	67	2	81	160
LB13	Deep Outer harbor	14	57		47	157	13	137	265
LB14	Inner harbor	18	45		48	78	2	87	167
LB2	Shallow Outer harbor	5	250	20	132	167	3	286	552
LB3	Deep Outer harbor	14	53		40	263	5	181	353
LB4	Deep Outer harbor	16	108	12	15	233	20	194	360
LB5	Deep Outer harbor	18	37	2	35	192	12	138	268
LB6	Deep Outer harbor	16	12	2	50	122	7	96	187
LB7	Deep Outer harbor	23	67	3	27	210	18	163	310
LB8	Deep Outer harbor	14	13	5	67	150	5	120	240
LB9	Deep Outer harbor	24	65	40	110	223	17	228	408
		Mean Total	*3,328*	*167*	*2,158*	*5,178*	*258*	*5,545*	*10,772*

Table 5.3-3. Mean and Total Benthic Infauna Biomass by Taxonomic Groups in Los Angeles and Long Beach Harbors, 2008.

Station	*Description*	*Depth (m)*	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Others*	*Annual Mean*	*Grand Total*
LA1	Deep Outer harbor	22.9	0.2	0.9	1.7	7.6	4.0	14.4	28.8
LA10	Deep Outer harbor	15.8	0.7	0.8	1.1	4.8	0.2	7.6	15.1
LA11	Deep Outer harbor	16.5	0.0	0.5	1.5	4.6	1.0	7.7	15.3
LA12	Inner harbor	11.9	0.2	0.3	2.1	2.0	0.1	4.7	9.3
LA13	Inner harbor	14.3	0.1	0.0	79.0	8.9	1.6	89.5	179.1
LA14	Inner harbor	7.3	2.3	0.0	0.0	1.8	0.0	4.1	8.3
LA15	Inner harbor	17.1	0.7	0.0	0.6	7.1	0.1	8.5	17.0
LA2	Shallow Outer harbor	6.1	1.4	0.1	1.4	0.5	0.0	3.4	6.9
LA3	Shallow Outer harbor	6.4	0.4	0.2	1.9	1.7	0.1	4.3	8.5
LA4	Deep Outer harbor	17.1	1.8	0.0	0.5	5.7	0.2	8.2	16.5
LA5	Inner harbor	18.3	1.0	0.0	0.4	2.0	0.5	3.8	7.5
LA6	Inner harbor	16.2	1.1	0.0	1.2	11.8	0.1	14.2	28.3
LA7	Shallow Outer harbor	5.5	2.8	0.6	3.2	1.1	0.0	7.7	15.3
LA8	Shallow Outer harbor	4.9	2.5	0.1	0.1	0.7	0.0	3.4	6.8
LA9	Shallow Outer harbor	18.3	8.8	0.2	0.9	5.3	0.1	15.3	30.6
LB1	Deep Outer harbor	12.5	0.4	0.5	0.7	4.7	0.0	6.3	12.7
LB10	Deep Outer harbor	20.4	0.4	0.0	2.9	5.1	0.0	8.5	17.0
LB11	Deep Outer harbor	13.4	1.1	0.0	1.3	2.6	0.0	5.0	10.1
LB12	Inner harbor	13.7	0.3	0.0	1.7	3.8	0.0	5.7	11.4
LB13	Deep Outer harbor	14.3	0.3	0.0	8.5	5.2	0.2	14.2	28.4
LB14	Inner harbor	18.3	1.5	0.0	0.7	3.5	0.0	5.8	11.5
LB2	Shallow Outer harbor	5.2	18.2	1.1	4.7	3.0	0.0	26.9	53.8
LB3	Deep Outer harbor	13.7	2.5	0.0	0.8	8.0	0.1	11.4	22.8
LB4	Deep Outer harbor	16.5	0.3	0.1	0.2	3.2	3.4	7.2	14.3
LB5	Deep Outer harbor	17.7	0.7	0.0	1.4	6.6	0.1	8.8	17.7
LB6	Deep Outer harbor	16.5	0.1	0.0	0.6	5.0	3.8	9.4	18.9
LB7	Deep Outer harbor	23.2	3.3	0.3	0.3	8.3	2.0	14.2	28.4
LB8	Deep Outer harbor	14.0	4.2	0.6	1.4	5.0	0.1	11.3	22.6
LB9	Deep Outer harbor	24.4	0.8	2.4	3.2	8.9	5.1	20.4	40.7
Mean Total			*58.1*	*8.8*	*123.8*	*138.7*	*22.5*	*351.8*	*703.7*

Table 5.3-4. Mean and Total Number of Benthic Infauna Species by Taxonomic Groups in Los Angeles and Long Beach Harbors, 2008.

Station	*Description*	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Other Minor Phyla*	*Combined Annual Mean*	*Grand Total*
LA1	Deep Outer harbor	6	4	16	25	4	32	107
LA10	Deep Outer harbor	8	2	8	14	3	31	68
LA11	Deep Outer harbor	3	2	5	23	4	34	72
LA12	Inner harbor	6	1	5	9	2	20	42
LA13	Inner harbor	7	0	9	32	5	32	105
LA14	Inner harbor	3	0	0	9	1	12	24
LA15	Inner harbor	5	1	2	21	2	28	60
LA2	Shallow Outer harbor	12	1	9	13	1	33	69
LA3	Shallow Outer harbor	12	2	16	17	2	29	98
LA4	Deep Outer harbor	13	1	7	41	3	38	128
LA5	Inner harbor	9	0	8	27	3	24	93
LA6	Inner harbor	8	1	7	29	3	43	91
LA7	Shallow Outer harbor	14	2	11	13	1	38	82
LA8	Shallow Outer harbor	9	1	2	7	0	17	33
LA9	Shallow Outer harbor	7	1	12	22	0	38	82
LB1	Deep Outer harbor	14	2	12	33	2	34	125
LB10	Deep Outer harbor	8	0	5	15	2	28	57
LB11	Deep Outer harbor	10	0	4	21	2	34	71
LB12	Inner harbor	9	0	6	19	1	23	67
LB13	Deep Outer harbor	8	0	7	19	3	35	72
LB14	Inner harbor	8	1	7	24	1	22	79
LB2	Shallow Outer harbor	17	5	16	27	2	39	132
LB3	Deep Outer harbor	6	0	5	18	2	28	59
LB4	Deep Outer harbor	5	2	5	23	4	32	75
LB5	Deep Outer harbor	8	1	6	30	2	34	91
LB6	Deep Outer harbor	3	1	13	20	3	31	76
LB7	Deep Outer harbor	8	1	6	26	4	40	86
LB8	Deep Outer harbor	4	1	7	23	1	34	68
LB9	Deep Outer harbor	6	3	17	27	3	51	108
	Mean Total	*8*	*1*	*8*	*21*	*2*	*31*	*80*
	Grand Total	*51*	*6*	*64*	*123*	*15*	*N/A*	*258*

Table 5.3-5. Total Abundance of Dominant Benthic Infauna Species in Los Angeles and Long Beach Harbors, 2008.

Taxon Code	*Species/Taxon*	*Total Abundance*	*% of Total*
M	*Theora lubrica***	1,443	10.4
C	*Nebalia pugettensis*-complex*	803	5.8
P	*Cossura* sp. A	665	4.8
P	*Streblosoma* sp. B	577	4.2
P	*Monticellina siblina**	465	3.4
C	*Amphideutopus oculatus*	427	3.1
C	*Scleroplax granulata*	378	2.7
P	*Pista agassizi*	370	2.7
P	*Pseudopolydora paucibranchiata**	350	2.5
P	*Pista wui*	345	2.5
C	*Euphilomedes carcarodonta*	320	2.3
C	*Corophium heteroceratum***	297	2.1
C	*Neotrypaea gigas*	270	2.0
C	*Eochelidium* sp. A**	255	1.8
P	*Euchone limnicola*	250	1.8
P	*Spiophanes berkeleyorum*	232	1.7
C	*Listriella goleta*	222	1.6
P	*Paramage scutata*	210	1.5
P	*Leitoscoloplos pugettensis*	187	1.4
P	*Aphelochaeta petersenae*	185	1.3
P	*Spiophanes duplex**	170	1.2
M	*Mactrotoma californica*	167	1.2
C	*Caecognathia crenulatifrons*	135	1.0
C	*Nuculana taphria*	133	1.0
M	*Paraprionospio alata*	132	1.0
P	*Scoletoma* sp. A*	128	0.9
P	*Laonice cirrata*	110	0.8
P	*Cossura candida**	108	0.8
O	*Tubulanus polymorphus*	107	0.8
C	*Amphiodia urtica*	88	0.6
P	*Chaetozone corona*	82	0.6
C	*Ampelisca cristata microdentata*	82	0.6
P	*Glycera americana*	80	0.6
P	*Sigambra tentaculata*	78	0.6
P	*Petaloclymene pacifica*	77	0.6
M	*Gadila aberrans*	77	0.6
	Total represented by dominant species	*10,004*	*72.4*
	Total abundance all species	*10,772*	*100*
	Total number of unique species	*258*	

** Non-indigenous, * Cryptogenic (origin unknown)

Table 5.3-6. Historical Comparison of the Ten Most Abundant Benthic Infauna Taxa, in Descending Order of Dominance, in Los Angeles and Long Beach Harbors.

Year	*1954*	*1973-1974*	*1978*	*1983*	*1986-1987*	*1994 and 1996*	*2000*	*2008*
Source	*Reish 1959*	*HEP 1976*	*HEP 1980*	*MBC 1984 ***	*MEC 1988**	*SAIC/MEC 1997 ***	*MEC 2002*	*Present Study*
1	*Pseudopolydora paucibranchiata*	*Tharyx ? parvus*	*Cossura candida*	*Cossura candida*	*Cossura candida*	*Cossura candida*	*Pseudopolydora paucibranchiata*	*Theora lubrica*
2	*Tharyx parvus*	*Capitita ambiseta*	*Mediomastus californiensis*	*Prinospio cirrifera*	*Prionospio lighti*	*Leitoscoloplos pugettensis*	*Amphideutopus oculatus*	*Nebalia pugettensis-complex*
3	*Cossura candida*	*Cossura candida*	*Tharyx* sp.	*Capitella capitata*	*Mediomastus* spp.	*Aphelochaeta multifilis* Type 2	*Cossura* sp. A	*Cossura spp. A*
4	*Capitella capitata*	*Capitella capitata*	*Prionospio cirrifera*	*Pseudopolydora paucibranchiata*	*Levinsenia gracilis*	*Chaetozone corona*	*Theora lubrica*	*Streblosoma spp. B*
5	*Cirriformia luxuriosa*	*Paraonis gracilis oculata*	*Capitella capitata*	*Polydora ligni*	*Euchone limnicola*	*Amphideutopus oculatus*	*Euphilomedes carcharodonta*	*Monticellina siblina*
6	*Dorvillea articulata*	*Euchone limnicola*	*Paraonis gracilis oculata*	*Tharyx* sp.	*Theora lubrica*	*Mediomastus* sp.	*Monticellina siblina*	*Amphideutopus oculatus*
7	*Phoronids*	*Chaetozone corona*	*Euchone limnicola*	*Mediomastus ambiseta*	*Tharyx* sp. C	*Monticellina tesselata*	*Euchone limnicola*	*Scleroplax granulata*
8	*Nereis procera*	*Sigambra tentaculata*	*Haploscoloplos elongatus*	*Carinomella lactea*	Nematoda	*Monticellina* sp. 1	*Mediomastus* spp.	*Pista agassizi*
9	*Capitita ambiseta*	*Prionospio cirrifera*	*Sigambra tentaculata*	*Mediomastus californiensis*	*Tharyx* sp. A	*Paraprionospio pinnata*	*Spiophanes berkeleyorum*	*Pseudopolydora paucibranchiata*
10	*Macoma nasuta*	*Schistomeringos longicornis*	*Nephtys cornuta franciscana*	*Paraprionospio pinnata*	*Tharyx tesselata*	*Euclymene grossanewporti*	*Chaetozone corona*	*Pista wui*

Table 5.3-7. Abundance Comparison of Infaunal Species Collected with Van Veen and Box Core Samplers in Los Angeles and Long Beach Harbors, 2008.

Station	*Gear*	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Other Minor Phyla*	*Grand Total*
LA1	vv	32	3	82	117	5	238
	bc	10	10	38	50	3	112
LA3	vv	33	5	195	85	3	322
	bc	147	5	117	88	3	360
LA4	vv	83	13	42	182	2	322
	bc	42		15	128	15	200
LA5	vv	73		110	178	2	363
	bc	38		35	177		250
LA13	vv	48		33	177	8	267
	bc	17		185	190	8	400
LB1	vv	65	5	70	195	20	355
	bc	35	2	20	37		93
LB2	vv	103	3	58	93	5	263
	bc	157	5	112	125	2	400
LB5	vv	30		23	75	2	130
	bc	12		27	92	7	137
LB12	vv	7		17	107		130
	bc	38		37	38	2	115
LB14	vv	43		107	137		287
	bc	18		37	37	2	93
Total	*vv*	*518*	*30*	*737*	*1345*	*47*	*2677*
	bc	*513*	*22*	*622*	*962*	*42*	*2160*

vv = Van Veen; bc = Box core

Table 5.3-8. Comparison of Total Number of Infaunal Species Collected with Van Veen and Box Core Samplers in Los Angeles and Long Beach Harbors, 2008.

Station	*Gear*	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Other Minor Phyla*	*Grand Total*
LA1	vv	7	2	7	18	2	36
	bc	2	1	11	13	2	29
LA3	vv	6	2	8	17	1	34
	bc	6	1	12	15	1	35
LA4	vv	8	1	7	29	1	46
	bc	10		7	28	2	47
LA5	vv	11		9	19	1	40
	bc	5		8	12		25
LA13	vv	8		7	20	2	37
	bc	3		4	18	3	28
LB1	vv	13	1	11	26	4	55
	bc	8	1	6	10		25
LB2	vv	10	1	9	25	1	46
	bc	10	3	14	20	1	48
LB5	vv	7		5	18	1	31
	bc	5		7	20	3	35
LB12	vv	2		5	13		20
	bc	11		4	13	1	29
LB14	vv	5		8	20		33
	bc	6		6	10	1	23
Total	*vv*	*77*	*7*	*76*	*205*	*13*	*378*
	bc	*69*	*7*	*86*	*177*	*16*	*355*

vv = Van Veen; bc = Box core

Table 5.4-1. Total Abundance of Macroinvertebrates in Day and Night Otter Trawls in Los Angeles and Long Beach Harbors, 2008.

Common Name	*Species/Taxon*	*Total Abundance*	*% of Total*
Black spotted shrimp	*Crangon nigromaculata*	2,702	38.37
Ridgeback prawn	*Sicyonia ingentis*	1,155	16.40
Black-tailed bay shrimp	*Crangon nigricauda*	969	13.76
Xantus' swimming crab	*Portunus xantusii*	748	10.62
Shrimps	*Heptacarpus spp.*	532	7.55
Tuberculate pear crab	*Pyromaia tuberculata*	236	3.35
Northern crangon shrimp	*Crangon alaskensis*	216	3.07
Spotted ridgeback prawn	*Sicyonia penicillata*	82	1.16
Stimpson's shrimp	*Heptacarpus stimpsoni*	52	0.74
Brown shrimp	*Penaeus californiensis*	48	0.68
Tunicate	*Styela spp.*	47	0.67
California spiny lobster	*Panulirus interruptus*	43	0.61
Paperbubble opisthobranch	*Philine spp.*	29	0.41
Ghost shrimp	*Callianassa californiensis*	24	0.34
California aglaja	*Navanax inermis*	12	0.17
Graceful decorator crab	*Oregonia gracilis*	12	0.17
Yellow crab	*Metacarcinus anthonyi*	8	0.11
Warty sea cucumber	*Parastichopus parvimensis*	8	0.11
Cone snails	*Conus spp.*	7	0.10
Stout bodied shrimp	*Heptacarpus palpator*	6	0.09
Spiny brittle star	*Ophiothrix spiculata*	6	0.09
California sea cucumber	*Parastichopus californicus*	5	0.07
White paperbubble	*Philine alba*	5	0.07
Razor clams	*Siliqua spp.*	5	0.07
Spotted triopha	*Triopha maculata*	5	0.07
California sea hare	*Aplysia californica*	4	0.06
Gastropod	*Caesia perpinguis*	4	0.06
Striped eualid	*Eualus lineatus*	4	0.06
Unidentified shrimps	*Pandalus spp.*	3	0.04
Short-spined sea star	*Pisaster brevispinus*	3	0.04
Sponge	*Porifera unid. (encrusting)*	3	0.04
Purple sea urchin	*Strongylocentrotus purpuratus*	3	0.04
Black-tipped spiny nudibranch	*Acanthodoris rhodoceras*	2	0.03
Stalked tunicate	*Boltenia villosa*	2	0.03
Crabs	*Brachyura unid.*	2	0.03
Nudibranch	*Dendronotus iris*	2	0.03
Lewis's moon snail	*Euspira lewisii*	2	0.03
Elbow crab	*Heterocrypta occidentalis*	2	0.03
Lean western nassa	*Hima mendica*	2	0.03
Sheep crab	*Loxorhynchus grandis*	2	0.03
White urchin	*Lytechinus anamesus*	2	0.03
Oriental shrimp	*Palaemon macrodactylus*	2	0.03

Table 5.4-1. Total Abundance of Macroinvertebrates in Day and Night Otter Trawls in Los Angeles and Long Beach Harbors, 2008 (continued).

Common Name	*Species/Taxon*	*Total Abundance*	*% of Total*
Bat star	*Patiria miniata*	2	0.03
Red sea urchin	*Strongylocentrotus franciscanus*	2	0.03
Bivalve	*Venerupis phillippinarum*	2	0.03
Pistol shrimps	*Alpheus spp.*	1	0.01
Spiny sand star	*Astropecten armatus*	1	0.01
Visored shrimp	*Betaeus longidactylus*	1	0.01
Milky venus (bivalve)	*Compsomyax subdiaphana*	1	0.01
Rainbow nudibranch	*Dendronotus iris*	1	0.01
Moss crab	*Loxorhynchus crispatus*	1	0.01
Simple tunicate	*Molgula sp.*	1	0.01
Channeled nassa	*Nassarius fossatus*	1	0.01
Nudibranchs	*Nudibranchia unid.*	1	0.01
California two-spot octopus	*Octopus bimaculatus*	1	0.01
Octopus	*Octopus sp.*	1	0.01
Mottled pea crab	*Opisthopus transversus*	1	0.01
Blackeyed armed hermit crab	*Pagurus armatus*	1	0.01
Spotwrist hermit crab	*Pagurus spilocarpus*	1	0.01
Hermit crabs	*Pagurus spp.*	1	0.01
Dock shrimp	*Pandalus danae*	1	0.01
Scallops	*Pectinidae unid.*	1	0.01
Pacific sea lemon	*Peltodoris nobilis*	1	0.01
Pea crabs	*Pinnotheridae unid.*	1	0.01
Opisthobranch	*Pleurobranchaea californica*	1	0.01
sea pen	*Stylatula elongata*	1	0.01
Sorcerer's nudibranch	*Polycera atra*	1	0.01
Stubby squid	*Rossia pacifica*	1	0.01
	Grand Total	*7,035*	
	Total Number of Unique species	*61*	

Table 5.4-2. Macroinvertebrate Mean Abundance, Biomass, and Number of Species during Day and Night, Los Angeles and Long Beach Harbors, 2008.

Station	*Depth (m)*	*Mean Abundance*			*Mean Biomass (kg)*			*Mean Number of Species*		
		Day	*Night*	*Combined*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*
LA1	22	65	74	70	0.98	0.38	0.68	4	6	11
LA2	5	10	179	94	0.12	0.76	0.44	2	4	6
LA3	6	8	11	9	0.34	0.52	0.43	4	6	11
LA4	17	93	72	83	0.14	0.25	0.19	5	7	12
LA5	17	4	33	19	0.03	0.06	0.04	3	4	8
LA6	17	32	152	92	0.33	0.73	0.53	7	8	15
LA7	5	2	62	32	0.01	1.05	0.53	2	5	6
LA10	25	21	47	34	0.34	0.16	0.25	4	5	9
LA14	13	6	74	40	0.01	0.26	0.13	2	6	8
LA15	16	2	230	116	0.01	0.88	0.44	3	9	10
LB1	13	28	156	92	4.49	1.10	2.80	3	5	7
LB2	8	8	121	64	1.76	0.58	1.17	2	5	6
LB3	14	56	199	127	0.19	0.40	0.30	4	7	11
LB4	14	3	67	35	0.16	0.66	0.41	4	8	10
LB5	16	9	109	59	0.02	0.46	0.24	2	7	8
LB6	15	9	118	64	0.08	0.80	0.44	3	5	7
LB7	24	23	83	53	0.05	0.74	0.40	3	6	9
LB12	12	6	65	36	0.37	0.23	0.30	2	7	10
LB14	17	10	99	55	0.06	0.20	0.13	2	7	9
Station Mean		*21*	*103*	*62*	*0.50*	*0.54*	*0.52*	*3*	*6*	*9*
Total Survey Mean		*394*	*1954*	*1174*	*9.50*	*10.20*	*9.85*	*9*	*18*	*27*
Grand Total		*7043*			*59.1*			*61*		

Table 5.4-3. Mean Diversity and Dominance of Macroinvertebrates During Day and Night in Los Angeles and Long Beach Harbors, 2008.

Station	*Depth (m)*	*Mean Shannon-Wiener Diversity*			*Mean Margalef Diversity*			*Mean Dominance*		
		Day	*Night*	*Combined*	*Day*	*Night*	*Combined*	*Day*	*Night*	*Combined*
LA1	22	0.54	0.81	1.37	0.37	0.34	0.79	2	2	3
LA2	5	0.78	0.57	1.17	0.72	0.51	1.19	3	2	3
LA3	6	0.88	0.91	1.11	0.56	0.31	0.76	3	2	2
LA4	17	0.79	0.99	1.30	0.60	0.36	0.89	1	2	3
LA5	17	0.98	0.66	1.17	0.69	0.45	1.08	4	3	3
LA6	17	0.74	0.68	1.26	0.43	0.35	0.83	3	2	4
LA7	5	0.67	0.97	1.24	0.43	0.43	0.84	2	1	1
LA10	25	0.61	0.97	1.26	0.49	0.32	0.79	3	2	2
LA14	13	0.06	0.86	1.22	0.22	0.40	0.73	2	3	4
LA15	16	0.00	0.54	0.57	0.00	0.31	0.47	2	2	2
LB1	13	0.74	0.35	0.79	0.49	0.33	0.82	2	1	1
LB2	8	0.44	1.01	1.36	0.54	0.38	0.91	1	2	2
LB3	14	1.03	0.94	1.19	0.54	0.32	0.78	1	2	2
LB4	14	0.64	1.02	1.28	0.46	0.44	0.87	5	4	5
LB5	16	0.94	0.92	1.37	0.49	0.35	0.85	2	2	3
LB6	15	0.21	0.28	0.68	0.27	0.37	0.72	1	1	2
LB7	24	0.74	0.82	1.11	0.50	0.32	0.78	2	2	2
LB12	12	0.89	0.93	1.10	0.80	0.36	0.89	3	2	2
LB14	17	0.69	0.93	1.06	0.78	0.33	0.83	2	3	4
Station Mean		*0.65*	*0.80*	*1.14*	*0.49*	*0.37*	*0.83*	*2*	*2*	*3*

Table 5.4-4. Mean and Total Abundance of Macroinvertebrate Species Collected in Day and Night Otter Trawls in the Ports of Los Angeles and Long Beach, January through October, 2008.

Taxon	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA10	LA14	LA15	LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB12	LB14	Total Catch
Crangon nigromaculata	13.5	3.0	29.3	29.8	7.8	2.7	14.7	23.5	10.3	14.3	62.0	25.3	70.5	0.2	34.5	31.2	33.8	32.2	11.7	2702
Sicyonia ingentis	41.5	0.2	1.2	4.2	0.0	1.2	0.0	59.0	0.3	1.0	1.8	0.0	9.8	4.2	4.3	6.7	51.2	1.5	4.5	1155
Crangon nigricauda	9.8	0.0	0.2	1.3	1.8	1.8	0.8	4.2	11.5	66.8	1.0	0.5	6.2	4.3	6.5	1.5	6.3	2.5	34.3	969
Portunus xantusii	0.2	4.3	83.7	3.3	0.8	6.5	0.5	1.8	0.8	3.8	0.2	12.0	0.2	0.2	3.2	1.7	0.8	0.5	0.2	748
Heptacarpus spp.	22.7	0.2	0.5	0.7	0.7	30.7	1.8	6.2	0.3	0.2	2.8	0.3	3.2	0.3	5.5	1.0	3.7	1.2	6.8	532
Pyromaia tuberculata	0.5	0.2	0.3	1.7	3.3	5.0	0.3	1.2	6.5	3.8	0.0	1.2	2.3	2.7	0.5	0.3	5.3	1.2	3.0	236
Crangon alaskensis	0.0	0.2	0.0	0.0	1.3	12.2	0.0	0.8	5.3	3.2	0.0	0.0	1.3	0.7	0.7	0.5	0.0	3.7	6.2	216
Sicyonia penicillata	0.5	0.0	0.0	1.3	0.0	0.2	0.0	0.3	0.0	0.3	3.0	0.0	1.2	0.8	2.7	0.3	1.8	0.5	0.7	82
Heptacarpus stimpsoni	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.5	0.0	0.0	5.0	0.3	0.0	0.0	0.0	0.0	1.0	52
Penaeus californiensis	5.8	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.2	0.3	0.2	0.3	0.8	0.0	0.0	0.0	48
Styela spp.	0.2	0.0	0.0	1.3	0.0	0.8	0.0	0.0	3.5	0.2	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.7	0.0	47
Panulirus interruptus	0.0	0.2	0.3	0.0	0.0	0.2	0.7	0.0	0.0	0.0	4.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	43
Philine spp.	0.2	0.0	0.7	0.2	0.3	0.3	0.0	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	1.3	29
Callianassa californiensis	0.0	0.0	0.0	1.2	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24
Navanax inermis	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.3	0.0	0.0	0.2	12
Oregonia gracilis	0.0	0.5	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
Metacarcinus anthonyi	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.2	0.0	8
Parastichopus parvimensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.3	0.3	8
Conus spp.	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
Heptacarpus palpator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	6
Ophiothrix spiculata	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Parastichopus californicus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.2	0.0	5
Philine alba	0.7	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
Siliqua spp.	0.0	0.0	0.0	0.3	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
Triopha maculata	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
Aplysia californica	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
Caesia perpinguis	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	4
Eualus lineatus	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4

Table 5.4-5. Historical Comparison of the Ten Most Abundant Benthic Infauna Taxa, in Descending Order of Dominance, in Los Angeles and Long Beach Harbors.

Year	*1986-1987*	*1993*	*1996*	*1998*	*1999*	*2000*	*2008*
Source	*MEC 1988**	*CLA - EMD 1994**	*MEC 1996***	*CLA - EMD 1999**	*CLA - EMD 2000**	*MEC 2002*	*Present Study*
1	*Balanus pacificus*	*Crangon nigromaculata*	*Pyromaia tuberculata*	*Philine auriformis*	*Crangon nigromaculata*	*Crangon nigromaculata*	*Crangon nigromaculata*
2	*Pyromaia tuberculata*	*Pyromaia tuberculata*	*Crangon nigromaculata*	*Portunus xantusii*	*Philine auriformis*	*Pyromaia tuberculata*	*Sicyonia ingentis*
3	*Ophiothrix spiculata*	*Pagurus spilocarpus*	*Philine auriformis*	*Crangon nigromaculata*	*Crangon alaskensis*	*Portunus xantusii*	*Crangon nigricauda*
4	*Muricea* spp.	*Portunus xantusii*	*Dendronotus iris*	*Astropecten armatus*	*Sicyonia ingentis*	*Philine auriformis*	*Portunus xantusii*
5	*Corynactis californica*	*Penaeus californiensis*	*Portunus xantusii*	*Sicyonia ingentis*	*Pyromaia tuberculata*	*Pagurus spilocarpus*	*Heptacarpus spp.*
6	*Crangon nigromaculata*	*Kelletia kelletia*	*Loligo opalescens*	*Pyromaia tuberculata*	*Astropencten armatus*	*Cancer gracilis*	*Pyromaia tuberculata*
7	*Mytilus edulis/californianus*	*Loxorhynchus grandus*	*Pagurus spilocarpus*	*Pagurus spilocarpus*	*Penaeus californiensis*	*Bulla gouldiana*	*Crangon alaskensis*
8	*Portunus xantusii*		*Asterina miniata*	*Nassarius perpinguis*	*Portunus xantusii*	*Panaeus californiensis*	*Sicyonia penicillata*
9	*Crepidula dorsata*		*Parastichopus californicus*	*Penaeus californiensis*	*Nassarius perpenguis*	*Navanax inermis*	*Heptacarpus stimpsoni*
10	*Chama arcana*		*Octopus* sp.		*Virgularia galapagensis*	*Crangon alaskensis*	*Penaeus californiensis*

Figure 5.2-1. Infauna Sampling Locations in Los Angeles and Long Beach Harbors, January – July 2008.

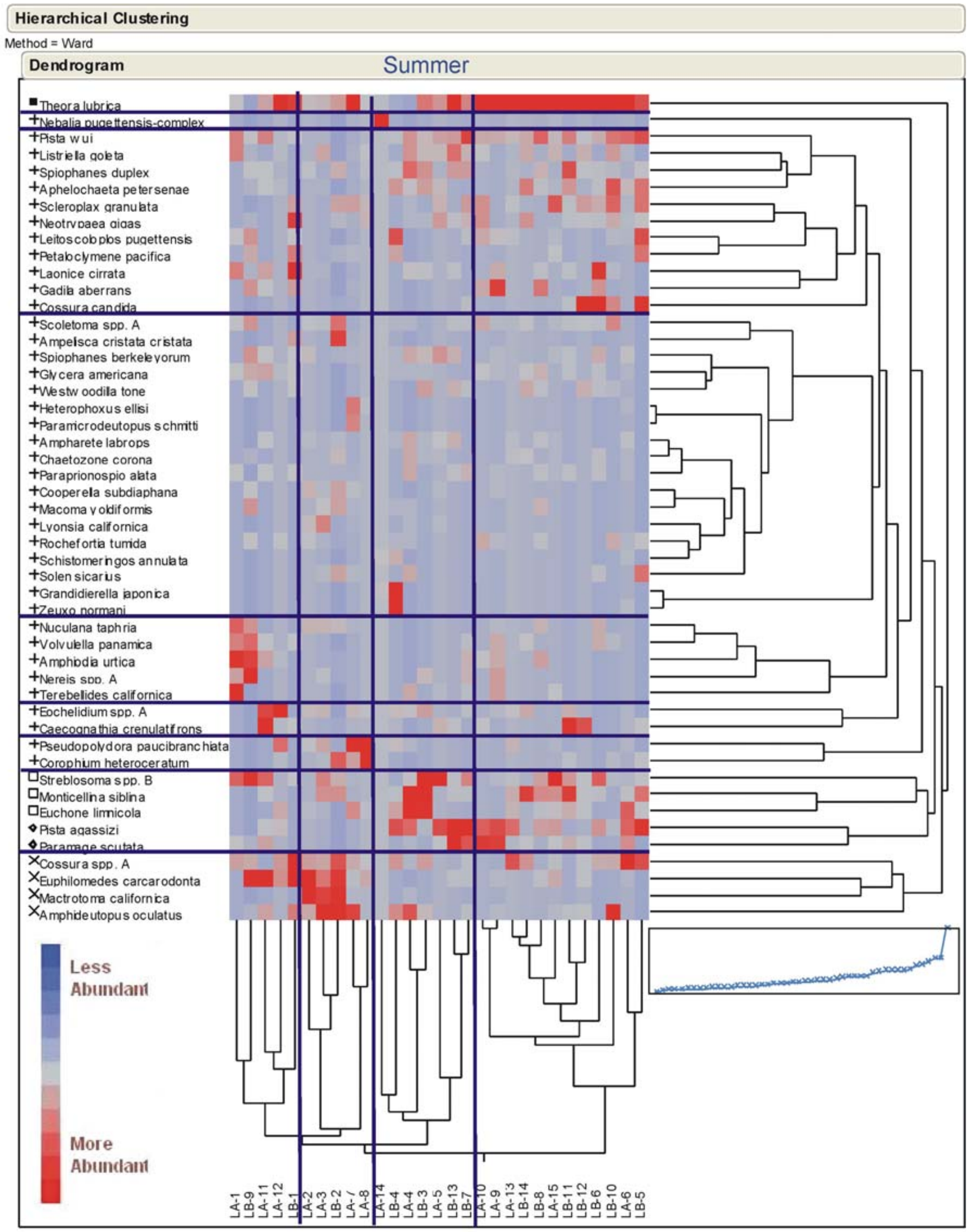


Figure 5.3-1. Cluster Analysis of Summer Abundance of Benthic Infauna Species Collected in Los Angeles and Long Beach Harbors, 2008.

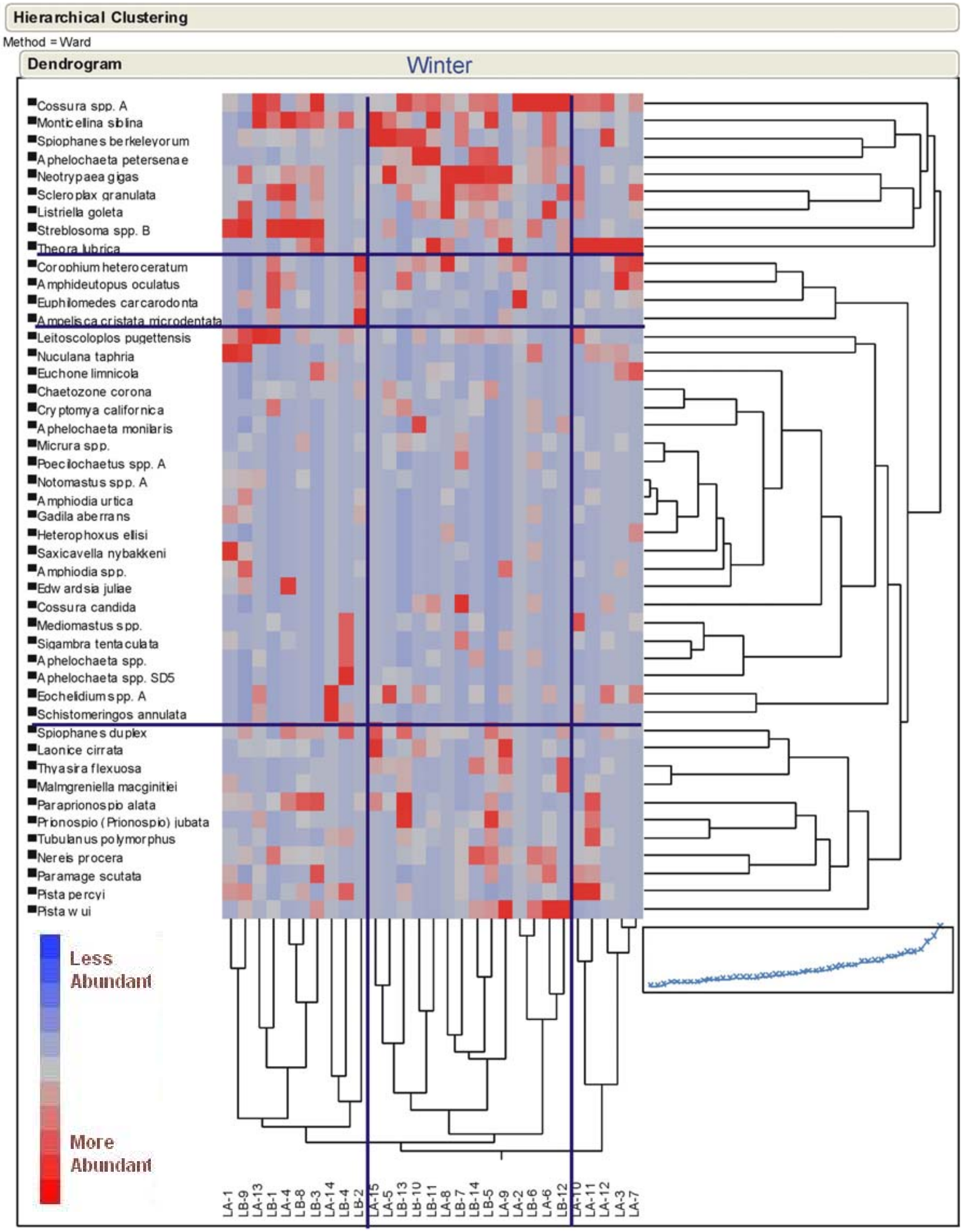


Figure 5.3-2. Cluster Analysis of Winter Abundance of Benthic Infauna Species Collected in Los Angeles and Long Beach Harbors, 2008.

CHAPTER 6

RIPRAP BIOTA

6.0 RIPRAP BIOTA

6.1 INTRODUCTION

Riprap biota occupies much of the shoreline in Los Angeles and Long Beach harbors. Riprap habitat is generally comprised of boulders found at the outer breakwaters and along the shoreline of many of the basins and channels. Pilings that support wharves and piers throughout the harbors and concrete debris also provide hard-bottom substrate for riprap communities. Riprap habitat extends from the upper tidal zone (intertidal) to the subtidal zone.

Several historical studies have described riprap biota in the harbors. MBC (1984) described community structure, recovery, and trophic interactions of riprap habitats in Long Beach Harbor and Queensway Bay. Previous baseline studies of riprap biota include MEC (1988) in Los Angeles Harbor and MEC (2002) in both Los Angeles and Long Beach harbors. These studies characterized dominant riprap organisms, measured physical conditions in riprap areas, and documented spatial and temporal variability of riprap biota.

The objective of the Year 2008 baseline study was to provide an updated characterization of the riprap community in Los Angeles and Long Beach harbors. Riprap associated invertebrates and algae were surveyed over two seasons at the same four locations in each harbor evaluated during the MEC (2002) study. Quadrats were sampled and biologist divers made general field observations to describe commonly observed organisms. Methods used to survey the community are described in Section 6.2. Ecological information on riprap biota in this report includes community summary measures (Section 6.3), species composition (Section 6.4), dominant species (Section 6.5), and spatial and temporal variation (Section 6.6). The survey results are compared to historical data in Section 6.7. Exotic species considered non-indigenous to the harbors are identified in Section 6.8. Raw data summaries are provided in Appendix F.

6.2 METHODOLOGY

6.2.1 Diver Surveys

Riprap biota, including invertebrates and algae, were sampled in January (winter) and August (summer). Four locations were surveyed in each harbor for a total of eight stations (Figure 6.2-1). Stations were identified by harbor unique number (e.g., LARR1 = Los Angeles riprap Station 1). Representative photographs showing typical habitat and biological resources were taken at each location. Some of the diver collection methods used during this survey differed from the previous (2000) baseline study (MEC 2002), particularly relative to samples collected in the subtidal zone. For example, the previous study sampled in the upper intertidal (barnacle zone), middle intertidal (mussel zone), and a “shallow subtidal” zone (a few feet below Mean Lower Low Water). Samples for the current survey were collected based on a combination of tidal zones and biological zones, collecting samples from the upper intertidal (equivalent to the barnacle zone), middle to lower intertidal (equivalent to the mussel zone), and subtidal (near the deepest extent of the riprap, but about 3 to 5 feet shallower than the soft substrate bottom to avoid the ecotone/highest sedimentation zone). Actual differences in collection depths between the current and previous surveys cannot be determined more precisely due to the lack of more detailed sampling depth descriptions.

Los Angeles Harbor Station LARR1 was located on the Middle Breakwater and had riprap boulders 5 to 6 feet in diameter. Station LARR2, in the East Basin, was comprised mostly of cement slabs, with few rocks in the lower zone. The subtidal area at this site had little to no hard bottom substrate to sample and was covered with thick silt. Winter samples were taken only from the upper tidal zone and this station was relocated for the summer sampling a distance of approximately 800 m (0.5 mile) into the next cove in front of Banning's Landing Community Center. This location was chosen for its relatively close proximity to the previously sampled location during the winter survey, similar inner harbor habitat location, and riprap rock throughout all sampling depths. Station LARR3 was in the Los Angeles West Basin near the TraPac pier and had no existing riprap, so an outer pier piling was sampled. Station LARR4 was situated at the end of the G.A.T.X. Terminal in outer Los Angeles Harbor. Similar to Station LARR2, not all tidal zones could be sampled in winter (lower tidal zone excluded) even though this site was comprised of large concrete blocks in the upper and middle tidal zones. For the summer survey, this station was moved approximately 100 m west to a location where riprap rock occurred throughout all tide zone depths. All samples were collected in each tide zone at all stations during the summer survey.

Long Beach Harbor Station LBRR1 was located at the Pier J breakwater. Riprap boulders were 4 to 5 feet in diameter. Station LBRR2 was near the Turning Basin of Cerritos Channel near some gas lines that extend into the water. The upper and lower tidal zones consisted of small boulders, 1 to 2 feet in diameter. The subtidal zone was characterized by silt with shell hash and a few rocks. Station LBRR3 was in the Long Beach West Basin. Large cement slabs were found in the upper and lower tidal zone, and cement slabs and rocks made up the substrate in the subtidal zone. For the summer survey, LBRR3 was moved a short distance west (~150 m) so that the samples were taken on rock riprap similar to most stations. Station LBRR4 was in the Southeast Basin. The upper and lower tidal zones consisted of boulders ranging from 1 to 3 feet in diameter, whereas boulders in the subtidal zone were 3 feet in diameter.

Similar to previous baseline surveys, riprap sampling for understory organisms in the present study utilized two quadrats (7.5 by 15 cm), established at three tidal levels (upper intertidal, lower intertidal or “middle tidal zone”, and lower subtidal). For each tidal level, all of the organisms in a randomly sited 7.5 by 15 cm quadrat were removed by scraping with a

2.5 cm-wide chisel. Scrapings were placed in approximately 0.333 mm mesh labeled bags (panty hose), transferred to jars labeled with station identification numbers, and fixed in 10% buffered formalin. Relatively large organisms observed by the diving biologists in the vicinity of the quadrats were also noted.

In the laboratory, scraped quadrat samples were sorted into major taxonomic groups, including molluscs, polychaetes, crustaceans, echinoderms, minor invertebrate phyla (others), and algae. Organisms were identified to the lowest practicable taxon (usually species) and counted. Algae and colonial animals were classified as present, common, or abundant based on the presence of one, two to five, or more than five colonies or holdfasts per sample, respectively. Wet weight biomass was measured for each of the six taxonomic groups.

6.2.2 Data Analyses

Count and biomass data for the scraped samples were entered into a database from the taxonomic laboratory sheets and reviewed for completeness. Data for these samples are presented as abundance and biomass per 0.01 m^2 (7.5 cm by 15 cm area). The number of unique species was calculated for each station. Statistical analyses (Analysis of Variance, *t*-test) were performed to test for differences between box core and Van Veen samplers.

Diversity was calculated with three different indices, which are derived measures based upon the number of species (species richness) and their abundances (equitability). The Shannon-Wiener diversity index tends to emphasize the equitability of the species distribution in a community. The Margalex Index incorporates the number of species and total number of individuals. The Dominance Index computes the number of species that account for 75% of the total abundance.

6.3 COMMUNITY SUMMARY MEASURES

6.3.1 Abundance

A total of 16,528 invertebrates per 0.01 m^2 was collected from riprap scrapings during the winter and summer surveys combined (Table 6.3-1). Mean total abundances (mean of the eight stations) were highest in the lower intertidal (233 per 0.01 m^2), lowest in the upper intertidal (140 per 0.01 m^2), and intermediate in the subtidal zone (183 per 0.01 m^2) (Table 6.3-1).

Mean abundances ranged highest on the Middle Breakwater (Station LARR1) (185 to 670 per 0.01 m^2) in the outer harbor. Otherwise mean abundances were similar among inner and outer harbor stations. Mean abundances at other outer harbor stations ranged from 14 to 276 per 0.01 m^2 across tide zones. Mean abundances at inner harbor stations ranged from 55 to 254 per 0.01 m^2 across tide zones.

Differences in mean abundances generally were similar among stations that varied in substrate type with few exceptions. For example, mean abundances across tide zones were similar at Station LARR3 located on a pier piling (150 to 254 per 0.01 m^2), Station LBRR2 located on relatively small boulders (122 to 223 per 0.01 m^2), and Station LARR4 located initially on cement slabs and relocated to riprap (128 to 226 per 0.01 m^2).

The lowest mean abundances across surveys were observed at Station LBRR4 located in the Long Beach Southeast Basin and at Station LARR2 located in the Cerritos Channel (55 to 118 per 0.01 m^2).

6.3.2 Biomass

A total of approximately 2.4 kg of biomass was collected among all stations and surveys (Table 6.3-1). Mean biomass was similar among depth zones, ranging from 24.1 to 25.6 g/0.01 m^2. Mean biomass ranged highest across tide zones on piling habitat at Station LARR3 in the inner harbor (69 to 102 g). The second highest mean biomass values were collected in upper intertidal and subtidal zones at Station LBRR2 in the inner harbor. There were few other differences in mean biomass among stations.

6.3.3 Number of Species

A total of 334 species was collected across surveys and stations (Table 6.3-1). The number of species substantially increased between upper and lower intertidal depths. On average, 12 species were collected in the upper intertidal, and 38 to 40 species were collected in the lower intertidal and subtidal zones, respectively.

There was no obvious pattern in number of species between inner and outer harbor stations. The number of species ranged highest from upper intertidal though subtidal depths at outer harbor Station LARR1 on the Middle Breakwater (25 to 62/0.01 m^2) and in the inner harbor on piling habitat at Station LARR3 (28-42/0.01 m^2). There was a broader range in number of species across tide zones at other stations with substantially more collected in lower intertidal and subtidal zones than in the upper intertidal. Mean number of species ranged from 6 to 53/0.01 m^2 across tide zones at other outer harbor stations. Mean number of species at other inner harbor stations ranged from 5 to 60/ 0.01 m^2 across tide zones.

6.3.4 Diversity and Dominance

Mean diversity index values (Shannon-Wiener, Margalef, Dominance) were lower in the upper intertidal and similarly high in the lower intertidal and subtidal zones (Table 6.3-1). Mean Shannon-Wiener values across stations were 1.48 for the upper intertidal, 2.55 for the lower intertidal, and 2.54 for the subtidal zone. Mean Margalef values were 2.3 in the upper intertidal, 5.98 in the lower intertidal, and 6.51 in the subtidal zone. Similarly, Dominance values were 3.44 in the upper intertidal, 6.56 in the lower intertidal, and 7.63 in the subtidal zone.

Diversity values were relatively similar among inner and outer harbor stations. However, Stations LARR1 and LBRR1, located on breakwater habitats in the outer harbor, had relatively higher values across depth zones. Station LARR3 on piling habitat in the inner harbor also had relatively high values in the upper intertidal; however, lower intertidal and subtidal values were within the range of other stations.

6.4 SPECIES COMPOSITION

6.4.1 Scraped Quadrats

Crustaceans were numerically dominant with an average of 99 individuals/0.01 m^2 collected across tide zones (Tables 6.3-2). Crustacean mean total abundance was similar among the different depth zones with 94/0.01 m^2 in the upper intertidal, 120/0.01 m^2 in the lower intertidal, and 82/0.01 m^2 in the subtidal.

Polychaetes were the second most abundant taxonomic group with a mean abundance of 33 individuals/0.01 m^2 across tide zones. Mean polychaete abundance was substantially greater in lower intertidal and subtidal zones (38 to 45/0.01 m^2) than in the upper intertidal (15/0.01 m^2).

Echinoderms, molluscs, and other phyla similarly accounted for a mean abundance of 12 to 14 individuals/0.01 m^2 across tide zones. Similar to crustaceans, molluscs had a similar mean abundance across depth zones with 14/0.01 m^2 in the upper intertidal, 12/0.01 m^2 in the lower intertidal, and 17/0.01 m^2 in the subtidal. Minor phyla generally were more abundant at lower intertidal (24/0.01 m^2) and subtidal depths (10/0.01 m^2) than in the upper intertidal (3/0.01 m^2). Echinoderms were absent from the upper intertidal, but had a similar mean abundance in the lower intertidal and subtidal (21/0.01 m^2).

Crustaceans and polychaetes were the most diverse taxonomic groups with mean numbers of species ranging from 2 to 24 and 0 to 25 across stations, respectively, and overall total means of 10 to 11 across tide zones (Table 6.3-3). All taxonomic groups generally had fewer species collected in the upper intertidal compared to lower intertidal and subtidal zones at most stations. Molluscs were moderately diverse with mean numbers of species ranging from 2 to 10 across stations and an overall mean of 6 across tide zones. Echinoderms and minor phyla were less diverse. Mean numbers of species ranged from 0 to 3 for echinoderms and 0 to 6 for minor phyla across stations; overall total means across tide zones were 1 and 2 for these two taxonomic groups, respectively.

Molluscs dominated the mean biomass values across depth zones (Table 6.3-4). However, crustacean biomass values were similarly high or greater at most stations in the upper intertidal due to the relatively high occurrence of barnacles and weight associated with their calcite shells. Echinoderms and minor phyla biomass contributions were more localized according to station.

Generally, numbers of species, abundance, and biomass of taxonomic groups were similar among inner and outer harbor stations with few exceptions. Mean numbers of species and abundance, particularly crustaceans, ranged higher at outer harbor Stations LARR1 and LBRR1. A greater number of polychaete species was collected at Station LBRR3, although only in the subtidal zone. Molluscs contributed to relatively greater biomass values at inner harbor Stations LARR3 and LBRR2.

6.4.2 Diver Observations

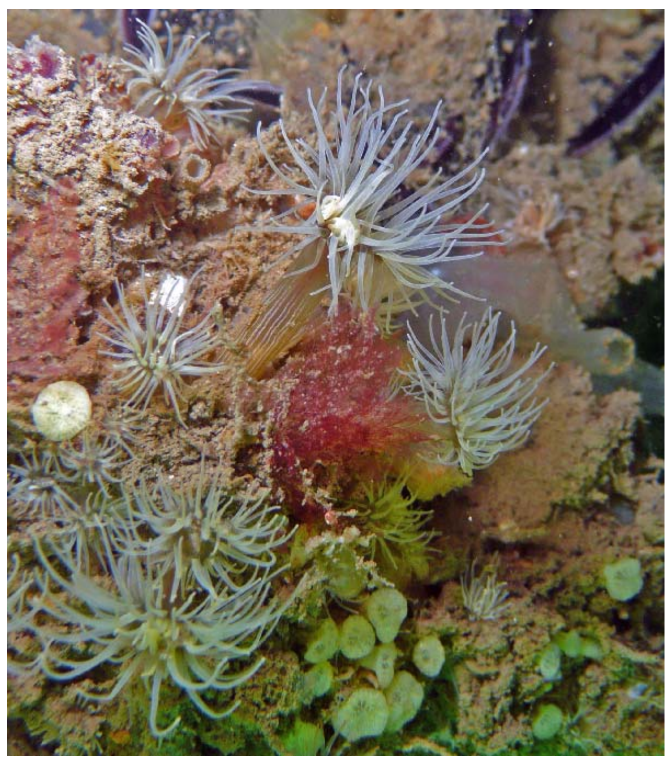
Dominant epifaunal invertebrates included barnacles (e.g., *Balanus* spp. and *Chthalamus fissus*), and mussels (*Mytilus galloprovincialis*). Other commonly observed crustacean species included California spiny lobster (*Panulirus interruptus*), crabs (*Mimulus foliatus, Pugettia* spp.), and hermit crabs (Pagurus spp.). Molluscs also included chitons (e.g., *Mopalia muscosa*), chestnut cowrie (*Cypraea spadicea*), gem murex (*Maxwellia gemma*), Norris's top shell (*Norrisia norrisi*), rock scallops (*Crassedoma giganteum*), scaled wormsnail (*Serpulorbis squamigerus*), sea slugs (e.g., *Hermissenda crassicornis, Navanax inermis, Peltodoris nobilis*), turbon snails (*Tegula* spp.), and wavy turbon topsnail (*Megastrea undosa*).

Relatively common echinoderms included red and purple sea urchins (*Strongylocentrotus franciscanus, P. purpuratus*), seastars (*Asterina miniata, Pisaster gigartina*, *P*. *ochraceous*), and sea cucumber (*Parastichopus parvimensis*). Several species of cnidarians were observed, including colonial cup corals, aggregating anemone (*Anthopleura elegantissima*), giant green anemone (*A. xanthogrammica*), burrowing anemones (*Pachycerianthus* spp.), strawberry anemone (*Corynactis californica*), and sea fans (*Muricea californica, M. fructosa*). Bryozoans (e,g., *Diaporecia californica*), sponges, and tunicates (unidentified colonial, *Styela montereyensis*) were very common in the lower intertidal and subtidal zones.

Relatively common fish species included barred sand bass (*P. nebulifer*), blacksmith (*Chromis punctipinnis*), black perch (*Embiotoca jacksoni*), California sheepshead (*Semicossyphus pulcher*), horneyhead turbot (*Pleuronichthys verticalis*), garibaldi (*Hypsypops rubicundus*), giant kelp fish (*Heterostichus rostratus)*, kelp bass (*Paralabrax clathratus*), and opaleye (*Girella nigricans*).

Macroalgae such as giant kelp (*Macrocystis pyrifera*), feather boa kelp (*Egregia menziesii*), and sargassum (*Sargassum muticum*) occurred in subtidal areas at many of the stations. A variety of encrusting coralline and other small attached algae also were relatively common, including *Chondracanthus* sp., *Colpomenia peregrina*, *Dictyota* sp., and *Ulva* sp. Detailed information on kelp and macroalgae in outer and inner harbor locations is discussed in Chapter 7.

6.5 DOMINANT SPECIES



The acorn barnacles *Chthalamus fissus* and *Balanus glandula* comprised 43% and 19% of the overall total abundance, respectively, in the upper intertidal zone (Table 6.3.5). Two amphipod species, *Caprella simia* and *Photis* spp. 1, and the dwarf brittlestar (*Amphipholis squamata*) accounted for the highest percent abundances (individually ranging from 6.5 to 12%) in the upper intertidal and subtidal zones.

There was no obvious difference in dominant species abundance between inner and outer harbor stations in the upper intertidal zone. There also were few differences in overall percent abundance of dominant species in the lower intertidal and subtidal zones of several of the inner and outer harbor stations. However, the highest abundances of several dominant species were collected in the lower intertidal and subtidal zones at outer harbor breakwater Stations LARR1 or LBRR1, including amphipods (e.g., *Ampelisca lobata, Caprella californica*, *Ericthonius brasiliensis, Gammaropsis thompsoni, Monocorophium acherusicum, Photis* spp.1*),* cumaceans (*Cumella californica*), and polychaetes (*Pseudopotamilla socialis, Syllis gracilis*-species complex). Several of these species also were numerically dominant at Station LARR4 in outer Los Angeles Harbor (i.e., *Caprella californica, Cumella californica, Photis* spp. 1).

A few species were collected in greatest abundance on the piling habitat surveyed at Station LARR3, including tunicates (*Acidia* spp.), dwarf brittlestars (*Amphipholis squamata*), and mussels (*Mytilus galloprovincialis*).

6.6 SUMMARY OF SPATIAL AND TEMPORAL VARIATIONS

Tide level influences the development of the riprap community in the harbors. Riprap biota was less diverse and abundant in the upper intertidal compared to lower intertidal and subtidal depth zones. However, biomass was relatively similar across depth. Dominant animals of the upper intertidal (e.g., barnacles, limpets) have shells that protect them from desiccation during low tides, which also contributes to the relatively high biomass for the upper intertidal zone. Fewer differences in number of species and abundance were apparent between lower intertidal and subtidal depths.

Generally, the riprap community was similar among inner and outer harbor areas. The only notable difference was a relatively greater number of species and abundance at breakwater habitats in the outer harbor (Stations LARR1, LBRR2) and at a piling habitat surveyed in the inner harbor (Station LARR3).

Dominant species generally were similar throughout the harbors. However, some differences were noted that may have been associated with attachment substrate. For example, the piling habitat surveyed at Station LARR3 supported greater numbers of mussels, dwarf brittlestars, and tunicates than other stations located on rock riprap or boulders.

6.7 HISTORICAL COMPARISONS

Results of the present study were similar to previous studies, which have found tide level to be the major factor associated with the distribution of riprap organisms (MBC 1984, MEC 1988, 2000). Similar to historical studies, barnacles dominated the upper intertidal and a greater variety of organisms were present in the lower intertidal and subtidal zones. The Mediterranean mussel *Mytilus galloprovincialis* was conspicuous in the lower intertidal and shallow subtidal.

Previous studies have noted increased community development with depth. The present study also documented lower community development in the upper intertidal, but noted similar community development at both lower intertidal and subtidal depths. As pointed out in the 2000 study (MEC 2002), variations in where samples are collected along the tide gradient and slight sampling differences likely contribute to reported differences in community development with depth.

Historical studies also have noted relatively greater community development in outer harbor compared to inner harbor areas (MEC 1988, MEC 2002). A notable finding of the present study was the overall similarity in community development throughout the harbors. Although diversity was somewhat greater at outer harbor breakwater stations (LARR1, LBRR1), the difference was mainly associated with the upper intertidal zone. Community summary measures did not show distinct trends among inner and outer harbor stations for the lower intertidal and subtidal zones. Somewhat different species assemblages were observed at some stations that may have been related to substrate or site-specific environmental conditions; however, no large-scale differences in riprap community development were noted between inner and outer harbor areas. This result suggests a relative improvement in environmental quality at inner harbor stations since the 2000 study.

6.8 EXOTIC SPECIES

A total of 12 non-indigenous (introduced) species was collected, representing approximately 3% of the 334 observed species in the riprap community (Appendix F). Another 31 species were cryptogenic (of unknown origin). Thus, approximately 13% of the riprap fauna were potentially non-native in origin. The species were associated with a variety of taxonomic groups, including ascidians, amphipod crustaceans, ophiuroid echinoderms, molluscs, nemerteans, and polychaete worms. The percentage of introduced and cryptogenic species identified with the present study is similar to the 11% reported for the 2000 study (MEC 2002); however, the proportion of introduced to cryptogenic species differed among these studies. Further distinction of introduced versus cryptogenic species has been made with more recent studies (e.g., Ranasinghe et al. 2005, Foss 2008), which were consulted for this study.

The most conspicuous non-indigenous species observed in the riprap community was the Mediterranean mussel *Mytilus galloprovincialis.* This mussel has occurred in the harbor for many years, but was misidentified in earlier studies as *M. edulis.* The non-indigenous oyster *Crassostrea* also was noted at Station LARR3 in Los Angeles West Basin. This species was identified as *C. gigas* in the 2000 study (MEC 2002), but was identified as *C. virginica* in the present study. The most abundant introduced species was the amphipod crustacean *Caprella simia.*

Other relatively abundant cryptogenic species included the amphipods *Monocorophium ascerusicum* and *Zeuxo normani*; ophiuroids *Amphipholis squamata* and *Ophiactix simplex*; and polychaetes *Exogone lourei*, *Polydora limicola*, and *Sylllis gracilis*.

Several of the non-indigenous and cryptogenic species collected on riprap and piling habitats also were collected at the benthic infauna stations, including amphipods (*Eochelidium* sp A, *Grandidierella japonica, Hemiproto* sp. A, *Podocerus brasiliensis*, *Zeuxo normani*), dwarf brittlestar, semele clam, and polychaetes (*Boccardia hamata, Dipolydora bidentata, D. socialis, E. lourei, Harmothoe imbricata*-complex, *P. limicola, Pseudopolydora paucibranchiata*, *Syllis (Syllis) gracilis, Typosyllis fasciata,* and *Typosyllis nipponica*) (see Section 5.5, Appendix E).

Table 6.3-1. Mean Abundance, Biomass, Number of Species, Diversity, and Dominance of Riprap Biota by Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008.

Harbor Location - Substrate	*Station*	*Abundance*	*Biomass (g)*	*Number of Species*	*Shannon-Wiener Diversity*	*Margalef Diversity*	*Dominance*
Outer - Riprap	LARR1	185	26.88	25	1.88	3.31	4.50
Inner – Cement Slabs (W), Riprap (S)	LARR2	109	17.50	9	0.53	0.79	1.50
Inner - Piling	LARR3	154	101.95	28	1.98	3.20	4.00
Outer – Cement slabs (W), Riprap (S)	LARR4	128	11.78	10	1.14	1.98	3.00
Outer - Riprap	LBRR1	218	4.59	6	2.57	4.32	7.00
Inner – Boulders (1- to 2-foot)	LBRR2	164	11.63	5	1.31	1.44	2.50
Outer – Cement slabs (W), riprap (S)	LBRR3	148	21.25	6	1.31	1.91	3.00
Outer – Boulders (1- to 3-foot)	LBRR4	14	8.15	7	1.15	1.43	2.00
Upper Intertidal Mean		140	25.47	12	1.48	2.30	3.44
Outer - Riprap	LARR1	670	8.59	51	2.56	6.99	6.00
Inner – Cement Slabs	LARR2*	55	2.72	16	2.51	4.92	6.00
Inner - Piling	LARR3	254	68.76	42	2.19	5.44	5.00
Outer – Cement slabs (W), Riprap (S)	LARR4 *	170	5.26	20	2.35	4.37	6.00
Outer - Riprap	LBRR1	257	7.74	54	3.09	8.08	10.00
Inner – Boulders (1- to 2-foot)	LBRR2	223	70.38	60	2.40	6.59	5.00
Outer – Cement slabs (W), riprap (S)	LBRR3	135	4.52	36	2.75	6.30	9.50
Outer – Boulders (1- to 3-foot)	LBRR4	98	24.59	28	2.52	5.11	5.00
Lower Intertidal Mean		233	24.07	38	2.55	5.98	6.56
Outer - Riprap	LARR1	285	5.77	62	3.11	9.21	11.00
Inner – Rocks (W), Riprap (S)	LARR2*	118	6.12	26	2.87	6.06	10.00
Inner – Piling	LARR3	150	92.52	35	2.25	6.36	6.00
Outer – Cement slabs (W), Riprap (S)	LARR4	226	5.22	30	1.14	1.98	3.00
Outer – Riprap	LBRR1	276	4.98	47	2.88	7.30	8.00
Inner – Few Rocks	LBRR2	122	69.00	35	2.90	8.64	10.00
Outer – Cement slabs/Rocks (W), Riprap (S)	LBRR3	194	16.78	53	2.56	7.44	6.50
Outer – Boulders (3-foot)	LBRR4	91	4.23	28	2.61	5.09	6.50

Table 6.3-1. Mean Abundance, Biomass, Number of Species, Diversity, and Dominance of Riprap Biota by Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008 (continued).

Harbor Location – Substrate	*Station*	*Abundance*	*Biomass (g)*	*Number of Species*	*Shannon-Wiener Diversity*	*Margalef Diversity*	*Dominance*
Subtidal Mean		183	25.58	40	2.54	6.51	7.625
Total Mean Across Tidal Zones		186	25.04	30	2.19	4.93	5.88
Grand Total Across Surveys		16,528	2,404	334	--	--	--

Values are per 0.01125 m^2 quadrat; Algae not included.

* Sample collected only during summer survey.

Table 6.3-2. Mean Abundance of Riprap Invertebrates within Taxonomic Groups by and across Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008.

Harbor Location	*Station*	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Other Minor Phyla*	*Mean Total*	*Grand Total Across Surveys*
Upper Intertidal								
Outer	LARR1	100	0	10	73	2	185	738
Inner	LARR2	97	0	11	1	0	109	436
Inner	LARR3	61	0	26	44	23	154	615
Outer	LARR4	109	0	18	1	0	128	510
Outer	LBRR1	105	0	5	0	0	218	436
Inner	LBRR2	154	0	11	0	0	164	657
Outer	LBRR3	118	0	30	0	0	148	591
Outer	LBRR4	7	0	4	3	0	14	55
Upper Intertidal Mean		94	0	14	15	3	140	505
Lower Intertidal								
Outer	LARR1	452	7	12	74	126	670	2679
Inner	LARR2*	21	0	2	32	0	55	218
Inner	LARR3	104	59	25	41	26	254	1016
Outer	LARR4 *	75	1	4	5	0	170	339
Outer	LBRR1	179	14	7	48	9	257	1028
Inner	LBRR2	90	42	21	58	13	223	893
Outer	LBRR3	10	37	22	57	9	135	539
Outer	LBRR4	30	8	4	44	12	98	391
Lower Intertidal Mean		120	21	12	45	24	233	888
Subtidal								
Outer	LARR1	198	3	22	48	15	285	1140
Inner	LARR2*	74	5	5	29	7	118	472
Inner	LARR3	22	59	23	36	10	150	599
Outer	LARR4	70	1	10	26	6	226	450
Outer	LBRR1	195	9	31	34	7	276	1102
Inner	LBRR2	52	33	12	23	3	122	487
Outer	LBRR3	20	40	25	91	18	194	774
Outer	LBRR4	27	21	9	20	15	91	363
Subtidal Mean		82	21	17	38	10	183	673
Total Mean Across Tidal Zones								
Outer	LARR1	250	3	15	65	47	380	380
Inner	LARR2 *	64	2	6	20	2	94	94
Inner	LARR3	62	39	25	40	20	186	186
Outer	LARR4	85	1	11	11	2	175	108

Table 6.3-2. Mean Abundance of Riprap Invertebrates within Taxonomic Groups by and across Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008 (continued).

Harbor Location	*Station*	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Other Minor Phyla*	*Mean Total*	*Grand Total Across Surveys*
Outer	LBRR1	159	8	14	27	5	250	214
Inner	LBRR2	99	25	15	27	5	170	170
Outer	LBRR3	49	26	26	49	9	159	159
Outer	LBRR4	21	10	6	22	9	68	67
Total Mean Across Tidal Zones		99	14	14	33	12	186	NA
Grand Total Across Surveys		*9460*	*1337*	*1391*	*3146*	*1196*	*NA*	*16528*

Notes: Values are per 0.01125 m^2 quadrat. NA = not applicable.

* Sample collected only during summer survey.

Table 6.3-3. Mean Number of Species of Riprap Biota within Taxonomic Groups By and Across Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008.

Station	*Mean Total Crustaceans*	*Mean Total Echinoderms*	*Mean Total Molluscs*	*Mean Total Polychaetes*	*Mean Total Other Minor Phyla*	*Total Mean*	*Total Number of Species*
Upper Intertidal							
LARR-1	5	0	7	12	1	25	38
LARR-2	5	0	3	1	0	9	15
LARR-3	5	0	9	9	5	28	47
LARR-4	5	0	4	1	0	10	14
LBRR-1	3	0	2	0	1	6	9
LBRR-2	3	0	2	0	0	5	9
LBRR-3	3	0	3	0	0	6	11
LBRR-4	2	0	2	3	0	7	11
Upper Intertidal Mean	4	0	4	3	1	12	19
Lower Intertidal							
LARR-1	24	1	6	14	6	51	75
LARR-2*	5	0	2	9	0	16	29
LARR-3	11	2	8	17	4	42	66
LARR-4*	12	1	3	3	1	20	38
LBRR-1	23	3	7	16	5	54	84
LBRR-2	24	2	9	20	5	60	93
LBRR-3	7	2	7	18	2	36	57
LBRR-4	8	1	4	11	4	28	48
Lower Intertidal Mean	14	2	6	14	3	38	61
Subtidal							
LARR-1	27	1	9	19	6	62	99
LARR-2*	7	1	4	11	3	26	49
LARR-3	8	1	6	18	2	35	60
LARR-4	11	2	7	9	1	30	57
LBRR-1	22	3	7	12	3	47	71
LBRR-2	15	3	6	10	1	35	57
LBRR-3	11	2	10	25	5	53	91
LBRR-4	6	1	8	12	1	28	48
Subtidal Mean	13	2	7	15	3	40	67
Total Mean Across Tidal Zones	*11*	*1*	*6*	*10*	*2*	*30*	*49*

Notes: Values are per 0.01-m2 quadrat.

* Summer sample only

Table 6.3-4. Mean Biomass of Riprap Biota within Taxonomic Groups By and Across Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008.

Station	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Other Minor Phyla*	*Total Mean*	*Total Biomass*
Upper Intertidal							
LARR-1	25.27	0.00	0.86	<.01	0.75	26.88	108
LARR-2	15.94	0.00	1.55	<.01	0.00	17.50	70
LARR-3	0.20	0.00	97.44	0.42	3.67	101.95	408
LARR-4	10.80	0.00	0.97	0.01	0.00	11.78	47
LBRR-1*	4.23	0.00	0.37	0.00	<.01	4.59	18
LBRR-2	11.27	0.00	0.36	0.00	<.01	11.63	47
LBRR-3	20.16	0.00	1.08	0.00	0.00	21.25	85
LBRR-4	2.39	0.00	5.70	0.06	0.00	8.15	33
Upper Intertidal Mean	11.28	0.00	13.54	0.08	0.74	25.47	102
Lower Intertidal							
LARR-1	0.95	0.04	1.41	0.77	5.42	8.59	34
LARR-2*	0.69	0.00	1.96	0.03	<.01	2.72	11
LARR-3	1.07	5.71	33.61	0.44	27.94	68.76	275
LARR-4*	0.20	4.39	0.07	0.01	<.01	5.26	21
LBRR-1	0.36	0.07	4.72	0.27	2.33	7.74	31
LBRR-2	0.66	2.22	51.42	0.66	15.43	70.38	282
LBRR-3	0.79	0.09	1.15	1.02	1.47	4.52	18
LBRR-4	1.70	0.02	20.73	0.24	1.90	24.59	98
Lower Intertidal Mean	0.80	1.57	14.38	0.43	6.89	24.07	96
Subtidal							
LARR-1	0.87	0.05	1.65	0.59	2.61	5.77	23
LARR-2*	0.23	0.01	5.59	0.07	0.23	6.12	24
LARR-3	8.01	0.02	78.81	0.13	5.56	92.52	370
LARR-4*	0.13	4.31	0.06	0.11	0.62	5.22	21
LBRR-1	0.45	0.10	3.38	0.19	0.87	4.98	20
LBRR-2	0.10	8.37	58.17	0.77	1.60	69.00	276
LBRR-3	0.96	0.22	2.02	2.51	11.09	16.78	67
LBRR-4	0.39	0.07	0.84	0.13	2.80	4.23	17
Subtidal Mean	1.39	1.64	18.81	0.56	3.17	25.58	102
Total Mean Across Tidal Zones							
LARR-1	9.03	0.03	1.30	0.68	2.93	13.74	55
LARR-2	5.62	0.00	3.03	0.05	0.09	8.78	35
LARR-3	3.09	2.86	69.95	0.33	12.39	87.74	351
LARR-4*	3.71	2.90	0.37	0.04	0.40	7.42	30
LBRR-1*	1.68	0.06	2.82	0.15	1.60	5.77	23

Table 6.3-4. Mean Biomass of Riprap Biota within Taxonomic Groups By and Across Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008 (continued).

Station	*Crustaceans*	*Echinoderms*	*Molluscs*	*Polychaetes*	*Other Minor Phyla*	*Total Mean*	*Total Biomass*
LBRR-2	4.01	3.53	36.65	0.48	8.51	50.34	201
LBRR-3	7.31	0.10	1.42	1.18	4.19	14.18	57
LBRR-4	1.49	0.03	9.09	0.14	1.57	12.32	49
Mean Total Across Tidal Zones	4.49	1.19	15.58	0.38	3.96	100	NA
Total Biomass Across Tidal Zones	*431*	*104*	*1496*	*34*	*340*	*NA*	*2,404*

Notes: Values are per 0.01-m2 quadrat;

* = Sample collected only during summer survey.

NA = not applicable

Table 6.3-5. Mean Abundance of Dominant Riprap Biota in Scraped Quadrats by Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008.

Species	*Mean Abundance*	*Percent Abundance*	*LARR 1*	*LARR 2*	*LARR 3*	*LARR 4*	*LBRR 1*	*LBRR 2*	*LBRR 3*	*LBRR 4*
Upper Intertidal										
Chthamalus fissus	58	43	51.3	36.8	0.0	72.0	205.5	109.0	62.8	0.0
Balanus glandula	25	19	13.5	44.3	43.5	1.5	0.0	36.0	44.0	6.3
Balanus crenatus	5	4	20.3	10.0	0.0	0.5	1.5	6.3	0.0	0.0
Tetraclita rubescens	4	3	10.5	0.0	0.0	20.5	0.0	0.0	1.3	0.0
Collisella scabra	4	3	4.8	4.8	0.0	14.3	3.0	3.8	2.8	0.0
Lasaea adansoni	4	3	1.3	5.8	0.0	0.5	0.0	5.0	18.3	0.0
Lower Intertidal										
Photis spp. 1	28	12	189.3	0.0	0.0	8.0	12.8	0.0	0.8	2.5
Caprella simia	21	9	9.8	5.3	54.3	24.0	55.5	12.8	2.8	3.3
Amphipholis squamata	20	8	6.3	0.0	58.3	0.5	9.5	35.0	32.5	5.0
Phoronida	14	6	102.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0
Gammaropsis thompsoni	12	5	71.3	0.0	0.0	0.5	14.8	2.3	1.3	0.5
Ericthonius brasiliensis	11	4	71.0	0.0	0.0	0.5	6.0	2.5	0.0	0.3
Caprella californica	8	3	14.8	0.3	0.0	24.0	26.0	3.0	0.0	5.0
Zeuxo normani	6	2	2.5	5.0	19.3	5.0	6.8	5.3	1.5	1.0
Caprella spp.	6	2	4.8	0.0	5.5	27.0	12.5	3.8	0.0	3.0
Pseudopotamilla socialis	6	2	15.0	0.0	0.8	1.5	14.3	2.0	7.8	0.8
Ascidia spp.	5	2	7.8	0.0	14.5	0.0	4.0	5.5	0.0	4.5
Spirorbidae	4	2	0.0	12.0	0.0	0.0	0.0	0.0	0.5	18.5
Monocorophium acherusicum	4	2	17.3	1.5	3.5	10.0	0.8	1.0	0.0	0.3
Subtidal										
Caprella simia	21.6	12.0	21.5	55.3	9.0	31.0	26.3	13.3	3.8	12.8
Amphipholis squamata	19.8	11.0	0.0	4.0	58.5	0.5	1.5	29.5	34.3	20.5
Photis spp. 1	11.7	6.5	118.0	0.0	0.0	4.5	23.3	0.0	0.5	0.5
Caprella californica	7.3	4.0	22.5	0.0	0.0	0.0	37.5	2.3	0.3	3.3
Caprella spp.	5.8	3.2	8.0	4.3	2.5	9.3	15.0	3.3	0.8	4.3
Gammaropsis thompsoni	5.4	3.0	33.5	0.0	0.0	3.5	19.8	0.0	0.8	0.0
Crepipatella dorsata	4.8	2.7	21.0	0.0	1.5	0.0	14.8	1.3	6.8	1.0
Exogone lourei	4.5	2.5	22.0	2.5	2.8	5.0	3.0	1.8	4.5	3.0
Ascidia spp.	4.1	2.3	8.0	1.0	0.8	2.8	2.5	1.8	6.3	12.0
Mytilus galloprovincialis	3.5	2.0	0.0	0.3	17.0	1.0	0.3	1.5	5.0	1.5

Table 6.3-5. Mean Abundance of Dominant Riprap Biota in Scraped Quadrats by Tidal Zones in Los Angeles and Long Beach Harbors, January and July 2008 (continued).

Species	*Mean Abundance*	*Percent Abundance*	*LARR 1*	*LARR 2*	*LARR 3*	*LARR 4*	*LBRR 1*	*LBRR 2*	*LBRR 3*	*LBRR 4*
Cumella californica	3.5	1.9	22.5	0.0	0.0	7.8	6.5	0.0	0.0	0.5
Pseudopotamilla socialis	3.1	1.7	0.0	0.0	4.3	0.0	0.0	0.0	19.3	0.0
Ampelisca lobata	3.0	1.7	44.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Zeuxo normani	2.9	1.6	0.5	4.8	2.3	0.8	7.0	4.0	1.8	0.8
Syllis gracilis-complex	2.6	1.4	22.0	0.0	0.0	0.3	7.8	0.0	0.3	0.0
Photis bifurcata	2.4	1.3	5.0	1.5	0.0	1.0	5.3	2.8	2.8	2.3
Crepipatella lingulata	2.3	1.3	0.0	3.8	0.8	0.0	0.0	0.0	12.5	0.0
Pseudopotamilla spp.	2.2	1.2	0.0	0.5	0.0	0.0	15.5	0.3	0.0	0.0
Ophiactis simplex	2.2	1.2	3.5	0.5	0.0	0.3	5.5	2.8	5.5	0.0
Dodecaceria concharum	2.0	1.1	5.0	0.0	0.0	3.0	4.3	2.8	2.8	0.0
Leptochelia dubia	1.9	1.1	8.5	1.3	5.5	0.8	0.0	0.0	2.5	0.0
Hiatella arctica	1.8	1.0	9.0	0.5	1.5	0.8	1.8	0.5	2.8	1.3
Nicolea spp. A	1.5	0.8	0.0	0.0	0.8	0.0	0.0	0.0	9.0	1.5
Joeropsis dubia	1.5	0.8	10.5	1.0	0.0	0.3	3.5	0.8	0.3	0.0

Notes: Values are per 0.01125 m^2 quadrat

Figure 6.2-1. Riprap Station Locations in the Ports of Los Angeles and Long Beach.

CHAPTER 7

KELP AND MACROALGAE

7.0 KELP AND MACROALGAE

7.1 INTRODUCTION

Macroalgal species comprise a wide variety of brown, green, and red algae (including coralline algae). Beds of the macroalga *Macrocystis pyrifera* ("giant kelp") represent one of the most diverse, productive, and dynamic ecosystems in southern California (Mann 1973, Dayton 1985, Barnes and Hughes 1988, Graham 2004): over 200 species of algae, invertebrates, fishes, and mammals are known to inhabit kelp beds (North 1971, Foster and Schiel 1985). Kelp plants can reach 25 meters in length, and a dense stand of such plants is known as a kelp forest. Kelp forests dominate shallow (<25-30 m depth), nearshore coastline areas that have some hard substrate and are protected or moderately exposed (Foster and Schiel 1985). In southern California, *M. pyrifera* has the highest productivity and biomass per square meter of all the kelps. Kelp forests include other macroalgae: common subcanopy (understory) species include *Eisenia arborea* and *Pterygophora californica,* and low-lying forms such as *Egregia menziesii, Dictyoneuropsis reticulate*, and *Laminaria farlowii* are also common in kelp beds. Other macroalgal communities in shallow, rocky, nearshore areas also represent productive ecosystems that provide important structure, food, and habitat for many species of invertebrates and fishes (Steneck et al. 2002).

Some of the primary factors dictating macroalgal community composition are substrate, temperature, wave exposure, water depth, salinity and sedimentation. The dynamic nature of weather patterns and the fluctuation of dominant water masses within southern California contribute to diverse algal assemblages over large geographical areas. However, the persistence of specific algal species depends on relatively consistent conditions conducive to individual species growth and reproduction.

Biological interactions in the form of competition and predation also serve to structure algal communities and determine dominant and persistent species within specific locations. While competition among dominant species plays an important role in determining macroalgae species composition, there are numerous micro-level interactions that can affect species composition. For example, physical structure, algal biomass, and organisms associated with kelp forests can substantially alter local environments and species ecology (Steneck et al. 2002). The complexity and make up of algal communities is a balance of physical and biological conditions that also include predation in the form of grazers, particularly invertebrates and fish. Some species or groups of macroalgae (e.g., coralline red algae) are more adapted to resist grazing pressure than others (e.g., fleshy species), but all algae are susceptible to some form of physical or biological impact. Taking into account variable conditions within subtidal habitats combined with inconsistencies in recruitment and survivorship, the development and/or persistence of macroalgal communities can be highly variable and often unpredictable seasonally and spatially.

The 2008 biological baseline study evaluated (1) surface coverage of kelp (primarily *M. pyrifera*) canopy based on aerial photography and vessel surveys; and (2) subtidal macroalgae based on site specific diver transects completed in winter and summer 2008. The occurrence of invasive ("exotic") species such as *Sargassum muticum* and *Undaria pinnatifida* was also assessed.

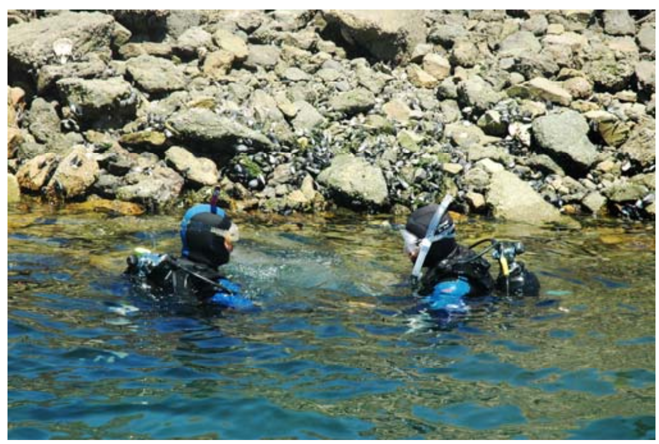
7.2 METHODOLOGY

7.2.1 Aerial Photography

Los Angeles and Long Beach harbor areas were photographed on February 15 and September 9, 2008, at a scale of 1:1600 by Focal Flight (Ojai, CA). Two cameras were used simultaneously, one configured for natural color and one for near infrared (IR). Aerial imagery was timed to coincide with the maximum low tide, optimum (high) sun angle, and low wind conditions to optimize photographic resolution and feature interpretation. Images were processed and geo-rectified to create a single mosaic of the entire survey area. A base image was created from mosaics to evaluate the spatial extend of kelp and other macroalgae (the same imagery was used to delineate eelgrass communities, see Chapter 8). Aerial imagery was geo-rectified using 2005 orthographic images of the Ports to match shoreline features and delineate the boundaries of the kelp and macroalgae surface canopy. The boundaries of the kelp and macroalgae surface canopy were identified and mapped from the mosaic in an Arc Map® Geographic Information System (GIS) format.

Kelp canopy extent, health, and dominant species within the project area were ground-truthed along the perimeter of the surface canopies using a small vessel (13 ft. Boston Whaler) and positional data collected using a Trimble® dips with an accuracy of ± 1 m. Kelp canopy boundary data overlaid with IR aerial imagery were utilized to develop final maps and calculate area estimates for kelp and macroalgae surface canopy.

7.2.2 Diver Surveys



To provide a characterization of macroalgae species composition and vertical distribution, 20 transects (Figure 7.2-1) were surveyed by divers in winter and summer 2008, based on locations established during the 2000 baseline study (MEC 2002). Surveys were performed by SCUBA divers using a modified belt transect methodology. Transect endpoints were recorded using a handheld GPS unit and locations provided in Appendix A. Two divers swam from the waterline (the edge of the rock dike structures, known as riprap, that form most of the shoreline of the Ports) to the harbor floor following a fiberglass measuring tape. The divers recorded dominant macroalgae species (presence/absence data) that occurred within one meter on either side of the measuring tape. Thus, total species noted for each transect represents the total number of dominant species, not an exhaustive list of all species present. This approach is consistent with the methods used for the 2000 baseline study (MEC 2002). Each transect ended at the point where algae was no longer found and the probability of encountering further algae on lower portions of the transect was low, typically at the riprap/mud interface. Dominant macrofauna were noted but not systematically quantified.

Observed algae were generally recorded by genus because either multiple species were observed within a genus or because identification to species level was not possible during the surveys for some specimens, instead requiring additional examination on the survey vessel or in the laboratory. Some common algal species that could not be identified during dives were collected and subsequently identified by a qualified biologist using reference books such as Marine Algae of California (Abbott and Hollenberg 1976) and Seashore Plants of California (Dawson and Foster 1982). Two species of brown algae (*Dictyota flabellata* and *Pachydictyon coriaceum*) are not distinguished in this report due to microscopic taxonomic differences (Dawson and Foster 1982) and speciation that may be in question (Stewart 1991). Therefore, *Dictyota* and *Pachydictyon* identified in this survey are denoted as "*Dictyota"*, consistent with the 2000 baseline study.

7.2.3 Data Analysis

Aerial imagery combined with vessel ground-truthing provided sub-meter accuracy data on the spatial extent of the kelp and macroalgae surface canopy. Polygons for dominant species (attached and unattached "drift" surface canopy) were delineated using aerial imagery based, and ground truthing surveys. The surface area coverage of *E. menziesii* was estimated based on its length of occurrence, in meters, along harbor structures (riprap and jetties) multiplied by three meters, representing the average width of canopy cover. Maps produced from aerial photographs and vessel surveys were used to delineate the kelp surface canopy. Kelp surface canopy area estimates were calculated based on the areas contained within developed boundaries (polygons) around individual kelp features.

The kelp surface canopy is rarely comprised of a 100% cover within delineated areas. Accordingly, three density categories were developed to describe the relative density of each area for the 2008 baseline survey: "dense" describes a kelp bed containing greater than 75 percent surface coverage, "moderate" is 25-75 percent coverage, and "sparse" is less than 25 percent coverage. Drift canopy was common within several areas of both Ports, and its aerial extent was subtracted from overall estimates as appropriate.

Descriptive statistical analyses were performed on macroalgae data collected during diver surveys to characterize spatial and temporal differences.

7.3 KELP BED DISTRIBUTION

Aerial coverage of the kelp and other macroalgae surface canopy in the Ports is presented in Figures 7.3-1 and 7.3-2 for spring 2008 and Figures 7.3-3 and 7.3-4 for fall 2008. The primary macroalgae surface canopy species mapped during surveys were *M. pyrifera* and *E. menziesii*. The surface canopy of these species formed mostly linear kelp beds consistently associated with rocky substrate adjacent to shoreline structures and the outer breakwater jetties Figure 7.3-1 and 7.3-2). No kelp was observed in the inner harbor areas of the Ports.

7.3.1 Spatial Distribution

Almost all kelp forests occur on hard substrata (North 1971). The distribution of kelp and other surface-canopy-forming macroalgae is partially dependent on the extent of available hard substratum for suitable attachment and growth (Dayton and Oliver 1985). Within the Ports, the majority of kelp and macroalgae surface canopy is closely associated with the outer breakwaters and with riprap structures in the Outer Harbor facing the harbor entrances (Figures 7.3-1 through 7.3-4). These structures tend to be steeply sloped, so that they form only a limited amount of subtidal substrate suitable for kelp and macroalgae growth. The canopy thus forms essentially linear beds, with the exception of an area near the entrance to Fish Harbor, two areas off Cabrillo Beach, and an area near the entrance to the Port of Long Beach (Queens Gate). The largest and most robust kelp beds occur near the entrance of Fish Harbor and at Angels Gate in the Port of Los Angeles, and on the south-facing dikes and jetties of both Ports

(Figure 7.3-1 through 7.3-4). The kelp bed near the entrance to Fish Harbor was moderately dense, with individual plants spaced approximately 1-2 meters apart. The surface canopy near the Fish Harbor kelp bed and adjacent to the Federal Penitentiary (the rectangular peninsula southwest of Fish Harbor) extended up to 30 meters away from the riprap in some places; *M. pyrifera* in these locations appeared to be mostly perennial adults.

The macroalga *Egregia menziesii* occurred most commonly near the terminus of the outer breakwater and along the western portions of the breakwall near Cabrillo Beach and the entrance to the Port of Long Beach (Figure 7.3-1 and 7.3-2). *Sargassum muticum*, a non native species (Abbott and Hollenberg 1976) was intermittently observed under piers and areas of low wave exposure during vessel surveys. No spatial data for *S. muticum* was established because occurrences of this species was limited to very small areas and typically occurred in conjunction with the other dominant surface canopy species.

Sedimentation and scour are highly detrimental to kelp plants (Dayton 1985). On the other hand, water movement is essential to kelp: motion resulting from tidal cycles, internal waves, and alongshore currents replenishes dissolved nutrients within kelp beds and removes waste products (North 1994). Kelp and macroalgae communities near the harbor entrances (outer harbor) likely benefit from increased water clarity, lower water temperatures, and less turbidity than stations farther into the harbors (inner stations) with lower water clarity and higher turbidity. The combination of proximity to the harbor entrance and the presence of extensive hard substratum likely explains the abundance of kelp and macroalgae associated with the Cabrillo Shallow Water Habitat (CSWH; Figures 7.3-1 and 7.3-3).

7.3.2 Temporal Variability

Global distribution of kelp forests is physiologically constrained by light at high latitudes and by nutrients, warm temperatures, and other macrophytes at low latitudes (Steneck et al. 2002). Other important environmental factors influencing kelp communities include available substrata, sedimentation, water motion, and salinity. (Dayton 1985). Temporal unpredictability, especially episodic recruitment events, should be considered characteristic of kelp (Dayton and Tegner 1984). Annual variations in surface kelp canopy coverage area and density have important implications to the associated community within kelp beds.

Temporal variability of surface kelp canopy was evident within the Ports during the 2008 spring and fall sampling events, similar to those noted during the 2000 baseline sampling. During the 2008 spring surveys, total surface canopy cover of *M. pyrifera* and *E. menziesii* was 77.8 acres and 2.33 acres, respectively (Figures 7.3-1 and 7.3-2). By fall, the cover of *M. pyrifera* had declined markedly, to 50.41 acres and *E. menziesii* decreased to approximately 2.12 acres (Figures 7.3-3 and 7.3-4). In addition to declines in the extent of canopy coverage, the density of the kelp beds declined between spring and fall (Table 7.3-1).

Variations in the *M. pyrifera* surface canopy were especially dramatic between the spring and fall 2008 surveys throughout the CSWH: linear subtidal rock dikes installed to stabilize the soft sediment used to develop the shallow water habitat supported kelp in the spring (Figure 7.3-1) but not during the fall surveys (Figure 7.3-3). Additionally, the kelp surface canopy associated with the largest kelp bed near the entrance to Fish Harbor was noticeably reduced between the spring and fall surveys (Figure 7.3-1 and 7.3-3). Similar differences in kelp canopy spatial extent was observed in the Port of Long Beach between spring and fall, including reduced kelp canopy cover and density near the boundary line between the Ports of Los Angeles and Long Beach and a reduced width of delineated kelp canopy areas just shoreward of the Port of Long Beach entrance (Figures 7.3-2 and 7.3-4).

The categorization of surface canopy densities within polygons provides a summary of the total standing stock of kelp canopy observed during surveys and ultimately available for utilization by associated invertebrates, fish, and wildlife.

Temporal fluctuations of kelp canopy cover and density within the Ports follow typical southern California seasonal trends observed between late winter and early fall (Dayton et al. 1999, North 1994, among others). Factors affecting the degree of change of kelp canopy standing stock within the Ports are complex but likely involve oceanic circulation and large-scale movements of regional water masses within the Southern California Bight.

During the spring surveys, kelp plants appeared healthy, dense, and more closely spaced. Kelp fronds (blades) contained low epiphyte loads and displayed few signs of stress or senescence. Surveys of the same locations in fall found fewer, smaller kelp plants that were more widely spaced and heavily infested with epiphytic bryozoans. Overall, kelp plants observed in the fall had fewer stipes and fronds, thus showing signs of stress and deterioration. In kelp beds, stratification in the water column during summer results in a warm, nutrient-poor environment above the thermocline and cool, nutrient-enhanced conditions below (North 1983). Consequently, kelp deterioration is greatest in the surface layers while basal portions may survive with little, if any, damage. When sea surface temperatures fall during autumn, basal portions may regenerate the canopies in a few weeks or months (North 1983). In addition, the fall surveys may have been too early to document any basal regeneration. Nutrient availability is negatively correlated with water temperature for values greater than 15.5°C (Zimmerman, 1983). Consequently, reported observations of summertime deterioration by *Macrocystis* attributed to high temperature probably represent combined effects from elevated water temperatures and low nutrients (Jackson 1977, Zimmerman and Kremer 1984).

The observed seasonal changes are to be expected in view of the elevated water temperatures, reduced water circulation, and low nutrient concentrations typical of the summer months in southern California, especially in enclosed bays and estuaries. Overall, seasonal decreases in the extent and density of the kelp surface canopy also reduce primary and secondary productivity, and habitat for associated biota. However, even though seasonal decreases are evident, the persistence of some kelp canopy in the majority of surveyed areas stabilizes community structure and species composition, increases the probability that more plants will settle, and enhances recruitment of dependent invertebrates and fishes.

The Ports are near healthy kelp forests to the north, near Palos Verdes, that likely provide a steady supply of sporophytes and gametophytes for colonization of suitable areas of the Ports. For example, the 2000 baseline study noted relatively rapid colonization of kelp plants during the construction of Pier 400 (MEC 2002). Similar recruitment events have been noted near Cabrillo Marina, where substrate is commonly covered and uncovered by winter storms, thereby making new suitable substratum available for settlement.

7.4 MACROALGAE SPECIES COMPOSITION

Although giant kelp was found only in the outer harbor, other macroalgae species occur throughout the Los Angeles-Long Beach harbor complex. The variability and complexity of the subtidal environments present within the Ports of Los Angeles and Long Beach are reflected in variable species composition and algal communities that are most accurately compared between surveys of similar habitats and exposures, such as comparisons among inner harbor stations or among outer harbor stations. Additional information for each transect is presented in Appendix G.

7.4.1 Inner Harbor

Inner harbor stations typically experience reduced tidal flushing, decreased wave surge and currents, increased water temperatures and sedimentation, and lower dissolved oxygen levels compared to the outer harbor (MEC 2002). Restrictions in circulation tend to exclude the highly productive, habitat-forming kelp and macroalgae species such as *Egregia* and *Macrocystis*, but other macroalgae are tolerant of inner harbor conditions. Divers swimming transects at inner harbor locations (T7, T8, T10, T11, T12, T13, T18, and T19) found between five and eleven common species at each transect, including *Sargassum*, *Ulva*, *Colpomenia, Chondracnathus,* and *Halymenia* (Table 7.4-1). The invasive brown algal species *Sargassum* (also see Section 7.6) was present at all stations except T7, typically growing in dense bands along the entire transect. *Colpomenia* and *Ulva* were also present on transects at all inner harbor study sites. The greatest number of common macroalgal species at inner harbor sites was at Transect T10 in the Los Angeles Turning Basin near Berth 170, with eleven common species. The lowest diversity was observed at Transect T7 in the Port of Long Beach near Pier C, which had patchy areas of only five macroalgal species (Table 7.4-1). The only other species consistently present along inner harbor transects was the invasive species *Undaria* (see Section 7.6).

7.4.2 Outer Harbor

Algal diversity at outer harbor sites was generally similar to that at inner harbor stations, with the greatest observed diversity (11 common species) occurring at Transect T15 along the outer part of Pier T (near the SeaLaunch facility) in the Port of Long Beach. Diversity was also high (maximum of 10 species) on outer harbor transects T16, T17, and T20, all in the Port of Los Angeles. The fewest number of outer harbor macroalgal species was the four species observed on Transect T1, located on the outer breakwater in the Port of Long Beach. Although this station had high abundances of herbivores, primarily the purple and red sea urchins *Strongylocentrotus purpuratus* and *S. franciscanus*, a relatively healthy kelp (*Macrocystis*) canopy persists at this location, with numerous plants surviving on isolated boulders surrounded by small sand channels that likely are difficult for urchins to cross. Similar observations were recorded at this location during the previous baseline survey (MEC 2002) and studies conducted nearly 15 years earlier (1986-1987, as noted in MEC 1988).

Overall, outer harbor transects were dominated by *Macrocystis* and *Egregia* (Table 7.4-1). *Macrocystis* was present at all outer harbor sites, but was not observed along any inner harbor transects. *Egregia,* a shallow subtidal to intertidal alga, was present at eight of twelve outer harbor sites. This species generally occupied relatively shallow water habitats while *Macrocystis* was found in slightly deeper waters. Understory species such as the coralline red algae *Corallina* spp. and the brown algae *Dictyota* and *Colpomenia* were also common in outer harbor habitats (Table 7.4-1). The invasive brown algae *Sargassum muticum* and *Undaria* were found at ten of the twelve and seven of twelve outer harbor sites, respectively (see Section 7.6).

7.5 HISTORICAL COMPARISONS

Giant kelp*, Macrocystis pyrifera,* has a relatively short history within the Ports of Los Angeles and Long Beach. Port habitats supported little *Macrocystis* until transplantation efforts in 1977 (Rice 1983). Spatial distribution data for *Macrocystis* in the Ports prior to the 2000 baseline study is limited. Some kelp surface canopy coverage data is available from aerial surveys performed in 1989 by the California Department of Fish and Game (CDFG), but the data set is limited to small areas adjacent to the outer breakwater. MEC (1988) studied the fauna of the kelp forest along the breakwater near the current station T2, but did not map kelp elsewhere in the harbor complex. Anecdotal data suggests that kelp abundance in the Ports has increased significantly since 1977 and that relative densities have fluctuated in tandem with coastal populations at Palos Verdes (MEC 1988). Regional kelp abundance has only recently started to recover from significant die offs attributed to El Niño events in the 1980s and 1990s. Comparisons of CDFG aerial surveys performed throughout California in1989, 1999, and 2002-2006 found a noticeable increase in kelp surface canopy coverage within the Southern California Bight during recent years.

Increases in giant kelp density are also due to increases in available habitat in the outer harbors of the Ports through construction of additional jetties, riprap-supported piers, and the Cabrillo Shallow Water Habitat. Assuming that portions of the historically described kelp beds located along the outer breakwater are perennial and reproductive, they have likely contributed to the development of kelp communities elsewhere in the Ports. Persistent kelp beds adjacent to the outer breakwater, along with the expansion of kelp forests off the Palos Verdes Peninsula, likely represent a consistent supply of sporophytes and gametophytes that can establish new kelp communities in the Ports.

Scientific investigations of kelp forest habitats within the Ports have been limited to a kelp forest productivity study (fauna only) performed by MEC in 1986-87 (MEC 1988) and the previous 2000 baseline study (MEC 2002). The 2000 baseline study was the first systematic effort to quantify kelp surface canopy coverage throughout the Ports. The total mapped canopy cover of *Macrocystis* in the spring of 2000 was 24.8 acres, which decreased to 14.2 acres in fall 2000. During the present baseline study, the *Macrocystis* canopy totaled 77.8 acres in spring 2008 and decreased to 50.4 acres in the fall of 2008. Kelp die-off between winter and fall can explain seasonal declines in kelp canopy cover for both the 2000 and 2008 studies. The 2000 baseline study reported a 43% decrease in canopy cover between spring and fall surveys compared to 35% decrease in 2008. Total mapped canopy cover of *Macrocystis* in the spring of 2008 was over 300% greater than reported in the spring of 2000, with kelp canopy cover being identified in several new areas within the Ports.

New kelp beds in the Port of Los Angeles that were not noted during the 2000 survey included a large, dense bed adjacent to the Fish Harbor entrance, kelp canopy cover associated with the Cabrillo Shallow Water Habitat, and a bed east of the Angels Gate harbor entrance approaching the Port of Long Beach. Within the Port of Long Beach, kelp canopy cover near the entrance to the West Basin and along Pier J increased dramatically in the present study compared to the

2000 survey. Overall, the *Macrocystis* canopy extended greater distances along outer breakwaters and the kelp beds appeared broader and more contiguous during the 2008 surveys compared to the 2000 surveys. Total kelp canopy cover for *Egregia* was similar between the two baseline survey efforts (2.33 acres in 2008 and 2.14 acres in 2000), and the spatial distribution was nearly identical, the species remaining concentrated along the breakwaters near the harbor entrances.

The increases in kelp canopy cover within the Ports between baseline survey efforts closely follow trends observed in CDFG aerial imagery data for the Palos Verdes Peninsula coastline. The Palos Verdes imagery showed a 243% increase in the extent of the kelp beds between 1999 and 2006. Considering that kelp growth is affected by regional water masses and circulation and that recruitment of kelp within the Ports is either controlled or supplemented by adjacent coastal kelp beds, the CDFG data are a reasonable, broad-scale basis for comparison with changes in kelp canopies during the Port baseline surveys.

Dominant macroalgal communities in the present study were similar to those described in MEC (2002). For example, outer harbor stations had from 4 to 11 dominant groups recorded during the 2008 surveys compared to 2 to11 groups during the 2000 surveys. Moreover, MEC (2002) reported 18 species groups, while the present study found 20 species and two unidentified species (Table 7.4-1). The main differences between the two baseline studies are at inner harbor stations, with the 2008 surveys reporting substantially more species per station than the 2000 surveys (5 to 11 species in 2008, one to six species in 2000). The reasons for these inner harbor differences between surveys are unknown, but could be related to improved habitat conditions in the Ports.

Technology related to aerial imagery and its interpretation is continuing to evolve and will provide future kelp canopy evaluations with additional tools to refine coverage estimates and investigate density considerations. The extent of kelp beds within the Ports has remained the focus of previous and current surveys, but future study plans should consider assessing the relative density of mapped kelp beds in order to quantify the quality and extent of kelp habitat available for associated biota more accurately.

7.6 INVASIVE SPECIES

Invasive species have become a common element of the flora and fauna of southern California waters. Some of these species have an invasive nature and are potentially detrimental to the native biota. Two invasive species of brown algae, *Sargassum muticum* and *Undaria pinnatifida*, have been found in the Ports during this and previous studies.

The occurrence of *Sargassum muticum* on the west coast of the North America is well documented. The species was most likely introduced accidentally to Washington in the 1930s on Japanese oysters and has spread rapidly along the Pacific Coast, currently extending as far south as Baja California. The ecological impact of this species is not well understood, but it has generally been accepted as a permanent part of local flora due its abundance and wide distribution. During the present study, Sargassum was observed in both inner and outer harbor areas, being recorded in 17 of 20 transects (Table 7.4-1). MEC (1988) estimated the annual productivity of *Sargassum* to be at least 5 kg/m^2/yr, a productivity rate far less than the 70 kg/m^2/yr estimated for *Macrocystis* within the Ports.

Undaria pinnatifida was first reported in the United States in spring 2000 during the previous baseline study (MEC 2002). This kelp species is native to Japan, where it is cultured and harvested for commercial uses. It has been introduced both inadvertently and intentionally in Europe, where it has grown rapidly and been reported to outcompete native species and to pose a significant economic problem as a fouling agent. *Undaria* is introduced primarily on boat hulls and in ballast water.

Undaria was documented during the present study at all eight inner harbor sites and at 7 of 12 outer harbor locations. *Undaria* has also been reported at Port Hueneme, Santa Barbara Harbor, and Catalina Island (MEC 2002), and as far north as Monterey Bay and as far south as Ensenada, Mexico (Chapman 2005). It is believed by many scientists that a successful eradication is not possible due to its mode of reproduction, which involves the release of millions of motile spores that are readily spread locally through natural dispersion and to remote locales by shipping traffic. If this species becomes a major competitor in the kelp forest, commercial harvesting could represent a control option, similar to an approach used in France (Chapman 2005).

In comparison to *Sargassum* and *Undaria*, the highly invasive green algae *Caulerpa* (NMFS 2008) was not detected or encountered in either Port, although surveys for this species were not comprehensive or targeted during the study. The Ports are required to conduct *Caulerpa* surveys prior to any dredging project, in accordance with established *Caulerpa* protocols (NMFS 2008) and have never detected *Caulerpa* during any of these surveys.

Table 7.3-1. Relative Density of Kelp Beds Surveyed and Delineated (Percent of Total Area).

February 2008		*September 2008*	
Density	*% of total area*	*Density*	*% of total area*
Dense	12 %	Dense	0 %
Moderate	71.4 %	Moderate	12 %
Sparse	16.6 %	Sparse	88 %

Table 7.4-1. Presence of Macroalgae and Plant Species on Diver Transects Within Ports of Los Angeles and Long Beach, April and October 2008 Combined.

	Transect																			
Species	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Chondracanthus *		X		X			X	X	X	X	X	X	X		X	X	X	X	X	X
Codium *								X	X						X					
Colpomenia *		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Corallina *	X		X	X	X	X		X							X		X			X
Cystosiera						X											X			
Dictyopteris *		X																		
Dictyota/Pachydicton *	X	X		X	X	X		X		X	X	X		X	X	X	X	X		X
Ectocarpoid fuzz				X		X		X		X		X	X		X				X	X
Egregia *	X			X	X									X	X	X	X			X
Enteromorpha *													X							
Gymnogongrus *																X				
Halymenia *		X								X	X	X	X			X		X		
Leathesia							X													
Macrocystis *	X	X	X	X	X	X								X	X	X	X			X
Prionitis *										X										
Rhodymenia *				X						X	X	X								
Sargassum *		X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X
Ulva *		X					X	X	X	X	X	X	X		X		X	X	X	X
Undaria *		X	X			X	X	X		X	X	X	X		X	X	X	X	X	X
Unidentified brown alga																X				
Unidentified red alga									X											
Zostera marina									X	X									X	
Total Dominant Groups	4	9	5	8	6	8	5	9	7	11	8	9	8	4	11	10	10	7	7	10
2000 Baseline Total Dominant Groups (MEC 2002)	5	11	11	8	3	9	2	6	6	4	3	4	2	7	7	8	3	1	1	3

* = Observed during 2000 baseline study (MEC 2002).

Shaded transects represent outer harbor locations.

Figure 7.2-1. Kelp and Macroalgae Sampling Locations in the Ports of Los Angeles and Long Beach, January – July 2008.

Figure 7.3-1. Distribution of *Macrocystis pyrifera* and *Egregia menziesii* in Port of Los Angeles, Spring 2008.

Figure 7.3-2. Distribution of *Macrocystis pyrifera* and *Egregia menziesii* in Port of Long Beach, Spring 2008.

Figure 7.3-3. Distribution of *Macrocystis pyrifera* and *Egregia menziesii* in Port of Los Angeles, Fall 2008.

Figure 7.3-4. Distribution of *Macrocystis pyrifera* and *Egregia menziesii* in Port of Long Beach, Fall 2008.

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CHAPTER 8

EELGRASS

8.0 EELGRASS

8.1 INTRODUCTION

The primary objective of this task was to characterize the occurrence of eelgrass beds within the Ports of Los Angeles and Long Beach (Ports) and compare changes in eelgrass bed extent and density since the last baseline survey (MEC 2002).

Seagrasses (Spermatophyta) inhabit soft bottom habitat, and the extensive meadows they form rank among the most productive coastal ecosystems in the world (McRoy and McMillan 1977). Of the three separate species of seagrass *(Zostera marina, Z. pacifica,* and *Z. asiatica)* that have been observed in the Southern California Bight (SCB), eelgrass *(Zostera marina)* is the most common species occurring in embayments (Dailey et al. 1993).

Eelgrass is an aquatic angiosperm distributed sporadically in bays, estuaries, and within offshore beds throughout the majority of the Northern Hemisphere. Along the west coast of North America, eelgrass is found from southeastern Alaska to southern Baja California and Mexico, typically in protected bays and estuaries from the low intertidal to a depth of approximately 20 meters (m) (Green and Short 2003). Eelgrass beds create a defined community structure for a wide variety of aquatic organisms and perform important physical and biological functions that allow for the persistence of highly productive habitat. Eelgrass beds function as habitat and nursery areas for commercially and recreationally important marine fish and invertebrates, and provide critical structural environments for resident bay and estuarine species (Hoffman 1986, Kitting 1994). Their function as nursery areas for fish and invertebrates and as foraging grounds for many marine bird species make eelgrass beds highly valuable as a marine resource far beyond their physical extent.

Eelgrass is important both ecologically and economically, representing a key species in maintaining healthy coastal and estuary ecosystems (Davis et al. 1998, Gayaldo et al. 2001, and Williams 2001).

Eelgrass reproduces sexually through seeds and asexually through horizontal rhizomes and leaf shoots. Although dispersal of pollen and individual seeds is limited, genetic studies have shown that the seed-bearing spathes can be transported from one area to another via rafting of detached plants or inflorescences (Reusch 2002). Although considerable attention has been given to limitations of seagrass growth by variability in light, temperature, and nutrients (e.g., McRoy and McMillan 1977, Orth 1977, Williams and McRoy 1982, Dennison and Alberte 1985, and Dennison 1987), growth is affected by a more complex array of factors including hydrology, grazing, and epiphytic growth (Fonseca and Kenworthy 1987, Thayer et al. 1985, Williams and Carpenter 1988, Williams and Ruckelshaus 1993). As water quality in many bay and coastal environments declines due to increases in anthropogenic nutrient and sediment loading, the distribution of eelgrass within temperate estuaries can also decline (Borum 1985, Twilley et al. 1985, Orth et al. 1986).

The following analysis compares the 2000 baseline for eelgrass beds within the Ports of Los Angeles and Long Beach (MEC 2002) to the present 2008 studies, along with a discussion of temporal and spatial variations. The methods used for surveying and analysis of eelgrass beds are presented below.

8.2 METHODOLOGY

Surveys conducted in 2008 to document eelgrass communities within the Ports used a variety of established techniques including aerial photography to map bed extent, side-scan sonar to map extent and bathymetry, and diver surveys to validate and ground-truth the aerial and side-scan methods. Tierra Data Inc. (TDI) researchers conducted side-scan sonar surveys to determine eelgrass presence and density (determined by method resolution) in spring and fall 2008, followed by diver side-scan sonar verification and leaf shoot (turion) density surveys during the same seasons. Documentation of eelgrass turion density using diver performed quadrats served two primary purposes. First, turion density measurements within eelgrass beds provided information on the relative consistency and continuity of the individual eelgrass beds in conjunction with knowledge of the dominant plant characteristics (e.g., blade size) and associated species. Secondly, diver-performed turion density counts provided important ground truthing information for the evaluation of side-scan sonar imagery.

The methods used during 2008 baseline study eelgrass surveys were complementary to those used during the baseline study conducted in 2000 (MEC 2002), and consistent with methodologies specified by the Southern California Eelgrass Mitigation Plan Policy (SCEMP) for monitoring eelgrass mitigation sites. Diver surveys to evaluate eelgrass turion densities and ground truth side-scan sonar imagery were performed more intensively in 2008 compared to previous baseline studies in order to access spatial consistency of identified eelgrass beds while capturing the maximum turion densities of individual stands as reported in the 2000 baseline surveys. The National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and California Department of Fish and Game (CDFG) developed the SCEMP to provide monitoring and remediation guidelines for unavoidable impacts to eelgrass resources. SCEMP provisions require any impacts to eelgrass be mitigated in a manner that compensates for direct habitat loss. SCEMP also requires monitoring of mitigation areas and suitable local reference sites for a period of 5 years to assess mitigation site performance compared to a natural reference bed.

8.2.1 Aerial Photography

On February 15 and September 9, 2008, Focal Flight (Ojai, CA) took 140 photographic images of the Los Angeles and Long Beach Ports complex at a scale of 1:1600. Two cameras were used simultaneously, one configured for natural color and one for near infrared (IR). The aerial imagery flight was timed to coincide with the maximum low tide, optimum (high) sun angle, and low wind conditions to optimize photo resolution and feature interpretation. The images were then processed and geo-rectified using ESRI ArcMap 9.2 editing software to create a single mosaic of the Ports complex. Mosaics were used to create a base image and initiation point for evaluating the spatial extent of the upper edge of eelgrass communities and to document the presence/absence of eelgrass within portions of the study area. The images were also geo-rectified in conjunction with 2005 orthographic images of the Ports areas to match up shoreline features and delineate the observable boundaries of eelgrass beds.

8.2.2 Side-Scan Sonar

The acoustic surveys involved integration of dGPS and side-scan sonar, with the surveys focused on areas that were less than -20 feet (ft) MLLW in depth and which had previously been documented as supporting eelgrass (MEC 2002). TDI analyzed digitally collected data using an Edge Tech 272-TD side-scan sonar deployed from a 13-ft Boston Whaler. Side-scan sonar data were collected at 500 kHz with approximately 60% overlap between transects (~20 m apart) to capture all notable features. Survey operations were performed as close to shore as possible. Navigation was maintained through an onboard sonar computer as well as a redundant navigation laptop on board the survey vessel. Edge Tech Discover 560 A/D software was used to log the raw data directly from the side-scan sonar to a lap top computer for post-processing rectification and referencing. Concurrently, sonar signal imagery was collected and processed using Chesapeake SonarWiz Map software in conjunction with a Trimble AG 122 DGPS to provide a real-time, geo-referenced mosaic of the bathymetric topography. Differential correction was provided using the Coast Guard COORS DGPS signal.

Relative densities (high or low) for eelgrass communities were determined from side scan sonar imagery in conjunction with diver observations (see below) made during turion density counts. Density classifications were determined based on similar side scan sonar imagery within individual areas. Since eelgrass communities are not distributed homogeneously throughout their range, diver transects and turion counts provided the most accurate evaluation of density. Diver transects and turion counts were performed three times more frequently during the 2008 evaluation than in the previous evaluation and provided in depth insight to eelgrass communities.

8.2.3 Diver Surveys

Divers verified side-scan sonar acoustic data records of identified eelgrass beds at multiple locations. They made observations to characterize the health and vigor, epiphytic load, and associated invertebrate and fish species within individual eelgrass patches. Methods included the use of 1/16 m^2 quadrats to estimate eelgrass turion density at multiple locations and to determine the extent and consistency of various eelgrass beds.

After reviewing the side-scan sonar acoustic data records from subsequent mapping efforts, divers selected several locations within the most prominent eelgrass beds as targets to collect density data using linear transects along specific bathymetric contours. They deployed a small weighted buoy at each selected location and recorded dGPS coordinates and then conducted the survey using a 50 m tape and 1/16 m^2 quadrats, collecting density data within unique quadrats every 2 meters along the tape. A total of twenty-five 1/16 m^2 quadrat density counts were performed along each transect at each location.

During the spring surveys, divers completed 200 quadrats at eight separate locations. During the fall, they expanded surveys to 300 quadrats at twelve separate, adding four new locations to the eight from the spring surveys. Diver transects were increased during the spring survey effort to increase the sample size and ensure that observed turions densities were representative of identified eelgrass beds. Diver transects performed in the fall used the same methodology as during the spring, but expanded sampling along a bathymetric gradient in both directions from a single point rather than just one direction. Divers performed observations adjacent to most transects within the selected eelgrass beds to ensure that density transects were representative of the surrounding area and to acquire ancillary information used for side-scan sonar density interpretations.

8.2.4 Data Analysis

Statistical analysis of eelgrass distribution and turion density was consistent with previous baseline studies (MEC 2002) to provide direct comparisons between survey efforts. Turion density (turions/m^2) means and standard deviations were calculated for each transect. The spatial extent of eelgrass beds was calculated as acres per location and compared to previous results. Some differences in turion density sampling methodologies, including differences in the level of effort (number of quadrats sampled), are discussed below. Patch analysis was considered, but the low number of transects representing most of the eelgrass beds, patchy distribution of the beds, variable turions densities, and high density standard deviations made this approach infeasible.

8.3 RESULTS

8.3.1 Eelgrass Distribution

The distribution of eelgrass beds is limited primarily by physical factors such as depth, light, and substrate, such that only limited habitat is available within the generally deep water of the Ports of Los Angeles and Long Beach. Both Ports are spatially dominated by waters greater than -20 ft MLLW depth and are well protected (e.g., by breakwaters) to accommodate marine commerce and public recreation, thus reducing circulation and water quality compared to open coastal environments. The majority of the Ports' bathymetry is comprised of well maintained dredged channels that limit the optimum habitat available to support extensive eelgrass beds. Two areas have previously been identified that support persistent and concentrated eelgrass beds within the Port of Los Angeles: (1) Cabrillo Beach near the far west end of the outer Los Angeles Harbor, including the Cabrillo Beach Youth Facility to the north and Inner Cabrillo Beach to the south; and (2) east of Pier 300 including the shallow water mitigation habitat and Seaplane Lagoon (Figure 8.3-1). Eelgrass was introduced to the Port of Los Angeles in 1985 as a result of plantings off the Cabrillo Beach Youth Camp as part of mitigation to offset eelgrass impacts from dock construction in Huntington Harbor, although a limited amount of eelgrass was already present in the general area (Hoffman pers. comm. 2009). No eelgrass beds were observed within the boundary limits of the Port of Long Beach, but potential habitat and adjacent eelgrass beds were observed, as discussed below.

8.3.2 Results by Eelgrass Area and Season

8.3.2.1 Cabrillo Beach

Spring (April) 2008

A total of 36.0 acres of eelgrass was recorded in the Cabrillo Beach area adjacent to the swim beach ("Cabrillo South") and Cabrillo Beach Youth Facility ("Cabrillo North") during the April 2008 surveys (Figure 8.3-2). This was comprised of 26.7 acres at the north site, and 9.33 acres at Cabrillo South. The eelgrass bed at Cabrillo South was located primarily along the shoreline out to the first swim buoy, but also included isolated eelgrass beds to the east of the main bed, along the north facing portion of the swim beach. The eelgrass bed extended from 0.0 to -10 ft MLLW. Plants observed on the outer (deeper – 8ft MLLW) edge were generally small (8-10 inches), interspersed with larger (2-3 ft) plants growing in uniform mud substrate, and several plants appeared to represent new growth. The majority of the bed was limited to shallower areas (-6 ft MLLW to -3ft MLLW) of fine sand/mud substrate and consisted of large (2-3 ft) tall plants with a low to moderate epiphyte load. Cover was patchy outside the main bed and data from stratified random quadrats along the transect line varied in density from 0 to 208/m^2.

Turion counts varied widely from 0 to 13 turions per quadrat and the beds were patchy (Table 8.3-1). Divers performed two transects at Cabrillo South, beginning in the center of observed beds. Mean turion density (± standard deviation) in the bed ranged from 49.3 ± 44.5 turions/m^2 for transect CS1 to 97.9 ± 53.1 turions/m^2 for transect CS2. Mean turion density varied between transects primarily based on the absence of turions within several quadrats near the terminus of transect CS1. Transect CS1 was performed perpendicular to shore to evaluate the deeper edge of the eelgrass bed. These data illustrate that the several quadrats containing no plants strongly influenced conclusions of low mean density and high standard deviation along this transect.

The Cabrillo North eelgrass was expansive and diverse, consisting of various depth gradients, plant sizes, and exposure aspects. Cabrillo North extends from the Cabrillo boat launch ramp north to the jetty of Cabrillo Marina (Figure 8.3-2). The eelgrass bed in this area measured 17.4 acres in April 2008 and extended from 0 to -12 ft MLLW. Adjacent to the launch ramp and at the outflow of the salt marsh, this bed was composed of dense, short eelgrass (4-10 inches tall), was observable at low tide (tide -0.2 ft @12:58 PM), and appeared uniform in distribution on sand/mud substrate. The eelgrass bed at this location was the largest and most consistent of all beds surveyed during the 2008 study. The northern portion of the bed beginning near the Cabrillo marina jetty was thick and continuous along a -4 ft MLLW depth contour and was comprised of plants that were 2-3 ft tall with a moderate epiphytic load. Areas surveyed between the Youth Facility pier and the jetty contained dense mats of the green alga *Chaetomorpha spiralis* (hereafter *Chaetomorpha*) intertwined with the eelgrass plants. *Chaetomorpha* mats varied from 6 inches to 2 ft thick along the bottom and complicated the turion density counts. The red alga, *Gracillaria spp*. (likely *G. veleroae*), was also present within the eelgrass beds at Cabrillo North and was most common within the far northern portions of the bed adjacent to the Cabrillo Marina jetty.

The diver transect results were consistent with the observations above regarding the density and extent of eelgrass meadows at Cabrillo North. During the April surveys, two diver transects were performed within Cabrillo North. Turion counts varied from 1 to 17 turions per 1/16m^2 quadrat, but were relatively consistent throughout the eelgrass bed (Table 8.3-2). Mean turion density among Cabrillo North transects was relatively consistent based on the moderate to low standard deviations of the transect data and observed homogeneous nature of the bed. Mean turion density (± standard deviation) in the bed was 143.4 ± 54.4 turions/m^2 for Cabrillo North CN1 and 122.2 ± 35.1 turions/m^2 for CN2, highest among all sampled transects (Table 8.3-2). One transect, Cabrillo North CN2, was performed perpendicular to shore to evaluate the consistency of the eelgrass bed throughout its depth range, as the bed extends well offshore based on sonar observations. Plants within the quadrats appeared to increase in size moving offshore. Observations beyond the eelgrass bed surveyed at Cabrillo North CN2 noted that the eelgrass bed extended offshore more than 50 m beyond the swim buoys and became patchy with lower densities. Size differences were evident throughout much of the Cabrillo North area with small plants (6 inches) sometimes growing adjacent to larger (2 ft +) plants. The epiphytic load on the plants was mostly diatomaceous film and varied from low to moderate in most areas.

Fall (September) 2008

Eelgrass coverage increased slightly in September in both the Cabrillo North and South areas (Figure 8.3-3). Eelgrass coverage within both Cabrillo North and South totaled 38.2 acres. This represents an increase of approximately 5% in eelgrass coverage among all areas within Cabrillo Beach between April and September 2008. Eelgrass plant morphology changed noticeably between survey periods with fall surveys reporting very few small (4-10 in.) plants and the majority of plants ranging from 2-4 ft tall.

During September, 10.5 acres of eelgrass were recorded in Cabrillo South. The eelgrass bed associated with this area was primarily along the shoreline out to the first swim buoy. Plants observed on the inner and outer edges of the bed were patchy and widely spaced. Individual plants were predominantly tall (2-4 ft) growing in uniform mud substrate, and several plants showed evidence of new growth. The majority of the bed was observed in intermediate depths of -3 ft to -8ft MLLW and consisted of plants with low epiphyte loads that were comprised of diatom film and crustose coralline algae. Cover was patchy outside the main bed and quadrats placed in a stratified-random manner along the transect line ranged in density from 0 to 128 turions/m^2 (Table 8.3-3).

Overall the eelgrass bed within the Cabrillo South area was sparse and patchy outside of a defined band running parallel to shore, and Cabrillo South transect CS2a contained eelgrass within only 6 of the 25 quadrats. Divers performed six transects within Cabrillo South, beginning in the center of observed beds. Turion counts and corresponding densities were relatively low compared to Cabrillo North, with the exception of transect CS1b (Table 8.3-3 and Table 8.3-4). Mean leaf shoot (turion) density (± standard deviation) in the bed ranged from 4.60 ± 2.31 turions/m^2 to 73.6 ± 37.0 turions/m^2 (Table 8.3-3). Quadrat sampling by divers at this site was increased between the April and September surveys in an attempt to more accurately quantify the associated eelgrass beds observed during side-scan sonar surveys.

Turion counts were less dense in the fall than during the spring 2008 surveys; however, the densities were consistent among bathymetric contours at Cabrillo North. Eelgrass acreage also increased slightly. For example, during September 27.7 acres of eelgrass were recorded in Cabrillo North - representing an increase of less than 3% from the spring. During the September surveys six diver transects were performed within Cabrillo North (Figure 8.3-4). Turion counts varied from 0 to 14 turions per quadrat, a reduction from April 2008. Densities were relatively consistent throughout the eelgrass bed, with the exception of Cabrillo North transect CN1a, nearest to the Cabrillo Marina jetty, where competing algae (*Chaetomorpha spp*.) was dense within individual quadrats (Table 8.3-3). Mean turion density in the bed ranged from 24.32 ± 31.71 turions/m^2 to 85.76 ± 33.59 turions/m^2 (Table 8.3-4). With the exception of transect CN1a, densities were noticeably similar among all other Cabrillo North transects and highlights the homogeneity of this eelgrass bed along bathymetric contours (Table 8.3-4). Cabrillo North transects CN3a and CN3b were placed parallel to shore in the area of densest eelgrass coverage and perpendicular to the April 2008 Cabrillo North transect CN2 location (Figures 8.3-2 and 8.3-3). Plant size differences within Cabrillo North were much less evident than observed during the April surveys, with very few small (4-10 in) plants observed. Hard substrate (rocks) was observed in several locations along the transects. *Gracillaria* spp. and *Prionitis lanceolata* was recorded in conjunction with eelgrass in several quadrats, with *Chaetomorpha spp*. remaining prominent in the northern-most transects and noticeably decreasing in occurrence moving south towards the boat ramp.

8.3.2.2 Pier 300/Seaplane Lagoon Area

Spring (March/April) 2008

The Pier 300 and Seaplane Lagoon area eelgrass beds occur in three physically distinct locations (Figures 8.3-4 and 8.3-5). The first, "Seaplane Lagoon," is an old Seaplane anchorage that is located farthest from the harbor entrance. The second location, "Mitigation Site," is adjacent to Pier 300 and is the shallow water habitat mitigation site constructed as part of the Pier 400 project, was planted in the winter of 2002/2003, and was augmented with additional sediment and planting efforts in 2007 (Merkel & Associates 2008). This site is comprised of dredge fill with rock revetments that created very shallow water habitat, suitable for establishing an eelgrass bed. The third area, "Terminal Site," is adjacent to a container shipping terminal with a rock dike to the west and a small sandy beach to the north (Figure 8.3-4).

The Mitigation site, Seaplane Lagoon site, and Terminal Site contained a total of 30.7 acres of eelgrass based on the March 2008 side-scan surveys. The Mitigation Site contained 15.4 acres of eelgrass, with 4.8 acres mapped within the Seaplane Lagoon, and 10.4 acres of eelgrass within the Terminal Site (Table 8.3-11). The Mitigation Site eelgrass bed was dispersed, but with patches that appeared evenly spaced, as indicated by the data for transects M1 and M2 (Table.8.3-5). Associated algal species *Chaetomorpha spp*. and *Gracillaria spp.* that were observed at the Cabrillo Beach area were also common within the Mitigation Site, near rocks or shell piles, in conjunction with healthy patches of primarily large (2-3 ft) eelgrass plants growing in uniform mud substrate. The majority of the eelgrass bed was in central portion of the Mitigation Site (-6 ft to -8ft MLLW), but individual plants were observed throughout most of the site. The lowest densities were noted on the far north portion of the site adjacent to the rock jetty. Substrate was variable throughout the Mitigation Site with evidence of scouring and patches of course shell fragments observed throughout the site, but most prominent near the margins.

Turion counts at the Mitigation site in the spring varied widely from 0 to 6 turions per 1/16m^2 quadrat and typified the patchy nature of the eelgrass bed associated with this site (Table 8.3-5). Divers performed two transects within the Mitigation Site in April, beginning in the center of eelgrass beds identified during side-scan sonar surveys. Mean turion density (± standard deviation) was low within the Mitigation Site and the Seaplane Lagoon compared to the nearby Terminal Site (Table 8.3-5). Two areas adjacent to the surveyed transects, but not represented in quadrat counts, had slightly higher densities based on diver observations (10 turions per quadrat). Observations within the general Mitigation Site indicated dense and persistent red algae (*Gracillaria spp.* and *Prionitis spp*.) growing within the eelgrass bed and commonly intertwined with large mature eelgrass plants. Diver observations of eelgrass density, spatial consistency, and associated algae provided important information utilized for sonar density mapping interpretation.

The Seaplane Lagoon bed contained 4.8 acres of eelgrass during the April survey and consisted of small fragmented linear patches from -1 ft to -7ft MLLW. Plants were sparse and comprised of a mixture of small (6 in) and large (2-3 ft) individuals. The eelgrass beds within the Seaplane Lagoon were variable, such that the low density habitat likely grades between a defined eelgrass bed (at least one plant/m^2) under the SCEMP (NMFS 1991) and potential eelgrass habitat (less than one plant/m^2). Substrate within the Seaplane Lagoon consisted of fine mud.

In the spring turion counts at the Seaplane Lagoon were relatively low compared to other sites, thereby illustrating the spatial variability and limited nature of the eelgrass bed in this area

(Table 8.3-5), based on one diver transect within the Seaplane Lagoon in April. Investigations of areas immediately outside the transect footprint found similar eelgrass distribution and density, with no plants observed deeper than -7 ft MLLW. Poor visibility and debris along the bottom made conditions difficult for identifying associated invertebrates or fish, although they were present along the transect.

The Terminal Site eelgrass bed encompassed 10.4 acres during the April survey and consisted of a well-established linear bed along the sandy beach and along the western jetty (Figure 8.3-4). Plants were comprised of a mixture of 10-20% small (4-6 inches) and the remainder large (2-3 ft) individuals. Substrate within the site consisted of a sand mud mixture and plants had a low epiphytic load of diatom film. Red algae (e.g., *Gracillaria spp.)* was not observed at either the Terminal Site or Seaplane Lagoon and appeared associated with areas characterized by coarse sediments or shell fragments.

Divers performed one transect within the Terminal Site in April. Turion counts varied from 0 to 9 turions per 1/16m^2 quadrat and displayed the least variability and greatest density of all the Pier 300 area transects (Table 8.3-5). Eelgrass densities were uniform at the beginning of the transect and became gradually patchy near the end point. Investigations of areas outside the transect footprint found similar eelgrass distribution and density with no plants observed deeper than -11 ft MLLW. Round stingrays (*Urolophus halleri*), topsmelt (*Atherinops affinis*), sand bass (*Paralabrax nebulifer*), and spiny lobster (*Panulirus interuptus*) were among the main fish and invertebrate species observed during quadrat counts.

September 2008

The general distribution of eelgrass within the Pier 300/Seaplane Lagoon area remained similar to observations from the spring surveys. Eelgrass coverage within all three Pier 300/Seaplane Lagoon sites totaled 28.6 acres (Figure 8.3-4) in September, a decrease of less than 5% from the April survey. The Mitigation Site bed contained 15.1 acres of eelgrass in September, nearly unchanged from the April 2008 survey. Individual eelgrass plants remained a composition of small (<6-8 in) and large (2-4 ft) plants distributed in patchy clumps and linear areas parallel to shore. The greatest density of eelgrass in the Mitigation Site was located within the central portion of the site near transect MS2b (-6 ft to -8 ft MLLW), comprised of individual plants estimated at approximately 3 ft in height along with some very small (3 in) plants. The lowest densities remained within the far Northern portion of the Mitigation Site and were associated with substrate that was comprised of coarse shell fragments. Associated algal species, *Chaetomorpha spp*. and *Gracillaria spp.*, noted during spring surveys also were present in dense aggregations where suitable substrate exists, as well as epiphytically within the denser eelgrass stands. The boundaries of the Mitigation Site are composed of rock revetments, deep channels, and rock jetties which expose the site to numerous physical and biological factors that appear to regulate eelgrass growth, production, and distribution over a large area.

Consistent with the patchy nature of the eelgrass bed associated with this area, turion counts at the Mitigation Site varied widely from 0 to 9 turions per quadrat. Mean turion density in the bed varied between 10.2 turions/m^2 at for transect MS1a to 72.3 turions/m^2 for transect MS2b (Table 8.3-6). Eelgrass areas over all transects within the Mitigation Site appeared representative of the surrounding community and were diverse and patchy based on turion density (Table 8.3-6). Observations within the Mitigation Site documented dense and persistent red algae (*Gracillaria spp.* and *Prionitis spp*.) growing within the eelgrass bed in association with hard substrate or shell fragments and commonly intertwined with large mature eelgrass plants, similar to conditions observed at Cabrillo North. Diver observations of eelgrass density, spatial consistency, and associated algae were used for sonar density mapping interpretation.

Overall, eelgrass beds within the Seaplane Lagoon were less dense and more spatially dispersed than beds surveyed during the same time period in the other two area sites. The Seaplane Lagoon bed contained 4.6 acres of eelgrass during the September survey and was similar in density and distribution to observations made during spring (April) surveys. Visibility was limited (less than 3 ft) during diver surveys and associated fish and invertebrates were difficult to document.

The inconsistent, patchy nature of the eelgrass bed associated with this area was represented in diver transects performed within the Seaplane Lagoon, and was characterized by turion counts from 0 to 5 turions per quadrat with high variability. Mean turion density in the bed ranged from 3.8 ± 9.6 turions/m^2 for transect SP1a to 13.4 ± 18.86 turions/m^2 for transect SP1b (Table 8.3-7). Continuous eelgrass patches within the sampled transects occurred infrequently and large barren areas of greater than 5 meters were common (Table 8.3-7). Investigations of areas outside the transect footprint found similar eelgrass distribution and density with no plants observed deeper than -7 ft MLLW.

The Terminal Site eelgrass bed encompassed 8.9 acres of eelgrass during the September 2008 survey and remained a well-established linear bed along the sandy beach and along the western jetty (Figure 8.3-8). The most distinct and densest portion of the eelgrass bed was along the sandy beach, as represented by diver transects T1a and T1b. The eelgrass bed remained limited to a narrow band (-3 to -8 MLLW) parallel to the beach and jetty because of a relatively abrupt change in depth associated with a steep bottom slope. Divers described conditions within the Terminal Site as turbid and the substrate was comprised of fine silt/mud with few plants observed deeper than -11 ft MLLW.

Within the Terminal Site, diver transects documented turion counts that varied from 0 to 13 turions per quadrat and displayed the least variability of all the Pier 300 area transects. Mean turion density in the bed ranged from 65.3 ± 60.2 turions/m^2 for transect T1a to just 1.3 ± 4.4 turions/m^2 for transect T3b (Table 8.3-8). Eelgrass within the transects was similar to adjacent areas and spatial variability of eelgrass within individual beds and adjacent areas was consistent. Eelgrass observed along the transects had low-to-moderate epiphytic loads that consisted primarily of diatomaceous film and some crustose coralline algae.

8.3.2.3 Other Eelgrass Beds

The Ports of Los Angeles and Long Beach represent a large harbor complex typified by extensive areas of hardened shoreline (riprap and quay wall) and dredge-maintained shipping channels that provide only limited eelgrass habitat. Side-scan sonar surveys principally targeted areas less than -20 ft MLLW and concentrated on areas previously identified to support eelgrass beds (MEC 2002). While the eelgrass beds described above appear well established by their persistence, as also documented by previous investigations, the patchy distribution highlighted from diver transects illustrates the dynamic aspect of the individual sites and associated eelgrass beds. Considering the narrow physical tolerances of light and substrate required for eelgrass growth, it is possible that individual plants or narrow bands of eelgrass exist elsewhere in the Ports but went undetected by the present and prior surveys. No eelgrass beds were identified within the Port of Long Beach. One area just outside the Port's boundary line northeast of Island Grissom was identified as supporting a sizeable eelgrass bed.

Additional sparse eelgrass beds have been reported within Cabrillo Marina and intermittently in small narrow linear bands along riprap where suitable depth and conditions exist (Merkel & Assoc. 2009, pers. comm.). Eelgrass is often displaced by natural and anthropogenic events (e.g., storms and boat anchoring, respectively) eventually resettling in new areas that may provide suitable conditions for growth within limited time periods. However, the development and persistence of such outlying patches is ultimately tied to the stability of the substrate and sufficient, consistent clarity of the overlying water column.

8.3.3 Eelgrass Characteristics

Leaf blade morphology characteristics and widths were documented for several locations during the fall surveys to determine whether more than one species of eelgrass was present within the surveyed beds. Leaf blades collected from the Cabrillo North eelgrass bed (n = 15) were measured for width. All measured blades were described as flat in cross section consistent with *Zostera marina* (as described in Coyer et al. 2007) and overall eelgrass blades had a low epiphytic load consisting of primarily diatom film and crustose coralline algae.

Recent publications (Coyer et al. 2007, Engle and Miller 2003) confirmed that up to three species of eelgrass (*Zostera spp*.) may inhabit various areas of southern California, although their optimal growth requirements and transport mechanisms are not completely understood. During the fall diver verification surveys, eelgrass widths and morphology were recorded and described by a visiting researcher (Dan Martin, University of South Alabama) and he identified two distinct blade cross sections. Collections were taken from Cabrillo North, Seaplane Lagoon, and the Mitigation Site. Cabrillo North samples averaged 4.1 mm (n=15) in width and all displayed a flat blade. In contrast, approximately 30% of all collected samples (n = 25) from the Seaplane Lagoon and the Mitigation Site had a W-shaped cross section and several displayed a prominent mid rib. The differences in eelgrass blade morphology suggest that more than one species of Zostera spp. may exist in the Ports and/or that some degree of hybridization may have taken place within eelgrass areas surveyed. More in-depth morphological investigations would be required to fully describe the variations among individual plants and eelgrass beds, but current findings indicate that eelgrass recruitment or transplantation events may have multiple sources.

8.3.4 Comparison of 2000 and 2008 Surveys

In general, 2008 delineated eelgrass beds were similar in area and location to those surveyed during the 2000 baseline survey (Figure 8.3.6). Turion densities from diver transects indicated that Cabrillo North and South supported the greatest densities and least variable eelgrass areas while the Pier 300/Seaplane Lagoon Area was variable and patchy in nature (Table 8.3-5, 8.3-6, and 8.3-7). The greatest turion densities within quadrats from the 2008 surveys were comparable to densities from the 2000 baseline study using slightly different quadrat placement methods (Table 8.3-9).

In the previous baseline study (MEC 2002) turion density was estimated by selectively counting turions within the densest stands of eelgrass for each identified eelgrass community. While those reported densities provided valuable information on the densest areas of eelgrass within specific beds they were not representative of the entire area or the majority of the surveyed eelgrass communities. In contrast, the eelgrass communities were elevated as follows. Density counts were organized by selecting the most prominent eelgrass beds observed from side-scan sonar imagery and marking each location with a weighted buoy for subsequent diver surveys. This transect method provided an accurate representation of mean eelgrass turion density within the delineated eelgrass bed using repeatable methods that documented spatial variations in turion densities as well as maximum turion densities within the individual eelgrass beds. Maximum turion densities collected during the 2008 survey were lower than those reported from the 2000 surveys but remained within expected variation based on seasonal differences and sampling methods. However, because the present methods also cover the full range of densities, the highest turion densities recorded in quadrats sampled in 2008 were consistent with densities reported in the 2000 baseline study among the surveyed areas (Table 8.3-9).

The importance of mean turion (shoot) density and the associated standard deviation is to establish the continuity and consistency of surveyed eelgrass beds within the Ports. By examining the relatively low mean shoot densities and high standard deviations reported earlier in this section, in conjunction with documented visual observations, it is apparent that the majority of eelgrass beds delineated in 2008, with the exception of Cabrillo North, are of low density interspersed with higher density patches (Figures 8.3-1 through 8.3-4), and that the plants varied in size and spacing. Several areas exemplified dense, well-defined eelgrass beds while the majority of the areas appeared to border on ephemeral or fringe habitat during the 2008 evaluations.

8.4 SPATIAL AND TEMPORAL VARIATION

8.4.1 Seasonal Eelgrass Dynamics within Los Angeles Harbor

Eelgrass beds or meadows are highly dynamic systems that exist in a constantly changing state where eelgrass density and survival rate is directly affected by numerous environmental factors (Durance 2002). It is common for the density and survival rate of eelgrass meadows to fluctuate on a seasonal basis. Therefore, monitoring of eelgrass should consider the natural and seasonal variation of the eelgrass growth cycles. These dynamic systems can change with the seasons or remain unchanged for decades (Fonseca et al. 1983).

Eelgrass exhibits seasonality in growth throughout its range depending on the physical and biological factors acting on the individual areas. Eelgrass in the North Pacific, including southern California, becomes dormant during the winter to a varying degree, depending on location, leaves, and sustaining reserves within its underground rhizome system (Backman 1991). Eelgrass beds at the southern extent of their distribution (Sea of Cortez) typically die off during mid-summer and are reestablished by recruitment in the fall. Considering the extensive distribution range of eelgrass (*Zostera spp.*), seasonal declines and expansions are variable based on the environmental conditions experienced within specific geographical locations. In southern California, including the Ports, the seasonality of growth and reproduction is less pronounced and eelgrass often grows year around. For example, flowering may occur during any month, although it is most pronounced in the spring (Ruckelshaus 1996). The presence and extent of eelgrass fluctuates yearly based on localized and regional conditions, but early winter typically marks the end of the growth period and the initiation of die off or senescence of eelgrass populations, as associated with lower water temperatures and increased turbidity from storms or runoff. During the summer, eelgrass begins vegetative growth, expanding from dormant rhizomes and increasing in shoot density. Meanwhile, recruitment from seed production provides potential recolonization or expansion to areas previously devoid of eelgrass or to fringe areas containing marginal habitat conditions. The inconsistency and variability of winter conditions experienced in southern California and the dynamics of coastal circulation determines the level of effect that different eelgrass beds or areas experience on a yearly basis.

Areas containing eelgrass beds within the Port of Los Angeles appear to be constrained primarily by physical factors associated with light and substrate, with distribution and abundance documented intermittently since initial investigations were completed in the mid 1990s (Merkel & Associates 2009 and MEC 2002). While the expansion of eelgrass to new locations throughout the Port is possible, it is more likely that the eelgrass beds associated with Cabrillo Beach and Pier 300/Seaplane Lagoon areas will continue to represent the most significant eelgrass areas. Additional suitable eelgrass habitat likely exists in very small narrow bands along some of the riprap and a small sparse area has recently been documented near Cabrillo Marina.

The 2008 eelgrass surveys documented eelgrass areas within expected locations and confirmed consistent seasonal patterns among surveyed locations. Eelgrass beds displayed seasonal changes in density and plant growth from spring to fall and dense mats of competing marine algae associated with rock or shell fragments were observed at Cabrillo North and the Mitigation Site in the Pier 300 area. The presence of *Chaetomorpha spp*. and *Gracillaria spp.* within quadrats was noted at nearly every eelgrass area to varying degrees and was formed dense mats up to 2 feet thick within the northern portion of the eelgrass bed at Cabrillo North and near the margins of the Mitigation Site within the Pier 300/Seaplane Lagoon Area. The degree to which the occurrence of these marine algae affects the spatial extent or density of eelgrass beds within the Port is unknown. However, their common occurrence and density in specific locations likely increases competition for space and/or light with existing and emerging eelgrass plants.

The Cabrillo North eelgrass bed substrate was variable throughout the site with some hard substrate (rock) observed within the northwestern and offshore portions of the bed. The majority of the bed persists in fine mud and silt in shallow areas less than -7 ft MLLW and is comprised of mostly small and evenly spaced plants, while deeper, offshore areas (> 8 ft MLLW) were typified by large plants that were distributed randomly among sand/mud and shell fragment substrates. The spatial extent of the Cabrillo North bed changed only slightly (increased approximately 5%) between the spring and fall surveys (Table 8.3-10). Most notably the bed extended to the south, connecting with the eelgrass bed at Cabrillo South, and the densest areas expanded offshore in the fall (Figures 8.3-1 and 8.3-3).

The Cabrillo South area consists of fine sand/ mud substrate near the beach and mostly fine silt/mud at deeper depths (> -6 ft MLLW). The inner edge of the eelgrass bed appeared well defined, possibly from wave action or from recent sand movement. The spatial extent of the Cabrillo South bed expanded from 9.33 acres in the spring to 10.5 acres in the fall (an increase of approximately 12.5%) (Table 8.3-10). Most notably, the bed extended to the south, forming a continuous bed along the shoreline that was not observed during the spring sampling and the densest areas expanded and shifted offshore (Figures 8.3-2 and 8.3-3). Depending on yearly fluctuations in recruitment and seasonal die-off in certain portions, the eelgrass bed at Cabrillo South may become discontinuous and fragmented/patchy as apparent from the 2008 surveys.

Surveys conducted in the Pier 300/Seaplane Lagoon area showed three distinct eelgrass beds or areas (Figure 8.3-4). The Seaplane Lagoon, located in a well-protected area in the northeastern section, has limited flushing and fine sediments. Water quality appeared poor during the surveys, with oil sheens and debris commonly observed on the surface and limited water clarity during diver surveys, compared to the Terminal Site and Cabrillo North/South. The spatial extent of the Seaplane Lagoon bed changed only slightly (decreased approximately 4%) between the spring and fall surveys; the bed became more discontinuous in the fall and the densest areas decreased noticeably (Figures 8.3-4 and 8.3-5). Nearly all observed eelgrass was orientated parallel to shore within narrow bands between -4 and -7 ft MLLW. Epiphyte loads were moderate and plants appeared randomly spaced and with little continuous bed formation evident. While this bed appears persistent from previously reported observations, seasonal differences in eelgrass bed extent were apparent from the side-scan surveys.

The Mitigation Site located in the center of the Pier 300/Seaplane Lagoon Area consisted of large, evenly spaced plants with occasional dense patches that were less than 3 m^2. Red algae (*Chaetomorpha spp*. and *Gracillaria spp.)* was commonly observed as potential competitors for space and light among the eelgrass plants and was particularly evident adjacent to the rock revetments and in areas with hard substrate (rock) or shell fragments. The southern portions of the Pier 300 site contained higher densities of *Gracillaria spp.*, to the extent that it was much more common than the eelgrass plants. Considering the Mitigation Site is composed of rock revetments constructed to support the dredge fill of various sizes, the occurrence on marine algae is not surprising based on the available substrate. Considering the location of the Mitigation Site between the small sandy beach embayment to the west, comprised of mostly fine sand and mud, and the deep dredged channel leading into the Seaplane Lagoon, circulation and scouring from tidal water movement likely contribute to the occurrence of courser sediments and the persistence of competitive algal species. Previous eelgrass transplantation that was conducted in 2003 and 2007 still appears spatially distinct and the associated eelgrass community is likely being shaped by the complex interactions of competition and hydrology that affects sediment distribution.

The eelgrass bed within the Mitigation Site displayed very little season change, decreasing from 15.4 acres in the spring to 15.1 acres in the fall (approximately 2.5%). The low density and evenly spaced plants observed throughout this site coupled with dense aggregations of *Gracillaria spp*. made evaluations of the differences in sonar surveys difficult. For example, although the imagery shown in Figures 8.3-4 and 8.3-5 depicts a continuous low density bed, the actual configuration of the site is likely more fragmented at a finer scale.

The Terminal Site in the western most portion of the Pier 300/Seaplane Lagoon area is the most consistent eelgrass habitat within this portion of the Port and consists of uniform sand/mud substrate supporting a continuous, healthy bed of eelgrass with only intermittent occurrences of algae (*Chaetomorpha spp*. and *Gracillaria spp.).* The Terminal Site extends from the sandy beach adjacent to the Mitigation Site to the south along the riprap. The spatial extent of the Terminal Site bed decreased from 10.4 acres in the spring to 8.9 acres in the fall (approximately 15%), with the bed contracting throughout the offshore edge and the densest areas decreased overall (Figures 8.3-2 and 8.3-4). Seasonal differences in plant sizes were evident with the eelgrass bed along the beach shifting from small and large plants in the spring to mostly large (>2 ft) plants in the fall, with a low epiphyte load. During both spring and fall surveys the eelgrass was evenly spaced, forming a continuous bed just inshore of a noticeable berm at approximately -5 to -8 ft MLLW. Extending south along the riprap adjacent to the terminal, the substrate contained several dark areas of fine mud where the eelgrass bed became increasing discontinuous and sparse moving away from the beach and the riprap.

In some cases considerable annual (seasonal) variation in abundance has been documented in southern California (e.g., winter die-off and spring/summer re-growth) due to a variety of factors, including but not limited to physical and biological disturbance, changes in nutrient availability, and changes in water quality parameters such as turbidity and salinity. These factors can result in long-term changes in eelgrass abundance depending on the frequency and intensity of unfavorable conditions. Eelgrass density also can vary substantially depending on the bottom depth of plant attachment. This is due to variations in the size of plant turions at different depths. For example, at shallower depths eelgrass density is typically greater than at deeper depths (Durance 2002 and Gussett 2002). Eelgrass density and morphology vary with respect to depth, exposure, substrate, and water clarity (Durance 2002). As a result, it can be difficult to define characteristics for a “normal” eelgrass bed.

Seasonal patterns among all surveyed areas were inconsistent. Cabrillo Beach eelgrass beds displayed expansion and growth while the Pier 300/Seaplane Areas had a slight decrease in overall eelgrass acreage. Diver surveys completed in the spring of 2008 recorded density differences with respect to depth at Cabrillo South transect CS1 and Cabrillo North transect CN2 (Table 8.3-1 and 8.3-2). The eelgrass beds associated with Cabrillo North and South expanded in spatial extent and density over the summer growth period, consistent with expected trends and with previously reported seasonal patterns within the Ports (MEC 2002). Decreases in eelgrass area and density within all three sites in the Pier 300/Seaplane Lagoon Area, although relatively small, were not expected. Observations documenting seasonal growth of individual eelgrass plants progressing from small (4-6 in) to >2 ft tall were recorded at all sites as expected.

8.4.2 Regional Eelgrass Dynamics within the Ports

In conjunction with anticipated seasonal and temporal variability in eelgrass bed distribution, eelgrass distribution can also be affected by localized or regional episodic events. For example, El Niño Southern Oscillation (ENSO) events can have negative effects on eelgrass health and persistence as a result of elevated sea surface water temperatures and increases in sea level. Eelgrass beds throughout southern California declined 50 to 70% during ENSO events in 1997/1998 and subsequently recovered by 2000 (Merkel & Associates 2000). Large regional episodic events that disrupt water quality can increase effects to eelgrass by limiting growth conditions or altering the substrate. Considering that habitat and conditions conducive for eelgrass recruitment and growth are relatively narrow within the Ports, minor perturbations could have significant implications for eelgrass distribution, persistence, and health.

Events such as El Niño/La Niña have broad implications on regional biological production and especially eelgrass growth. The trend of higher sea surface temperatures and corresponding El Niño conditions recorded between 2002 and the early portion of 2007 could be the source of decreased spatial extent and lower densities observed within the Ports during the 2008 baseline surveys (Figure 8.3-6). While 2007 and the early portion of 2008 were considered a mild La Niña condition, introducing cooler surface waters to the SCB, eelgrass growth and bed consistency likely require greater than one season to recover or experience a lag effect for regrowth or recruitment. Lower average monthly sea surface temperatures for the Central Pacific ocean waters in the late portion of 2007 and early 2008 were short lived with warmer sea surface temperatures returning in early summer and fall of 2008 (Table 8.3-12). Sea surface temperatures within the SCB followed a similar trend to the ones reported in the time series depicted in Figure 8.3-7.

Inter-specific competition from marine algae, phytoplankton blooms, and fouling from epiphytes can also have considerable effects on eelgrass distribution and health. Increases in nutrients from runoff and elevated water temperatures can be associated with algal blooms and increased epiphytic growth that reduces light availability. Diebacks are frequently observed in eelgrass communities when the epiphytic load reduces the amount of light reaching the plant to a level where photosynthesis can no longer balance metabolic demands (Hanson 2000). Species utilizing eelgrass beds and the associated benthic infauna as food sources can also have localized effects on eelgrass distribution. As examples, various waterfowl and benthic invertebrates graze directly on eelgrass blades while several species of rays can cause bioturbation and increased sediment cover within eelgrass beds when foraging for prey species in the substrate.

8.5 HISTORICAL COMPARISONS

Based on the multitude of physical and biological factors shaping eelgrass community growth, recruitment, and productivity, the Ports' 2008 eelgrass surveys should be viewed in a regional and historical context. While seasonal differences between the 2008 spring and fall surveys were not significant in terms of changes in the spatial extent of eelgrass, they reinforce the need to examine trends from broader time scale and regional perspective. The examination and evaluation of eelgrass communities throughout southern California has increased significantly since 1990 and provides expanded data sets of similar eelgrass systems that should be considered when evaluating trends in eelgrass distribution within bays and harbors.

Surveys of eelgrass resources within the Ports study area were conducted for the Port of Los Angeles in 1996 and again in 1999 by the Southern California Marine Institute (SCMI) and in both Ports for the 2000 baseline study (MEC 2002). The 1996 report only covered eelgrass areas at Cabrillo Beach, while the 1999 report looked at both Cabrillo Beach and the Pier 300 Shallow Water Habitat (Gregorio 1999). The 2000 baseline study surveyed all waters of both Ports for eelgrass, and was conducted prior to eelgrass transplantation at the Pier 300 shallow water habitat mitigation site, which was completed in the winter of 2002/2003. Survey methods utilized during the 1996 and 1999 investigations did not include side-scan sonar imagery, but provide important data records on the areal extent and turion density within eelgrass areas delineated during the present (2008) study and the 2000 baseline study. Considering the discontinuous nature of the eelgrass data sets available for the Port of Los Angeles, the combined data sets provide generally limited information on site-specific eelgrass trends. Equally important to site-specific eelgrass distribution and density variations within the study area are their relationship to regional trends documented in other bays and harbors throughout southern California.

Data sets available on the areal extent of eelgrass within the Ports are most comprehensive for the Cabrillo Beach areas (Figure 8.3-6). Off Cabrillo Beach, a total of 24.6 acres of eelgrass was reported in 1996 (season unknown), increasing to 54.5 acres in October 1999 (Gregorio 1999). The 2000 baseline survey reported 42.3 acres of eelgrass within the Cabrillo Beach area in August 2000 and the 2008 baseline survey mapped 26.7 acres within the same location. Differences in the spatial extent of eelgrass within the Port of Los Angeles between the 2000 and 2008 baseline surveys are attributed to natural variability and, to a lesser extent, changes in hydrology. The existing data sets provide sufficient trend data for comparisons with other bay and estuarine eelgrass data and compares favorably with trend data collected in San Diego Bay. Eelgrass data from San Diego Bay provides a more long-term and comprehensive basis for comparing changes in eelgrass distribution and abundance in a southern California harbor environment. In order to help understand relative trends in the areal extent of Port of Los Angeles/Long Beach eelgrass communities, San Diego Bay eelgrass communities are presented for comparison in Figure 8.3-8.

Factors that influence eelgrass growth, reproduction, and health can be somewhat localized, but also can be driven by regional water masses and weather conditions that are broadly applicable within the Southern California Bight. The increase in eelgrass coverage observed at Cabrillo Beach between 1996 and 1999/2000 was approximately 72% while San Diego Bay reported an increase of 57% between 1994 and 1999 (Figure 8.3-8). San Diego Bay investigations reported an additional expansion of 27% between 1999 and 2004 followed by a decrease of 37% between 2004 and 2008. In relative terms, the Port of Los Angeles Cabrillo Beach eelgrass coverage follows a similar trend to that of San Diego Bay, although without any data for comparison with the 2004 trend in San Diego Bay. Eelgrass coverage and health is well documented as being adversely affected by ENSO events in 1997/1998 and displayed substantial recovery during 1999 (Merkel & Associates 2000). The 2000 baseline study (MEC

2002) inferred that the significant increases in eelgrass coverage observed during the 2000 surveys were a result of recovery following a prior ENSO event. Eelgrass coverage reported from the present (2008) baseline survey for Cabrillo Beach areas is thought to be representative of regional performance by these communities.

Historical comparisons of eelgrass distribution for the Pier 300/Seaplane Lagoon area are more difficult to access because of changes in depth and habitat quality within that area. Prior to the construction of Pier 400 in 1996, eelgrass appeared to be mostly confined to the edges of Seaplane Lagoon and near the Pier 300 Terminal Site. However, construction of Pier 400 and the associated shallow water habitat mitigation site between the Seaplane Lagoon and the terminal likely caused subsequent changes in the circulation and bathymetry of the area. Based on eelgrass delineations between the 2000 and 2008 baseline surveys, eelgrass within the Seaplane Lagoon remained confined to the same areas previously documented and total coverage changed only slightly in spring and fall, respectively, from 6.29 and 4.28 acres in 2000 to 4.84 and 4.58 acres in 2008. The eelgrass area described in the 2000 baseline study at Pier 300 is currently divided into two distinct areas: the Mitigation Site and the Terminal Site (Figure 8.3-4). During construction of the Mitigation Site, rock revetments were established to support the dredge fill material that was placed to form the mitigation site and create suitable habitat for eelgrass transplantation. Eelgrass delineations for the Pier 300 area, as documented in the 2000 baseline report, indicated eelgrass communities well offshore of the Terminal Site in water that is now greater than -15 ft MLLW and which no longer supports eelgrass communities. Additionally, the 2000 baseline report noted eelgrass adjacent to what is now the western edge of the mitigation site. This area is now dominated by various marine algae associated with the rock revetments. Changes in circulation or sedimentation may be responsible for a well-developed berm observed in 2008 along the sandy beach that defines the associated eelgrass bed, and which was documented in 2000 as extending offshore and east towards what is now the mitigation site. Currently, few eelgrass plants are present in waters greater than -12 ft MLLW throughout the Ports. Considering the proximity of the Cabrillo Beach area to the open ocean and the influence of coastal nearshore circulation supplying clear, cool, and fresh waters to the area, deeper eelgrass populations would be expected similar to reports in San Diego Bay (-20 ft MLLW) and Newport Beach (-16 ft MLLW).

Overall, eelgrass coverage within the Pier 300/Seaplane Lagoon appears to have remained fairly consistent, with the March 2000 baseline surveys reporting a total of 28.5 acres compared to 30.7 acres during the April 2008 surveys. The noticeable seasonal increase in coverage observed between the spring and fall 2000 surveys was not apparent in 2008. The distribution and extent of eelgrass communities surveyed during the 2008 baseline study within the Ports are generally consistent with results from the 2000 baseline survey and follow regional fluctuations documented within similar bays and harbors such as San Diego Bay.

Table 8.3-1. Spring 2008 Turion Densities from Diver Transects for Port of Los Angeles, Cabrillo South Location.

Site		*Cabrillo South*			
Transect #		*CS1*		*CS2*	
Date	*Meter Tape #*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*
4/2/08	48	0	0	4	64
4/2/08	45	0	0	8	128
4/2/08	42	0	0	8	128
4/2/08	39	0	0	9	144
4/2/08	36	1	16	9	144
4/2/08	34	4	64	11	176
4/2/08	32	0	0	3	48
4/2/08	30	1	16	5	80
4/2/08	29	0	0	12	192
4/2/08	28	4	64	5	80
4/2/08	26	4	64	13	208
4/2/08	25	6	96	5	80
4/2/08	24	3	48	7	112
4/2/08	22	1	16	1	16
4/2/08	20	5	80	5	80
4/2/08	18	9	144	9	144
4/2/08	16	5	80	5	80
4/2/08	14	2	32	2	32
4/2/08	12	6	96	6	96
4/2/08	10	5	80	5	80
4/2/08	8	1	16	1	16
4/2/08	6	7	112	7	112
4/2/08	4	8	128	8	128
4/2/08	2	1	16	1	16
4/2/08	0	4	64	4	64
	n= 25				
	mean	*3.08*	*49.28*	*6.12*	*97.92*
	stdev	*2.78*	*44.52*	*3.32*	*53.13*

Table 8.3-2. Spring 2008 Turion Densities from Diver Transects for Port of Los Angeles, Cabrillo North Location.

Site		*Cabrillo North*			
Transect		*Transect CN1*		*Transect CN2*	
Date	*Meter Tape #*	*# of turion per quadrat*	*# of turions per m²*	*# of turions per quadrat*	*# of turions per m²*
4/2/08	48	8	128	6	96
4/2/08	45	14	224	7	112
4/2/08	42	6	96	7	112
4/2/08	39	9	144	6	96
4/2/08	36	9	144	4	64
4/2/08	34	8	128	7	112
4/2/08	32	7	112	11	176
4/2/08	30	9	144	8	128
4/2/08	29	12	192	6	96
4/2/08	28	8	128	13	208
4/2/08	26	11	176	9	144
4/2/08	25	14	224	7	112
4/2/08	24	9	144	9	144
4/2/08	22	9	144	13	208
4/2/08	20	6	96	9	144
4/2/08	18	9	144	9	144
4/2/08	16	14	224	6	96
4/2/08	14	6	96	7	112
4/2/08	12	17	272	6	96
4/2/08	10	10	160	7	112
4/2/08	8	5	80	6	96
4/2/08	6	9	144	9	144
4/2/08	4	8	128	7	112
4/2/08	2	6	96	6	96
4/2/08	0	1	16	6	96
	n= 25				
	mean	*8.96*	*143.36*	*7.64*	*122.24*
	stdev	*3.40*	*54.35*	*2.20*	*35.14*

Table 8.3-3. Fall 2008 Turion Densities from Diver Transects for Port of Los Angeles, Cabrillo South Location.

Site		*Cabrillo South*											
Transect #		*CS1a*		*CS1b*		*CS2a*		*CS2b*		*S3a*		*S3b*	
Date	*Meter Tape #*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*
9/30/08	50	0	0	8	128	0	0	2	32	2	32	4	64
9/30/08	48	1	16	7	112	0	0	0	0	3	48	1	16
9/30/08	46	5	80	3	48	0	0	2	32	0	0	3	48
9/30/08	44	3	48	3	48	0	0	2	32	7	112	2	32
9/30/08	42	1	16	2	32	0	0	3	48	7	112	3	48
9/30/08	40	3	48	5	80	0	0	0	0	2	32	1	16
9/30/08	38	2	32	4	64	0	0	3	48	3	48	2	32
9/30/08	36	5	80	7	112	0	0	1	16	6	96	3	48
9/30/08	34	2	32	4	64	0	0	2	32	5	80	2	32
9/30/08	32	3	48	7	112	0	0	4	64	4	64	1	16
9/30/08	30	4	64	1	16	0	0	3	48	6	96	2	32
9/30/08	28	6	96	4	64	0	0	1	16	3	48	4	64
9/30/08	26	5	80	3	48	0	0	2	32	2	32	5	80
9/30/08	24	0	0	3	48	0	0	2	32	3	48	1	16
9/30/08	22	3	48	4	64	0	0	3	48	1	16	0	0
9/30/08	20	0	0	6	96	0	0	4	64	3	48	2	32
9/30/08	18	5	80	7	112	3	48	4	64	5	80	2	32
9/30/08	16	0	0	8	128	2	32	5	80	4	64	0	0
9/30/08	14	6	96	8	128	0	0	5	80	5	80	2	32
9/30/08	12	3	48	5	80	1	16	3	48	3	48	0	0
9/30/08	10	4	64	3	48	1	16	3	48	7	112	3	48
9/30/08	8	2	32	7	112	1	16	6	96	7	112	0	0
9/30/08	6	2	32	2	32	0	0	5	80	5	80	1	16
9/30/08	4	2	32	4	64	0	0	4	64	2	32	1	16
9/30/08	2	6	96	0	0	2	32	3	48	7	112	1	16
	n= 25												
	mean	*2.92*	*46.72*	*4.60*	*73.60*	*0.40*	*6.40*	*2.88*	*46.08*	*4.08*	*65.28*	*1.84*	*29.44*
	stdev	*1.98*	*31.64*	*2.31*	*36.95*	*0.82*	*13.06*	*1.54*	*24.58*	*2.08*	*33.28*	*1.34*	*21.51*

Table 8.3-4. Fall 2008 Turion Densities from Diver Transects for Port of Los Angeles, Cabrillo North Location.

Site		*Cabrillo North*											
Transect #		*CN1a*		*CN1b*		*CN2a*		*CN2b*		*CN3a*		*CN3b*	
Date	*Meter Tape #*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*
9/30/08	50	0	0	8	128	2	32	3	48	4	64	2	32
9/30/08	48	2	32	9	144	2	32	3	48	5	80	3	48
9/30/08	46	4	64	5	80	1	16	4	64	14	224	8	128
9/30/08	44	7	112	5	80	4	64	6	96	6	96	3	48
9/30/08	42	5	80	11	176	6	96	4	64	3	48	10	160
9/30/08	40	0	0	4	64	5	80	4	64	4	64	8	128
9/30/08	38	0	0	5	80	10	160	2	32	5	80	3	48
9/30/08	36	3	48	2	32	4	64	6	96	3	48	6	96
9/30/08	34	4	64	8	128	6	96	6	96	8	128	2	32
9/30/08	32	3	48	4	64	8	128	9	144	8	128	8	128
9/30/08	30	0	0	5	80	6	96	6	96	6	96	6	96
9/30/08	28	0	0	6	96	3	48	9	144	5	80	5	80
9/30/08	26	0	0	3	48	3	48	5	80	3	48	3	48
9/30/08	24	0	0	0	0	10	160	6	96	5	80	5	80
9/30/08	22	0	0	1	16	3	48	3	48	0	0	0	0
9/30/08	20	1	16	0	0	5	80	5	80	4	64	4	64
9/30/08	18	0	0	5	80	4	64	5	80	5	80	5	80
9/30/08	16	0	0	6	96	6	96	7	112	2	32	2	32
9/30/08	14	0	0	7	112	4	64	8	128	1	16	1	16
9/30/08	12	0	0	1	16	4	64	3	48	3	48	3	48
9/30/08	10	1	16	5	80	0	0	6	96	2	32	2	32
9/30/08	8	3	48	2	32	6	96	7	112	7	112	7	112
9/30/08	6	0	0	2	32	5	80	6	96	6	96	6	96
9/30/08	4	2	32	3	48	7	112	9	144	9	144	9	144
9/30/08	2	3	48	0	0	8	128	2	32	7	112	7	112
	n= 25												
	mean	*1.52*	*24.32*	*4.28*	*68.48*	*4.88*	*78.08*	*5.36*	*85.76*	*5.00*	*80.00*	*4.72*	*75.52*
	stdev	*1.98*	*31.71*	*2.94*	*46.99*	*2.52*	*40.35*	*2.10*	*33.59*	*2.92*	*46.65*	*2.70*	*43.21*

Table 8.3-5. Spring 2008 Turion Densities from Diver Transects for Port of Los Angeles, Pier 300/Seaplane Lagoon Area.

Site		*Pier 300/Seaplane Lagoon Area*							
Transect #		*Terminal T1*		*Mitigation M1*		*Mitigation M2*		*Seaplane S1*	
Date	*Meter Tape #*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*
4/2/08	48	4	64	3	48	4	64	3	48
4/2/08	45	6	96	4	64	1	16	4	64
4/2/08	42	6	96	0	0	0	0	0	0
4/2/08	39	4	64	3	48	6	96	3	48
4/2/08	36	7	112	0	0	0	0	0	0
4/2/08	34	5	80	0	0	0	0	0	0
4/2/08	32	8	128	0	0	0	0	0	0
4/2/08	30	8	128	0	0	3	48	0	0
4/2/08	29	0	0	0	0	0	0	0	0
4/2/08	28	6	96	0	0	0	0	0	0
4/2/08	26	9	144	0	0	0	0	0	0
4/2/08	25	5	80	0	0	0	0	0	0
4/2/08	24	0	0	0	0	0	0	0	0
4/2/08	22	4	64	0	0	0	0	0	0
4/2/08	20	5	80	0	0	0	0	0	0
4/2/08	18	8	128	1	16	0	0	1	16
4/2/08	16	6	96	0	0	0	0	0	0
4/2/08	14	0	0	1	16	0	0	1	16
4/2/08	12	0	0	0	0	0	0	2	32
4/2/08	10	0	0	0	0	0	0	2	32
4/2/08	8	0	0	2	32	5	80	3	48
4/2/08	6	5	80	4	64	6	96	2	32
4/2/08	4	0	0	1	16	4	64	1	16
4/2/08	2	2	32	4	64	3	48	1	16
4/2/08	0	4	64	0	0	0	0	2	32
	n= 25								
	mean	*4.15*	*66.46*	*0.92*	*14.72*	*1.28*	*20.48*	*1.00*	*16.00*
	stdev	*2.98*	*47.61*	*1.47*	*23.52*	*2.11*	*33.79*	*1.26*	*20.13*

Table 8.3-6. Fall 2008 Turion Densities from Diver Transects for Port of Los Angeles, Mitigation Site Area.

Site		*Seaplane Lagoon Area*							
Transect #		*MS1a*		*MS1b*		*MS2a*		*MS2b*	
Date	*Meter Tape #*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*
10/01/08	50	0	0	0	0	4	64	2	32
10/01/08	48	0	0	0	0	0	0	0	0
10/01/08	46	0	0	0	0	0	0	0	0
10/01/08	44	0	0	0	0	0	0	0	0
10/01/08	42	0	0	1	16	0	0	3	48
10/01/08	40	0	0	0	0	0	0	0	0
10/01/08	38	0	0	1	16	0	0	7	112
10/01/08	36	0	0	1	16	0	0	7	112
10/01/08	34	0	0	2	32	7	112	2	32
10/01/08	32	0	0	1	16	0	0	1	16
10/01/08	30	2	32	6	96	0	0	6	96
10/01/08	28	0	0	7	112	0	0	4	64
10/01/08	26	3	48	0	0	0	0	8	128
10/01/08	24	2	32	0	0	3	48	6	96
10/01/08	22	1	16	1	16	5	80	7	112
10/01/08	20	0	0	0	0	1	16	5	80
10/01/08	18	0	0	0	0	4	64	8	128
10/01/08	16	0	0	0	0	0	0	6	96
10/01/08	14	1	16	0	0	1	16	8	128
10/01/08	12	0	0	0	0	0	0	2	32
10/01/08	10	0	0	0	0	3	48	7	112
10/01/08	8	0	0	0	0	4	64	9	144
10/01/08	6	3	48	1	16	5	80	6	96
10/01/08	4	0	0	0	0	2	32	7	112
10/01/08	2	4	64	0	0	2	32	2	32
	n= 25								
	mean	*0.64*	*10.24*	*0.84*	*13.44*	*1.64*	*26.24*	*4.52*	*72.32*
	stdev	*1.19*	*18.98*	*1.80*	*28.73*	*2.12*	*33.90*	*3.02*	*48.25*

Table 8.3-7. Fall 2008 Turion Densities from Diver Transects for Port of Los Angeles, Seaplane Lagoon Area.

Site		*Seaplane Lagoon*							
Transect #		*SP1a*		*SP1b*		*SP2a*		*SP2b*	
Date	*Meter Tape #*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*
10/01/08	50	0	0	2	32	3	48	5	80
10/01/08	48	2	32	1	16	2	32	0	0
10/01/08	46	0	0	1	16	3	48	0	0
10/01/08	44	0	0	1	16	0	0	0	0
10/01/08	42	0	0	0	0	4	64	0	0
10/01/08	40	0	0	0	0	0	0	3	48
10/01/08	38	0	0	0	0	0	0	0	0
10/01/08	36	0	0	0	0	2	32	0	0
10/01/08	34	0	0	0	0	0	0	2	32
10/01/08	32	0	0	0	0	1	16	0	0
10/01/08	30	0	0	0	0	0	0	0	0
10/01/08	28	0	0	1	16	2	32	0	0
10/01/08	26	0	0	1	16	0	0	0	0
10/01/08	24	0	0	0	0	1	16	0	0
10/01/08	22	0	0	0	0	1	16	0	0
10/01/08	20	0	0	0	0	1	16	1	16
10/01/08	18	0	0	0	0	0	0	0	0
10/01/08	16	1	16	1	16	0	0	0	0
10/01/08	14	0	0	0	0	0	0	0	0
10/01/08	12	2	32	0	0	0	0	0	0
10/01/08	10	0	0	0	0	0	0	0	0
10/01/08	8	1	16	0	0	0	0	0	0
10/01/08	6	0	0	0	0	0	0	1	16
10/01/08	4	0	0	1	16	0	0	1	16
10/01/08	2	0	0	3	48	1	16	2	32
	n= 25								
	mean	*0.24*	*3.84*	*0.48*	*7.68*	*0.84*	*13.44*	*0.60*	*9.60*
	stdev	*0.60*	*9.56*	*0.77*	*12.32*	*1.18*	*18.86*	*1.22*	*19.60*

Table 8.3-8. Fall 2008 Turion Densities from Diver Transects for Port of Los Angeles, Terminal Area.

Site		*Terminal Area*											
Transect #		*T1a*		*T1b*		*T2a*		*T2b*		*T3a*		*T3b*	
Date	*Meter Tape #*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*	*# of turions per quadrat*	*# of turions per m^2*
9/30/08	50	0	0	4	64	7	112	0	0	0	0	0	0
9/30/08	48	0	0	8	128	0	0	0	0	0	0	0	0
9/30/08	46	4	64	3	48	0	0	0	0	0	0	0	0
9/30/08	44	1	16	4	64	1	16	0	0	0	0	0	0
9/30/08	42	0	0	6	96	5	80	4	64	0	0	0	0
9/30/08	40	0	0	0	0	4	64	0	0	8	128	0	0
9/30/08	38	3	48	3	48	0	0	3	48	6	96	0	0
9/30/08	36	2	32	6	96	0	0	5	80	4	64	0	0
9/30/08	34	0	0	4	64	0	0	0	0	2	32	0	0
9/30/08	32	0	0	6	96	1	16	0	0	0	0	0	0
9/30/08	30	3	48	3	48	4	64	0	0	0	0	0	0
9/30/08	28	0	0	7	112	3	48	0	0	0	0	0	0
9/30/08	26	3	48	3	48	2	32	0	0	0	0	0	0
9/30/08	24	5	80	3	48	4	64	7	112	0	0	1	16
9/30/08	22	7	112	1	16	3	48	1	16	0	0	0	0
9/30/08	20	3	48	8	128	3	48	0	0	0	0	0	0
9/30/08	18	8	128	1	16	3	48	5	80	0	0	0	0
9/30/08	16	8	128	5	80	9	144	4	64	0	0	0	0
9/30/08	14	5	80	6	96	6	96	6	96	0	0	1	16
9/30/08	12	3	48	1	16	3	48	8	128	0	0	0	0
9/30/08	10	10	160	0	0	2	32	6	96	0	0	0	0
9/30/08	8	8	128	3	48	4	64	7	112	0	0	0	0
9/30/08	6	7	112	3	48	4	64	8	128	0	0	0	0
9/30/08	4	13	208	4	64	3	48	9	144	0	0	0	0
9/30/08	2	9	144	4	64	4	64	7	112	0	0	0	0
	n= 25												
	mean	*4.08*	*65.28*	*3.84*	*61.44*	*3.00*	*48.00*	*3.20*	*51.20*	*0.80*	*12.80*	*0.08*	*1.28*
	stdev	*3.76*	*60.21*	*2.27*	*36.27*	*2.29*	*36.66*	*3.32*	*53.07*	*2.08*	*33.31*	*0.28*	*4.43*

Table 8.3-9. Eelgrass Turion (shoot) Densities/m^2 from Diver Sampled Quadrats for the Port of Los Angeles 2000 and 2008 Surveys.

	Cabrillo Beach Area		*Pier 300/Seaplane Lagoon Area*	
	Turion (shoots)/m^2		*Turion (shoots)/m^2*	
	Cabrillo North	*Cabrillo South*	*Terminal*	*Seaplane*
Spring 2000	289.6	134.4	202.4	132.8
Fall 2000	267.2	396.8	171.2	147.2
Spring 2008	272	208	144	48
Fall 2008	176	128	208	64

Note: 2008 densities are based on the highest values observed within sampled quadrats for comparison purposes.

Table 8.3-10. Cabrillo Beach Area Eelgrass Acreages for the 2000 and 2008 Baseline Studies.

Cabrillo Beach Area			
Site	*Cabrillo North*	*Cabrillo South*	*Cabrillo Total*
Spring 2000	16.02	5.64	21.66
Fall 2000	22.51	19.76	42.27
Spring 2008	26.7	9.33	36.03
Fall 2008	27.7	10.5	38.2

Table 8.3-11. Pier 300/Seaplane Area Eelgrass Acreages for the 2000 and 2008 Baseline Studies.

Pier 300/Seaplane Lagoon Area				
Site	*Terminal*	*Seaplane*	*Mitigation*	*Pier 300 Total*
Spring 2000	22.23	6.29	No Data	28.52
Fall 2000	38.42	4.28	No Data	42.7
Spring 2008	10.4	4.8	15.4	30.6
Fall 2008	8.9	4.6	15.1	28.6

Table 8.3-12. Oceanic Nino Index.

	JFM	*FMA*	*MAM*	*AMJ*	*MJJ*	*JJA*	*JAS*	*ASO*	*SON*	*OND*	*NDJ*	*DJF*
2000	**-1.6**	**-1.4**	**-1.0**	**-0.8**	**-0.6**	**-0.5**	-0.4	-0.4	-0.4	**-0.5**	**-0.6**	**-0.7**
2001	**-0.6**	**-0.5**	-0.4	-0.2	-0.1	0.1	0.2	0.2	0.1	0.0	-0.1	-0.1
2002	-0.1	0.1	0.2	0.4	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.3**	**1.5**	**1.4**
2003	**1.2**	**0.9**	**0.5**	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	**0.5**	**0.7**	**0.8**	**0.9**	**0.8**	**0.8**	**0.8**
2005	**0.7**	**0.5**	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	**0.5**	**0.6**	**0.9**	**1.1**	**1.1**
2007	**0.8**	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	**-0.7**	**-1.0**	**-1.1**	**-1.3**
2008	**-1.4**	**-1.4**	**-1.1**	**-0.8**	**-0.6**	-0.4	-0.1	0.0	0.0	0.0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7					

Source: NOAA/ National Weather Service, National Centers for Environmental Prediction: Climate Prediction Center Internet Team

Note: Warm (**red**) and cold (**blue**) episodes based on a threshold of +/- 0.5oC for the Oceanic Niño Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Niño 3.4 region (5oN-5oS, 120o-170oW)], based on the 1971-2000 base period. For historical purposes, cold and warm episodes (blue and red colored numbers) are defined when the threshold is met for a minimum of five consecutive over-lapping seasons.

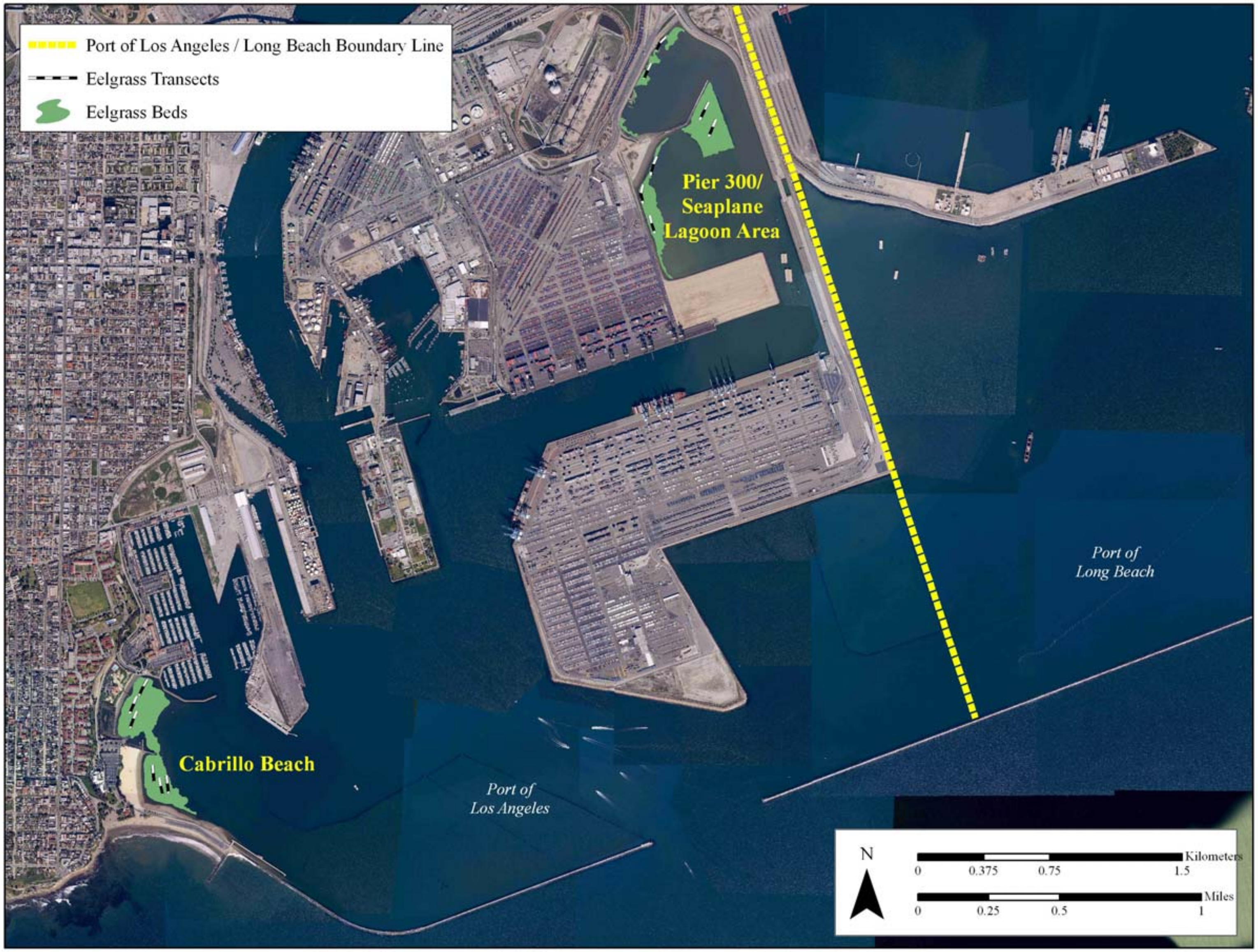


Figure 8.3-1. Overview of Eelgrass Distribution in Ports of Los Angeles and Long Beach during Biological Baseline Surveys, 2008.

Figure 8.3-2. Eelgrass Distribution and Density at Cabrillo Beach Youth Facility North (N1 and N2) and Cabrillo Beach South (S1 and S2) Sites in Spring 2008.

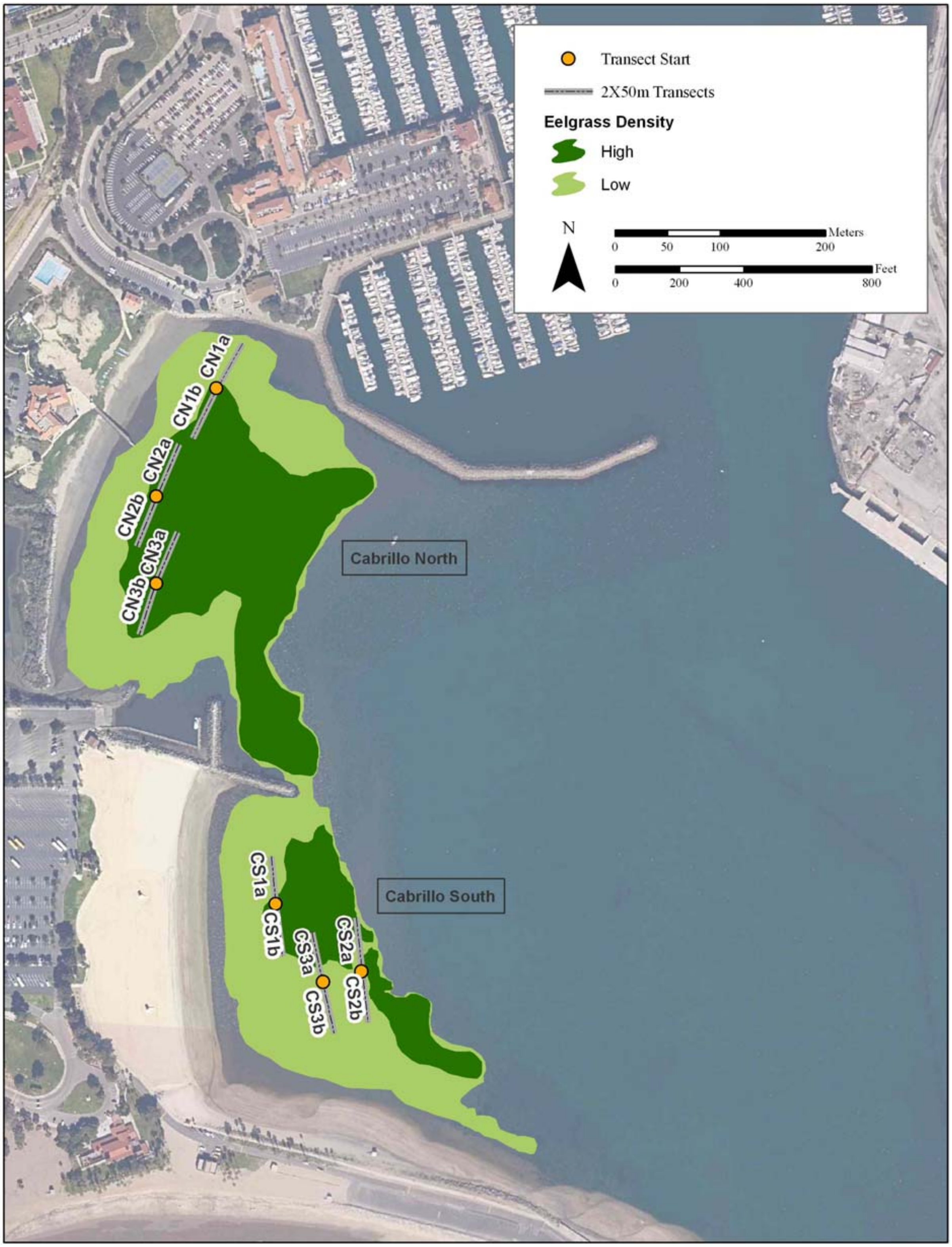


Figure 8.3-3. Eelgrass Distribution and Density at Cabrillo Beach Youth Facility North (N1 and N2) and Cabrillo Beach South (S1 and S2) Sites in Fall 2008.

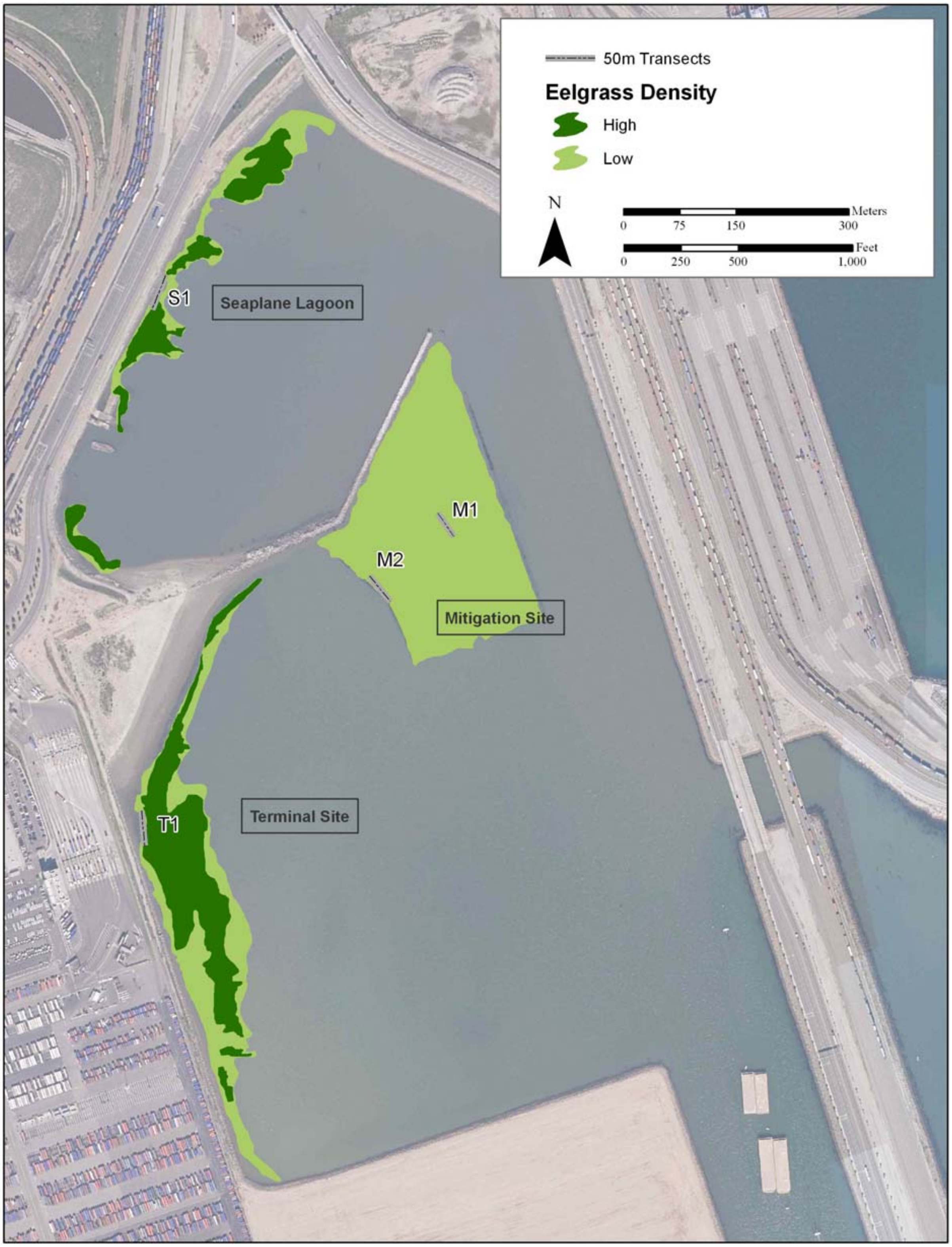


Figure 8.3-4. Eelgrass Distribution and Density at the Seaplane Anchorage, Pier 300 Terminal, and Pier 300 Shallow Water Habitat Mitigation Sites in Spring 2008.

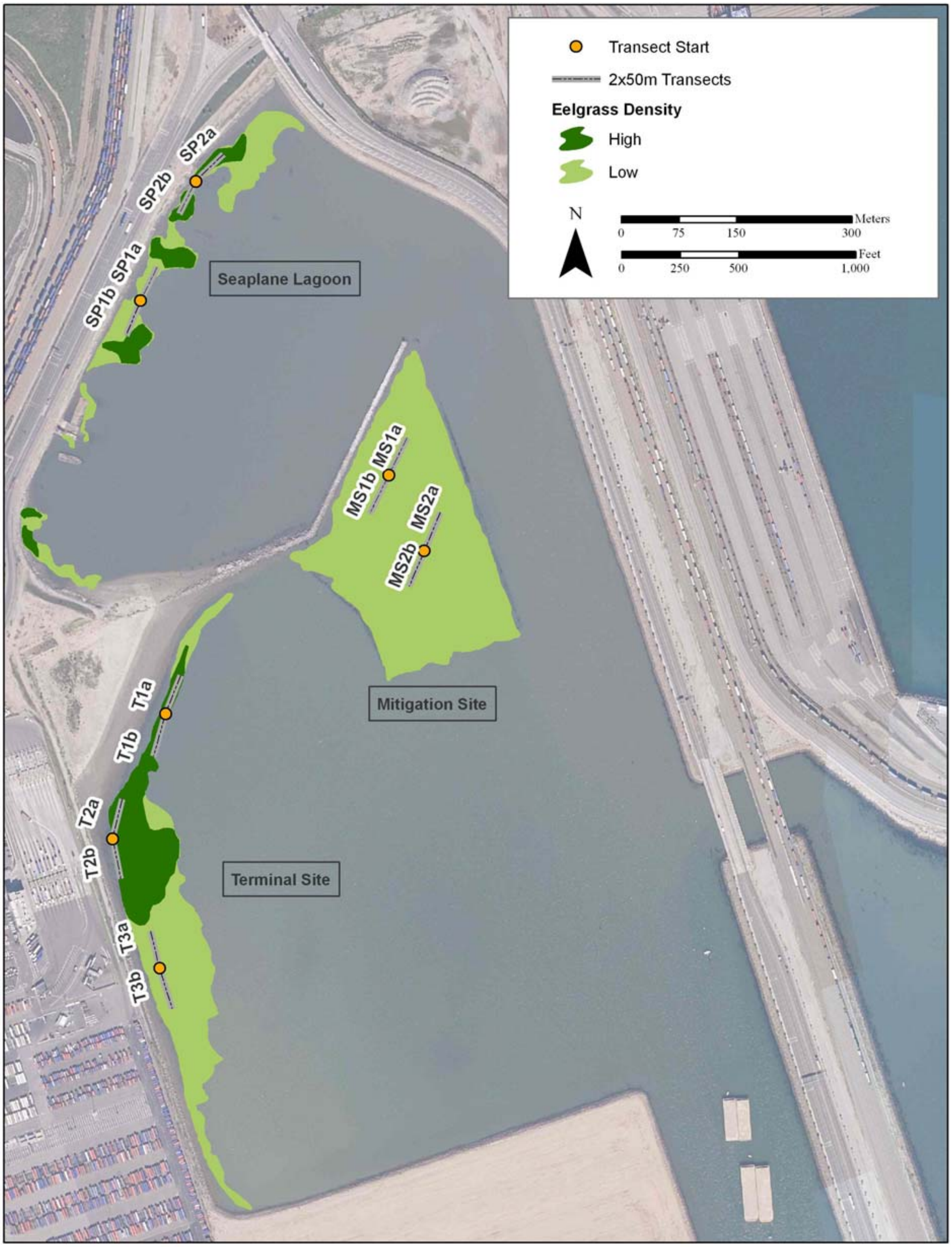


Figure 8.3-5. Eelgrass Distribution and Density at the Seaplane Anchorage, Pier 300 Terminal, and Pier 300 Shallow Water Habitat Mitigation Sites in Fall 2008.

Figure 8.3-6. Spatial Extent of Port of Los Angeles Eelgrass for the 2000 and 2008 Baseline Surveys, All Regions.

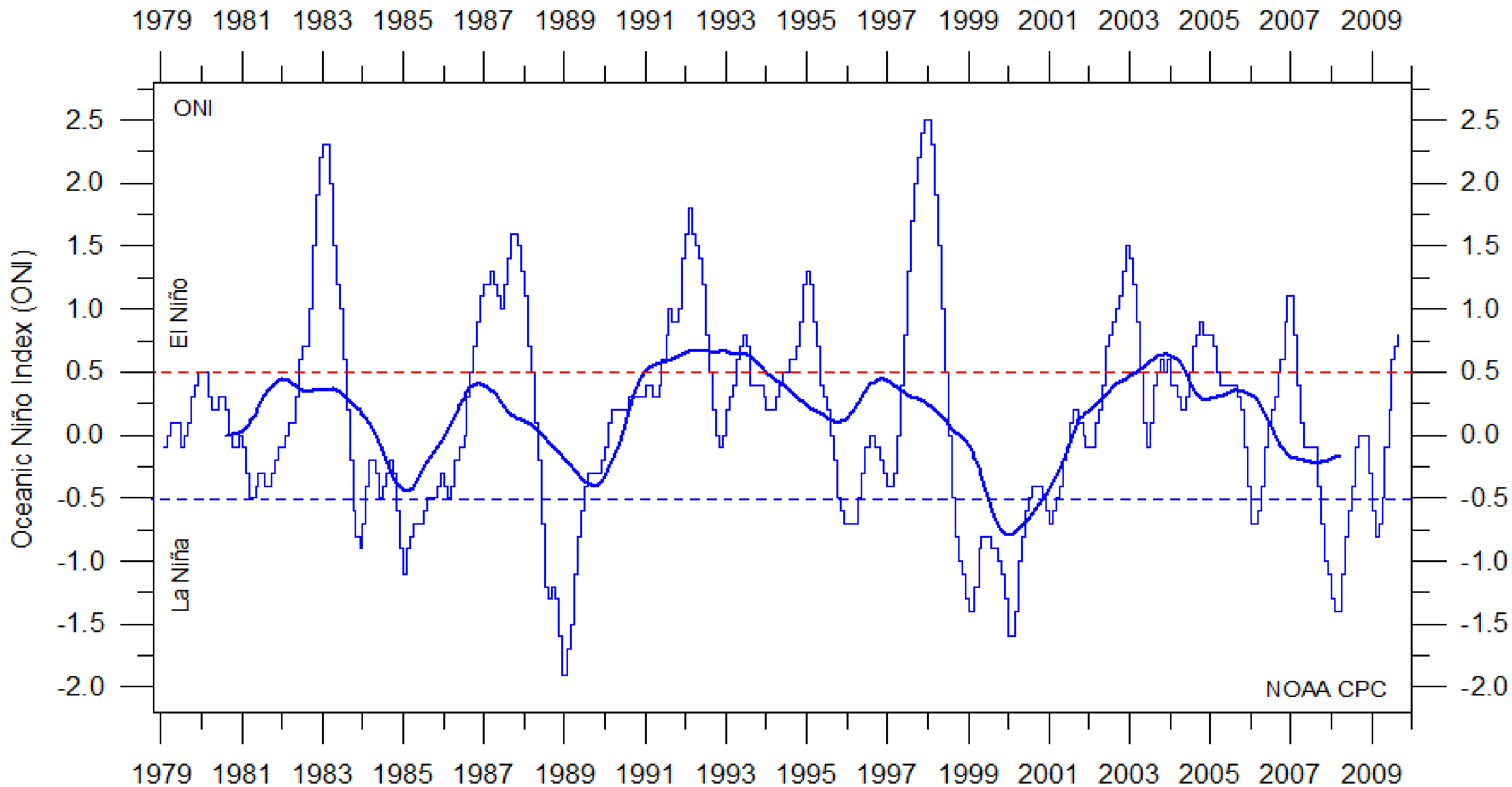


Figure 8.3-7. La Niña and El Niño Episodes.

Note: Warm (>+0.5°C; red stippled line) and cold (<0.5°C; blue stippled line) episodes for the Oceanic Niño Index (ONI), defined as 3 month running mean of ERSST.v3b SST anomalies in the Niño 3.4 region (5°N-5°S, 120°-170°W)]. Base period: 1971-2000. For historical purposes cold and warm episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons. The thin line indicates 3 month average values, and the thick line is the simple running 7 year average of these. Last 3 month running mean shown: May - July 2009. Last diagram update 19 August 2009.

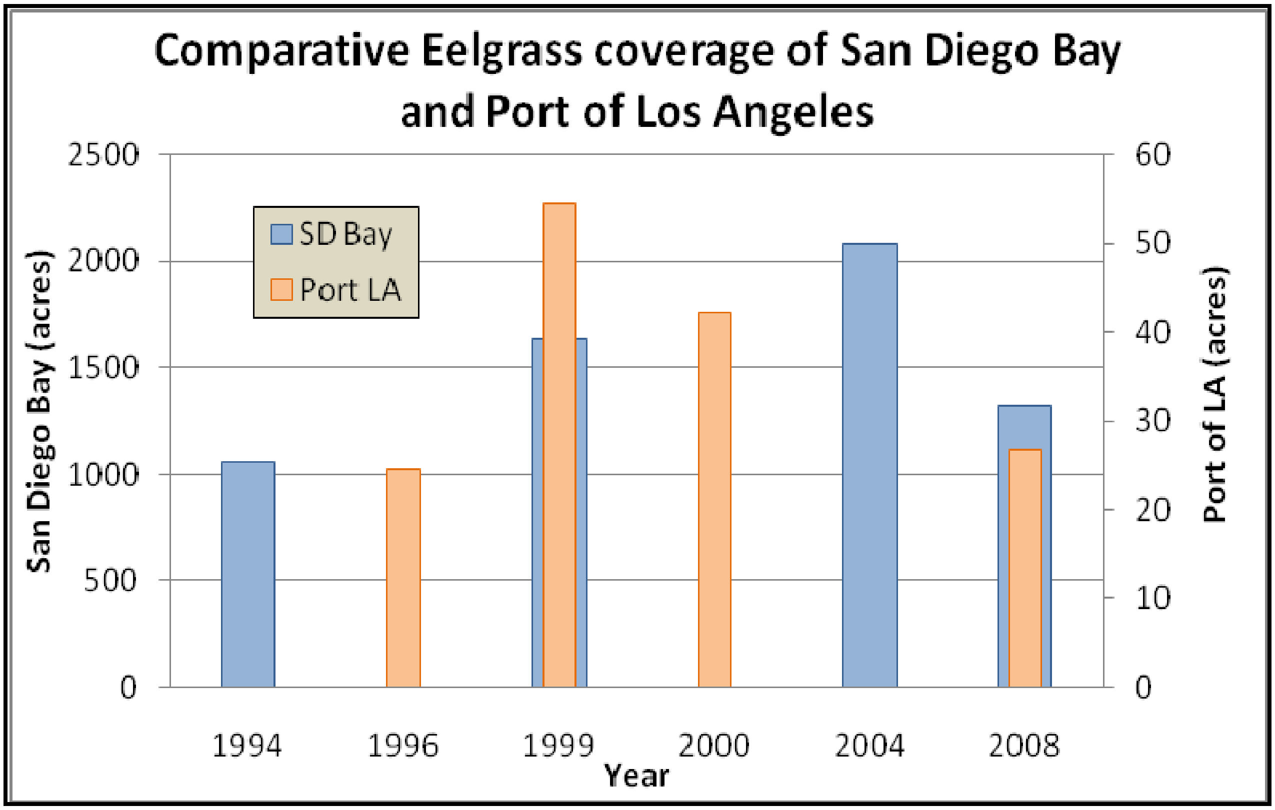


Figure 8.3-8. Eelgrass Coverage in San Diego Bay (all regions for all years) and Los Angeles Harbor-Cabrillo Beach (for all years).

Source for San Diego Bay: U.S. Navy/Port of San Diego (2008). Source for Los Angeles Harbor-Cabrillo Beach: Gregorio (1999), MEC (2002), and present (2008) study.

CHAPTER 9

BIRDS

9.0 BIRDS

9.1 INTRODUCTION

Southern California's coastal areas, including its shorelines, estuaries, bays, and harbors, provide several types of habitat for large numbers of waterfowl, shorebirds, wading birds, and birds that forage from the air. The open water and other habitats within the Ports of Long Beach and Los Angeles (Ports) provide opportunities for nesting, foraging, and resting by a diversity of bird species, including three species listed as endangered by the California and/or Federal Endangered Species Acts: California Brown Pelican, California Least Tern, and Peregrine Falcon. The Ports have conducted several previous studies of the avifauna over the past thirty years to document bird use of Port habitats; the current study represents a continuation of those efforts.

9.2 METHODOLOGY

9.2.1 Field Surveys

Methods used in the current study were similar to those of the 2000 baseline study (MEC 2002), including the same 31 survey zones (Figure 9.2-1). The survey zones generally correspond to those established during the 1983–1984 (MBC 1984) and 1986–1987 (MEC 1988) studies. Survey zones number from 1–15 and 19–34; the gap in the numbering sequence (16–18) reflects minor modifications to eliminate overlaps among studies and changes in harbor development, including the Pier 400 landfill and Pier J expansion (MEC 2002).

Saturation surveys were completed from a boat in all survey zones. Bird counts were conducted with binoculars by one observer and recorded by another observer who assisted with observations. Boat travel within survey zones was conducted in a manner that minimized flushing of birds to avoid double counts or observer-induced changes in bird behavior or habitat use.

A total of 20 surveys were conducted twice monthly from December 14 through March 22 and from August 14 through November 23, and once monthly from April 10 through July 26. For months with two surveys, they are designated as survey "A" and "B" in the report text and graphics. Surveys were more frequent during the fall and winter months to more thoroughly document the increase in avian activity that typically occurs in southern California during post-breeding dispersal, migration, and over-wintering; previous surveys (MBC 1984, MEC 1988, MEC 2002) also used this survey frequency. Each survey was conducted under suitable environmental conditions over a two- to three-day period, beginning early in the morning and ending in the late morning or early afternoon. Surveys were discontinued for the day if high winds, fog-limited visibility, rain, or other factors were deemed to be unsuitable for accurate and effective data collection.

Data recorded for each observation included species identity, numbers of individuals, habitat in which the birds occurred, and bird activity. Habitats were designated as anchor line, bridge, barge, buoy, dock/pilings, mudflat, open water (>1 foot deep), shallow water (<1 foot), sandy beach, salt marsh, spill boom, and aerial (for flying birds). Shallow water occurred along shorelines (beach, marsh) and artificial substrates (e.g., riprap). Bird activities were categorized as foraging, resting, courting, nesting, or flying. Other relevant information about particular observations was noted, such as presence of banded, dead, or injured individuals. Relevant environmental data were recorded, including wind speed and direction, sea surface and sky conditions, level of human activity, and any other circumstances that may have influenced the behavior and occurrence of the birds. Observations of marine mammals also were noted.

9.2.2 Data Analysis

All survey data were recorded in the field on hard-copy data sheets and then transferred in the office to digital database files. Data were analyzed to identify bird use of survey zones and habitat, and changes in bird use over the survey period. To facilitate data management and simplify presentation, each bird species was assigned to one of eight ecological guilds: Small Shorebirds, Large Shorebirds, Wading/Marsh Birds, Waterfowl, Aerial Fish Foragers, Raptors, Gulls, and Upland Birds. Appendix H-1 lists bird species by guild and includes scientific names for all species. Numbers of individuals by species are summarized for each survey according to the 31 survey zones in Appendix H-2.

Total and average numbers of individuals and species by survey were computed to examine seasonal variation in bird usage of the harbors. Percent composition of bird guilds was determined across surveys, by habitats and activities. Comparisons with prior surveys were based on total and average number of species, mean number of individuals per survey, percent composition of guilds across surveys, and percent abundance represented by the ten most common species. Further details as necessary on methods for data analysis are presented in the results sections below.

Mammal observations are given in Appendix I. California sea lions were commonly observed resting on buoys or docks or in open water throughout the Ports (Appendix I). Harbor seals were frequently observed hauled out on riprap or in open water of the outer harbor. Bottle-nosed dolphins were fairly common and common dolphins were seen on occasion in the outer harbor.

9.3 ABUNDANCE AND DIVERSITY

A total of 96 bird species representing 30 families was observed within the Ports during the 2007–2008 monitoring year (Table 9.3-1). Of these species, 68 are considered to be water-associated and dependent on the marine habitats of the Ports for food and shelter (Appendix H-1). The number of species ranged from 32 in May to 59 in November. Several thousand birds were observed during each survey, ranging from 3,870 in September to 9,732 in December. On average, 49 species and 6,277 individuals were observed per survey.

Bird species numbers, and to a lesser extent abundance, varied seasonally (Figure 9.3-1). Generally, species numbers were greater during fall to winter and lower in summer. Seasonal changes in species number were associated primarily with the Waterfowl (grebes, ducks, and geese) and Aerial Fish Forager (terns and pelicans) guilds (Figure 9.3-2). Although less abundant in the Ports, Shorebirds (sandpipers, oystercatchers, and stilts) also were seasonal in occurrence.

Waterfowl were more abundant from the second November survey through the April survey due to increased abundances of Brandt's Cormorant, Surf scoter, and Western Grebe as well as less abundant species such as Bufflehead, Clark's Grebe, Eared Grebe, Horned Grebe, Lesser Scaup, Mallard, Pelagic Cormorant, Pied-billed Grebe, and Ruddy Duck (Appendix H-2).

Aerial Fish Forager numbers followed an opposite pattern with higher numbers in May through July when Brown Pelicans return from offshore nesting areas and terns are at nesting sites at the Ports (Section 9.4, Appendix H-2). Abundances were lower in January through April coinciding with the period when Brown Pelicans are nesting at offshore Channel Islands and terns have departed for wintering areas. California Least Tern, Caspian Tern, and Elegant Tern nested at two sites in Los Angeles outer harbor (Section 9.4.2).

One species of shorebird, Black Oystercatcher, nested at the Ports and contributed to seasonally higher abundances during spring-summer (Appendix H-2). Other shorebirds such as Black-bellied Plover, Black Turnstone, Killdeer, Least Sandpiper, Sanderling, and Whimbrel generally were more abundant during winter and/or spring.

While the seasonal patterns indicate that many species are migratory, the Gulls and Upland Bird guilds were present in fairly consistent numbers throughout the year (Figure 9.3-2). Western Gull was a dominant species during all surveys. Heermann's Gull also was present each survey, but was much less abundant during March through May. California and Ring-billed Gulls were fairly common in winter and spring, whereas Herring and Mew Gulls were winter visitors. Upland Birds, primarily represented by Rock Dove, were present in fairly consistent numbers throughout the year (Figure 9.3-2).

A total of 20 species were observed during all or most surveys. These included the seventeen water-associated birds: Brown Pelican; Brandt's, Double-crested, and Pelagic Cormorants; Great Blue and Black-crowned Night Herons; Snowy Egret; Mallard; Surf Scoter; Black Oystercatcher; Western Grebe; Heermann's and Western Gulls (and Ring-billed Gull on 19 of the 20 surveys); and Caspian Tern (and Royal Tern on 19 of the 20 surveys). Three Upland birds (American Crow, Rock Dove, and House Finch) and one raptor species (Osprey) were observed during all surveys (Appendix H-2).

9.4 SPECIES COMPOSITION

9.4.1 Percent Guild and Species Abundance

Approximately 90 percent of the observed birds belonged to three water-associated guilds: Aerial Fish Foragers, Gulls, and Waterfowl (Table 9.4-1). The upland bird guild accounted for approximately 6% of the observations. Other guilds associated with land and water interface habitats (shorebirds, wading/marsh birds) and raptors represented less than 4% of the total observations. The ten most abundant species over all surveys accounted for over 91% of the bird counts.

The most abundant guild was Waterfowl (38.5%), with Brandt's Cormorant the most abundant waterfowl species and the second most numerous species overall (14.1% of total birds for all surveys) and (Table 9.4-1). Three other waterfowl species — Surf Scoter (11.2%), Western Grebe (8.0%) and Double-crested Cormorant (3.5%) — were among the ten most numerous species for the 2007–2008 surveys.

The second most abundant guild was Gulls (34.4%), with Western Gull (24.6%) the most abundant species observed during all 2007–2008 surveys. Also relatively common were Heermann's Gull (7.3%) and California Gull (1.2%). Aerial Fish Foragers were the third most abundant bird guild (17.5%), with Brown Pelican (9.6%) and Elegant Tern (7.0%) among the ten most numerous species (Table 9.4-1).

Nearly three times lower in abundance than Aerial Fish Foragers were Upland Birds (6.2%), which was not unexpected because, aside from areas that bordered the harbors' waters, upland habitats of the Ports were not surveyed. The most numerous upland bird was the non-native Rock Dove, comprising 5.1% of all birds and the majority of all Upland Birds (6.2% of total birds) (Table 9.4-1).

The remaining bird guilds — Small Shorebirds (1.6%), Wading/Marsh Birds (1.1%), Large Shorebirds (0.6%), and Raptors (0.9%) — comprised a relatively small percentage of all birds observed in 2007–2008 (Table 9.4-1). Aside from a small area of mudflat in zones 1, 5, and 27, no foraging habitat (saltmarsh, freshwater marsh, mudflat) preferred by shorebirds and Wading/Marsh Birds occurs in the Ports. Habitats for Raptors are also limited in the Ports, and, as top predators, Raptors are generally a less abundant guild.

9.4.2 Special-status Species

Table 9.4-2 summarizes the listing status of each of the special-status species historically observed within the Ports. In many cases, protective status applies to specific locations such as nesting colonies or communal roosts (rather than foraging or wintering areas). Species in the table are organized taxonomically. Figures 9.4-1a-f show habitat use within the Ports for listed species (Brown Pelican, Peregrine Falcon, Least Tern); the Black Oystercatcher, which nested on the outer breakwater; and other tern species (Caspian Tern and Elegant Tern) that nested in high numbers in the Los Angeles Harbor during the summer of 2008.

9.4.2.1 California Brown Pelican

Brown Pelicans accounted for 9.6% of the total observations during the 2007–2008 surveys (Table 9.4-1). The majority of individuals were observed roosting (resting) along the riprap of the outer breakwater (Figure 9.4-1a). The maximum number of Brown Pelicans was 2,886 individuals in May 2008. This likely was due to the pelicans returning to the coast from offshore island nesting areas; low pelican numbers during most surveys from January through April (Figure 9.4-1a) coincided with the peak breeding season. While Brown Pelicans do not nest within the Ports (the nearest nesting colonies are on west Anacapa and Santa Barbara islands), the Ports provide valuable roosting and feeding habitat, particularly the outer breakwater and open water.

The Brown Pelican has consistently been one of the most abundant species within the Ports, accounting for 9.5% of all birds during the 2000–2001 study (MEC 2002), 14% during the 1986–1987 study (MEC 1988), and 15.1% during the 1983–1984 study of outer Long Beach Harbor (MBC 1984). Although the percent composition of brown pelicans was lower in the most recent baseline studies compared to those in the 1980s, this was likely due to an increase in numbers of other species, particularly other Aerial Fish Foragers such as Elegant Terns. In contrast, Brown Pelicans accounted for a substantially lower percentage of total bird observations during the 1973 study (3.8%) (HEP 1980). There has been a substantial and widespread increase in the Brown Pelican population since the mid-1980s that has been linked to the ban of DDT (Burkett et al. 2007).

9.4.2.2 Double-crested Cormorant

The double-crested Cormorant was among the most numerous species recorded within the Ports during the 2007–2008 surveys, accounting for 3.5% of all birds counted (Table 9.4-1). This species nested on transmission towers north of the Gerald Desmond Bridge in Zones 25 and 26 of inner Long Beach Harbor; 89 nests were counted in Zone 26 on June 20 and 16 were counted in Zone 25 on July 26.

9.4.2.3 Great Blue Heron

Great Blue Herons were the most numerous Wading/Marsh Bird, and accounted for 0.8% of total birds counted in 2007–2008 (Table 9.4-1). During the 2000–2001 baseline study (MEC 2002), Great Blue Herons were observed nesting along with Black-crowned Night Herons within the Port of Long Beach at Gull Park on the Navy Mole, at the mouth of the Long Beach West Basin. They have continued to nest there annually; an estimated eight Great Blue Herons nested at Gull Park in 2007, with a minimum of 15 chicks fledged (MBC 2007). In 2008 there were seven nests, and seven to 14 young fledged (C. Pacquette, pers. comm.). Great Blue Heron nesting also was documented in several other areas of the Ports during 2007–2008 surveys, including Zone 2 (a maximum of 7 nests), Zone 4 (6 nests), Zone 7 (4 nests), and Zone 8 (on container terminal security lights) in outer Los Angeles Harbor, and Zone 26 (14 nests) in inner Long Beach Harbor.

9.4.2.4 Black-crowned Night Heron

A nesting colony of Black-crowned Night Herons was observed at Gull Park at the mouth of the Long Beach West Basin during the 2000–2001 baseline study (MEC 2002). None were observed nesting at this location during the 2007–2008 surveys. This species had apparently discontinued nesting in 2002 following a Navy remediation project at Gull Park in 2001; aside from one nest in 2002, no Black-crowned Night Heron nesting activities were observed during yearly surveys at Gull Park from 2002 through 2008 (MBC 2007, C. Pacquette, pers. comm). However, Black-crowned Night Herons were documented as nesting in 2008 in other nearby areas, including ficus trees adjacent to the federal building on Ferry Street (Keane Biological Consulting 2008).

9.4.2.5 Peregrine Falcon

Although no Peregrine Falcons were observed during the 1986–1987 biological baseline surveys (MEC 1988), this species was reported to occur within the Ports as early as 1982, and a single individual was documented in 1984 (ACOE 1984, MBC 1984). Nesting has been documented within the Ports since 1993 (J. Sipple, pers. comm.). Peregrine falcons have nested on the Schuyler F. Heim Bridge that separates the Ports of Long Beach and Los Angeles inner harbors. A pair of peregrine falcons has nested within the supporting structure below the Gerald Desmond Bridge off and on for the past several years, and they have successfully fledged young each year (Jeff Sipple, pers. comm.). During the 2007–2008 surveys, one or more Peregrine Falcons was observed on 11 of the 20 survey dates, with the majority either flying or roosting on bridges (Figure 9.4-1b), including one observation of nesting on June 20 at the Gerald Desmond Bridge in Zone 25 of inner Long Beach Harbor.

9.4.2.6 Western Snowy Plover

No Western Snowy Plovers were observed within the Ports during the 2007–2008 surveys. This species is occasionally observed during migration at the California Least Tern nesting site on Pier 400 (Keane Biological Consulting 2007). A few individuals also have been observed at Point Fermin and Cabrillo Beach outside the breakwater (Ryan et al. 2009).

9.4.2.7 Black Oystercatcher

Similar to the 2000–2001 surveys (MEC 2002), a nesting colony of Black Oystercatchers was observed on riprap along the entire length of the outer breakwaters within the both Ports (Zones 15, 12, 9, 3, 2) (Appendix H-2). Black Oystercatchers were also sometimes observed at other outer harbor locations in flight or on riprap (Zones 7, 8, 10, 19, 21). The species has been present within the Ports since at least 1973 (HEP 1979). Black Oystercatchers were the most common large shorebird observed in 2007–2008 (0.6% of all birds) (Table 9.4-1). Individuals were observed on all survey dates, with the highest number during July and August 2008 (Figure 9.4-1c), likely reflecting the presence of fledged chicks. Lower numbers of individuals were observed from October through December, but individuals remained concentrated along the breakwater. Black Oystercatchers typically nest along rocky shores and islands along the Pacific coast of North America (Pacific Wildlife Foundation 2009) and the nesting colony within the Ports is considered unusual.

9.4.2.8 Caspian Tern

Caspian Terns began nesting at Pier 400 in the Los Angeles Harbor in 1997 (Keane Biological Consulting 2005). This species continued to nest annually at or near the designated California Least Tern nesting site on Pier 400 (west area of Zone 8) until 2005 (Table 9.4-3), when they left the area due to a nocturnal predator (Keane Biological Consulting 2005). They nested once again in the Los Angeles Harbor in 2008 (Table 9.4-3), but did so on Pier 300 near Berth 305 (between Zones 6 and 7). The highest numbers of Caspian Terns were observed during May through August 2008 when they were nesting on Pier 300, although relatively high numbers also were counted in March (Figure 9.4-1d). Caspian Terns foraged most frequently in Zones 6 & 7, close to where they were nesting on Pier 305 (Table H-22).

9.4.2.9 Elegant Tern

The Elegant Tern was one of the most numerous bird species overall (7% of total birds), the second most numerous aerial fish forager, and the most numerous of the observed tern species (Table 9.4-1). Elegant Terns are a colonially nesting species with a relatively restricted distribution; 90 percent of their total population breeds at five southern California sites (MEC 2002). This species nested on Pier 400 in the Los Angeles Harbor between 1998 and 2005 and at Pier 300 in 2008 (Table 9.4-3). Numerous observations during 2007–2008 surveys of Elegant Tern flights over the breakwaters suggest they forage primarily outside the harbor, although they occasionally were observed foraging within the Ports. Elegant Terns are unusual in coastal southern California in the winter (C. Collins, pers. comm.), and 2007–2008 surveys reflected this, with no Elegant Terns observed during the December, January, February, or early March surveys (Figure 9.4-1e). Historical records of occurrence during those months may represent misidentified Royal Terns. High numbers of Elegant Terns roosted on the Ports' breakwaters with newly fledged young from June to early August (riprap; Figure 9.4-1e). Observations suggest that young Elegant Terns learn to forage with their parents in waters near the riprap. Similar to Caspian terns, Elegant Terns foraged most frequently in Zones 6 & 7, close to where they were nesting on Pier 305 (Table H-22).

9.4.2.10 California Least Tern

California Least Terns (Least Terns) reportedly nested within the Ports as early as the late 1800s and have been observed within the harbor almost every year since monitoring studies began in 1973 (Keane Biological Consulting 2008). Least Terns have nested at Pier 400 since 1997 (Table 9.4-3). Nest numbers increased from approximately 565 during the 2000–2001 study to 1,332 in 2005, and then declined to 521 in 2008. The decrease in nest numbers is believed to be related to increases both in vegetation and predation at the Pier 400 nesting site (Keane Biological Consulting 2008). During the 2007–2008 surveys, Least Terns were only present in the Ports from May through July (Figure 9.4-1f), since they migrate south for the winter in September and do not return until April (Keane Biological Consulting 2008). The majority of Least Tern observations during 2007–2008 surveys were of individuals foraging or flying in the vicinity of their designated nesting site on Pier 400, although Least Terns also were observed foraging along the outer breakwater and open-water areas of the outer harbors (Zones 1, 2, 3, 4, 5, 6, 7, 9, 14, 15, 19, 20, 21, 23) and within inner harbor basin and channel areas (Zones 25 and 28) (Appendix H-2). Least Terns foraged most frequently in Zone 8 (just off the nesting site), Zone 6 (off Pier 300 where the greatest amounts of foraging were recorded during 2001-2003 and previous surveys) also in Zone 1, Cabrillo Beach. Both Zones 6 and 1 have substantial eelgrass and shallow water that have been shown in the past to support high levels of Least Tern foraging (Table H-22).

9.4.2.11 Black Skimmer

Black Skimmers were observed roosting on the sandy beach of Zone 2 (highest numbers were of 94 individuals during the January-B survey and 68 individuals during February-B survey), flying, or foraging in several areas of the outer harbors (Zones 2, 6, 13, 19 and 21) (Appendix H-2). This species nested in the Los Angeles Harbor from 1998 through 2000 but have not nested at the Ports since then (Table 9.4-3).

9.4.2.12 Burrowing Owl

No Burrowing Owls were observed within the survey zones of the 2007–2008 study, although they were observed at the designated California Least Tern nesting site at Pier 400 California in both 2007 and 2008 (Keane Biological Consulting 2008). The nesting status of this species at the Ports is unknown.

9.4.2.13 Loggerhead Shrike

No Loggerhead Shrikes were observed during the 2007–2008 surveys. They were observed on four occasions in survey Zones 5, 25, and 26 during the 2000–2001 surveys (MEC 2002). The species has been reported as nesting in the Port area in previous years (ACOE 1984).

9.4.3 Rare Sightings

Several bird species rarely observed in Los Angeles County were recorded during the current surveys. One American Oystercatcher was observed on September 26, 2008, resting on riprap in Zone 7 of outer Los Angeles Harbor. This species regularly occurs as far north as the west coast of Baja California, Mexico, and is a casual visitor along the Los Angeles County coast where it often hybridizes with the more common Black Oystercatcher (Garrett et al. 2006). This species also was noted on three occasions during the 2000–2001 surveys on the outer breakwater in Zone 15 (MEC 2002).

Four Black Scoters, a type of diving duck, were observed during the current surveys, on December 28, 2007 (2 individuals), January (1 individual), and February 2008 (1 individual). All were observed in open-water habitats of Long Beach Harbor. The two observed on December 28 were in Zones 21 and 23; individuals observed on January 10 and February 16 were in Zone 23. Black Scoters are rare winter visitors to nearshore waters of Los Angeles County (Garrett et al. 2006). They usually occur in mixed flocks with the more common Surf Scoter.

Six Brant (= Black Brant in MEC 2002) were observed on February 15, 2008, on open water in the outer Long Beach Harbor (Zone 10). Brant, a species of goose, is a common migrant offshore in Los Angeles County, but only occasionally observed foraging and resting in harbors and estuaries (Garrett et al. 2006).

A Common Murre was observed on October 10, 2008, foraging in open water in the Pier J Basin of Long Beach Harbor (Zone 21). This species breeds along the Arctic and subarctic coasts south to central California and south to southern California when sea temperatures are cold (Ainley et al. 2002). This species is an irregular offshore visitor along the coast in Los Angeles County (Garrett et al. 2006). It was not observed during 2000–2001 surveys (MEC 2002).

One Cattle Egret was observed on October 10, 2008, on riprap in Zone 12 of outer Long Beach Harbor. The Cattle Egret is an uncommon migrant and wintering species in Los Angeles County. They typically occur in agricultural areas and are rare along the coast (Garrett et al. 2006).

One Merlin was observed on December 28, 2007, resting on riprap in Zone 13 of outer Long Beach Harbor. Merlin are uncommon winter visitors (Garrett et al. 2006). When sighted, they tend to be along the coastline and in harbors and estuaries, where they hunt small shorebirds.

Parasitic Jaegers (single individuals) were recorded on six occasions, in December 2007, and in January, April, October, and November 2008. Four of the six sightings were in the outer Long Beach Harbor (Zone 11) and most were on open water; one was an aerial sighting. In southern California, this species is relatively common offshore (Garrett et al. 2006). One individual was observed during the 2000–2001 baseline study (MEC 2002).

Two Thayer's Gulls were observed on January 10, 2008, and November 7, 2008, resting on riprap in Zone 15 and in open water in Zone 23, respectively. This species is very uncommon along the Los Angeles County coast in winter (Garrett et al. 2006) and is typically found among large flocks of gulls along the coast, within harbors, and estuaries. It is very difficult to identify from similar-appearing, more common gull species.

Several other species were relatively uncommon at the Ports, but may be common elsewhere in Los Angeles County. These included a few water-associated species (Blue-winged Teal, Green-winged Teal, Red-necked Phalarope) and several upland birds (Bullock's Oriole, Eurasian Collared-Dove, Great-tailed Grackle, Turkey Vulture, and Western Meadowlark). The teal species are both much more common at freshwater lakes and reservoirs, and the phalarope is common offshore, but occasional in bays and estuaries (Garrett et al. 2006). The upland birds are all relatively common elsewhere in the county, but given the lack of habitat they are unusual at the Ports.

9.5 HABITAT UTILIZATION

Previous studies have demonstrated that bird use generally is higher in zones with greater diversity of habitat types (HEP 1979, MEC 2002). However, bird densities may be greater in certain areas where birds congregate such as along the breakwater, Cabrillo Beach, and Fish Harbor (MEC 2002). With the exception of the 2000–2001 study, bird densities have not been reported in historical studies. For these reasons, bird abundance (count data) and species numbers are summarized in this section according to survey zones and habitats.

9.5.1 Distribution and Abundance in Survey Zones

The eight zones in which birds were most abundant are presented in Table 9.5-2. The Long Beach West Basin (Zone 23) had the greatest number of birds of all the survey zones: a total of 13,295 birds over all surveys (representing more than 10% of all birds counted) were observed there (Table 9.5-1 and Figure 9.5-1). Nearly half the observations were Surf Scoters (Table 9.5-2) foraging on mussels occupying the zone's numerous dock pilings. Western Gulls, Mew Gulls, Brandt's Cormorants, and Western Grebes also were abundant in Zone 23 (Table 9.5-2). In addition, 215 Brandt's Cormorant nests were counted on June 20, 2008, among the old docks on the south side of the basin. On average, more than 600 birds were observed per survey at Zone 23 (Figure 9.5-2).

Zone 34, in the main shipping channel of Los Angeles Harbor, supported the second-highest number of individuals (9,533) (Table 9.5-1 and Figure 9.5-1), particularly Western Gulls, Brown Pelicans, and Heermann's Gulls (Table 9.5-2). The Municipal Fish Market at Berth 72 in Zone 34 attracts large numbers of opportunistic birds such as gulls and pelicans. Over 8,000 birds were counted in Zone 27 (Table 9.5-1 and Figure 9.5-1), a large area of inner Los Angeles Harbor where groups of Western and California Gulls roosted on open water (Table 9.5-2). On average, more than 400 birds were counted per survey in Zones 27 and 34 (Figure 9.5-2).

More than 8,000 total birds, averaging greater than 400 birds per survey, were counted in Zone 7 adjacent to Pier 400. Nearly half of the individuals were Elegant Terns, which nest on Pier 400 and feed in the adjacent waters. High total numbers of individuals (6,610–7,689) were observed in Zones 6, 8, and 9 near Pier 400 and Zone 10 near the Long Beach West Basin. For Zones 6 and 7, this was primarily due to roosting by large numbers of Elegant Terns flying over these zones and resting on riprap bordering Pier 300, where they nested in 2008 (see Section 9.4.2 and the results of June and July surveys in Appendix H-2). Zone 8 was primarily open water and thus supported high numbers of Western Grebes, although high numbers of Brandt's Cormorants flying from roosting and nesting areas in Zone 23 to areas outside the harbor were frequently observed over Zone 8 as well (Table 9.5-2). Zone 9 on the outer breakwater supported high bird abundances due to large numbers of roosting Brown Pelicans, while high abundances in Zone 10 were primarily due to the preference for this zone by large numbers of Western Grebes (Table 9.5-2). On average, more than 300 birds were observed per survey in each of these zones (Figure 9.5-2).

Zones 28, 29, 30, 32, and 33 of the inner harbor supported the lowest total numbers of birds (Table 9.5-1 and Figure 9.5-1). These were small areas with few foraging opportunities for birds. On average, less than 50 birds were counted per survey in these zones (Figure 9.5-2).

The number of species also varied among survey zones (Table 9.5-1). The highest numbers of species were recorded in Zone 2 (50) and Zone 1 (47) in outer Los Angeles Harbor and Zone 27 (49) in inner Los Angeles Harbor. Zones 1 and 2 supported several species of gulls, terns, and shorebirds that roosted on its sandy beach habitat. The likely reason for high bird numbers in Zone 27 is the variety of habitats in that zone. Zones 11 and 14 in outer Long Beach Harbor and Zone 29 in inner Los Angeles Harbor had the lowest numbers of species (Table 9.5-1), possibly because these zones mainly included deep, open-water habitat with relatively few other habitats or were not on major flyover routes between nesting and foraging areas (Table 9.5-3).

During previous surveys, the highest numbers of species and individuals generally occurred in survey zones with the greatest diversity of habitat types (HEP 1979 and MEC 2002). While this pattern also was seen in 2007–2008, other factors such as size and composition of habitats as well as their location appeared to be influential. For example, Zones 6 and 25 had ten habitat types each (Table 9.5-3) and supported a similar number of species, yet Zone 6 in outer Los Angeles Harbor supported twice as many birds as Zone 25 in inner Long Beach Harbor (Table

9.5-1). Habitat composition differed somewhat between these zones with sandy beach at Pier 300 in Zone 6 supporting seasonally high numbers of nesting Elegant Terns. Zones 12 and 13 in the outer harbor both had five habitats and supported a similar number of species, but Zone 12 had nearly five times as many individuals. Bird abundance was greater on riprap habitat along the outer breakwater in Zone 12 than along the riprap at the edge of Pier J in Zone 13. Zone 11, with the fewest number of habitats (3 — Table 9.5-3), supported a similar number of species as Zones 14, 29, and 32 with four to six habitats each, but the number of individuals was greater in the open-water habitats of Zones 11 and 14 than the inner harbor basin and channel habitats of Zones 29 and 32 in Los Angeles Harbor. The substantially higher total number of individuals in Zone 14 than in Zone 11 was primarily due to seasonally large numbers of Brandt's cormorants in flight over Zone 14 to or from nesting and roosting sites in Zone 23. Zones 2 and 30 both had 8 habitats, but the much larger Zone 2 in outer Los Angeles Harbor supported twice as many species and five times as many individual birds as the smaller Zone 30 in inner Los Angeles Harbor (Table 9.5-1).

9.5.2 Distribution and Abundance in Habitat Types

Table 9.5-4 summarizes the percent composition of bird guilds by habitat type. The most used habitat type during the current surveys was open water, accounting for 30.1% of all bird observations. Riprap was the second most used habitat, supporting 24.1% of total birds, and was closely followed by dock/pilings, which accounted for 22.3% of total birds. As discussed above, the riprap habitat most used by birds was along the outer breakwaters. Less than 10% of total birds were counted within all other habitats, the majority being found in the sandy beach (3.3%) and barge (4.1%) habitats.

The various habitat types within the Ports were used differently by each guild (Figure 9.5-3). Over 60% of waterfowl observations were recorded in open water (Table 9.5-4). Aerial Fish Foragers were primarily observed along riprap (60.9%) and flying/foraging (20.4%) (Table 9.5-4, Figure 9.5-3).

Large and Small Shorebirds were more frequently observed on riprap than in other habitats. Riprap accounted, respectively, for 70.8% and 76.2% of total Large Shorebird and Small Shorebird observations (Table 9.5-4, Figure 9.5-3). Shorebirds also were observed on sandy beach or in flight (Table 9.5-4).

Wading/Marsh Birds were most commonly observed on riprap (44.2%) and dock/pilings (33.7%) (Figure 9.5-3). Although not abundant, they were more numerous than other guilds on spill booms (2.8%) and buoys (4.3%).

Dock/pilings supported more Gulls (43.4%) and more Upland Birds (32.9%) than other habitats, although Upland Birds were also numerous in aerial habitats (30.4%) and on barges (24.8%) (Table 9.5-4 and Figure 9.5-2).

Raptors were most commonly observed on riprap (37% these were primarily Osprey, totaling 52 observations) or flying (aerial- 31.5%) (Table 9.5-4). More raptors (9.3%) were observed on bridges than other guilds.

9.5.3 Activity

A total of 83,295 individuals, accounting for 66.4% of total observations, were observed resting during the current surveys. Foraging, flying, nesting, and courting accounted for 18.8%, 12%, 2.8%, and 0.1%, of total observations, respectively (Table 9.5-5). Species from only three of the eight guilds (Waterfowl, Aerial Fish Foragers, and Upland Birds) were observed courting. Birds from all guilds except Small Shorebirds were observed nesting; most of these (Caspian Tern, Elegant Tern, Black Oystercatcher, Double-crested Cormorant, Great Blue Heron) are discussed in Section 9.4.2. Other nesting species included three Upland species: American Crow in Zone 34 on riprap, Common Raven on dock/pilings in Zone 7, and European Starling on dock/pilings in Zone 27. Western Gulls nested on a barge in Zone 4, on riprap in Zone 23, and on dock/pilings in Zones 23, 25, and 31. In addition, an estimated 450 Brandt's Cormorants nested in Zone 23 (see Section 9.5.1). Although not specifically counted, Rock Doves are a common nesting species at the Ports, particularly on the underside of piers (MEC 2002).

9.6 HISTORICAL COMPARISONS

As mentioned at the beginning of the chapter, the Ports have conducted or sponsored a number of previous studies of the avifauna in the harbor complex. The major studies include:

- Studies of Marine-associated Birds in Los Angeles and Long Beach Harbors during 1973–1974 and 1978, prepared by Harbors Environmental Projects (HEP 1976, 1979). The 1973–1974 work included 43 surveys of 48 zones throughout the nearshore (not open water) habitats of inner and outer harbors of both Ports. The 1978 work included quarterly surveys within 31 of the original 43 zones. Data collected included counts of each species with each zone.
- Outer Long Beach Harbor-Queensway Bay Biological Baseline Survey, prepared by MBC (1984). Work included 36 weekly and biweekly surveys to record species, counts, habitat utilization (four habitat types), and bird activity within 10 large stations/survey zones in the outer harbor and Queensway Bay of the Port of Long Beach.
- A Biological Baseline and Ecological Evaluation of Habitats in Los Angeles Harbor and Adjacent Waters, prepared by MEC (1988). Work included 24 bimonthly and monthly surveys in 1986–1987 of the outer harbor of the Port of Los Angeles. Data collected included species, count, and habitat utilization in seven large blocks/zones.
- Ports of Long Beach and Los Angeles 2000 Baseline Study of San Pedro Bay, prepared by MEC (2002). Surveys by boat of 31 zones in the inner and outer harbors from February 2000 through January 2001 documented bird species, numbers, behavior, and habitat utilization. A total of 20 surveys was conducted twice monthly from August through March and once monthly from April through July, when coastal bird and species numbers are typically lower due to migratory patterns.

A number of physical changes in topography have occurred within the Ports over the last three decades. These changes, as well as differences in bird survey methodology among years, limit historical comparisons to general trends in species numbers, total abundance, and percent composition of bird guilds. However, more detailed comparisons are possible with the 2000–2001 surveys because the current study used the same methods and the same study zones.

A similar number of species was observed during the 2008 biological baseline study (96) and 2000–2001 (99) surveys (Figure 9.6-1). Generally, fewer species were observed during earlier studies that surveyed less area of the harbors or included substantially fewer survey dates. A total of 77 species was recorded during the 1973–1974 surveys, which included both inner and outer harbor areas but not open-water habitat. Surveys in the 1980s focused on the outer harbor, with more species (85) observed during the Long Beach Harbor study that also included Queensway Bay (MBC 1984) and fewer species (72) during the study limited to outer Los Angeles Harbor (MEC 1988). Few upland species were noted during historical surveys focused on the outer harbor (MEC 1988), whereas more than 20 upland species were counted with the current and 2000–2001 surveys that included both inner and outer harbor habitats. The lowest number of species (53) was recorded during the 1978 survey, which only included quarterly surveys at a subset of harbor locations in contrast to other historical studies that included at least monthly surveys.

Differences in survey methods also may contribute to differences in the number of birds counted between recent and historical studies (Figure 9.6-2). The current and 2000–2001 (MEC 2002) surveys covered more open water than previous studies. Open water, along with riprap and dock/pilings, supports the greatest numbers of birds in the Ports. On average, several thousand birds were counted per survey during these recent studies. Several thousand birds were also counted per survey during the 1973–1974 study of inner and outer harbor areas, even though those surveys excluded open-water habitat. In contrast, substantially fewer birds were counted when studies were limited to the outer harbor areas or were based on less frequent quarterly surveys (HEP 1979, MBC 1984, MEC 1988). Due to the fidelity of a number of species to particular habitats and location (e.g., Brown Pelicans and Black Oystercatchers on outer breakwaters, and Western Gulls on inner harbor docks), an increase in survey area generally corresponded to an increase in total abundance of birds, but not necessarily to an increase in abundance of each individual species.

Despite the differences associated with methodology, there have been changes in the relative abundance of some bird guilds over time (Figure 9.6-3). A major difference between earlier and more recent studies has been the decrease in dominance by gulls and increase in other bird guilds. Some increases in other bird guilds (e.g., Upland Birds, Waterfowl) are likely due to expanded survey areas in the more recent surveys. Recent nesting of Brandt's and Double-crested Cormorants also increased the percent contribution of Waterfowl in the current study. Increased nesting activity of Aerial Fish Foragers such as terns in the harbors has likely contributed to the substantial increase in the percent contribution of this bird guild over time. In addition, large numbers of Brown Pelicans roost at the Ports.

In some cases, the inclusion of both inner and outer harbor areas in more recent surveys has contributed to a decrease in the percent contribution of guilds that are more associated with one but not both of these harbor areas. For example, the percent contribution of Shorebirds declined from 1986–1987 surveys to 2000–2001 surveys; MEC (2002) hypothesized this was due to limited shorebird habitat being present in the inner harbor. However, Shorebirds declined again during the current study, likely due to fewer observations of Western Sandpipers (only 4 were observed in 2007–2008 compared to nearly 300 in 2000–2001; MEC 2002). This may be due to differences in tidal fluctuations when this species would be present on the Ports' few mudflat and sandy beach habitats.

Percent composition of Wading/Marsh Birds, which includes herons and egrets, has declined somewhat since the 1986–1987 surveys (Figure 9.6-3), likely due to inclusion of both inner and outer harbor areas in more recent surveys and suitable habitat being limited in the inner harbor.

Although most birds were observed resting during the current and previous studies, relatively more were observed foraging (18.8%) rather than resting (66.4%) during the current study compared to foraging (10.9%) and resting (76.8%) activities observed in 2000–2001 (MEC 2002). Foraging activity in 2007–2008 also was higher than in 1986–1987 (13%); MEC 1988). There was a notable increase in courting/nesting activity during the 2007–2008 (2.9%) compared to 2000–2001 (0.3%) surveys.

Table 9.6-1 provides a historical comparison of the percent contribution of the ten most abundant species during 2007–2008 compared to historical surveys using yearly averages for each species relative to total birds counted. Some of the variations in abundance have been attributed to improvements in waste treatment practices. For example, HEP (1979) attributed a decrease in the number of gulls between the 1973–1974 and 1978 surveys to the initiation in the mid 1970s of secondary treatment of sewage and reduction of cannery waste in outer Los

Angeles Harbor. The relatively higher percent contribution of Western Gulls in recent studies likely relate to the fact that the surveys encompassed both inner and outer harbor habitats, both of which are used by the species.

The HEP (1979) study suggested that the increased breeding success of Brown Pelicans after the ban on DDT discharges may have influenced the increase in Brown Pelicans counted in the harbors between the early and late 1970s surveys. The number of Brown Pelicans has remained relatively high since then. Although the percent contribution of Brown Pelicans to the total bird counts has been somewhat less in recent surveys, that result is attributable to differences in survey methodology compared to studies conducted in the 1980s. Because Brown Pelicans mainly occur in the outer harbor, inclusion of the inner harbor in the total count data of the 2000–2001 and current surveys contributes to a dilution of the percent contribution calculation for that species compared to studies that only surveyed the outer harbor.

The percent composition of terns (most notably the Elegant Tern) increased in 2000–2001 over previous surveys due to Elegant Tern nesting at Pier 400 (see Section 9.4.2). Elegant Terns nested once again in 2008 after a two-year hiatus, although their nesting location was different (see Section 9.4.2). Although nest numbers were similar to those during the 2000–2001 surveys (Table 9.4-3), the contribution of Elegant Tern decreased from approximately 10% in 2000–2001 to 7% in 2007–2008 (Table 9.6-1). This small reduction was likely associated with the slight increase in the total birds counted per survey during the current study.

The percent contribution of Brandt's Cormorants has increased over time, including a substantial increase from approximately 5% in 2000–2001to 14% in 2007–2008. This increase was due to their nesting in Zone 23 at the Long Beach West Basin during the current study. The percent contribution of Double-crested Cormorants is comparable to previous surveys.

Surf scoter relative abundance has varied among surveys. During the 2000–2001 surveys, the Surf Scoter showed a dramatic decline in percent contribution compared to previous surveys, which MEC (2002) suggested was possibly related to dredging activity in the Ports. During the 2007–2008 surveys, the percent contribution of Surf Scoters increased by nearly four-fold, from 3% to 11%, with most individuals observed in Zone 23 (Long Beach West Basin). Because dredging was ongoing in the West Basin and in other outer harbor areas during the 2000–2001 surveys, the relatively high abundance of Surf Scoters in the current study suggest that any potential dredging effects were not persistent.

Western Grebes increased from approximately 5% of total observations during 1986–1987 surveys to 8% during 2000–2001 and 2007–2008 surveys (Table 9.6-1), likely due, at least in part, to the addition of inner harbor stations in the recent studies.

Rock Dove accounted for approximately 5% of total birds during the 2000–2001 and 2007–2008 surveys (Table 9.6-1). Rock doves were most numerous on docks of the inner harbor (Table 9.5-2), presumably due to suitable roosting and nesting locations under the piers.

Table 9.3-1. Total Numbers of Species and Individuals of Birds in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

Survey Date	*Number of Species*	*Total Individuals*
DEC-A 2007	52	6,717
DEC-B 2007	56	9,732
JAN-A 2008	56	7,796
JAN-B 2008	55	6,903
FEB-A 2008	54	5,341
FEB-B 2008	58	5,845
MAR-A 2008	56	6,885
MAR-B 2008	52	7,845
APR-A 2008	50	5,020
MAY-A 2008	32	6,823
JUNE-A 2008	33	5,807
JUL-A 2008	37	7,891
AUG-A 2008	36	5,095
AUG-B 2008	42	5,666
SEPT-A 2008	45	3,870
SEPT-B 2008	40	4,713
OCT-A 2008	56	4,729
OCT-B 2008	51	5,064
NOV-A 2008	55	4,720
NOV-B 2008	59	9,073
Mean Per Survey	*49*	*6,277*
Total	*96*	*125,535*

Table 9.4-1. Percent Composition by Guild and Most Numerous Species in Los Angeles and Long Beach Harbors, December 2007 - November 2008.

Guild	*Percent*	*Most Abundant Species*	*% Total*	*Rank of Ten Most Abundant*
Aerial Fish Foragers	17.5%	Brown Pelican	9.6%	4
		Elegant Tern	7.0%	7
		other	1.0%	
Gulls	34.4%	Western Gull	24.6%	1
		Heermann's Gull	7.3%	6
		California Gull	1.2%	10
		Other	1.4%	
Large Shorebirds	0.6%	(Black Oystercatcher most numerous)	0.6%	
Raptors	0.1%	(Osprey most numerous)	0.1%	
Small Shorebirds	1.6%	(Black-bellied Plover most numerous)	1.6%	
Upland Birds	6.2%	Rock Dove	5.1%	8
		Other	1.1%	
Waterfowl	38.5%	Brandt's Cormorant	14.1%	2
		Surf Scoter	11.2%	3
		Western Grebe	8.0%	5
		Double-crested Cormorant	3.5%	9
		Other	1.6%	
Wading/Marsh Birds	1.1%	Great Blue Heron	0.8%	
		Other	0.3%	
Total	*100.0%*	*Top Ten Ranked Species*	*91.6%*	

Table 9.4-2. Status of Special-Status Bird Species Historically Observed within Los Angeles and Long Beach Harbors.

Common Name (Locations of Concern)	*Scientific Name*	*State Status*	*Federal Status*	*Other*[a]	*Nesting at Ports in 2007-2008*
Brown Pelican (nesting colony & communal roosts)	*Pelecanus occidentalis*	Endangered	Endangered		No
Double-crested Cormorant (nesting)	*Phalacrocorax auritus*			DFG:WL	Yes
Great Blue Heron (nesting)	*Ardea herodias*			DFG:SA	Yes
Black-crowned Night-Heron (nesting)	*Nycticorax nycticorax*			DFG:SA	No
Peregrine Falcon (nesting)	*Falco peregrinus*	Endangered	Delisted	DFG:FP, USFWS:BCC	Yes
Western Snowy Plover (critical habitat, nesting & wintering sites)	*Charadrius alexandrinus nivosus*		Threatened	DFG: CSC	No
Black Oystercatcher (nesting)	*Haematopus bachmani*			USFWS:BCC	Yes
Caspian Tern (nesting colony)	*Sterna caspia*			USFWS:BCC	Yes
Elegant Tern (nesting colony)	*Sterna elegans*			DFG:WL, USFWS:BCC	Yes
Least Tern (nesting colony)	*Sternula antillarum*	Endangered	Endangered	DFG:FP	Yes
Black Skimmer (nesting colony)	*Rynchops niger*			DFG:SSC, USFWS:BCC	No
Burrowing Owl (burrowing sites & some wintering sites)	*Athene cunicularia*			DFG:SSC, USFWS:BCC	unknown
Loggerhead Shrike (nesting)	*Lanius ludovicianus*			DFG:SSC, USFWS:BCC	unknown

[a] = DFG:SA - Special Animal tracked by California Dept. of Fish and Game, but no protective status
DFG:FP - Calif Dept of Fish & Game - Fully Protected
DFG:SSC - Calif Dept of Fish & Game - Species of Special Concern
DFG:WL - Calif Dept of Fish & Game - Watch List
USFWS:BCC - U.S. Fish & Wildlife Service Birds of Conservation Concern

Table 9.4-3. Nest Numbers for Special-Status Tern and Skimmer Species in Los Angeles Harbor, 1997–2008.

Species	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*[a]
Caspian Tern	25	146	250	336	160	151	170	125	125	0	0	270
Elegant Tern	0	3,662	1	3,656	166	5,598	1,516	10,170	2,700	0	0	3,300
Black Skimmer	0	10	170	115	0	0	0	0	0	0	0	0
Least Tern	105	218	367	565	459	320	963	1,071	1,332	907	710	521

[a] All other years, nesting was on Pier 400; in 2008, nesting by Caspian Terns and Elegant Terns was on Berth 305.

Table 9.5-1. Total Numbers of Species and Individuals of Birds by Zone in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

Zone	*Number of Species*	*Total Individuals*	*% of Total Individuals*
1	47	4,089	3.3%
2	50	5,483	4.4%
3	29	4,113	3.3%
4	40	5,013	4.0%
5	42	2,639	2.1%
6	43	7,689	6.1%
7	39	8,158	6.5%
8	38	7,566	6.0%
9	25	6,793	5.4%
10	39	6,610	5.3%
11	18	1,428	1.1%
12	31	5,150	4.1%
13	32	1,136	0.9%
14	17	4,620	3.7%
15	31	3,143	2.5%
19	41	2,935	2.3%
20	20	1,688	1.3%
21	35	1,660	1.3%
22	35	3,322	2.6%
23	43	13,295	10.6%
24	32	1,952	1.6%
25	42	3,096	2.5%
26	26	1,595	1.3%
27	49	8,070	6.4%
28	21	588	0.5%
29	17	465	0.4%
30	25	697	0.6%
31	30	1,137	0.9%
32	19	880	0.7%
33	42	992	0.8%
34	28	9,533	7.6%
Total	*96*	*125,535*	*100%*

Table 9.5-2. Species Composition for Survey Zones with the Highest Bird Abundances in Los Angeles and Long Beach Harbors, December 2007 - November 2008.

	Survey Zones with Highest Abundances							
Ten Most Abundant Species	*6*	*7*	*8*	*9*	*10*	*23*	*27*	*34*
Western Gull	436	1,322	497	617	584	1,222	5,353	6,122
Surf Scoter	1,104	1,374	254	5	679	5,785		
Brown Pelican	236	271	394	3,048	79	261	21	1,240
Brandt's Cormorant	37	120	1,457	2,322	948	2,500	23	44
Western Grebe	296	282	3,217		2,490	1,290	38	10
Heermann's Gull	52	1,005	1,287	568	151	259	137	1,000
Elegant Tern	3,743	3,284	125	59	370	24	1	27
Rock Dove	186	19			301	216	630	338
Double-crested Cormorant	437	125	14	18	474	377	273	522
California Gull	10	10	5	1	15	116	955	12

Table 9.5-3. Occurrence of Habitats by Survey Zones in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

Zone	*AE*	*AL*	*BA*	*BO*	*BG*	*BU*	*DP*	*MF*	*OW*	*RR*	*SB*	*SW*	*Total Habitats*
1	x					x	x	x	x	x	x	x	8
2	x		x			x	x		x	x	x	x	8
3	x						x		x	x		x	5
4	x	x	x	x		x	x		x	x		x	9
5	x		x			x	x	x	x	x	x	x	9
6	x	x	x		x	x	x		x	x	x	x	10
7	x	x	x	x			x		x	x			7
8	x		x			x			x	x		x	6
9	x								x	x		x	4
10	x	x	x			x			x	x		x	7
11	x		x						x				3
12	x					x			x	x		x	5
13	x						x		x	x		x	5
14	x		x			x			x				4
15	x								x	x		x	4
19	x		x			x	x		x	x			6
20	x		x			x	x		x				5
21	x		x				x		x	x		x	6
22	x	x	x				x		x	x		x	7
23	x	x	x	x		x	x		x	x		x	9
24	x	x	x			x	x		x	x		x	8
25	x	x	x	x	x	x	x		x	x		x	10
26	x	x	x		x		x		x	x		x	8
27	x	x	x	x	x	x	x	x	x	x		x	11
28	x	x	x	x			x		x	x			7
29	x	x	x	x			x		x				6
30	x	x	x	x		x	x		x	x			8
31	x	x	x	x	x		x		x	x			8
32	x	x					x		x	x			5
33	x	x		x		x	x		x	x		x	8
34	x	x	x				x		x	x		x	7

Habitat Codes: AE = Aerial, AL = anchor line, BA = barge, BG = bridge, BO = spill boom, BU = buoy, DP = dock or piling, MF = mudflat, OW = open water, RR = riprap, SB = sandy beach, SW = shallow water

Table 9.5-4. Percent Composition of Bird Guilds by Habitats in Los Angeles and Long Beach Harbors, December 2007 - November 2008.

Guild	*Habitat Type*												*Total Numbers*
	AE	*AL*	*BA*	*BG*	*BO*	*BU*	*DP*	*MF*	*OW*	*RR*	*SB*	*SW*	
Aerial Fish Foragers	20.4%	0.1%	3.1%	< 0.01%	0.2%	0.9%	8.6%		3.3%	60.9%	2.3%	0.2%	22024
Gulls	9.0%	0.3%	2.7%	< 0.01%	0.1%	0.5%	43.4%	0.2%	18.6%	17.6%	7.2%	0.3%	43245
Large Shorebirds	19.4%				0.1%		0.1%	0.8%	0.5%	70.8%	7.6%	0.7%	768
Raptors	31.5%		5.6%	9.3%			14.8%			37.0%	1.9%		108
Small Shorebirds	6.3%		0.3%		2.2%	0.3%	0.2%	2.7%		76.2%	11.8%	0.1%	1977
Upland Birds	30.4%	0.1%	24.8%	4.1%	< 0.01%	0.3%	32.9%		< 0.01%	5.4%	2.0%		7786
Waterfowl	13.2%	0.5%	2.6%		0.2%	1.5%	8.8%	< 0.01%	60.1%	12.8%	0.0%	0.04%	48293
Wading/ Marsh Birds	7.3%	0.1%	3.5%		2.8%	4.3%	33.7%	0.1%	0.1%	44.2%	0.5%	3.3%	1334
% of Total	*14.0%*	*0.3%*	*4.1%*	*0.3%*	*0.2%*	*1.0%*	*22.3%*	*0.1%*	*30.1%*	*24.1%*	*3.3%*	*0.2%*	*100.0%*

Habitat Codes: AE = Aerial, AL = anchor line, BA = barge, BG = bridge, BO = spill boom, BU = buoy, DP = dock or piling, MF = mudflat, OW =open water, RR = riprap, SB = sandy beach, SW = shallow water

Table 9.5-5. Activities by Bird Guild Members in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

Guild	*Courting*	*Foraging*	*Flying*	*Nesting*	*Resting*
Aerial Fish Foragers	74	1,816	2,693	2,039	15,402
Gulls		2,009	3,430	39	37,767
Large Shorebirds		174	148	2	444
Raptors		12	26	1	69
Small Shorebirds		826	134		1,017
Upland Birds	24	582	2,173	8	4,999
Waterfowl	2	17,977	6,355	1,274	22,685
Wading/Marsh Birds		228	95	99	912
Totals	*100*	*23,624*	*15,054*	*3,462*	*83,295*
Percent of Total	*0.1%*	*18.8%*	*12.0%*	*2.8%*	*66.4%*

Table 9.6-1. Historical Comparisons of Percent Composition of Ten Most Common Species of Birds Observed in Los Angeles and Long Beach Harbors.

Species		*Year*					
Common Name	*Scientific Name*	*1973-1974*[1]	*1978*[2]	*1983-84*[3]	*1986-1987*[4]	*2000-2001*[5]	*2007-2008*
Western Gull	*Larus occidentalis*	22.37	13.92	13.87	19.91	28.47	24.58
Brandt's Cormorant	*Phalacrocorax penicillatus*	0.02	0.11	5.71	1.57	4.99	14.12
Surf Scoter	*Melanitta perspicillata*	14.36	11.55	5.89	25.55	3.12	11.25
Brown Pelican	*Peliicanus occidentalis*	3.82	14.06	15.00	14.00	9.51	9.55
Western Grebe	*Aechmophorus occidentalis*	0.12	4.49	2.56	5.44	8.31	8.00
Heermann's Gull	*Larus heermanni*	28.60	28.42	27.39	9.32	12.54	7.27
Elegant Tern	*Sterna elegans*	0.40	0.42	0.28	0.37	10.41	6.98
Rock Dove	*Columba livia*	unknown	unknown	unknown	unknown	4.50	5.08
Double-crested Cormorant	*Phalacrocorax auritus*	0.77	2.32	1.48	2.65	3.00	3.53
California Gull	*Larus californicus*	6.60	0.71	0.58	0.08	2.12	1.19

Figure 9.2-1. Bird Monitoring Locations (Zones) in Los Angeles and Long Beach Harbors, January – July 2008.

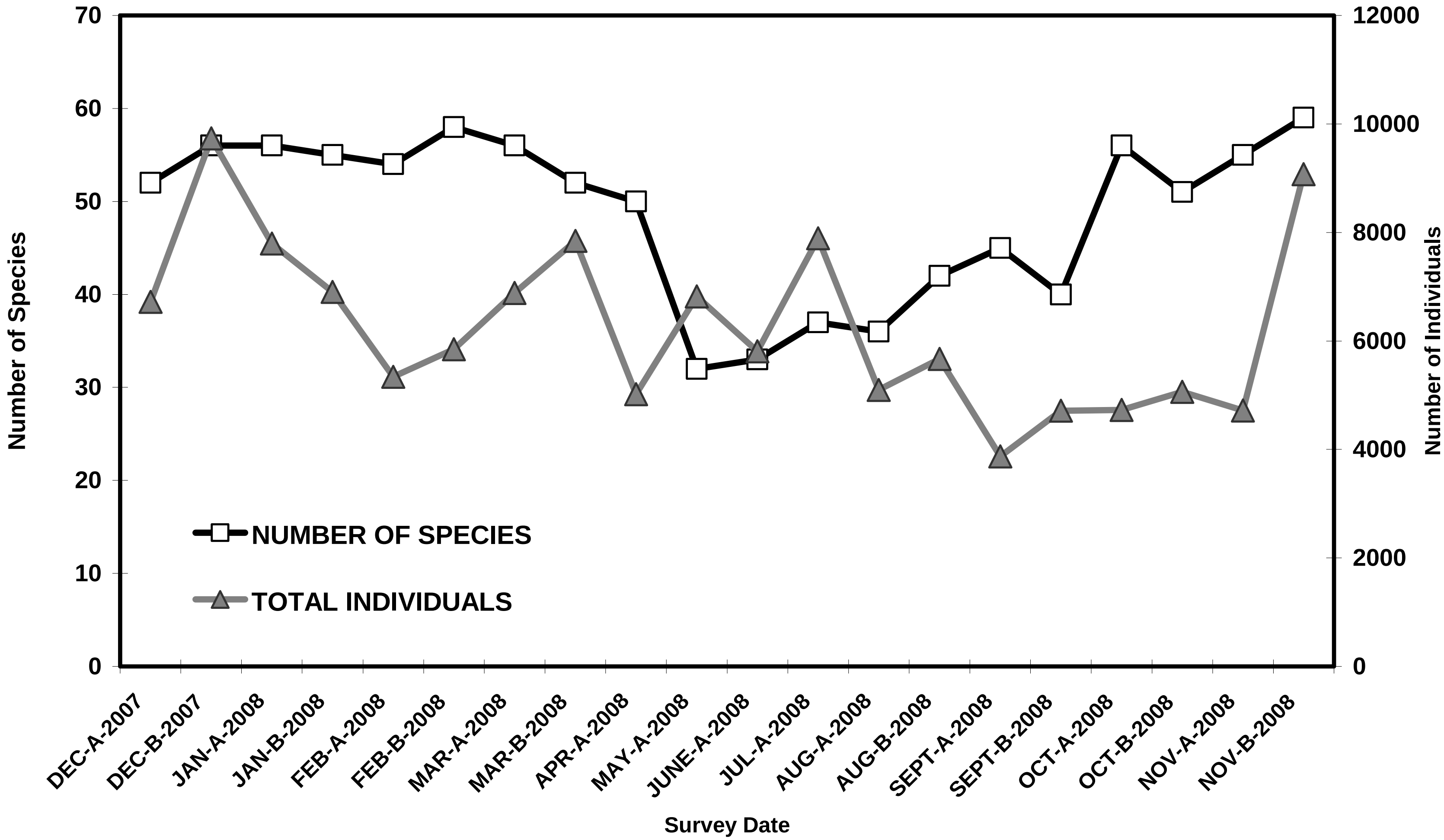


Figure 9.3-1. Numbers of Species and Individuals of Birds Observed Per Survey in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

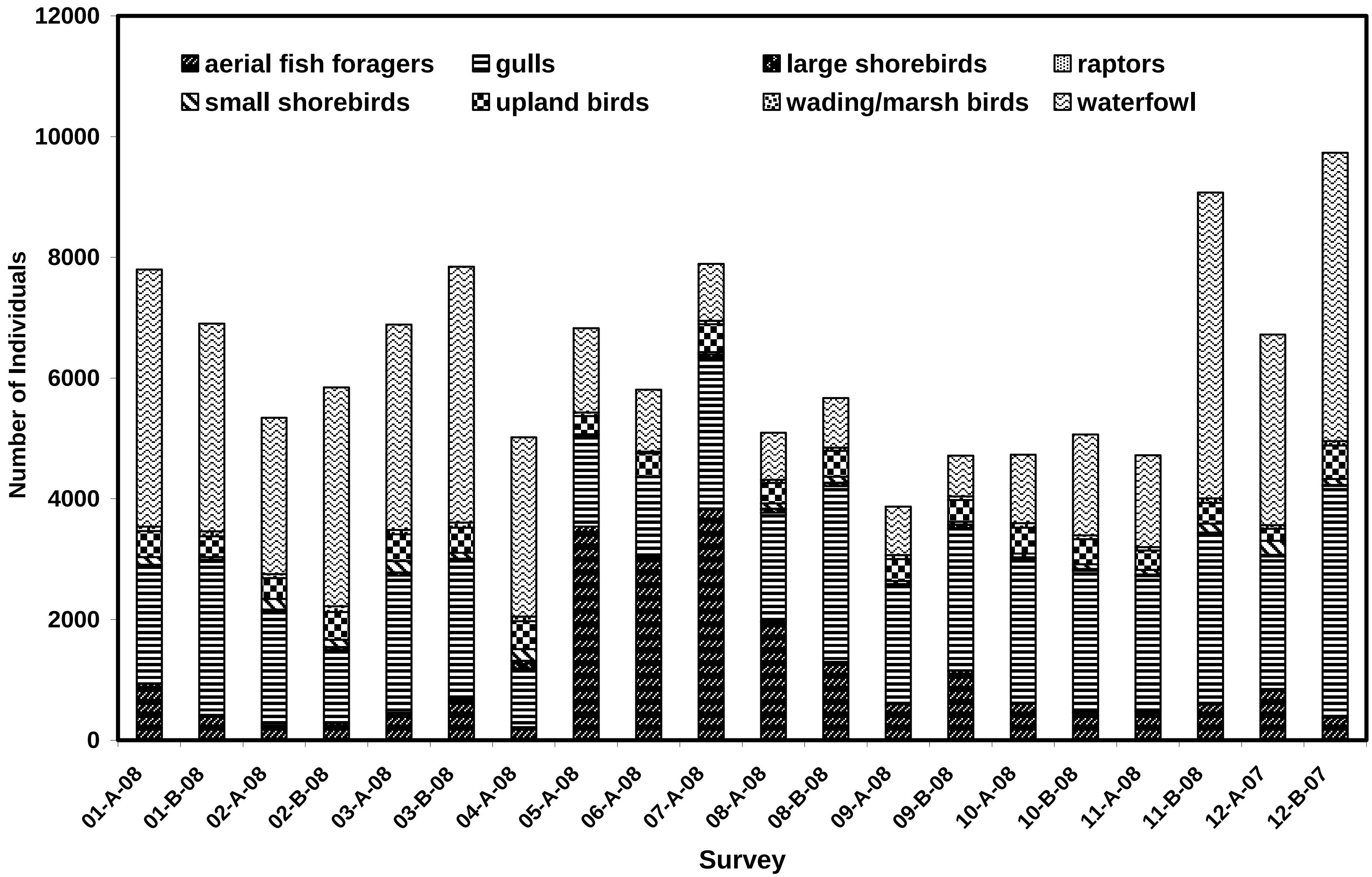


Figure 9.3-2. Total Number of Individuals by Bird Guild Per Survey in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

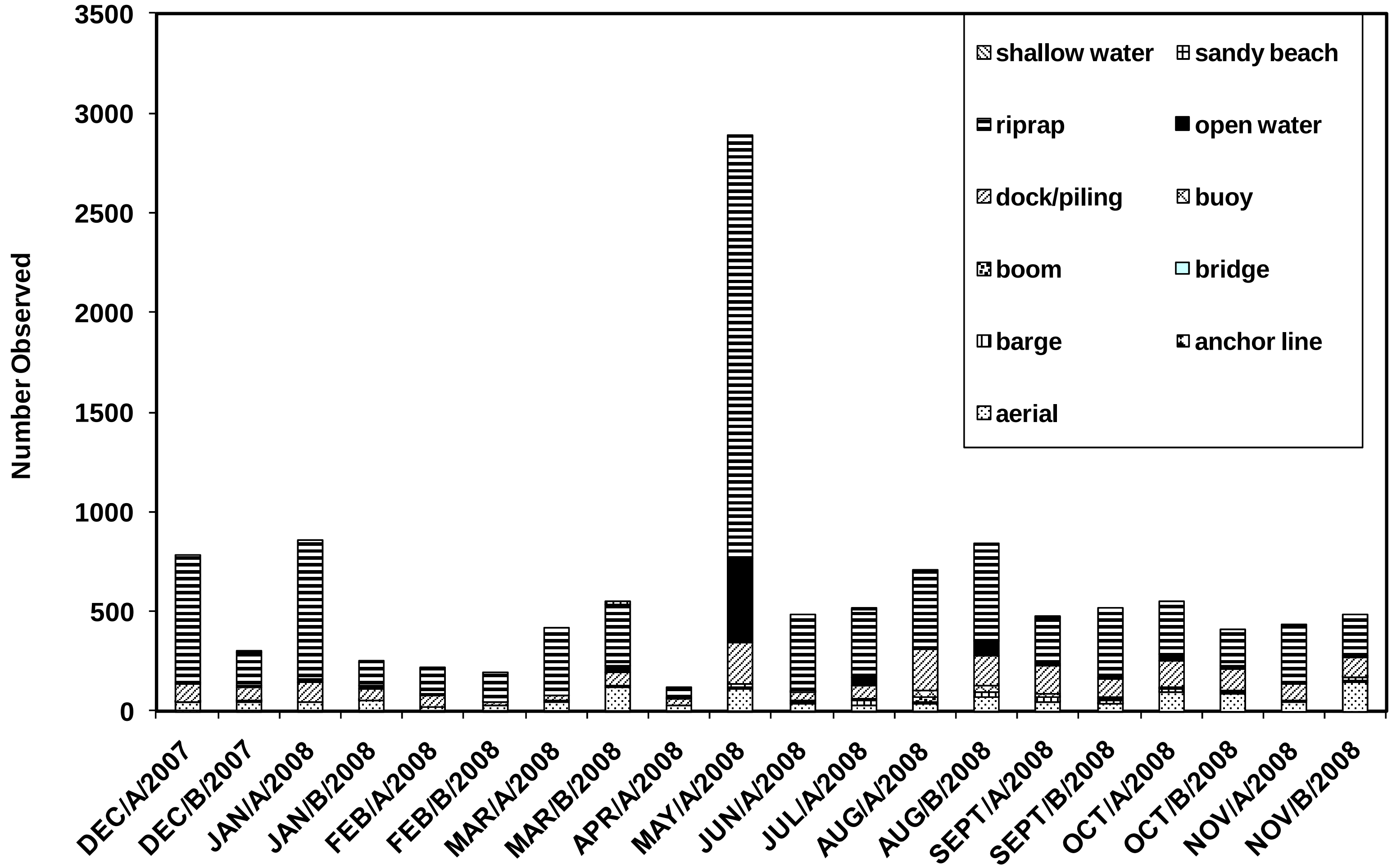


Figure 9.4-1a. Observations of Brown Pelicans by Survey and Habitat Type in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

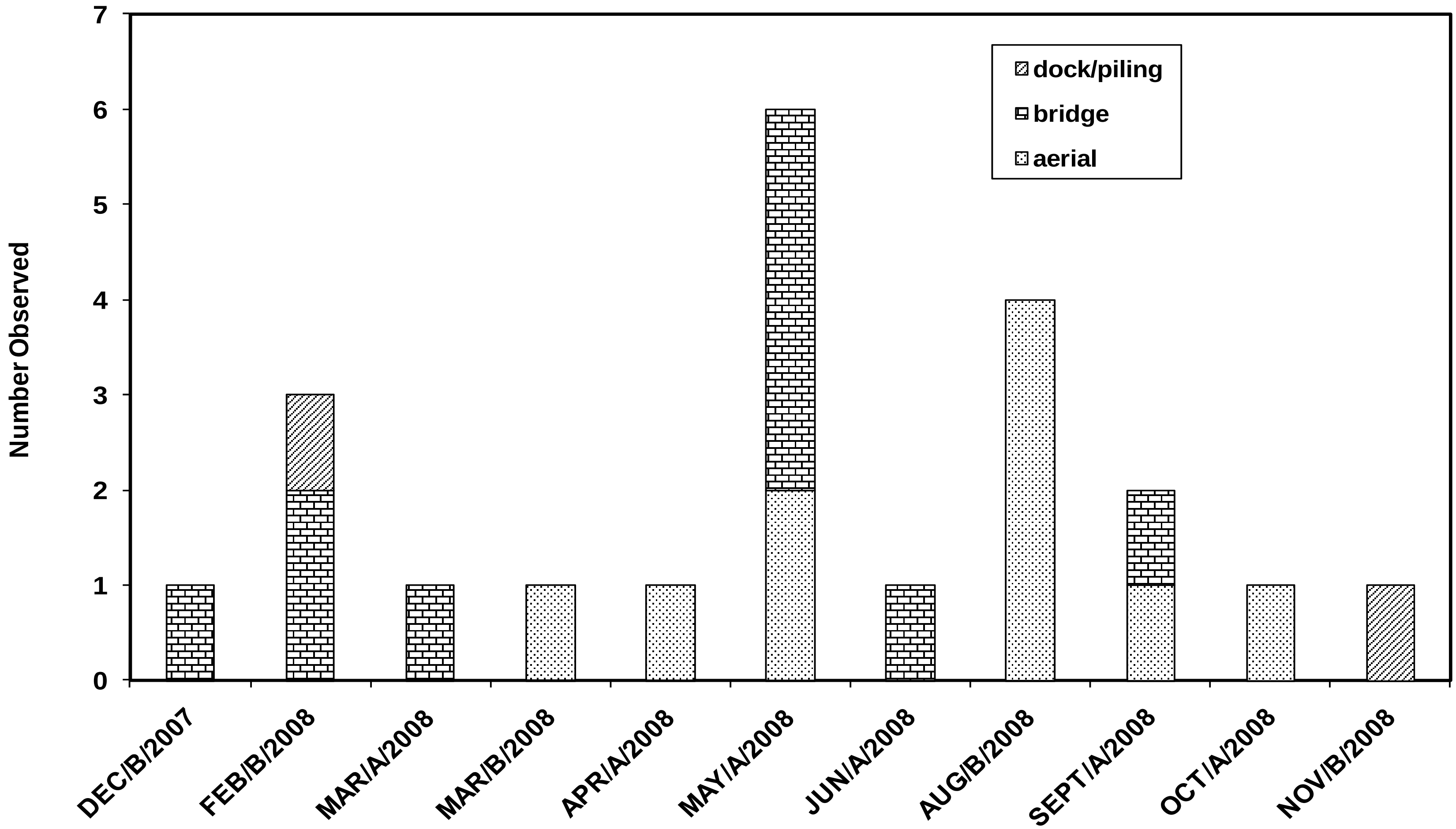


Figure 9.4-1b. Observations of Peregrine Falcons by Survey and Habitat Type in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

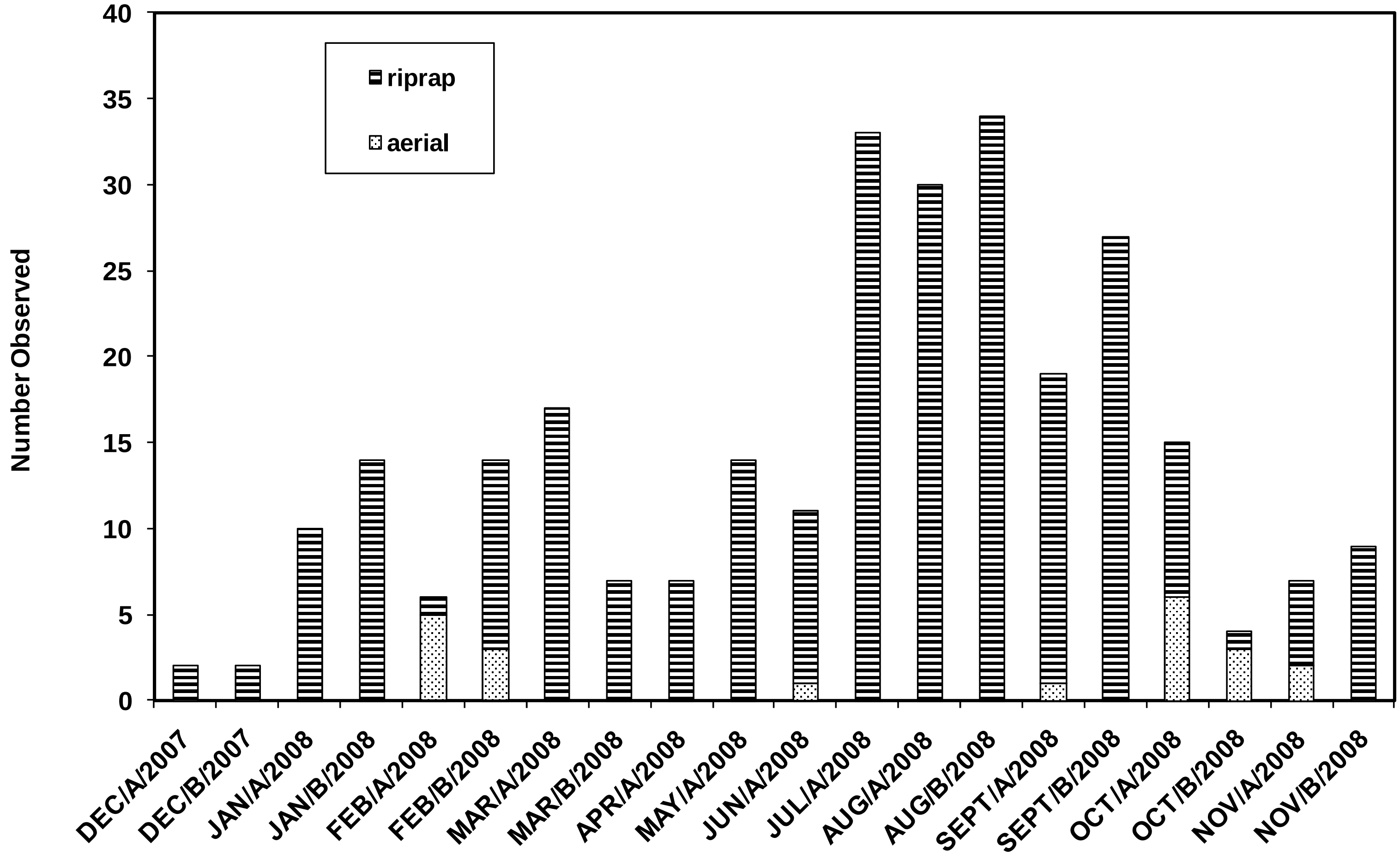


Figure 9.4-1c. Observations of Black Oystercatchers by Survey and Habitat Type in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

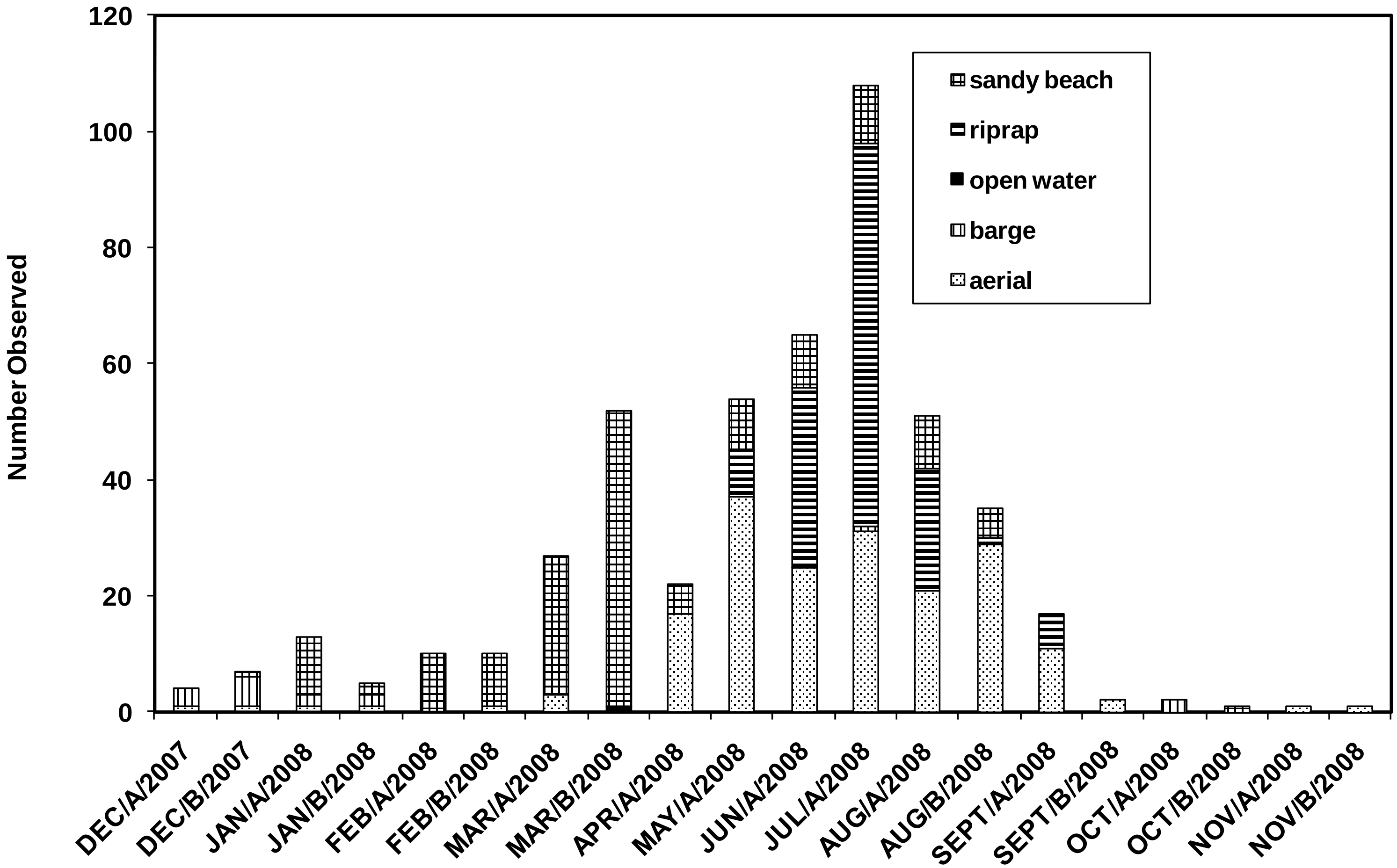


Figure 9.4-1d. Observations of Caspian Terns by Survey and Habitat Type in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

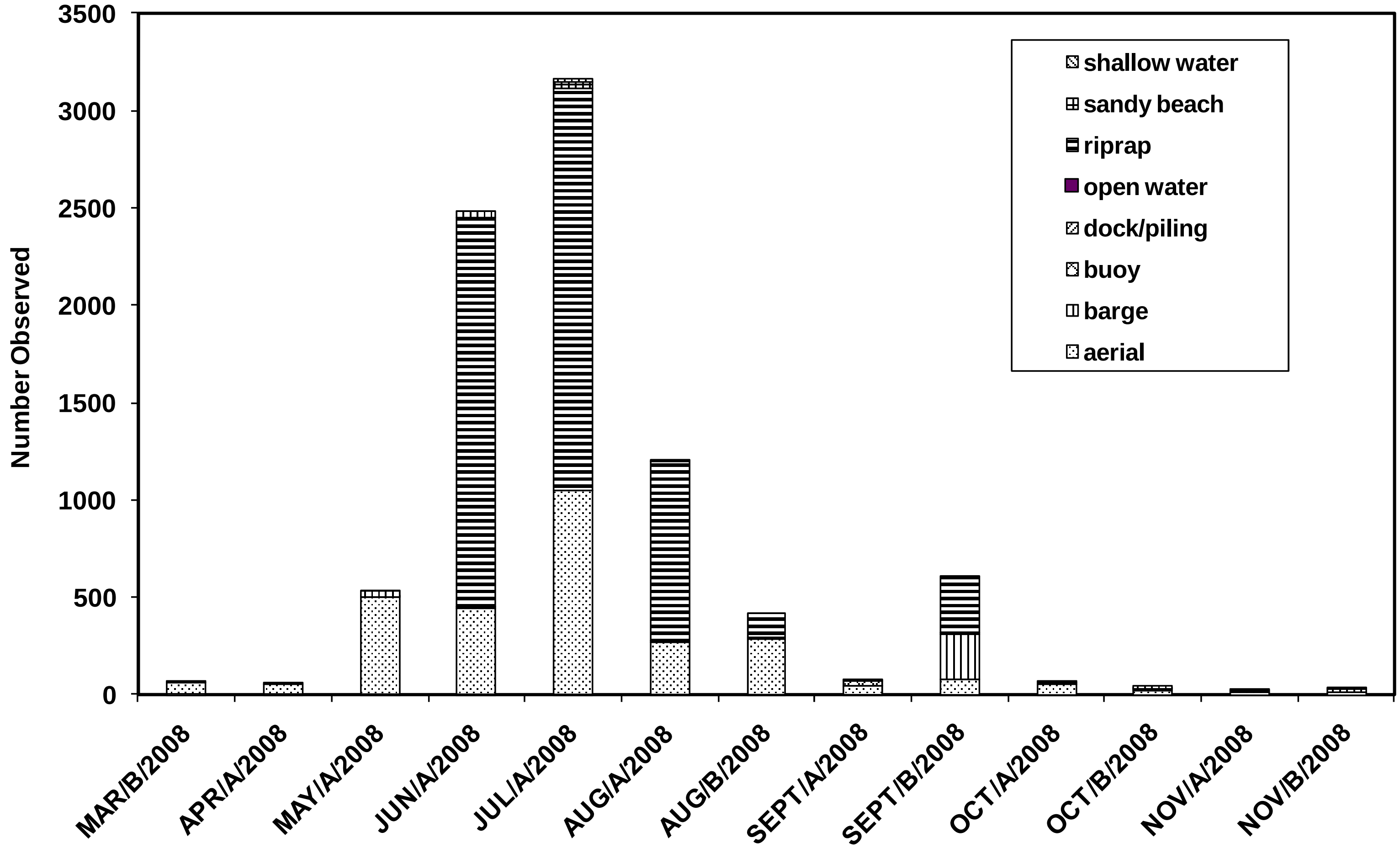


Figure 9.4-1e. Observations of Elegant Terns by Survey and Habitat Type in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

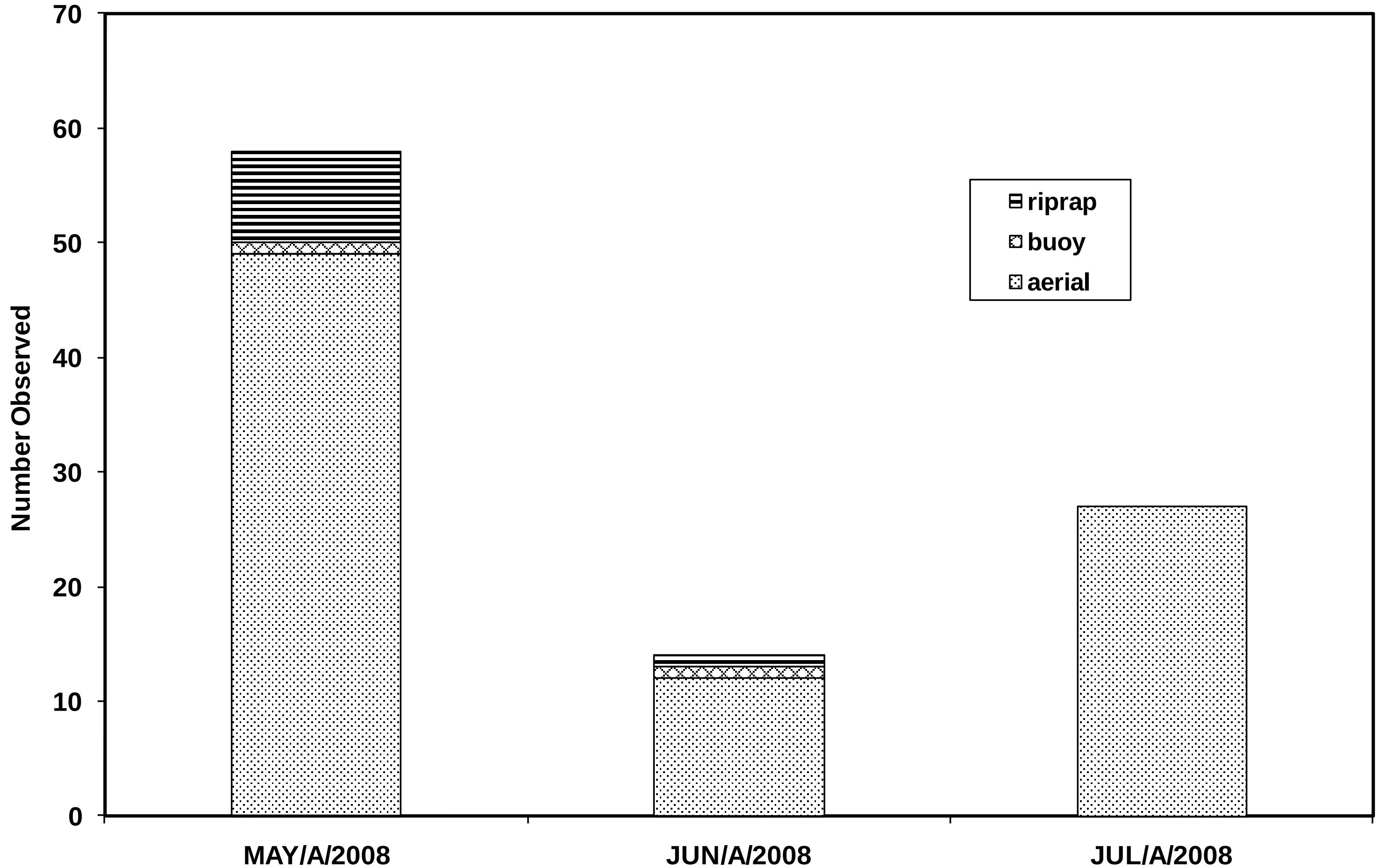


Figure 9.4-1f. Observations of Least Terns by Survey and Habitat Type in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

Figure 9.5-1. Total number of species and individuals of birds observed in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

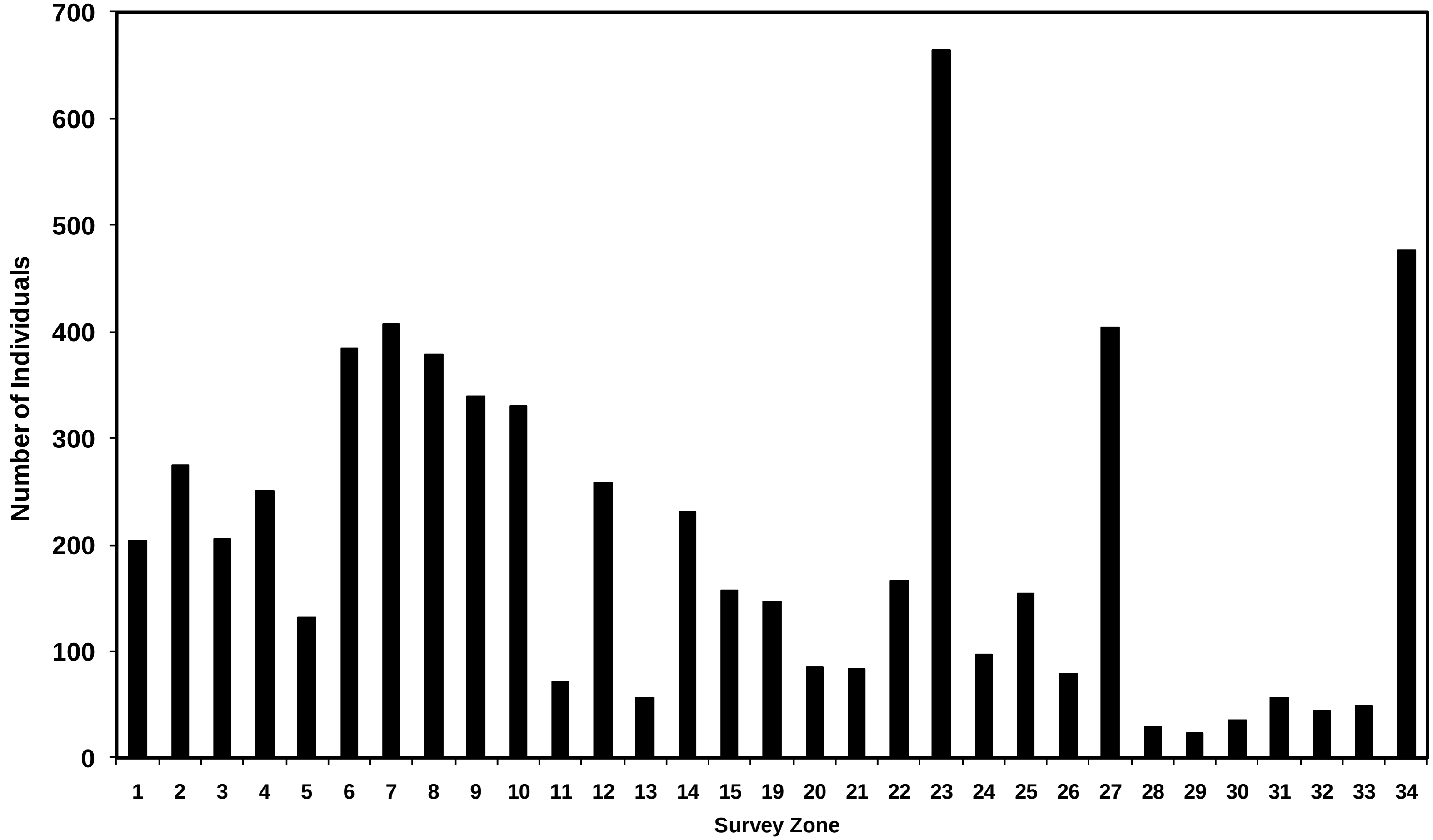
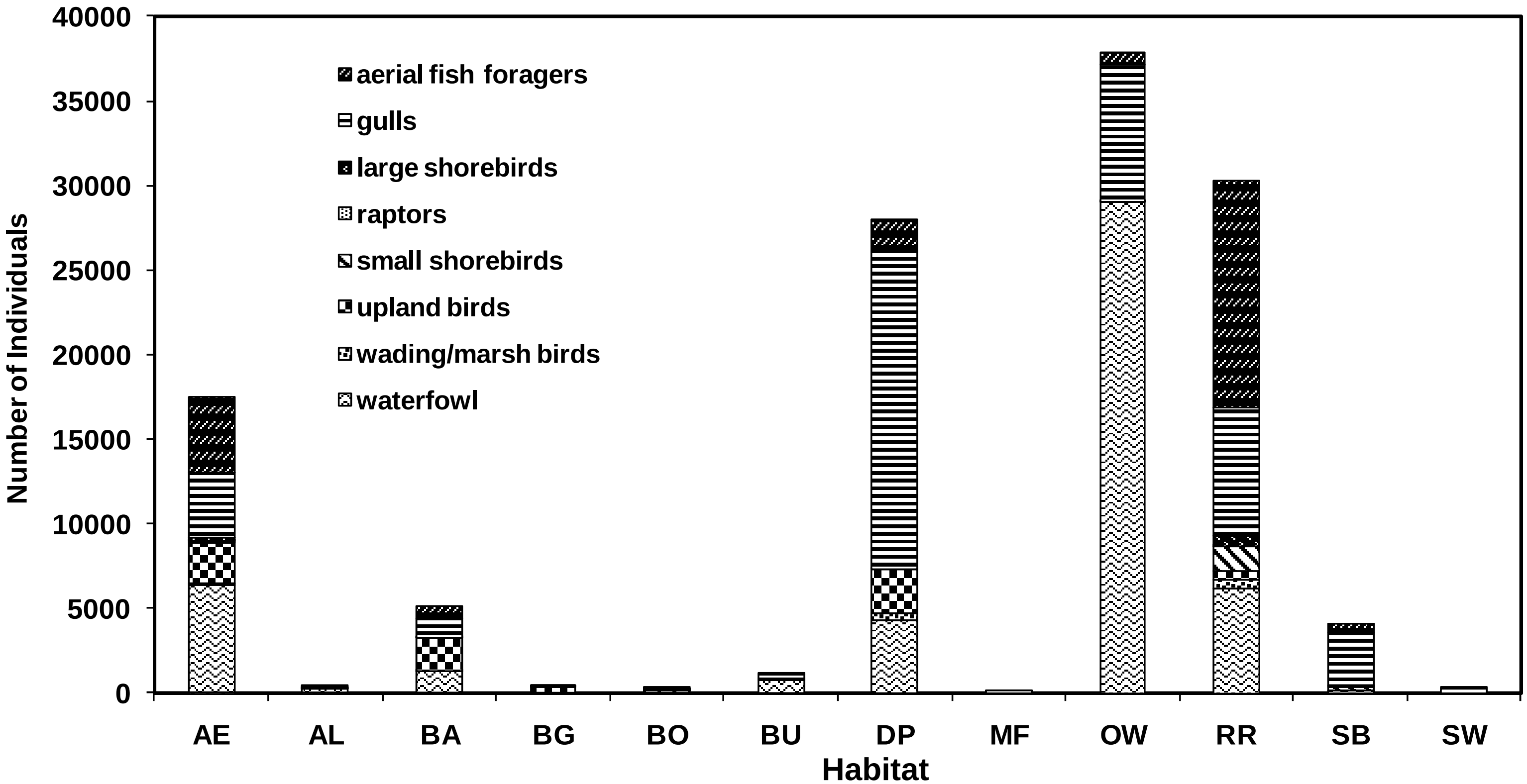


Figure 9.5-2. Mean Number of Individual Birds Observed per Survey Zone in Los Angeles and Long Beach Harbors, December 2007 – November 2008.



Key to Habitats:
AE = Aerial **AL** = anchor line **BA** = barge **BG** = bridge **BO** = spill boom **BU** = buoy **DP** = dock or piling **MF** = mudflat **OW** = open water **RR** = riprap **SB** = sandy beach **SW** = shallow water

Figure 9.5-3. Total Individuals by Bird Guilds within Different Habitats in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

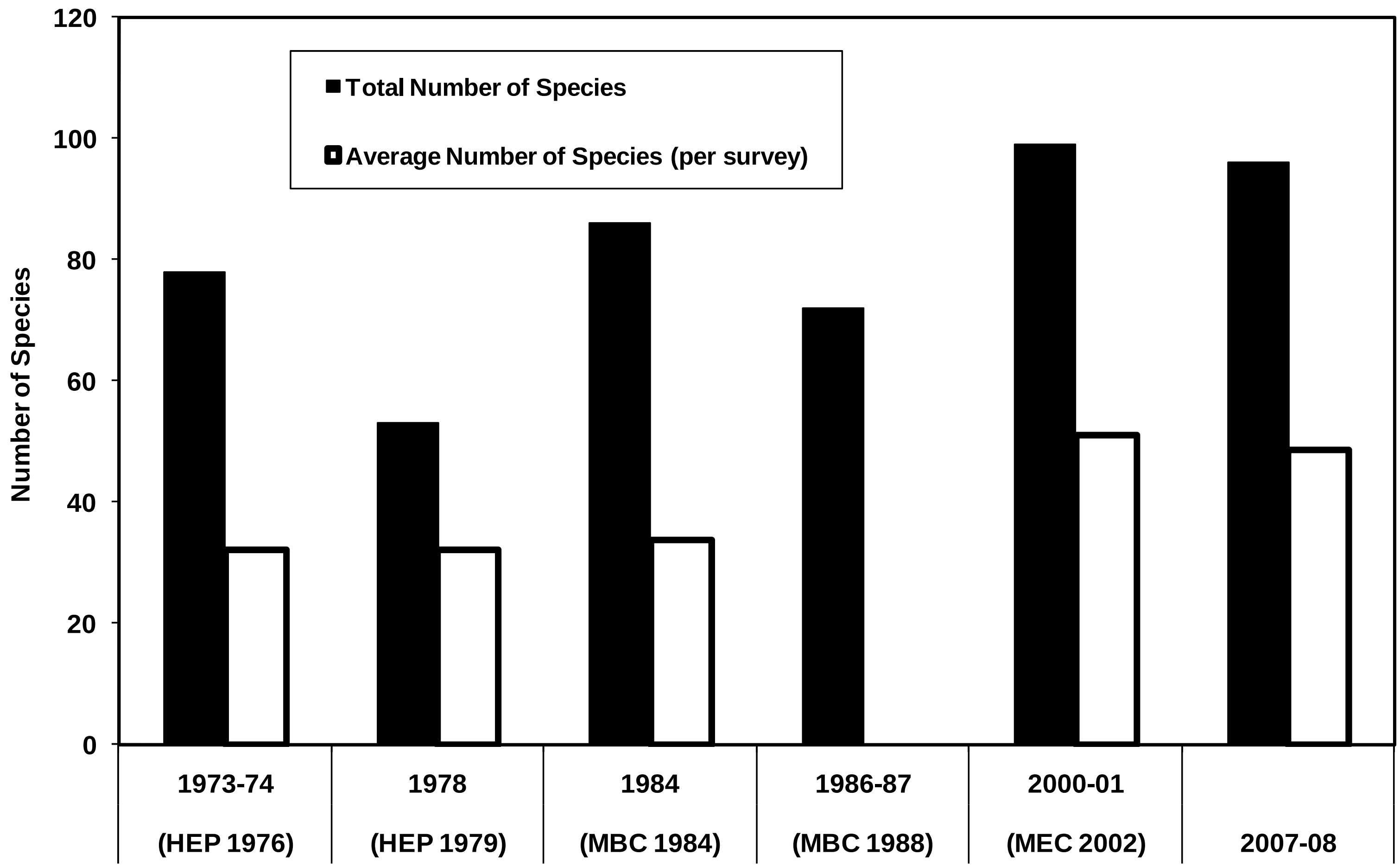


Figure 9.6-1. Historical Comparisons of the Total and Mean (per survey) Numbers of Species of Birds in Los Angeles and Long Beach Harbors.

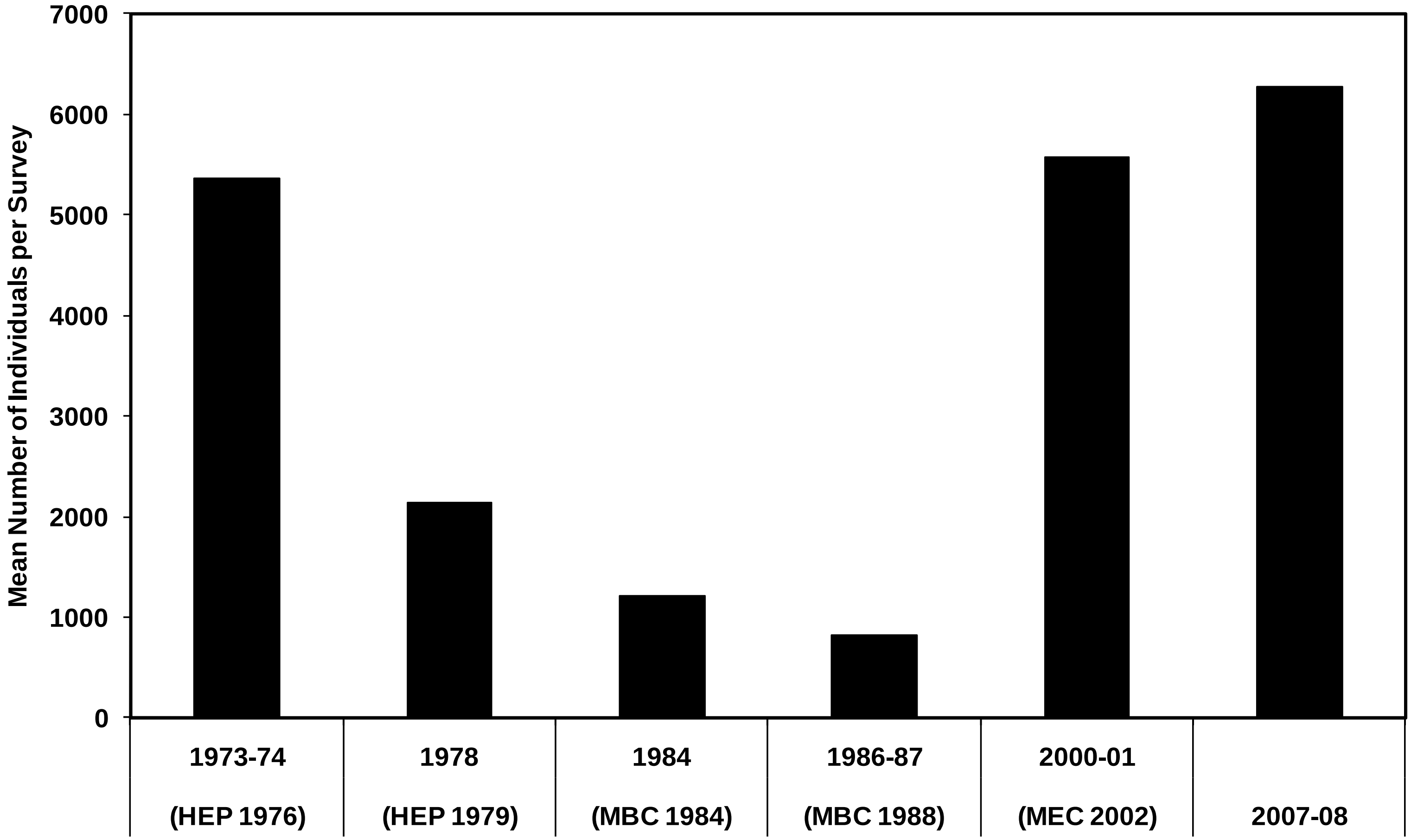


Figure 9.6-2. Historical Comparisons of the Total and Mean (per survey) Numbers of Individuals of Birds in Los Angeles and Long Beach Harbors.

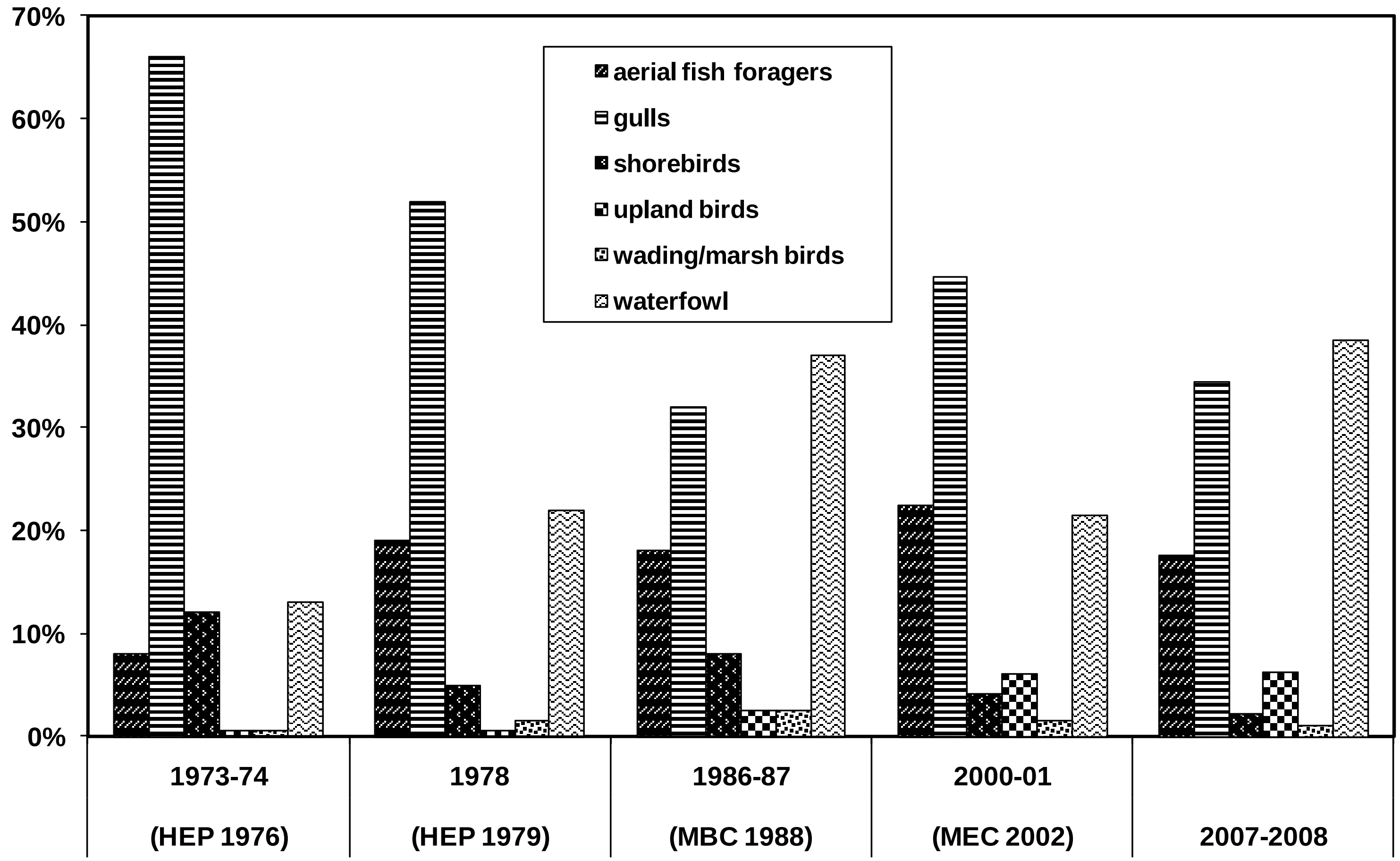


Figure 9.6-3. Historical Comparison of Percent Composition of Bird Guilds in Los Angeles and Long Beach Harbors, December 2007 – November 2008.

CHAPTER 10

MARINE MAMMALS

10.0 MARINE MAMMALS

10.1 INTRODUCTION

All marine mammals are protected under the Marine Mammal Protection Act (MMPA) of 1972, and some are also protected by the Endangered Species Act (ESA) of 1973. Marine mammals that are known to occur occasionally in waters of the Ports include pinnipeds (California sea lion, *Zalophus californianus,* and harbor seal, *Phoca vitulina*) and cetaceans (present study, MEC 2002, USACE and LAHD 1992). Cetaceans that have been observed in outer harbor locations in the Ports include the gray whale (*Eshrichtius robustus*), Pacific bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), and Pacific whitesided dolphin (*Lagenorhynchus obliquidens*) (USACE and LAHD 1992). None of these species breed in the Ports.

10.2 METHODOLOGY

For the present (2008) surveys, observations of marine mammals were primarily made during bird surveys. However, marine mammal observations were also recorded on daily log sheets during all other survey tasks, including benthic and fish sampling efforts. Observations included species, number of individuals, location (or survey zone), and other relevant information (e.g., activity, habitat use, and gender as feasible to determine).

10.3 SPECIES COMPOSITION

In 2008, California sea lions were the most commonly documented marine mammal species in the Ports and were generally observed on buoys and swimming throughout harbor waters (Table 10-1). California sea lions were observed more frequently in outer as compared to inner harbor stations. Harbor seals were observed in low numbers throughout the Ports, but occurred most frequently at outer harbor stations. A complete list of marine mammal species and their relative abundance is presented in Appendix I.

California sea lions have a broad distribution from British Columbia south to Tres Marias Islands off Mexico (Hanan and Sisson 1992). This species breeds in June and early July from the Channel Islands south into Mexico. California sea lions feed on a variety of prey, including squid, octopus, and fish (anchovy, mackerel, herring, rockfish, hake, and salmon), and can occur throughout the Ports, swimming and feeding.

Harbor seals range from Alaska to Cedros Island, Baja California (Hanan and Sisson 1992). These seals have been divided into three stocks, including a California group. Harbor seals are abundant along the entire California coast, typically occupying bays (including, harbors, and river mouths where they prey on epibenthic and benthic species (Ainley and Allen 1992).

A variety of marine mammals use the nearshore waters outside the breakwaters. These include gray whales that spend summers in the Bering and Chukchi seas off Alaska, and migrate to feeding grounds in winter along the west coast of Baja California, Mexico (Lagomarsino 1992).

Gray whales differ from other baleen whales, primarily in their feeding behavior. These whales are bottom feeders, taking up mouthfuls of sediment and then straining out water and mud through their baleen to capture benthic invertebrates.

In San Pedro Channel areas toothed whales and particularly dolphins can be found in larger groups of up to a thousand or more (Leatherwood and Reeves 1983). Several species of dolphin and porpoise that are commonly found in coastal areas near Los Angeles include the Pacific white-sided dolphin, Risso's dolphin (*Grampus grisseus*), Dall's porpoise (*Phocoenoides dalli*), bottlenose dolphin, northern right whale dolphin (*Lissodelphis borealis*), and common dolphin, with the common dolphin the most abundant (Forney et al., 1995). Bottlenose dolphin (*Tursiops* spp.) occur from southern California to the tropics. In California, both coastal and offshore forms are found (Lagomarsino 1992). The coastal form inhabits shallow areas beyond the surfzone and is sometimes observed in bays and estuaries. This species is generally abundant, especially in southern California coastal waters.

10.4 HISTORICAL COMPARISONS

Since most marine mammals were observed or sighted during other survey activities, it is difficult to compare historical levels among previous Port baseline and monitoring studies. It is likely that the diversity and abundance of marine mammals have not changed significantly between the baseline surveys. Some of the most commonly observed species, such as California sea lions and harbor seals, can be seen on channel markers (buoys), sleeping on boat swim steps (California sea lions), and hauled out on riprap rocks that line various locations throughout the harbors.

Table 10-1. Marine Mammal Observations in Ports of Los Angeles and Long Beach During Baseline Biological Surveys, 2008.

Station/Zone	*Survey*	*Bottlenose Dolphin*	*California Sea Lion*	*Common Dolphin*	*Harbor Seal*
Zone 1	Bird		X		X
Zone 2	Bird		X		
Zone 3	Bird	X			
Zone 4	Bird		X		X
Zone 5	Bird				X
Zone 6	Bird		X		X
Zone 7	Bird		X		X
Zone 8	Bird	X	X		X
Zone 9	Bird	X	X		X
Zone 10	Bird		X		X
Zone 11	Bird		X		
Zone 12	Bird		X		X
Zone 13	Bird	X	X		X
Zone 14	Bird		X		
Zone 15	Bird		X		X
Zone 19	Bird	X	X		
Zone 20	Bird	X	X	X	X
Zone 21	Bird		X		
Zone 22	Bird		X		
Zone 23	Bird		X		
Zone 24	Bird		X		
Zone 25	Bird		X		
Zone 26	Bird		X		
Zone 27	Bird		X		
Zone 28	Bird		X		
Zone 30	Bird		X		
Zone 31	Bird		X		
Zone 32	Bird		X		
Zone 33	Bird		X		
Zone 34	Bird		X		
LA1	Fish/Benthics		X		X
LA2	Fish/Benthics		X		
LA3	Fish/Benthics		X		
LA4	Fish/Benthics	X			
LA6	Fish/Benthics		X		
LA10	Fish/Benthics		X		X
LB2	Fish/Benthics		X		
LB5	Fish/Benthics		X		
LB6	Fish/Benthics		X		

Note that specific dates for observations are provided in Appendix I.

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CHAPTER 11

REFERENCES

11.0 REFERENCES

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APPENDIX A

STATION LOCATIONS

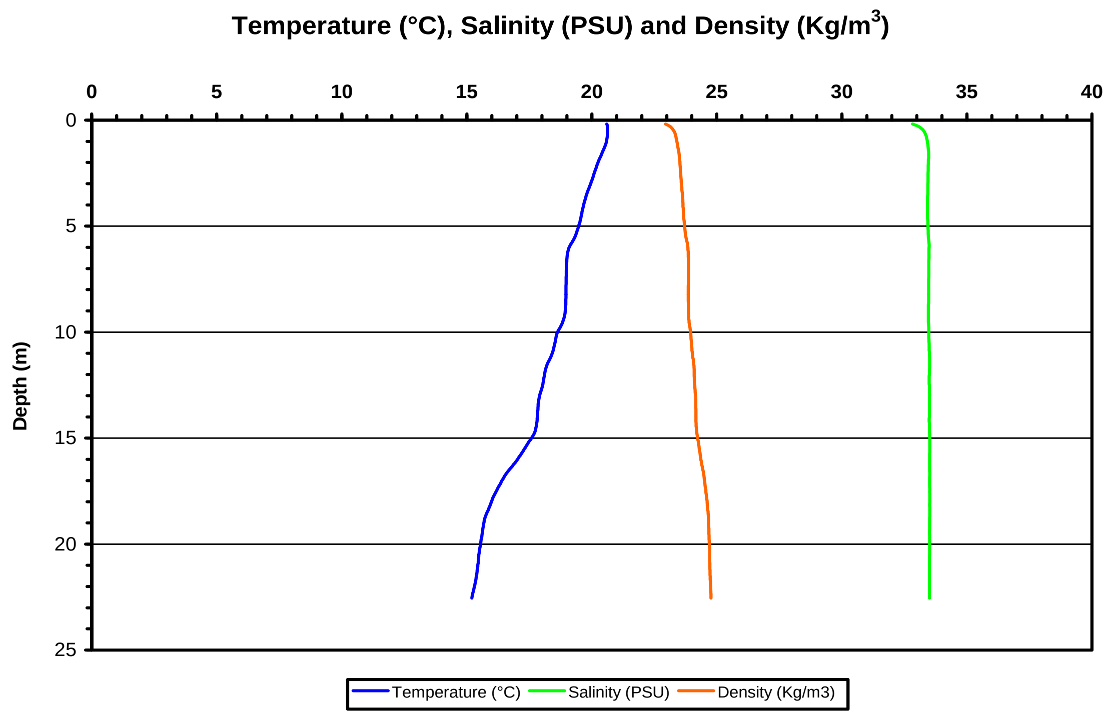
Station	*Station Coordinates (NAD 83)*		*Sampling Tasks*
	Lat	*Long*	
Port of Los Angeles			
LA1	33° 43.150'	118° 14.415'	Fish/Benthics
LA2	33° 42.543'	118° 15.795'	Fish/Benthics
LA3	33° 42.469'	118° 16.434'	Fish/Benthics
LA4	33° 44.305'	118° 16.589	Fish/Benthics
LA5	33° 45.871'	118° 16.476	Fish/Benthics
LA6	33° 45.495'	118° 15.683	Fish/Benthics
LA7	33° 44.391'	118° 14.735	Fish/Benthics
LA8	33° 44.869'	118° 15.032	Benthics Only
LA9	33° 43.896'	118° 15.187	Benthics Only
LA10	33° 43.693'	118° 15.947	Fish/Benthics
LA11	33° 43.072'	118° 16.136	Benthics Only
LA12	33° 43.249'	118° 16.754	Benthics Only
LA13	33° 45.293'	118° 16.997	Benthics Only
LA14	33° 46.17'	118° 15.054	Fish/Benthics
LA15	33° 45.283'	118° 16.499	Fish/Benthics
LARR1	33° 42.937'	118° 13.847	Rip Rap
LARR2	33° 45.816'	118° 15.431	Rip Rap
LARR3	33° 45.973'	118° 16.589	Rip Rap
LARR4	33° 42.866'	118° 16.401	Rip Rap
T2	33° 42.435'	118° 15.425'	Kelp/Macroalgae
T3	33° 42.765'	118° 16.886'	Kelp/Macroalgae
T9	33° 44.920'	118° 14.855'	Kelp/Macroalgae
T10	33° 45.176'	118° 16.031'	Kelp/Macroalgae
T13	33° 46.284'	118° 14.967'	Kelp/Macroalgae
T16	33° 43.290'	118° 16.025'	Kelp/Macroalgae
T17	33° 43.829'	118° 15.909'	Kelp/Macroalgae
T18	33° 45.578'	118° 16.148'	Kelp/Macroalgae
T19	33° 45.283'	118° 16.385'	Kelp/Macroalgae
T20	33° 42.889'	118° 16.367'	Kelp/Macroalgae

Station	Station Coordinates (NAD 83)		Sampling Tasks
	Lat	Long	
Port of Long Beach			
LB1	33° 44.000'	118° 13.400	Fish/Benthics
LB2	33° 43.964'	118° 14.290	Fish/Benthics
LB3	33° 44.851	118° 13.647	Fish/Benthics
LB4	33° 46.509	118° 12.823	Fish/Benthics
LB5	33° 44.622	118° 11.772	Fish/Benthics
LB6	33° 44.236	118° 11.306	Fish/Benthics
LB7	33° 44.946	118° 13.022	Fish/Benthics
LB8	33° 44.354	118° 10.986	Benthics Only
LB9	33° 43.700	118° 11.525	Benthics Only
LB10	33° 44.824	118° 12.636	Benthics Only
LB11	33° 44.760	118° 13.376	Benthics Only
LB12	33°45.569	118° 12.498	Fish/Benthics
LB13	33° 46.157	118° 13.388	Benthics Only
LB14	33° 46.042	118° 13.953	Fish/Benthics
LBRR1	33° 44.078	118° 11.026	Rip Rap
LBRR2	33° 46.228	118° 13.546	Rip Rap
LBRR3	33° 44.722	118° 13.223	Rip Rap
LBRR4	33° 44.645	118° 12.234	Rip Rap
T1	33° 43.286'	118° 12.792'	Kelp/Macroalgae
T4	33° 43.629'	118° 14.236'	Kelp/Macroalgae
T5	33° 43.417'	118° 11.938'	Kelp/Macroalgae
T6	33° 44.601'	118° 11.781'	Kelp/Macroalgae
T7	33° 46.360'	118° 12.584'	Kelp/Macroalgae
T8	33° 46.198'	118° 12.848'	Kelp/Macroalgae
T11	33° 46.442'	118° 12.959'	Kelp/Macroalgae
T12	33° 46.014'	118° 13.933'	Kelp/Macroalgae
T14	33° 44.031'	118° 11.048'	Kelp/Macroalgae
T15	33° 44.636'	118° 13.035'	Kelp/Macroalgae

APPENDIX B

WATER QUALITY PROFILES

(A)



(B)

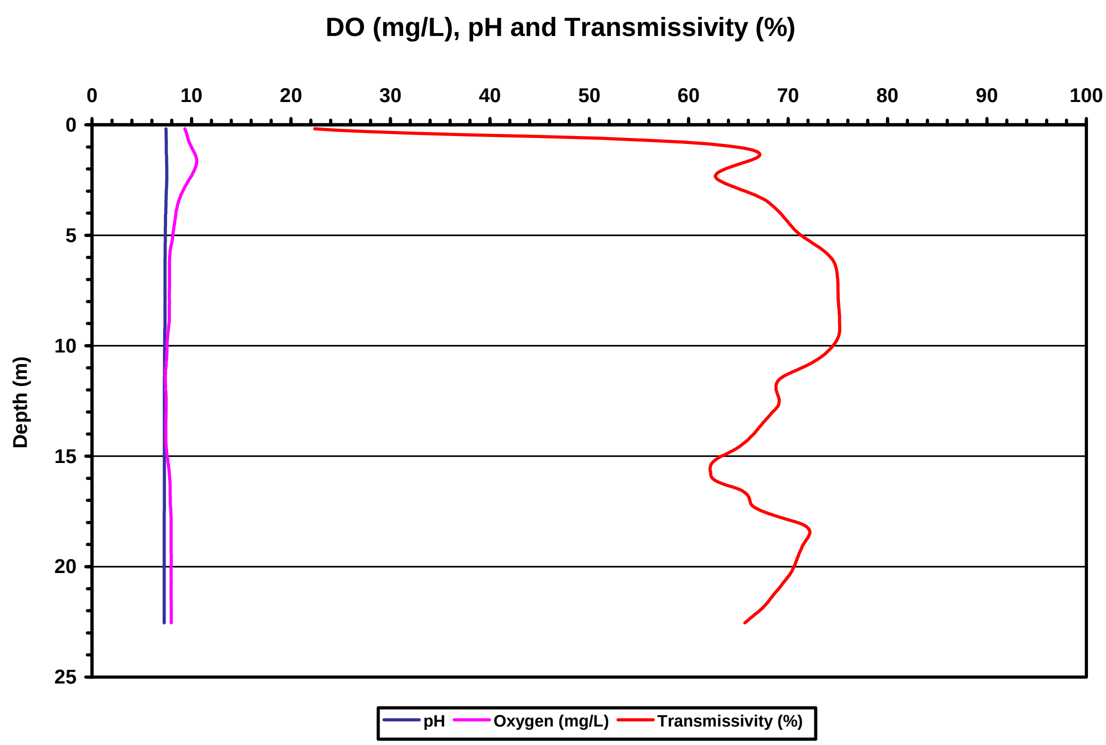
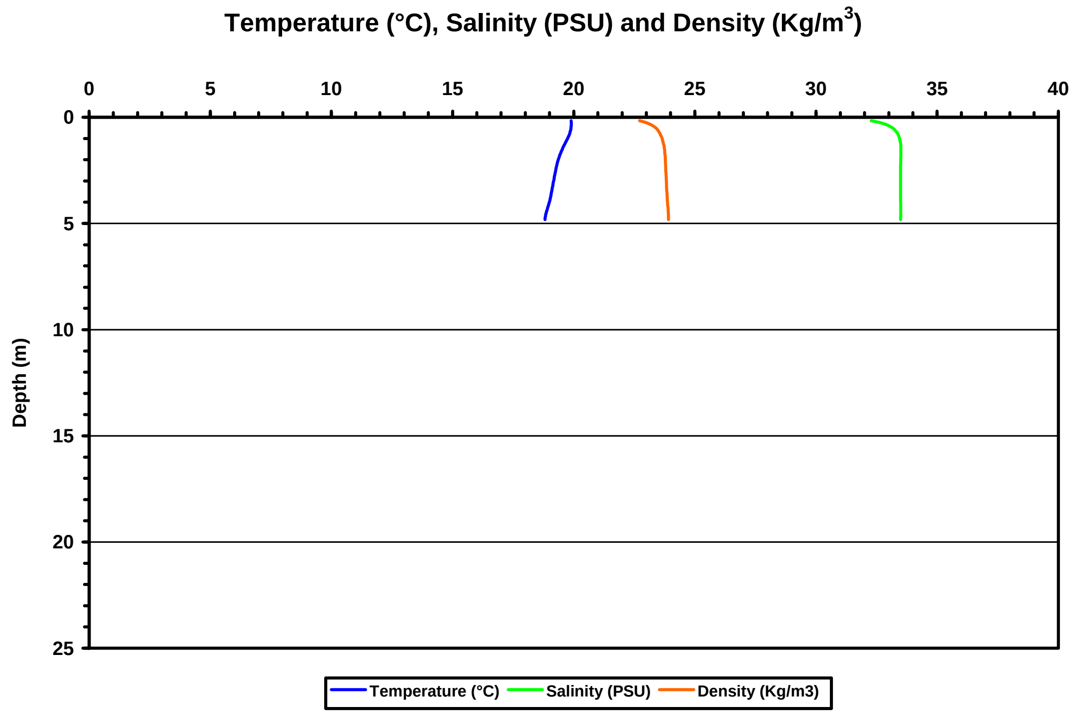


Figure B-1. Water quality profiles at Station LA – 1: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



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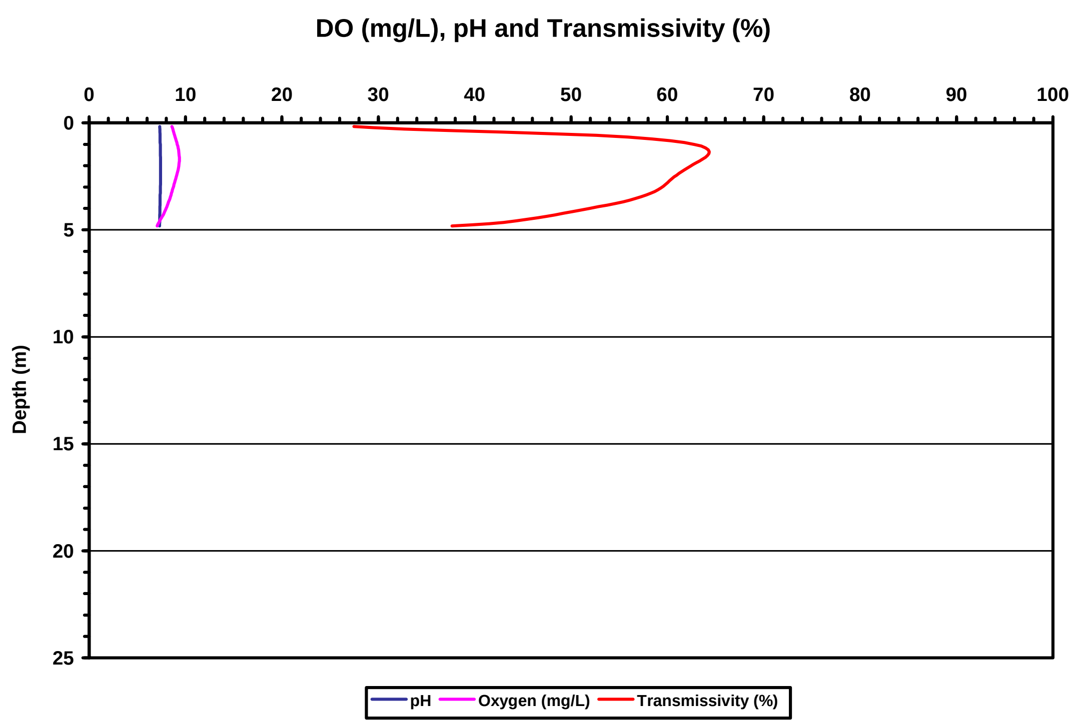
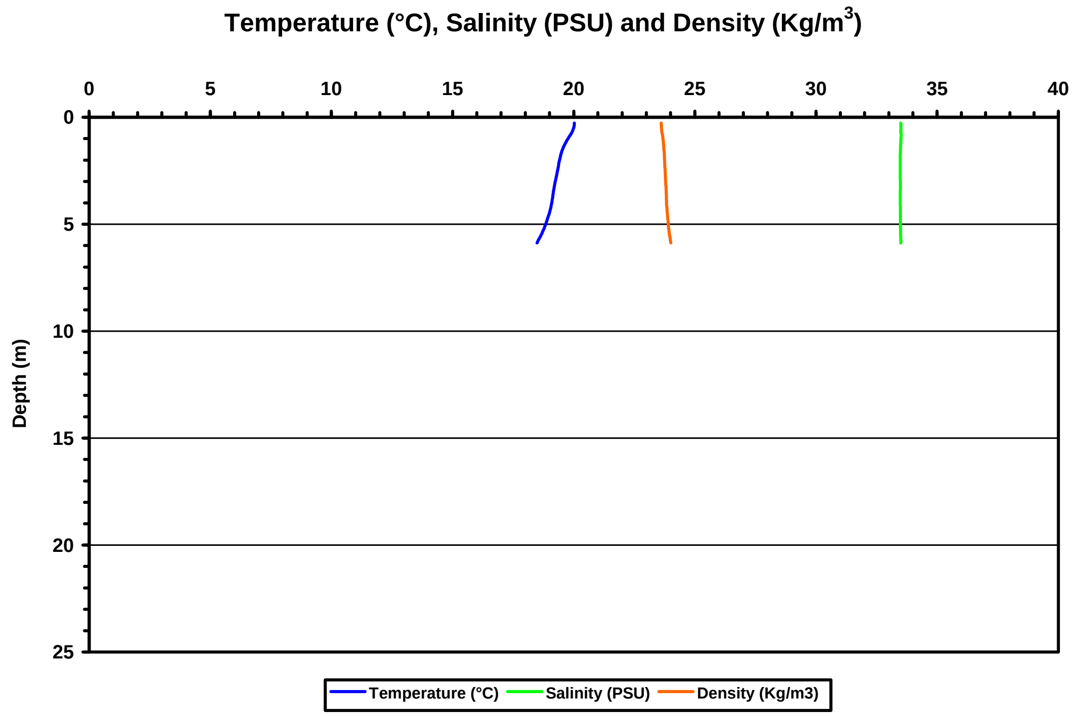


Figure B-2. Water quality profiles at Station LA – 2: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



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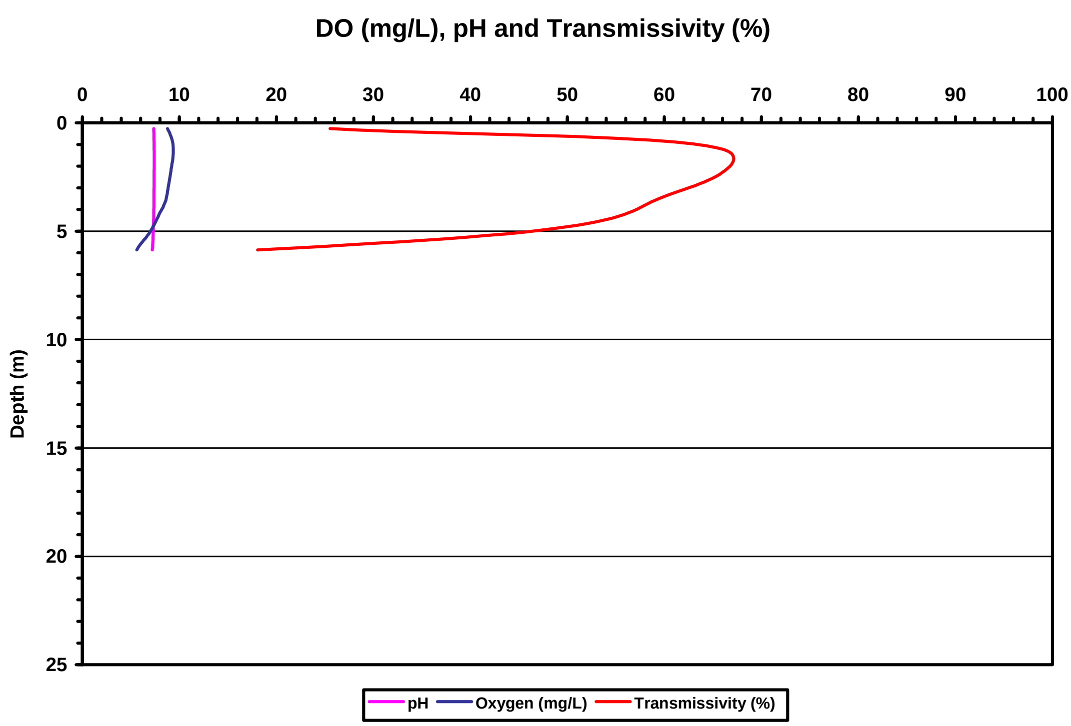
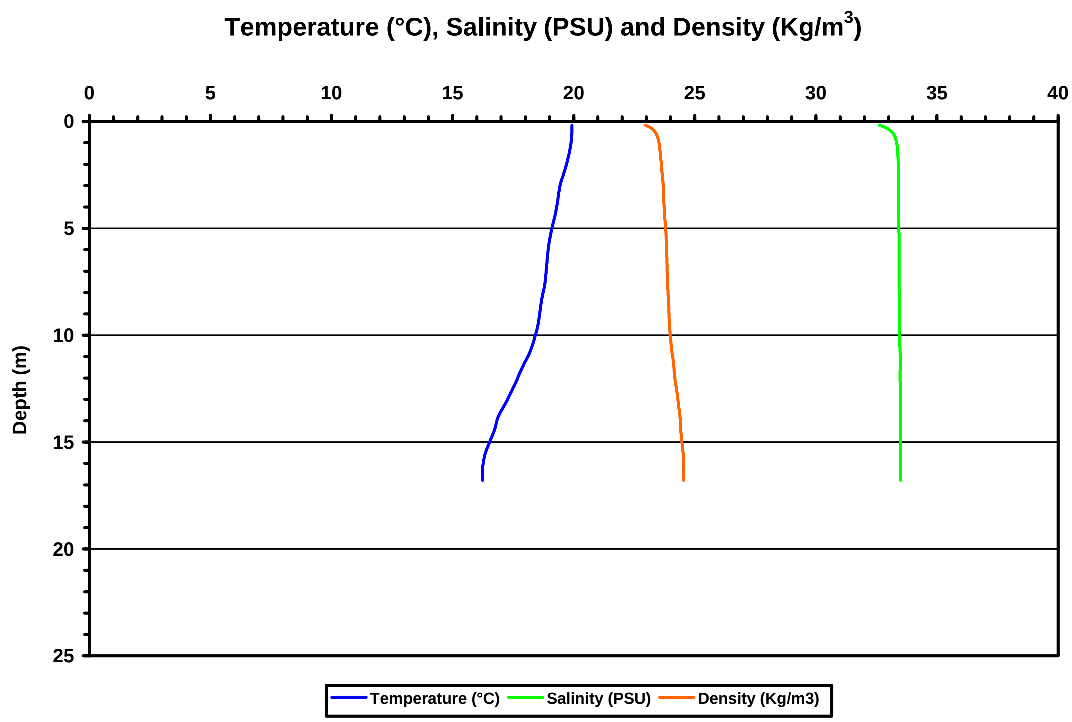


Figure B-3. Water quality profiles at Station LA – 3: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

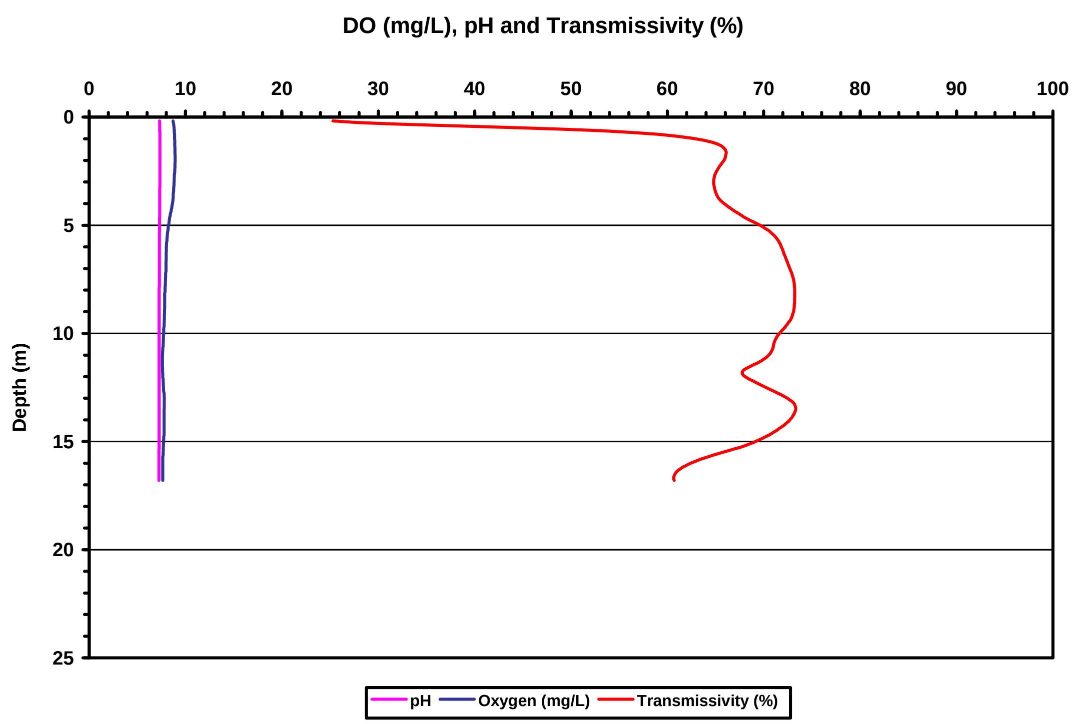
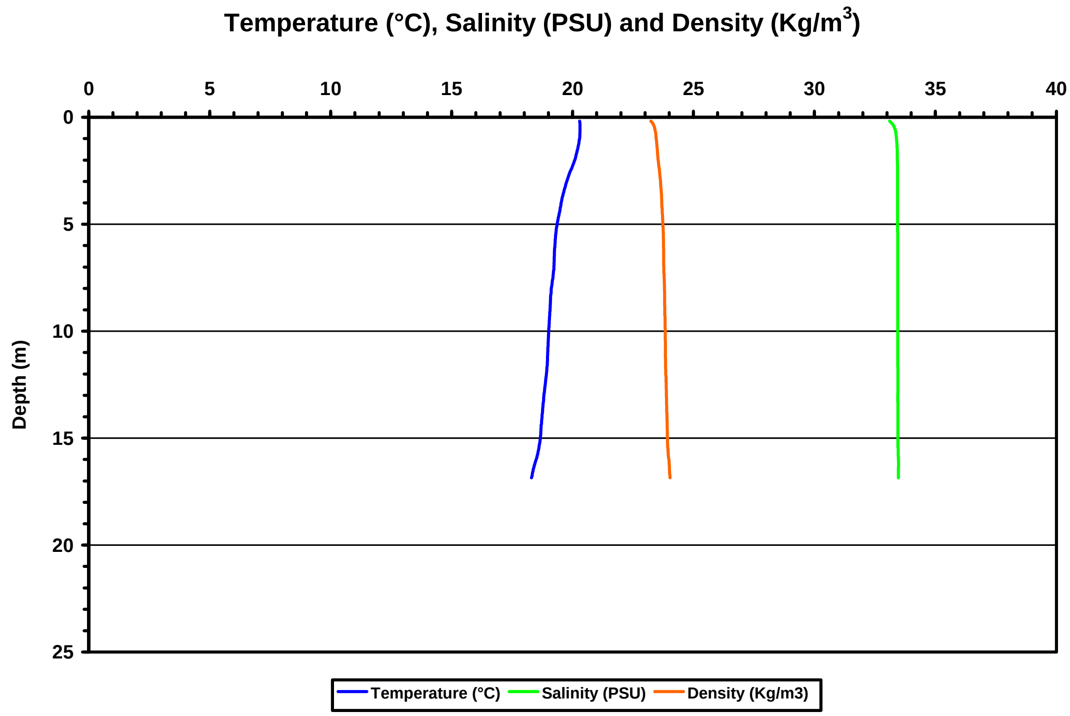


Figure B-4. Water quality profiles at Station LA – 4: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

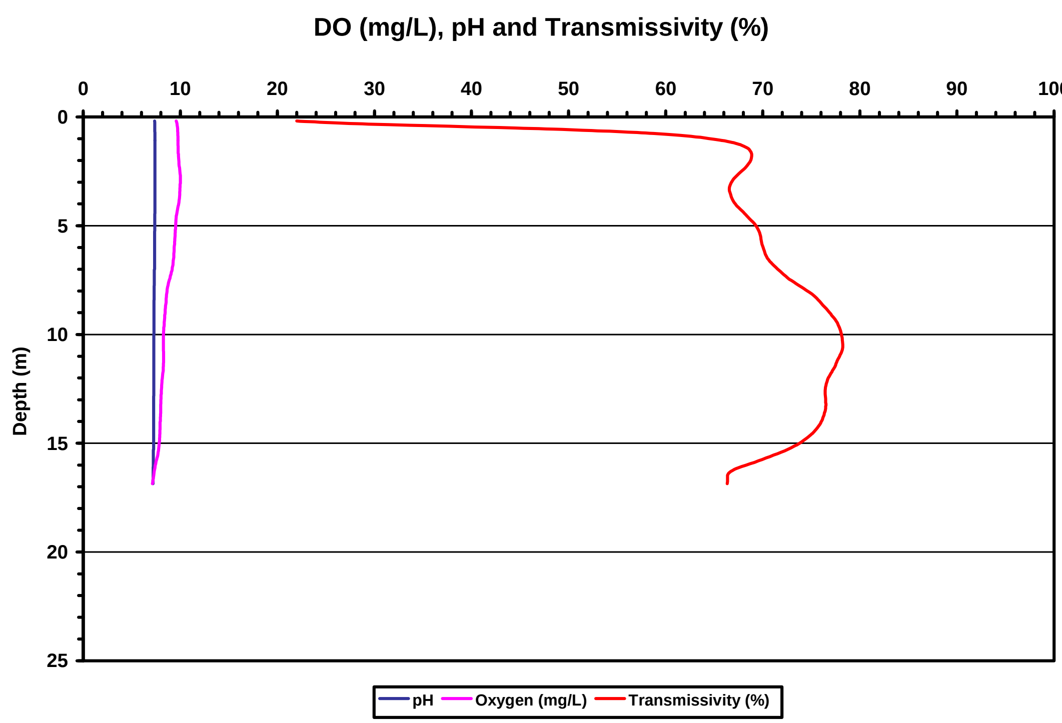
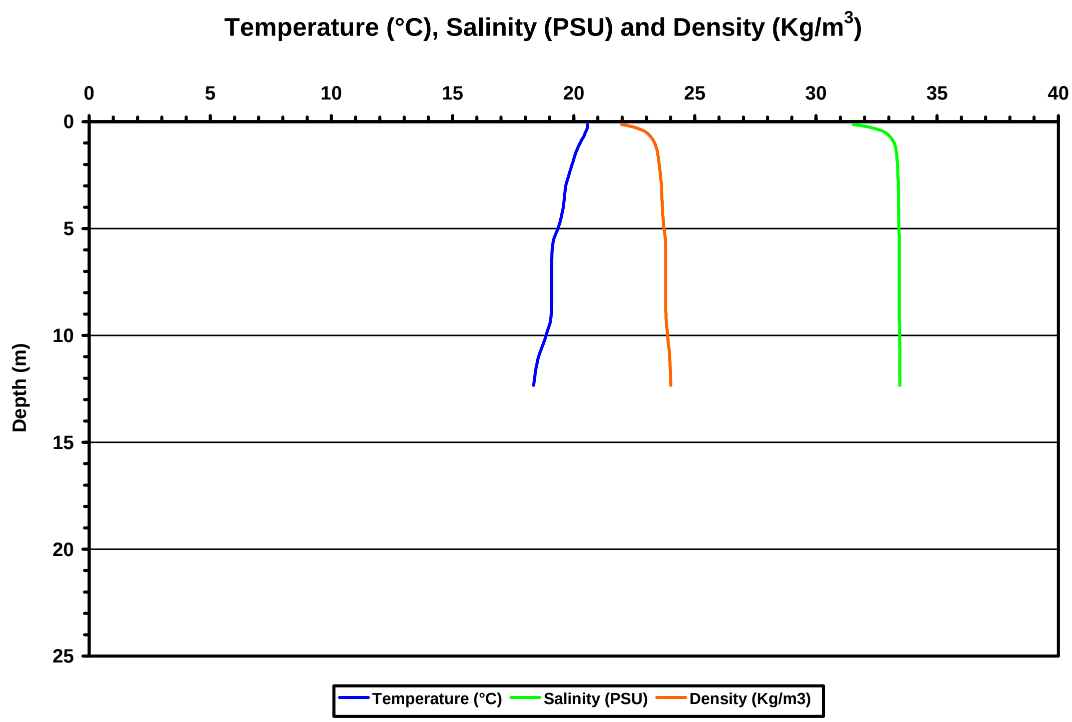


Figure B-5. Water quality profiles at Station LA – 5: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

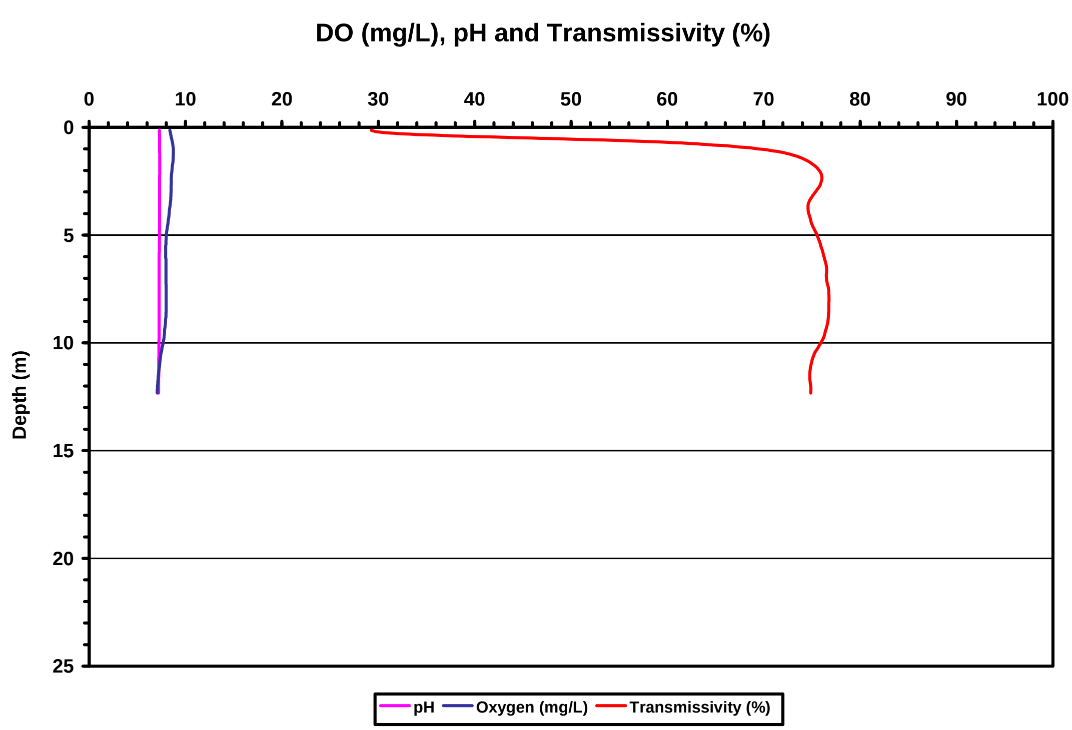
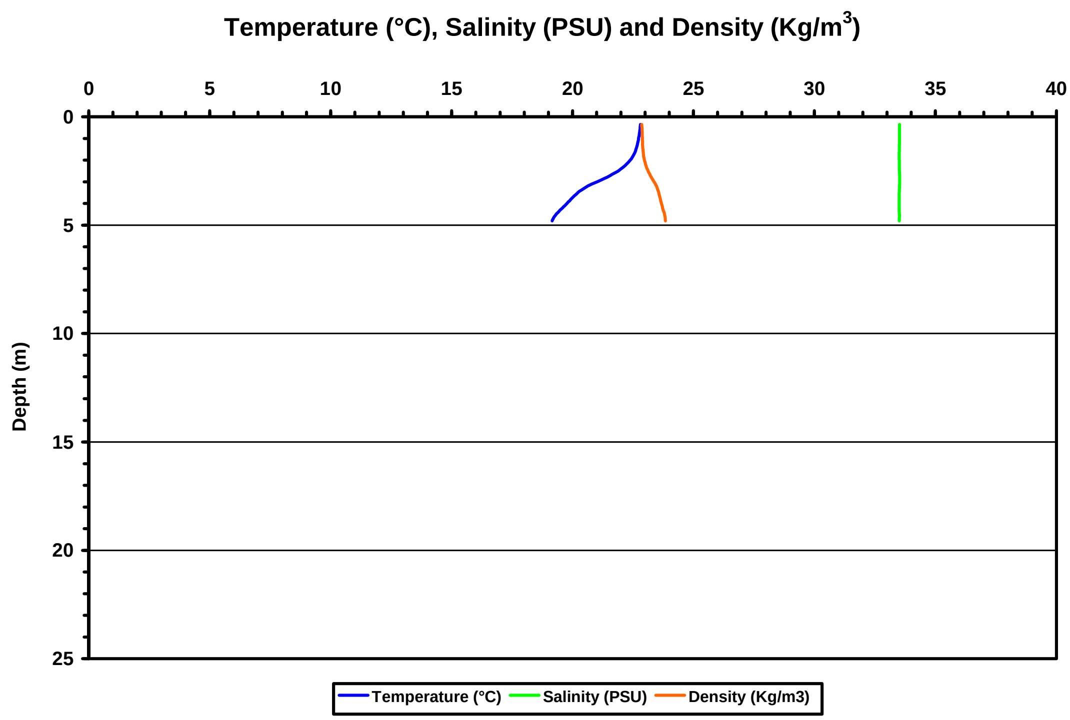


Figure B-6. Water quality profiles at Station LA – 6: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

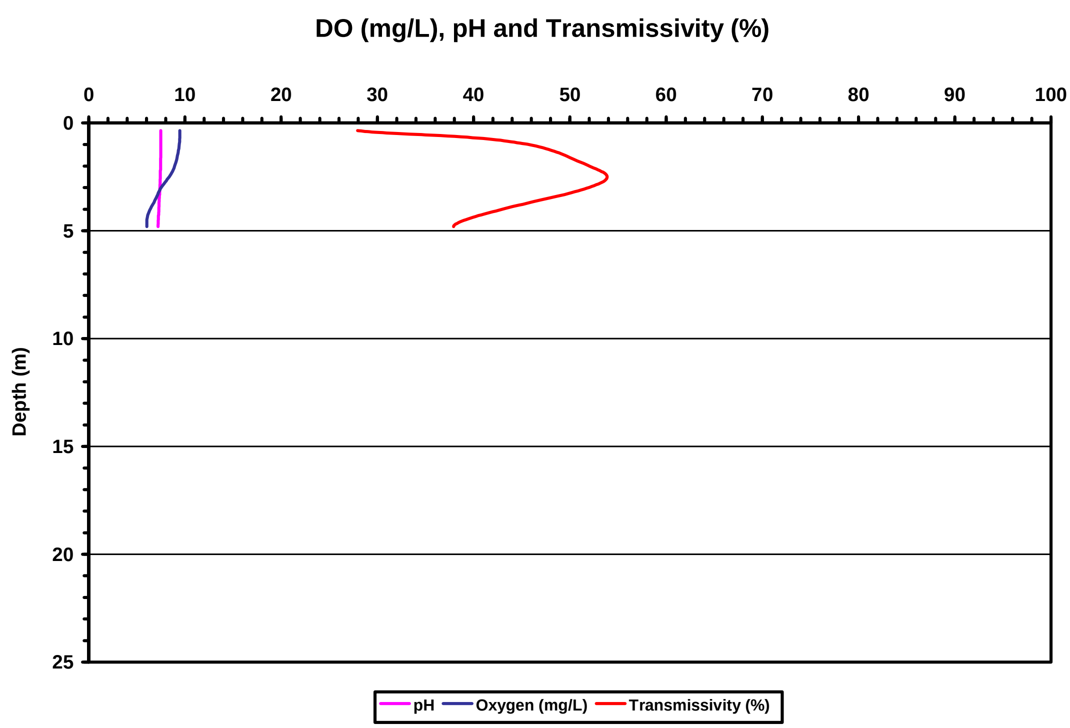
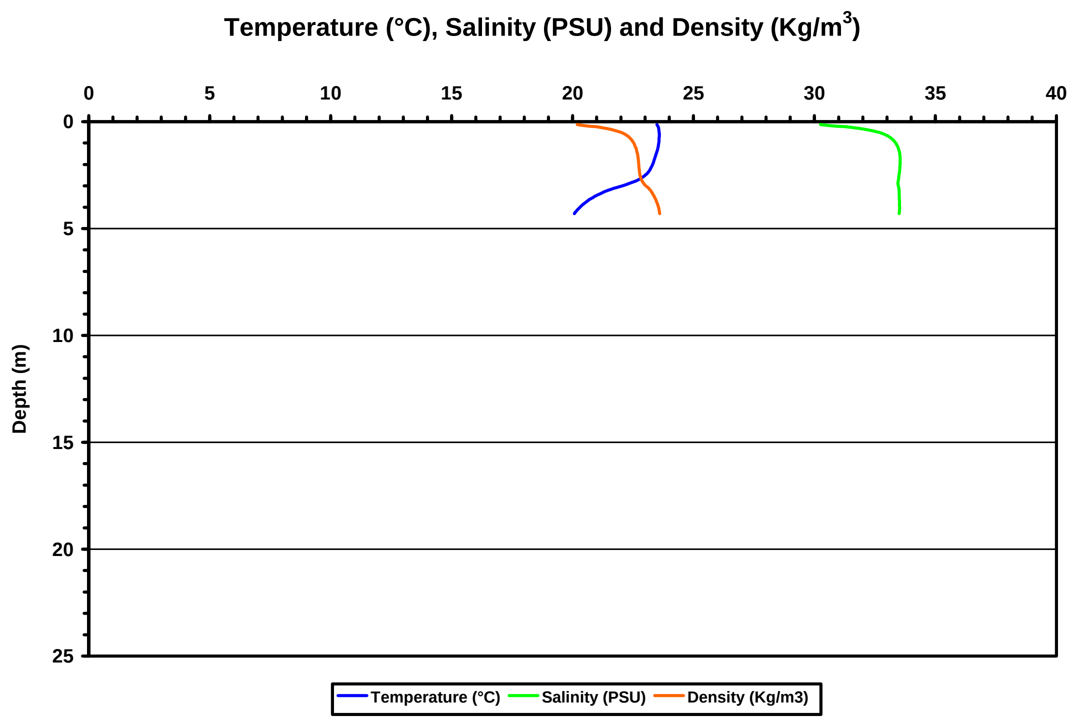


Figure B-7. Water quality profiles at Station LA – 7: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

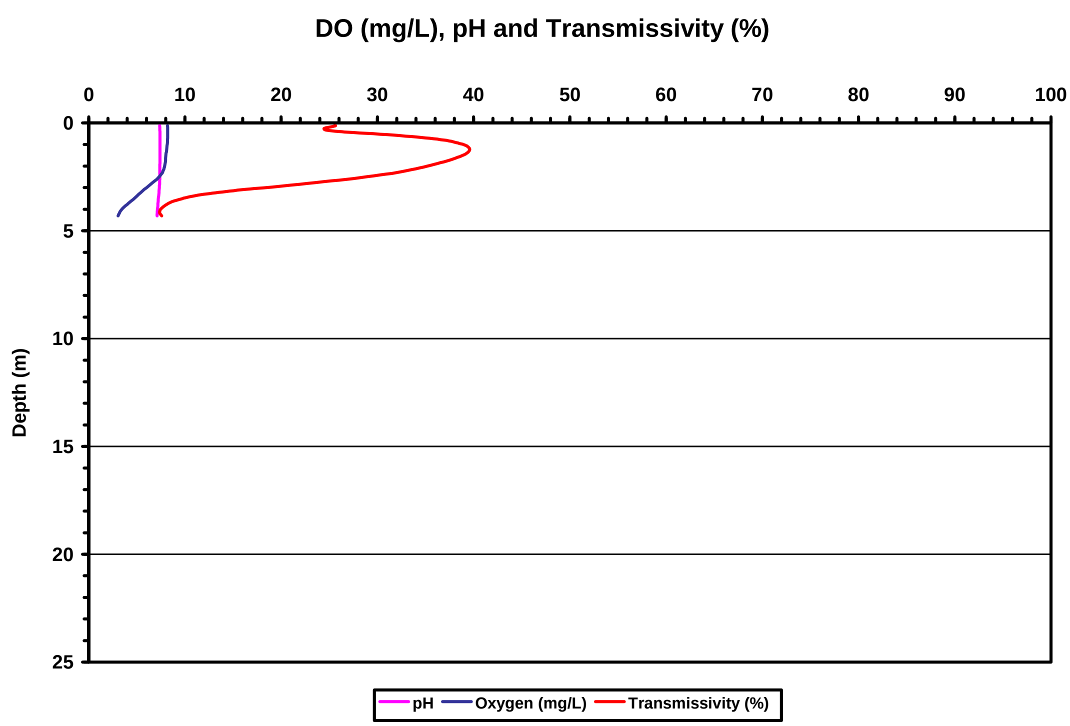
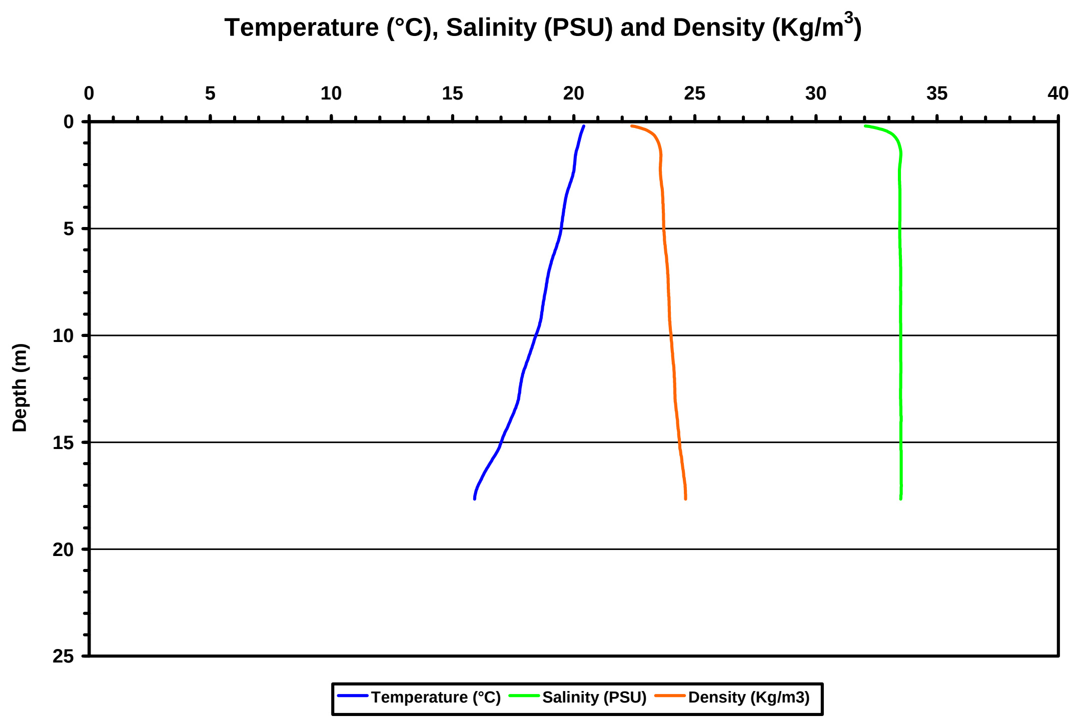


Figure B-8. Water quality profiles at Station LA – 8: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

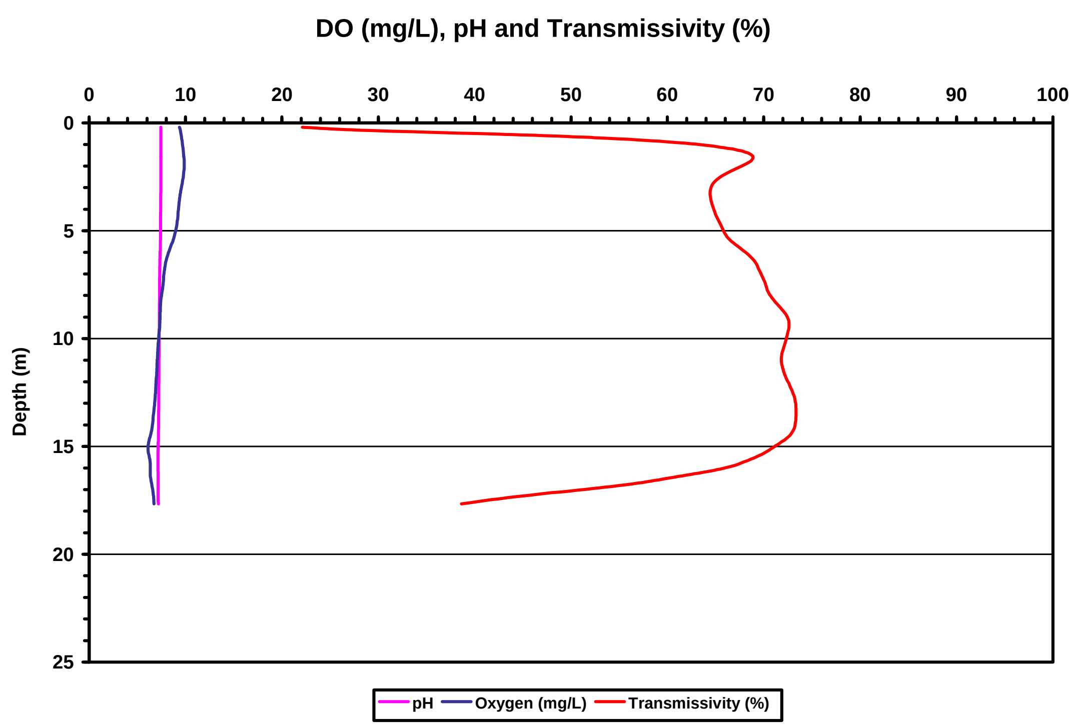
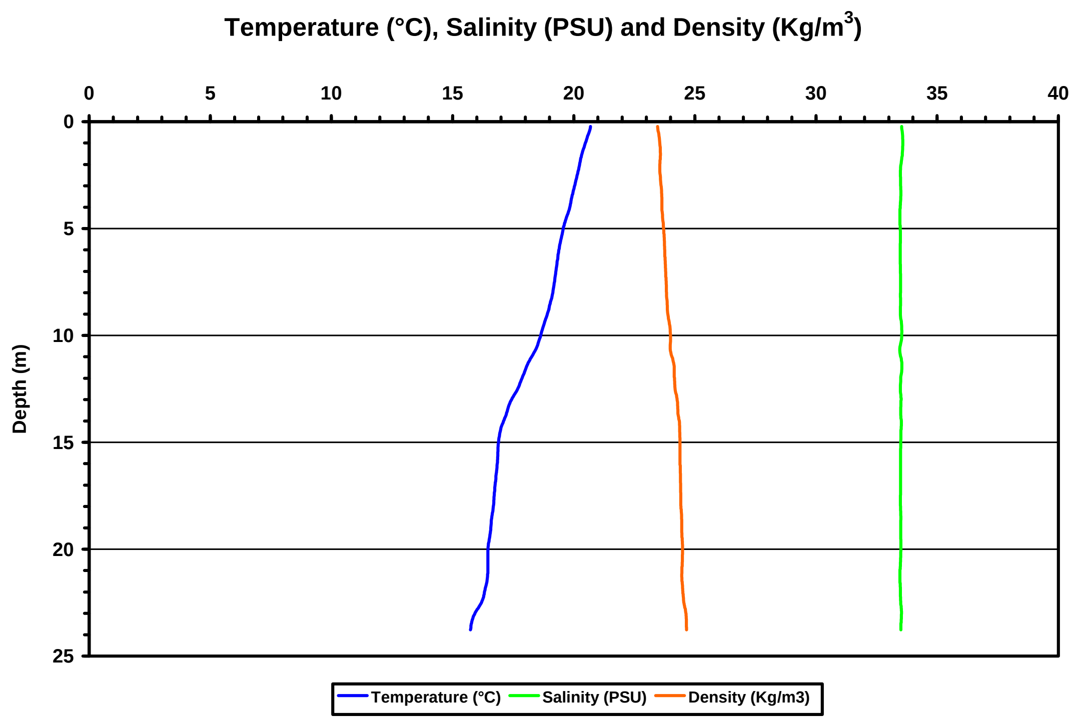


Figure B-9. Water quality profiles at Station LA – 9: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

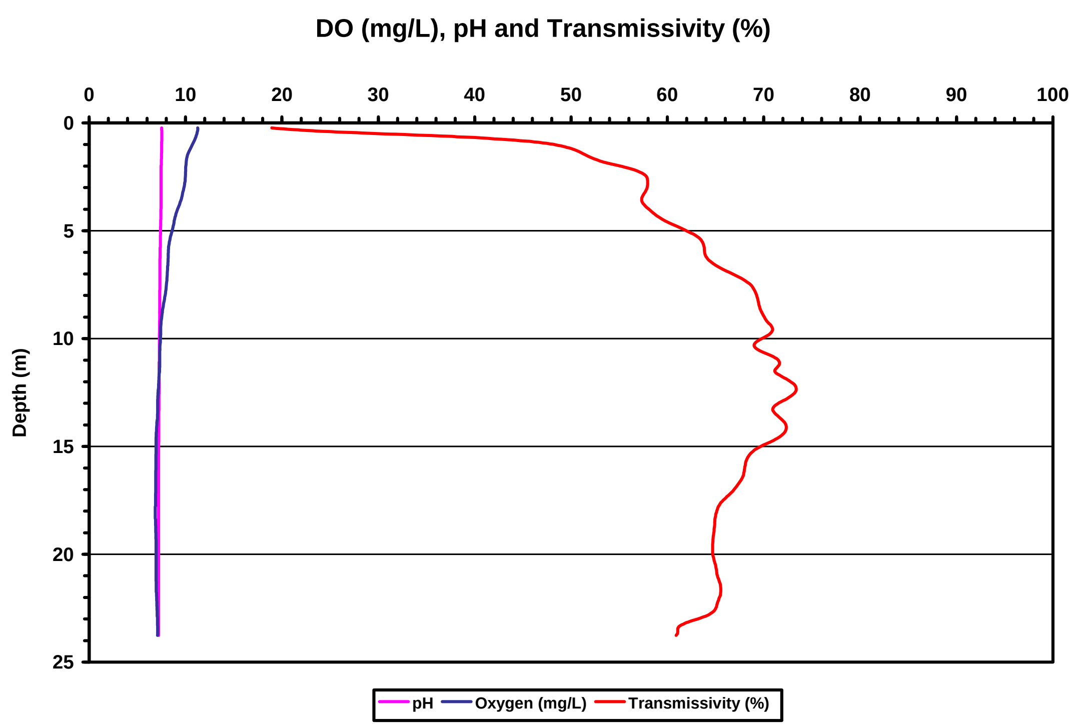
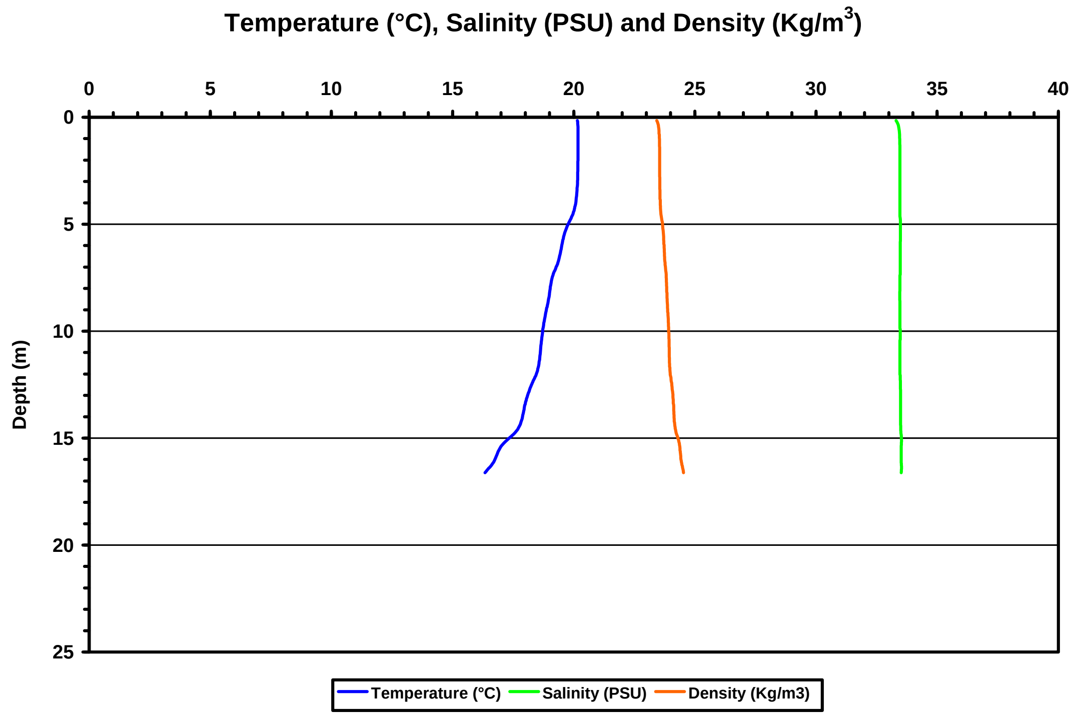


Figure B-10. Water quality profiles at Station LA – 10: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

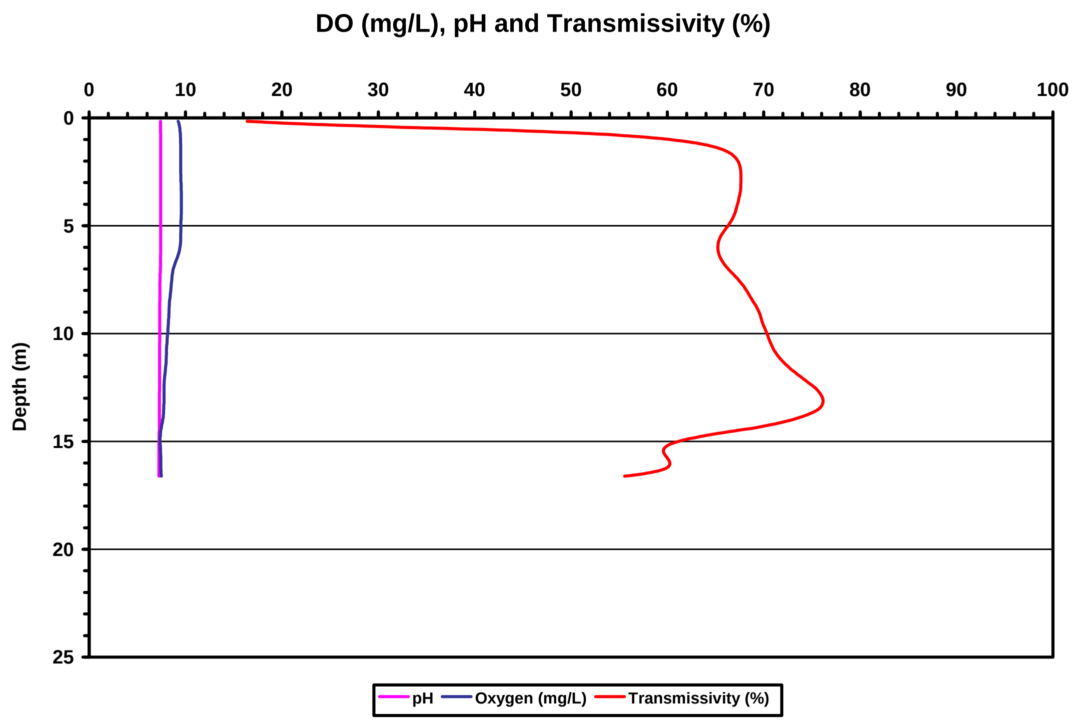
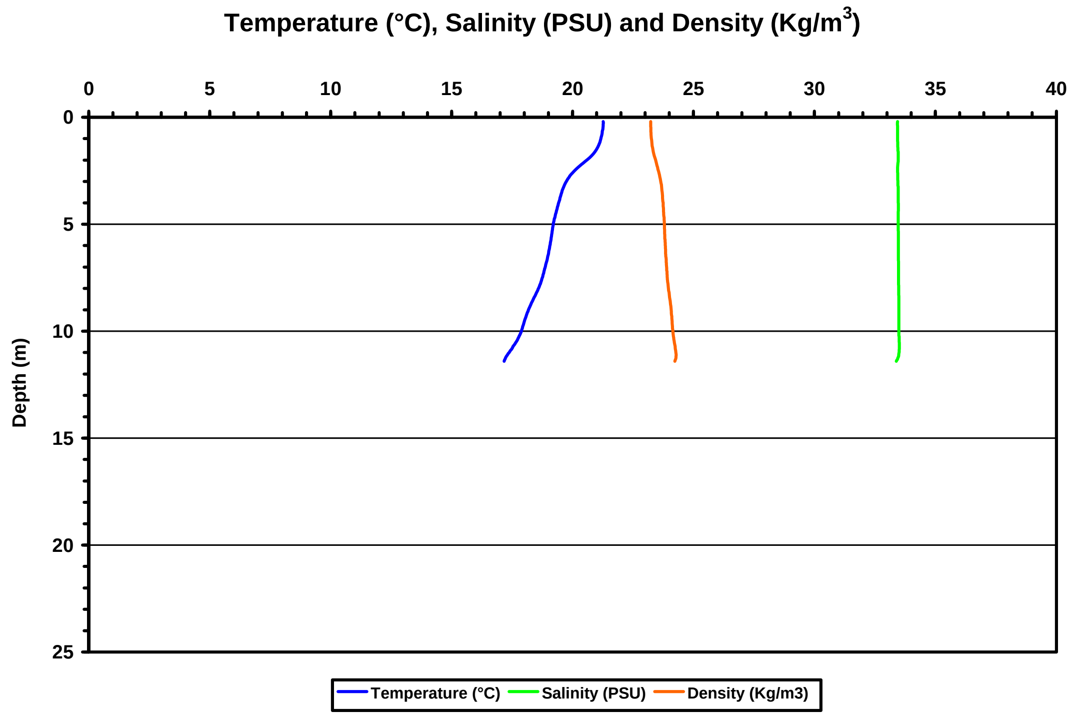


Figure B-11 Water quality profiles at Station LA – 11: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

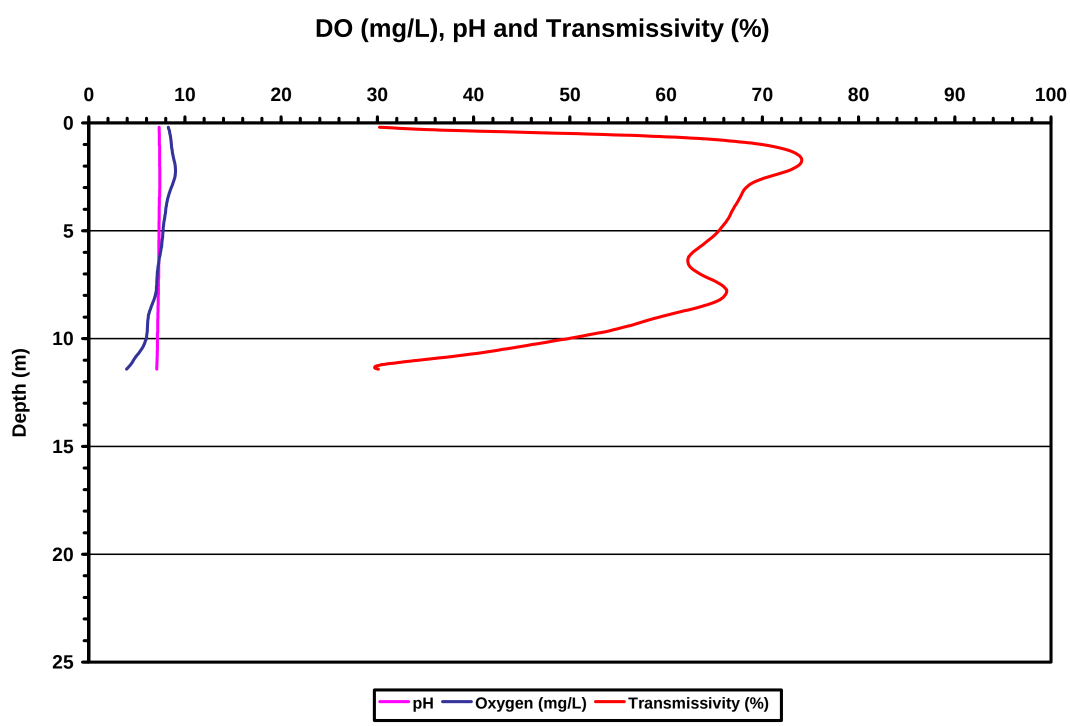
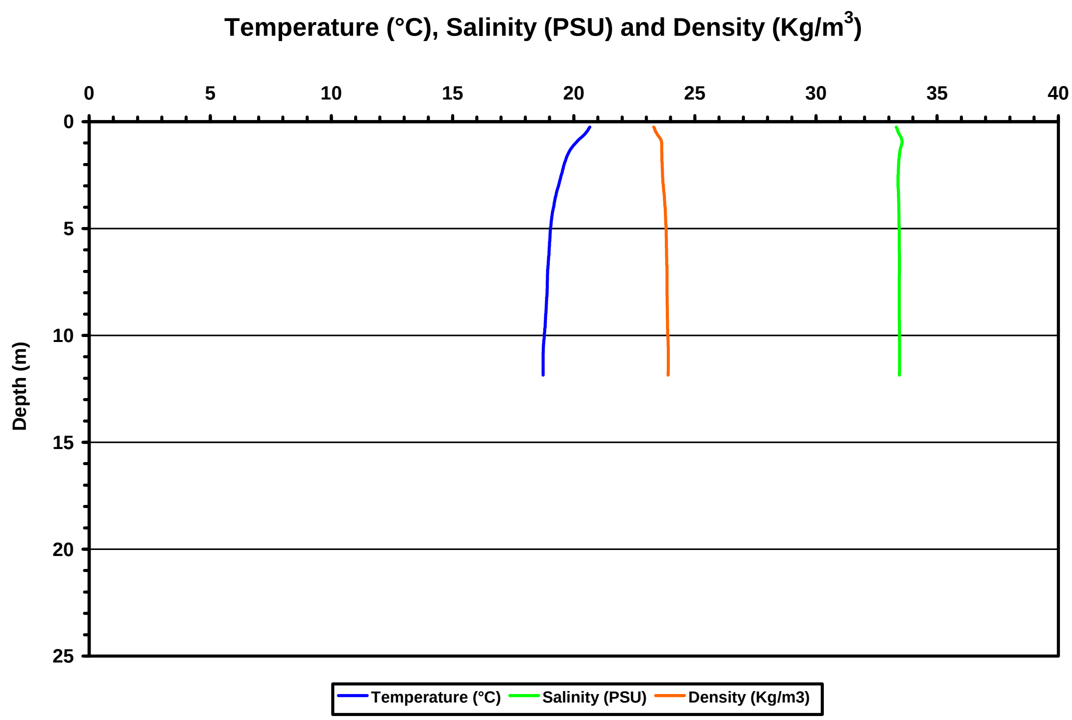


Figure B-12. Water quality profiles at Station LA – 12: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

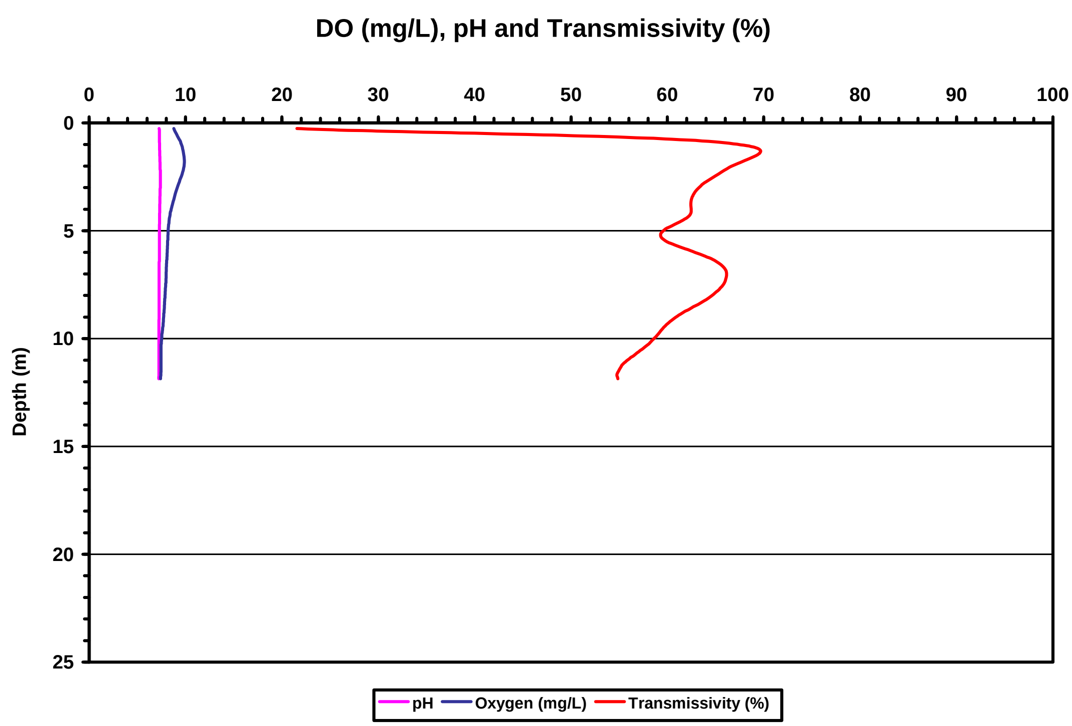
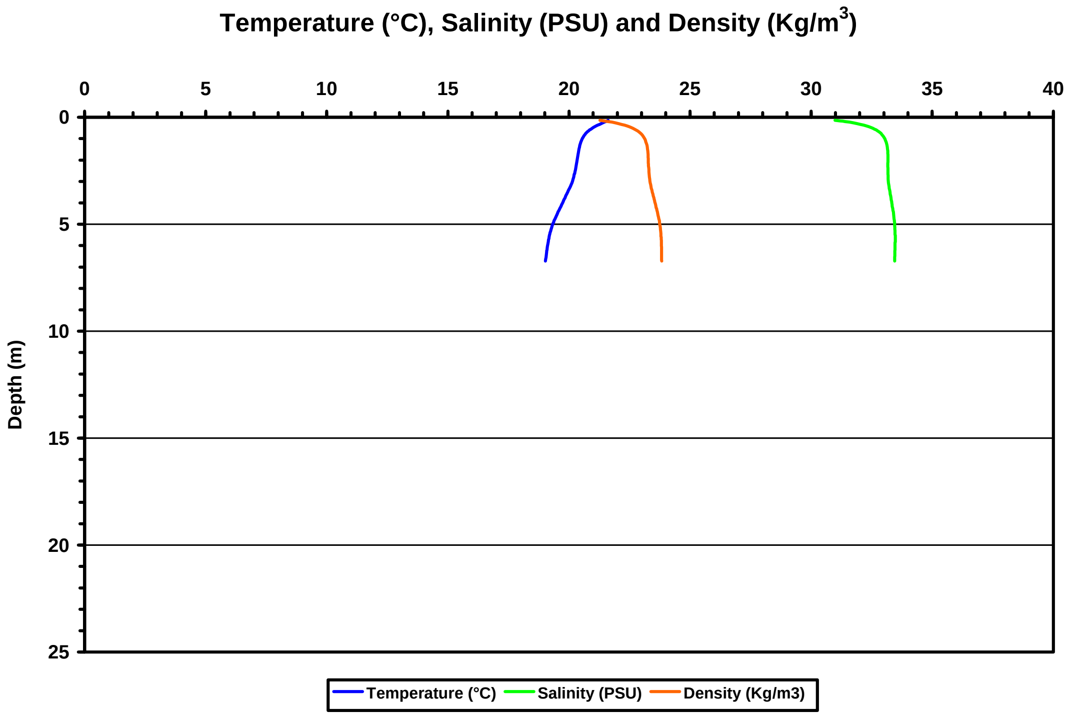


Figure B-13. Water quality profiles at Station LA – 13: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

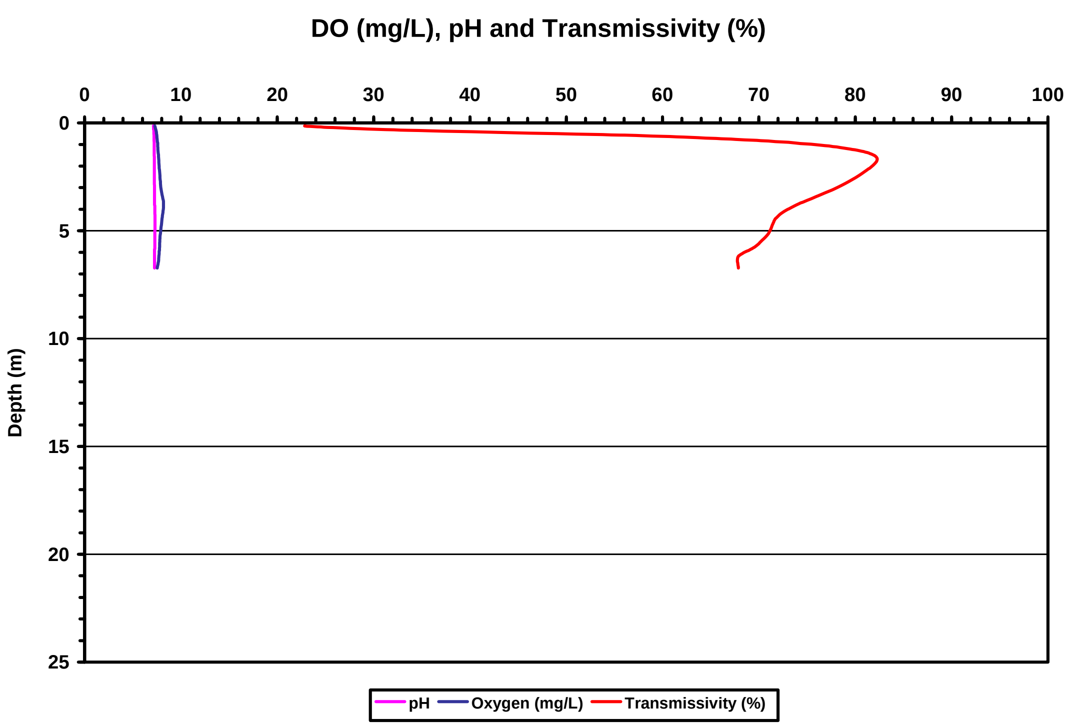
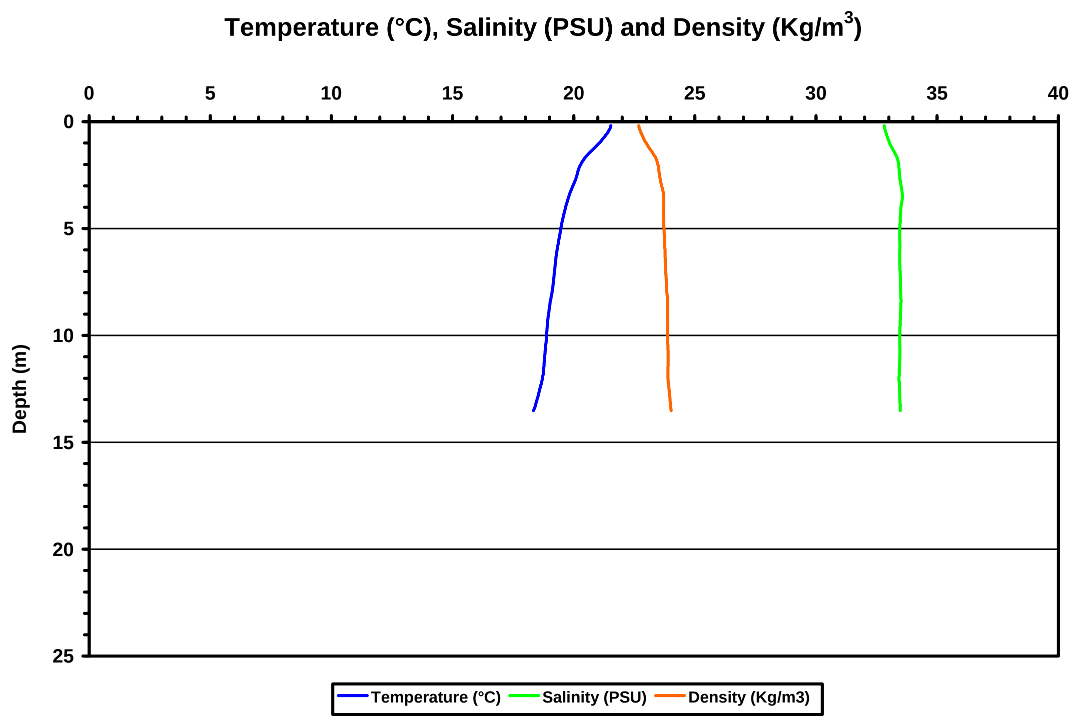


Figure B-14. Water quality profiles at Station LA – 14 (Inside): (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

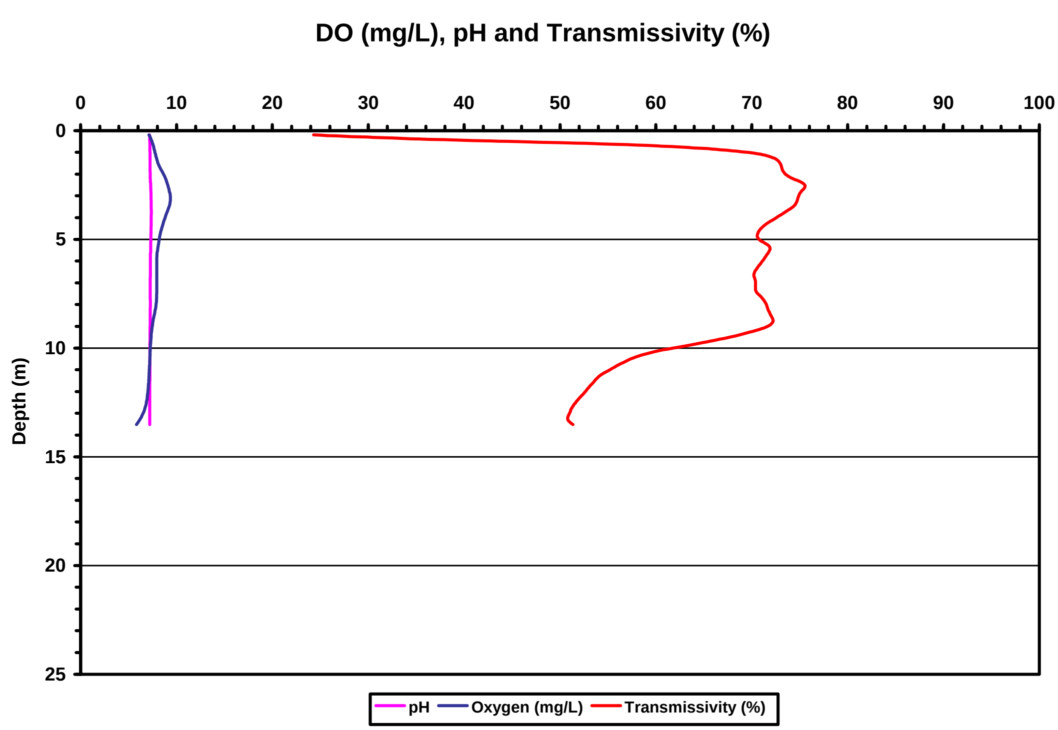
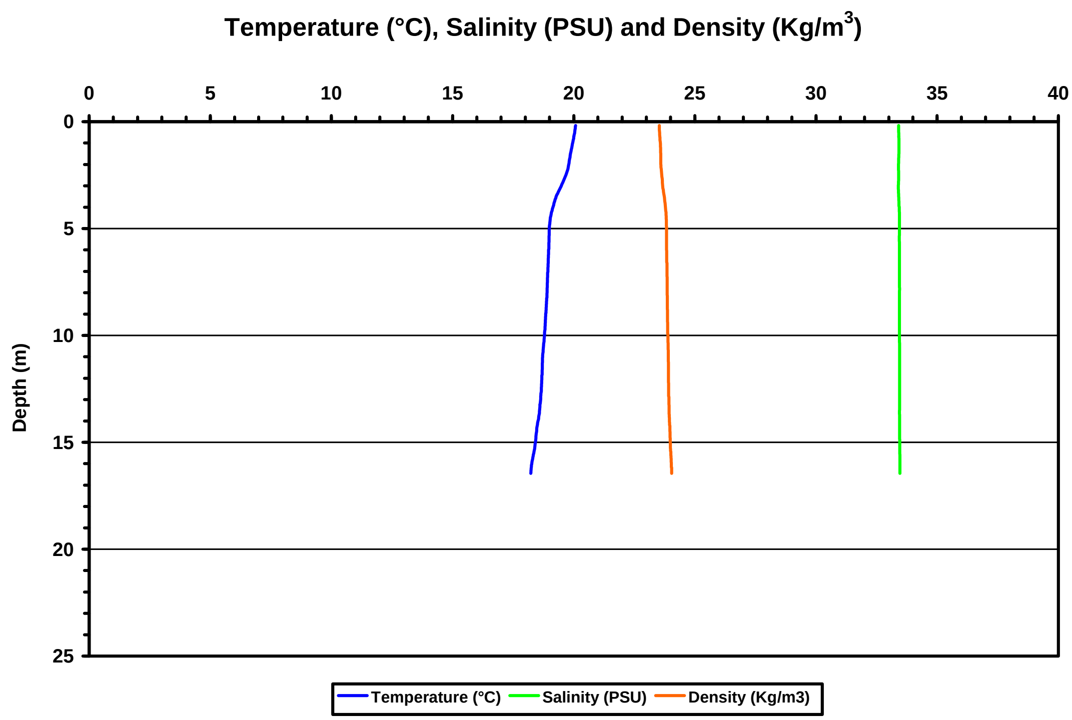


Figure B-15. Water quality profiles at Station LA – 14 (Outside): (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

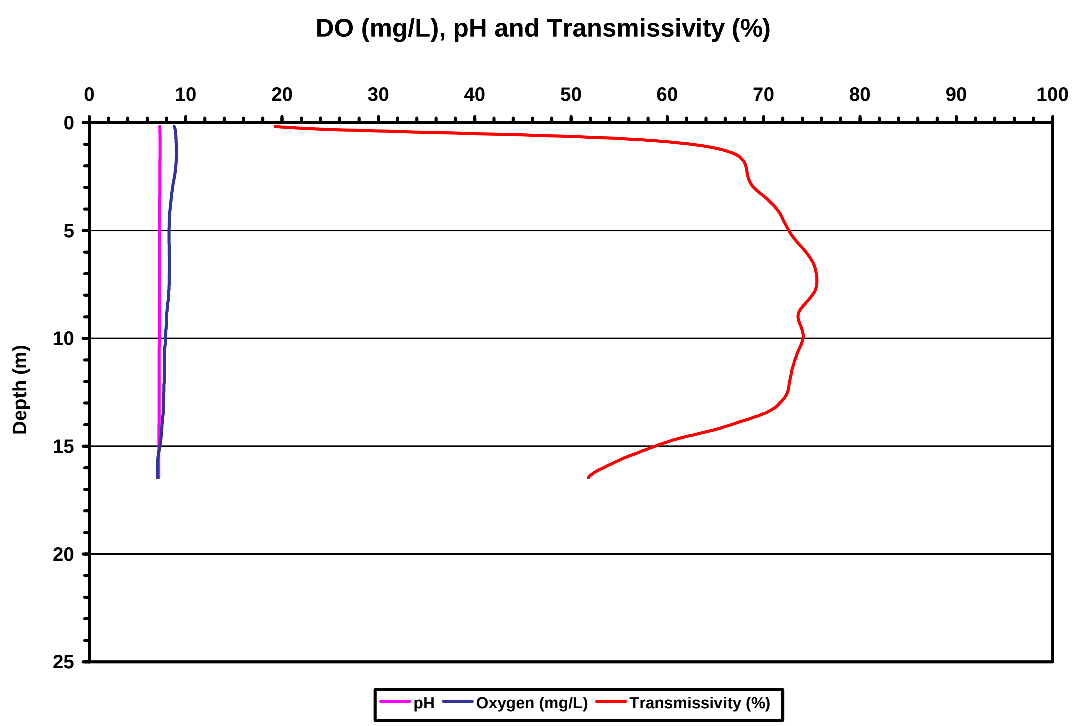
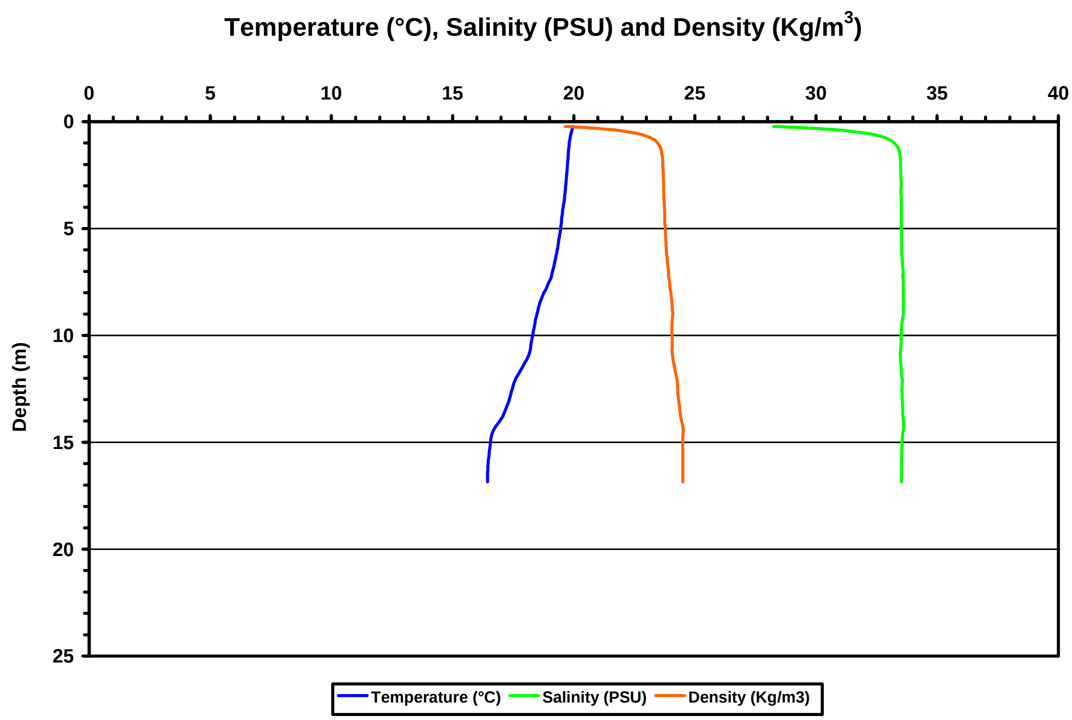


Figure B-16. Water quality profiles at Station LA – 15 (Outside): (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

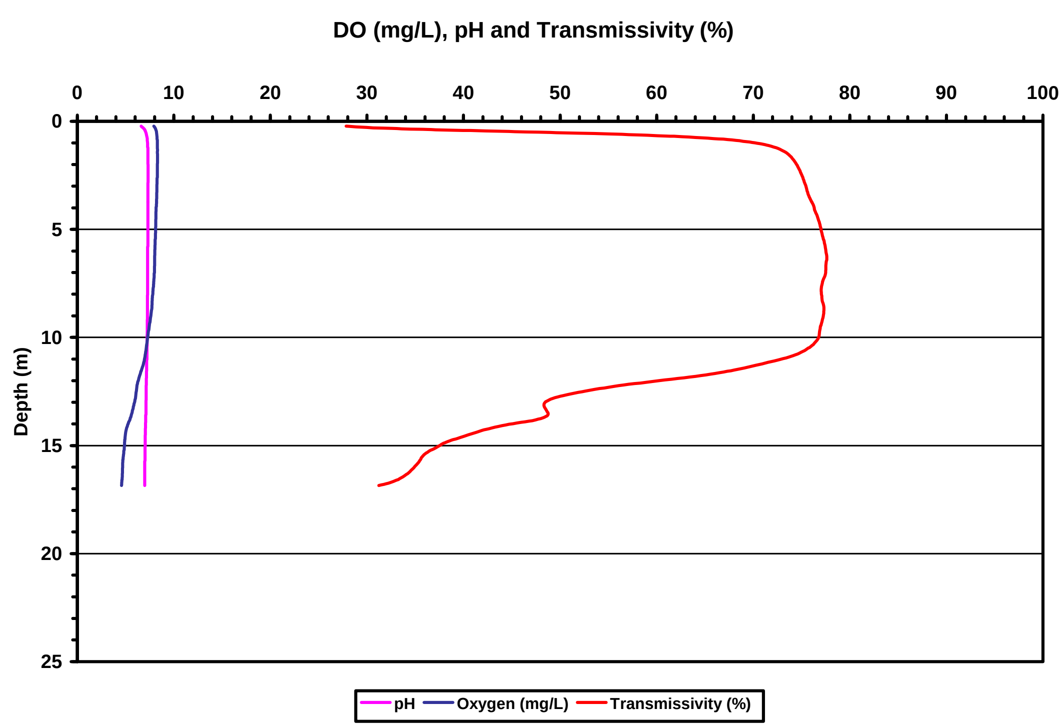
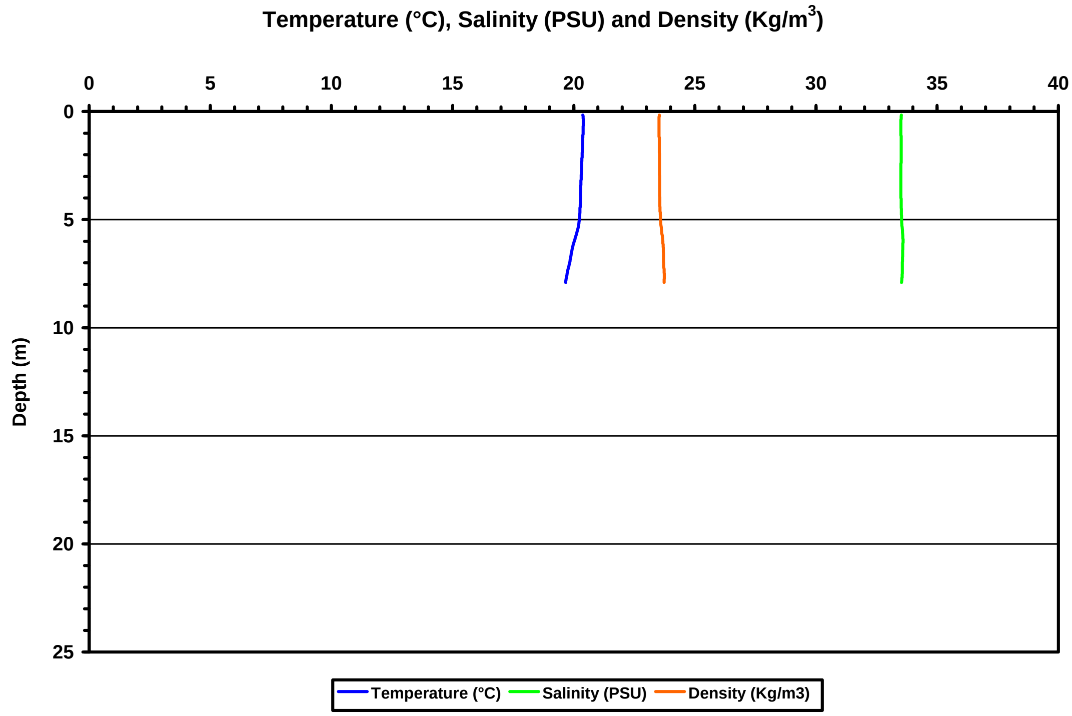


Figure B-17. Water quality profiles at Station LB – 1: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

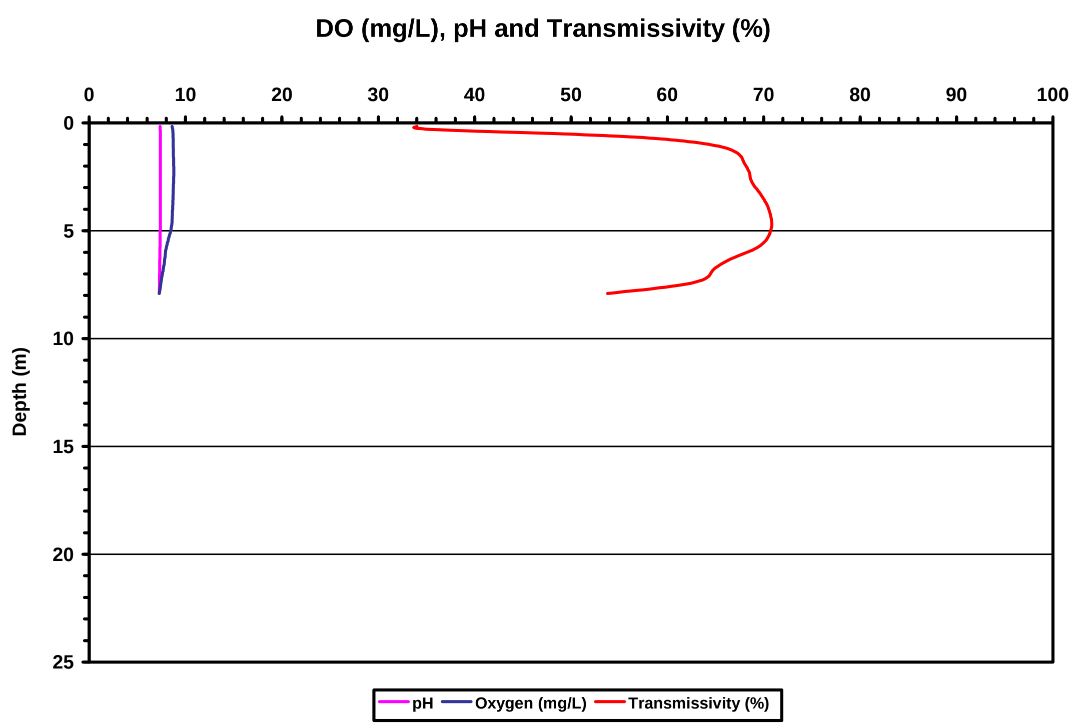
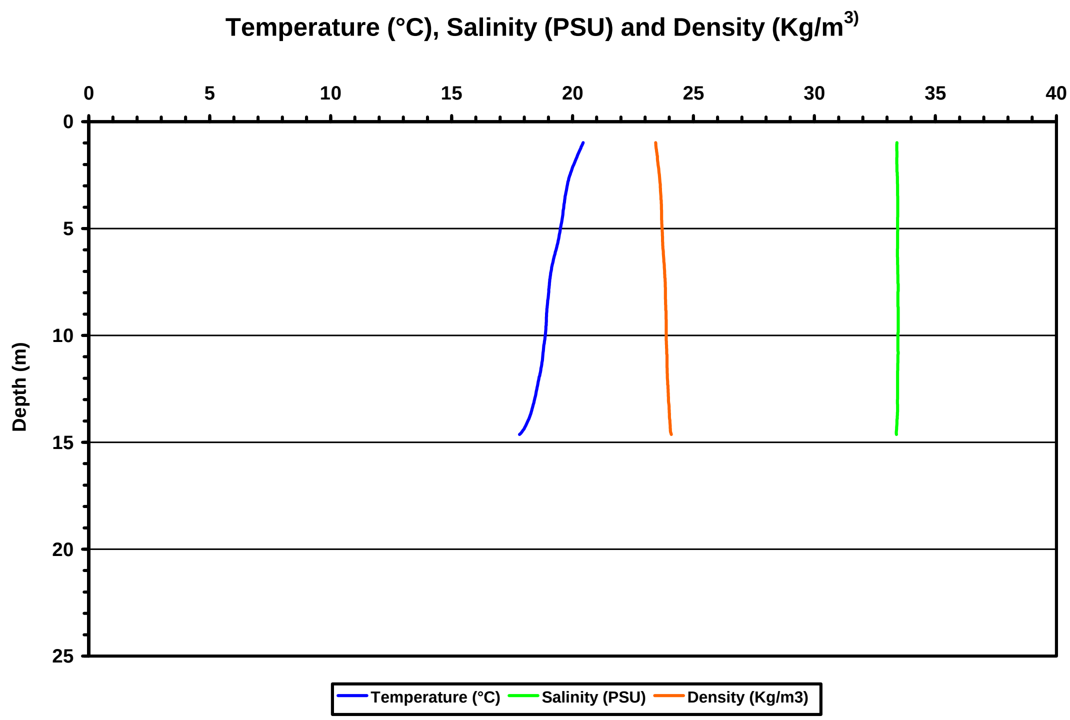


Figure B-18. Water quality profiles at Station LB – 2: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

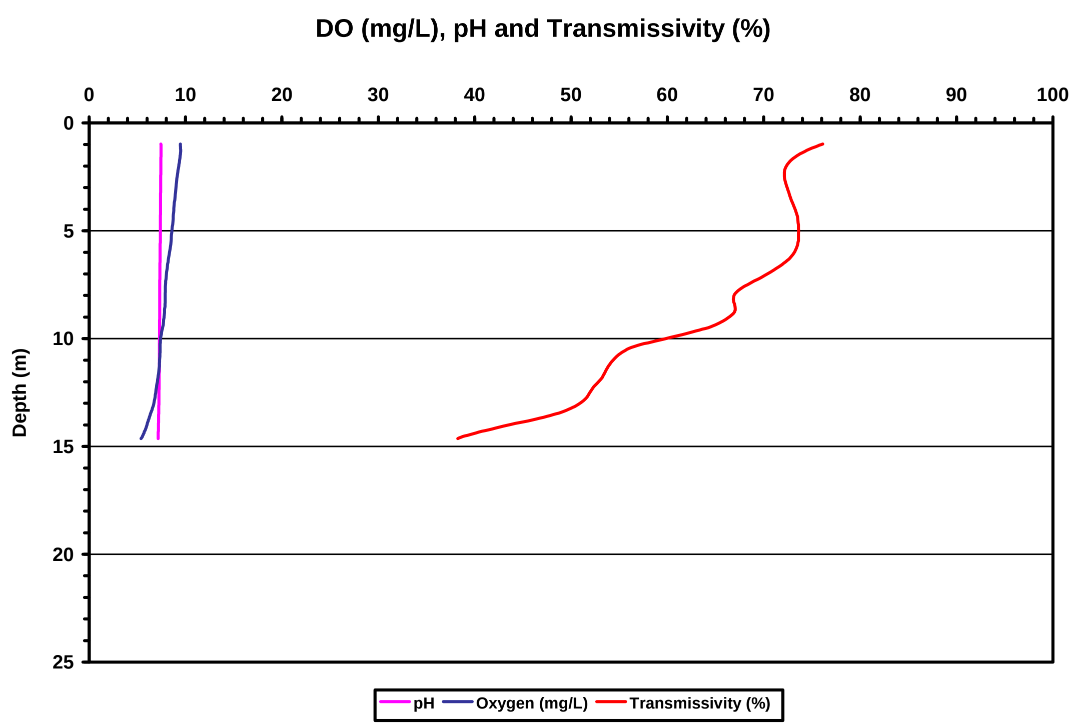
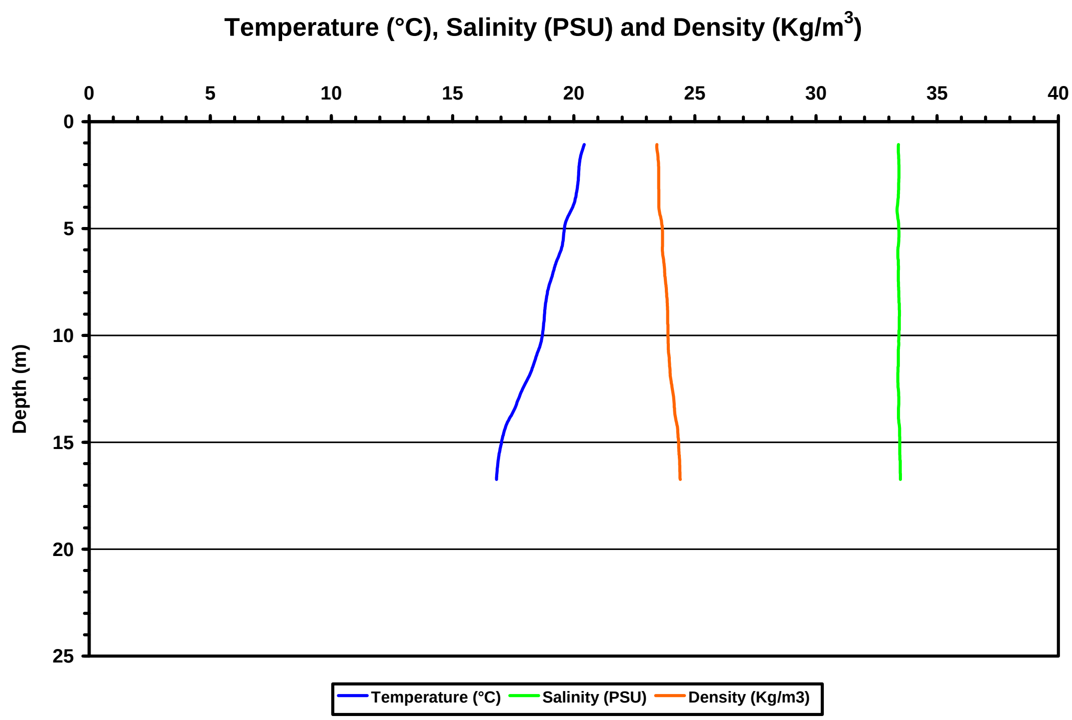


Figure B-19. Water quality profiles at Station LB – 3 (downcast): (A) temperature, salinity, and density; (B) pH, DO, and transmsisivity.

(A)



(B)

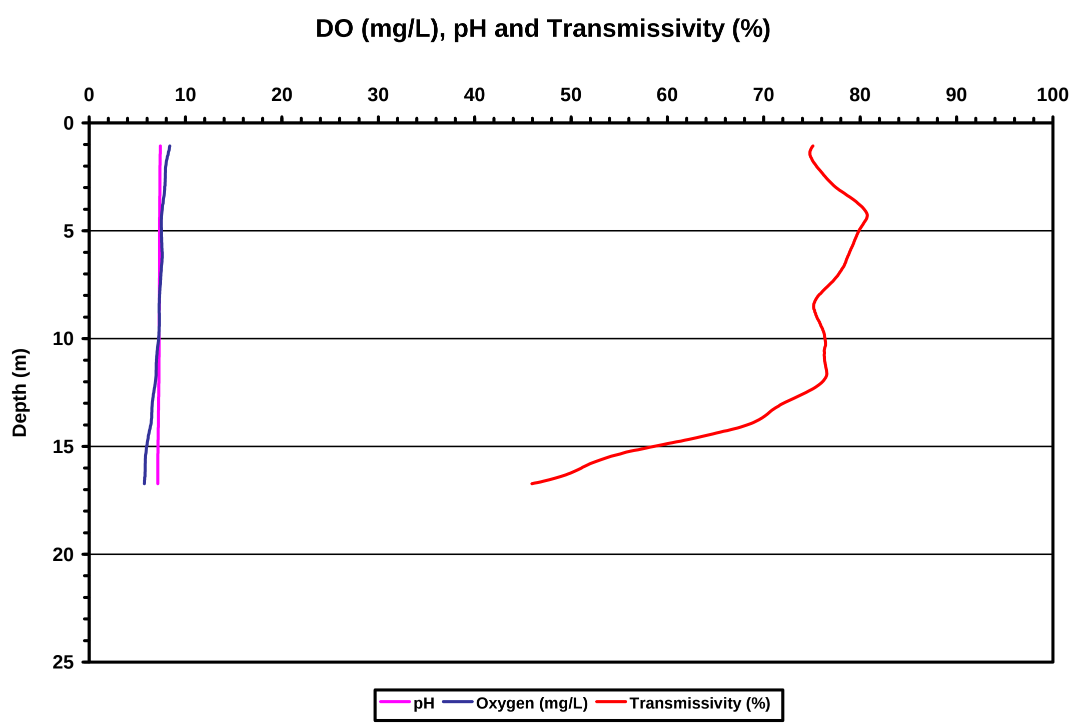
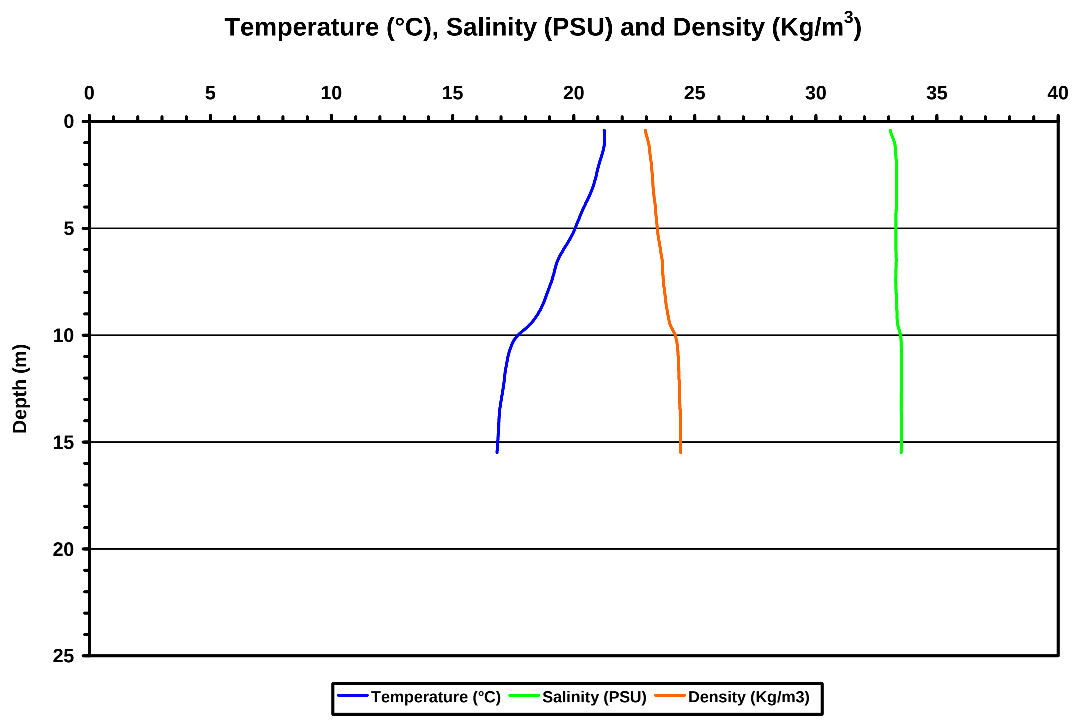


Figure B-20. Water quality profiles at Station LB – 5 (downcast): (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

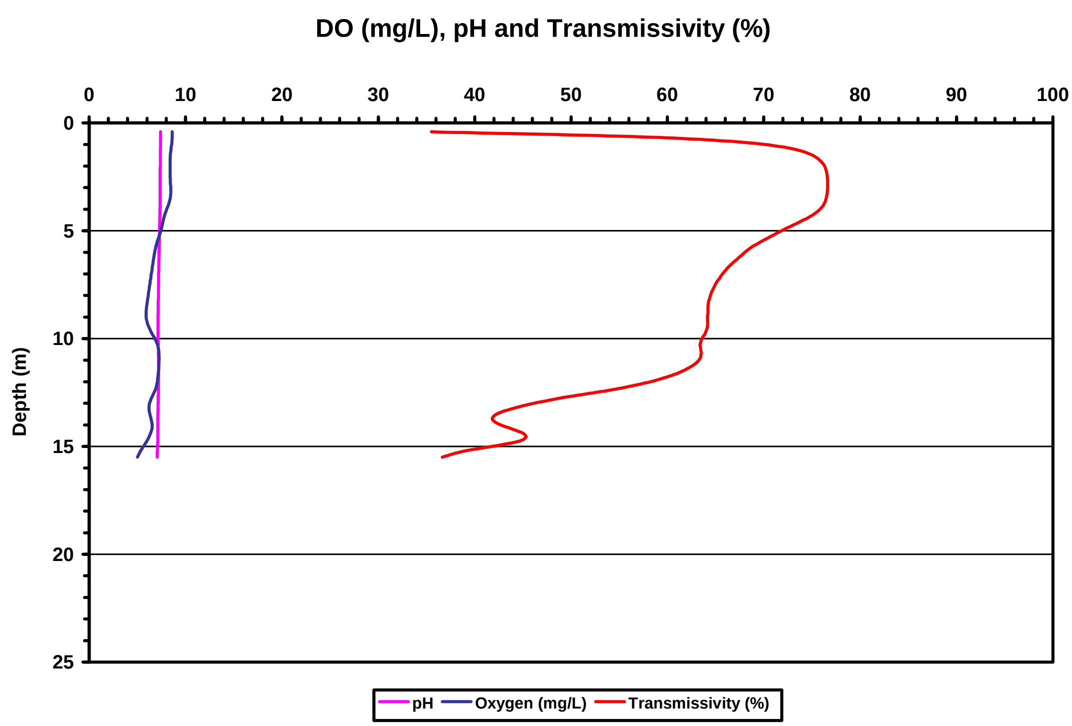
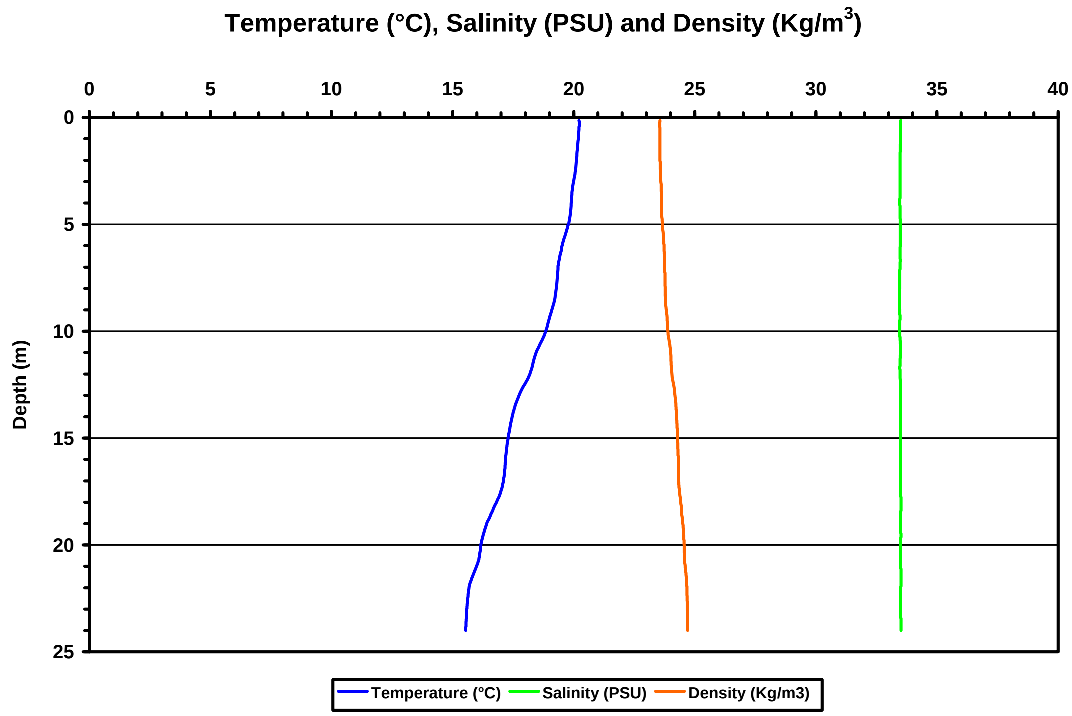


Figure B-21. Water quality profiles at Station LB – 6: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

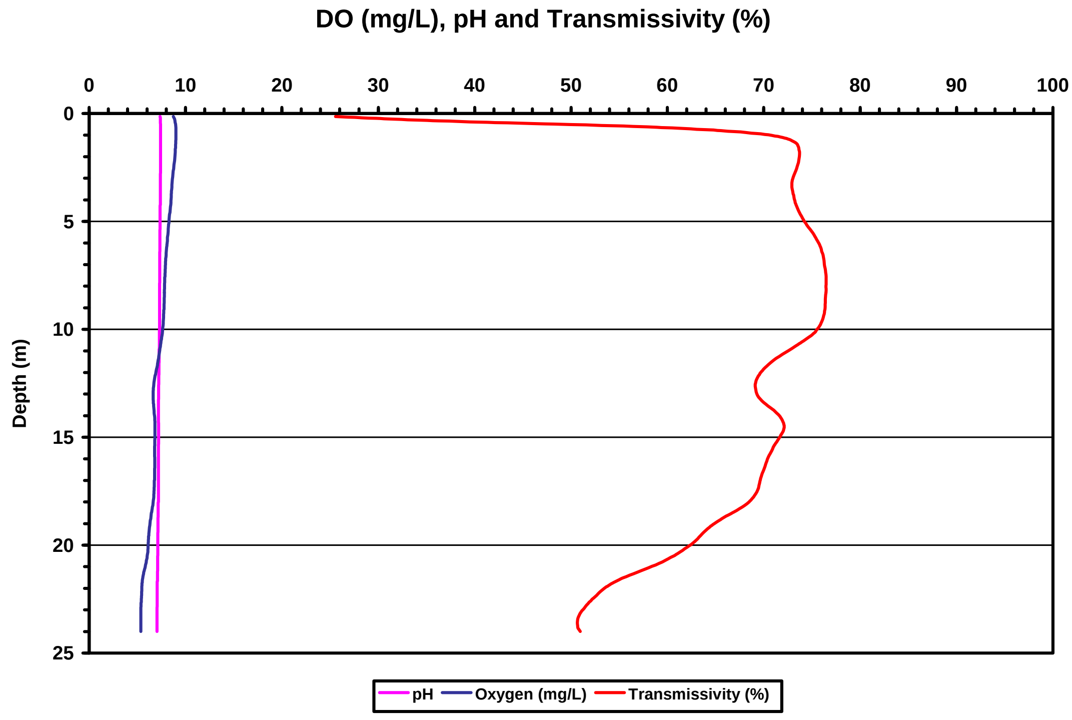
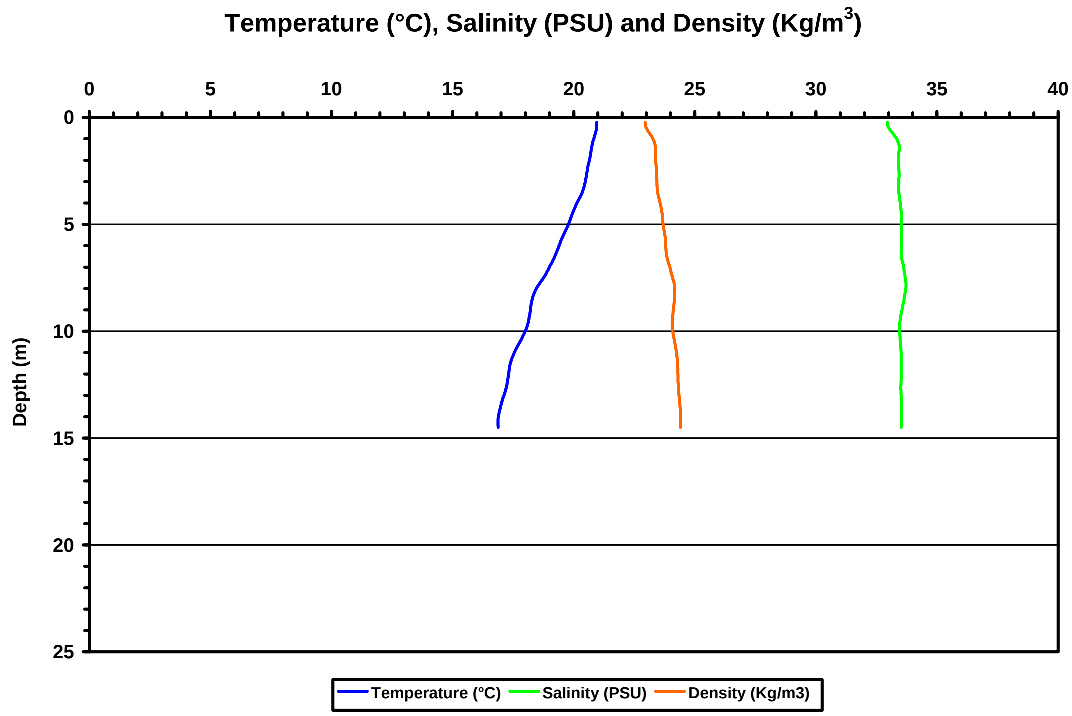


Figure B-22. Water quality profiles at Station LB – 7: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

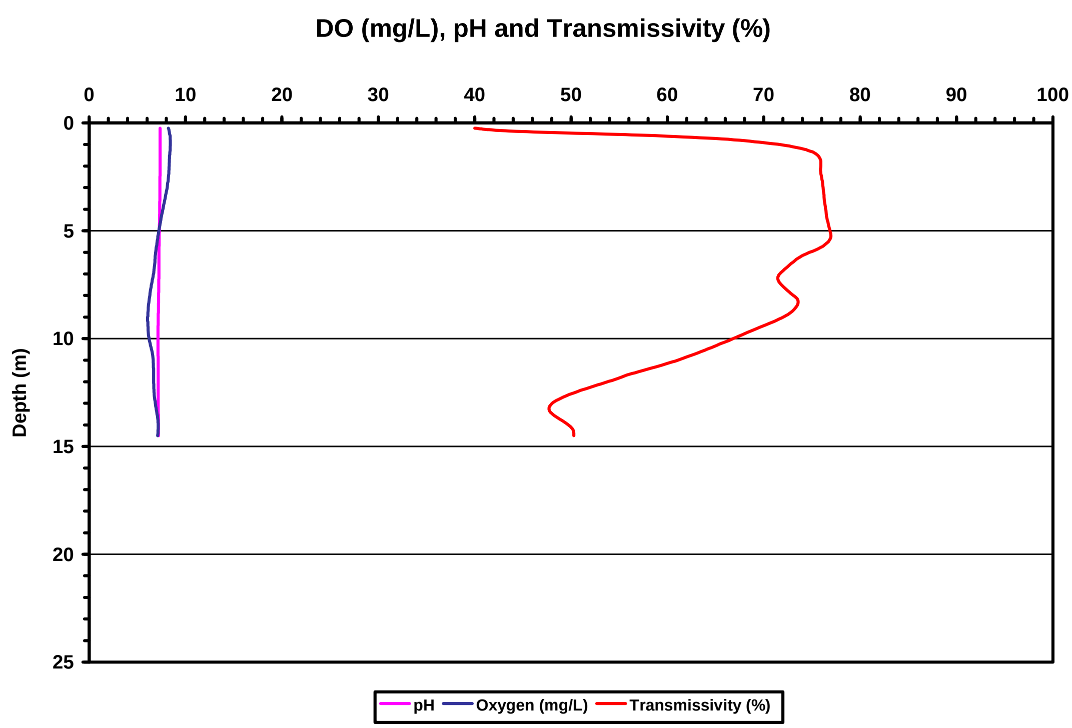
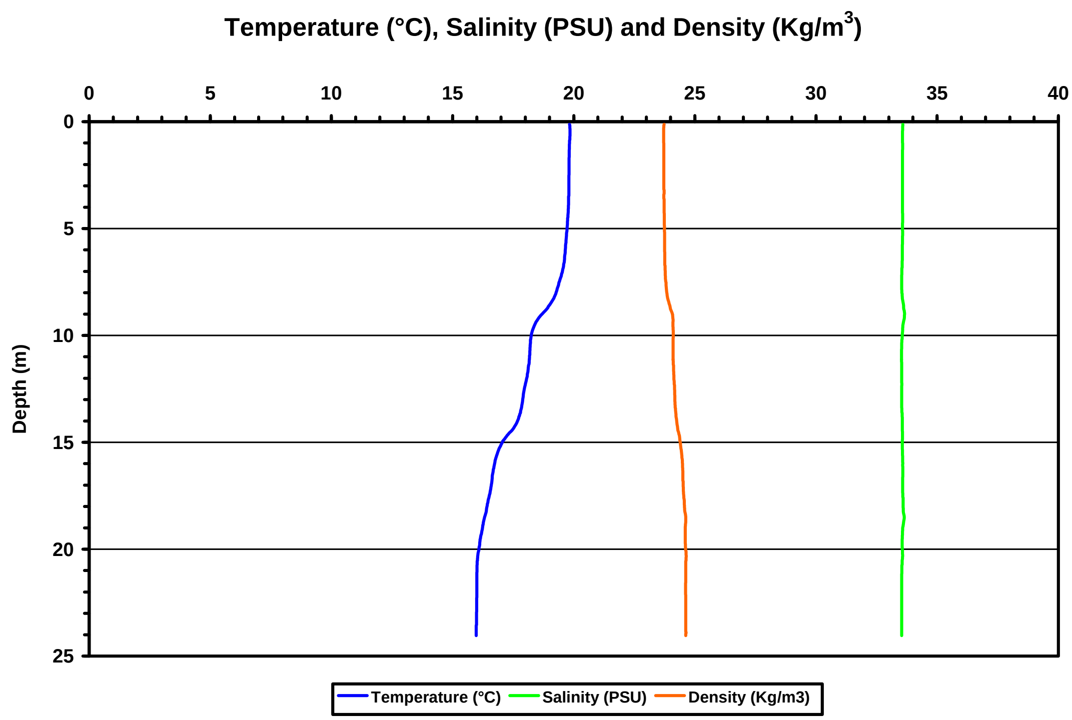


Figure B-23. Water quality profiles at Station LB – 8: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

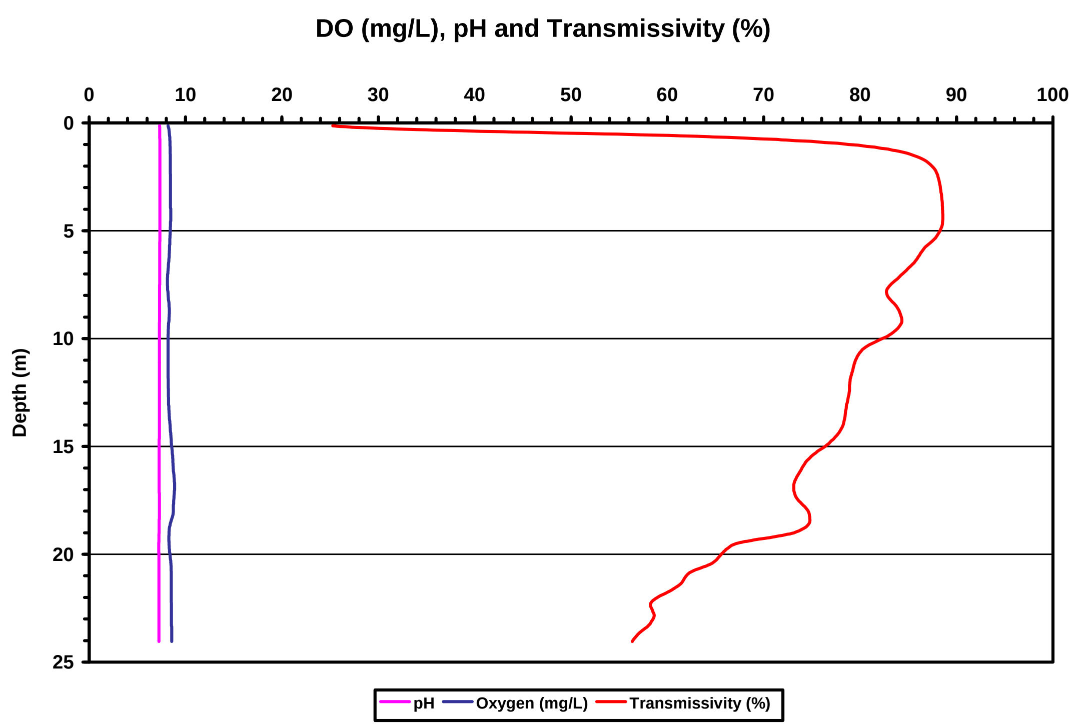
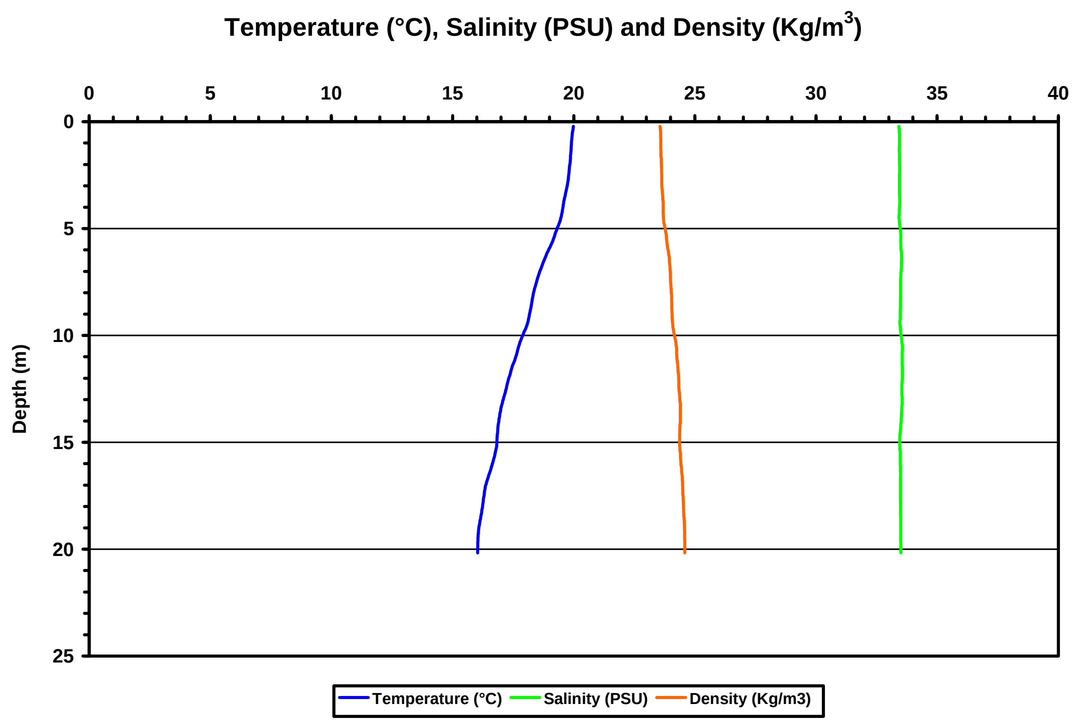


Figure B-24. Water quality profiles at Station LB – 9: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

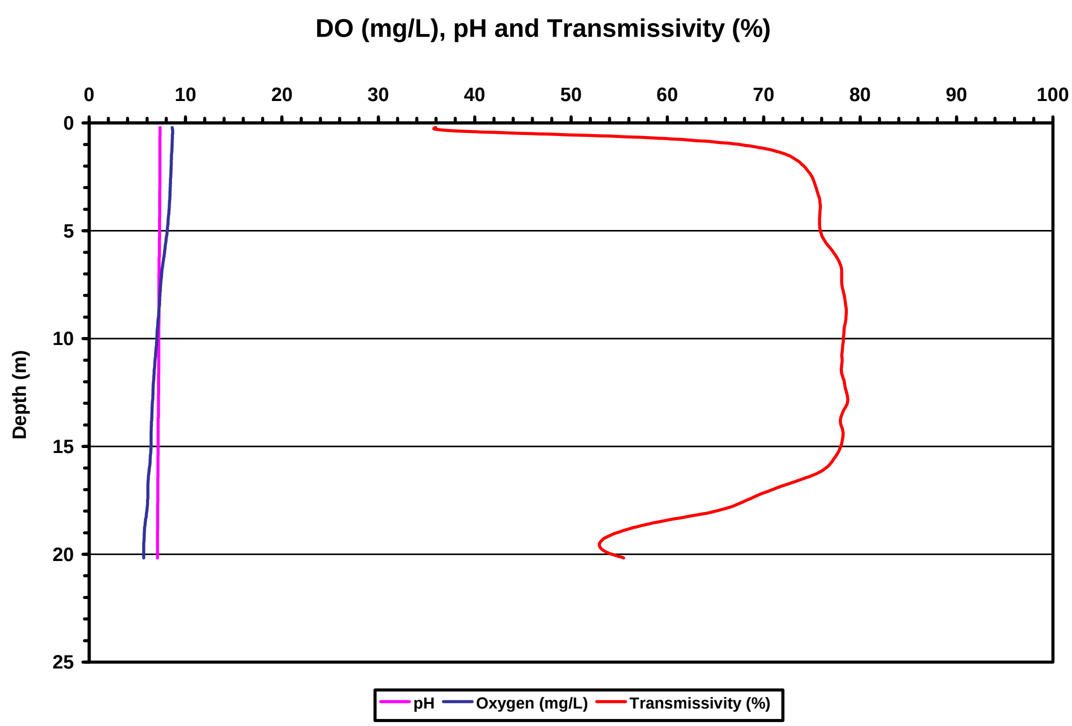
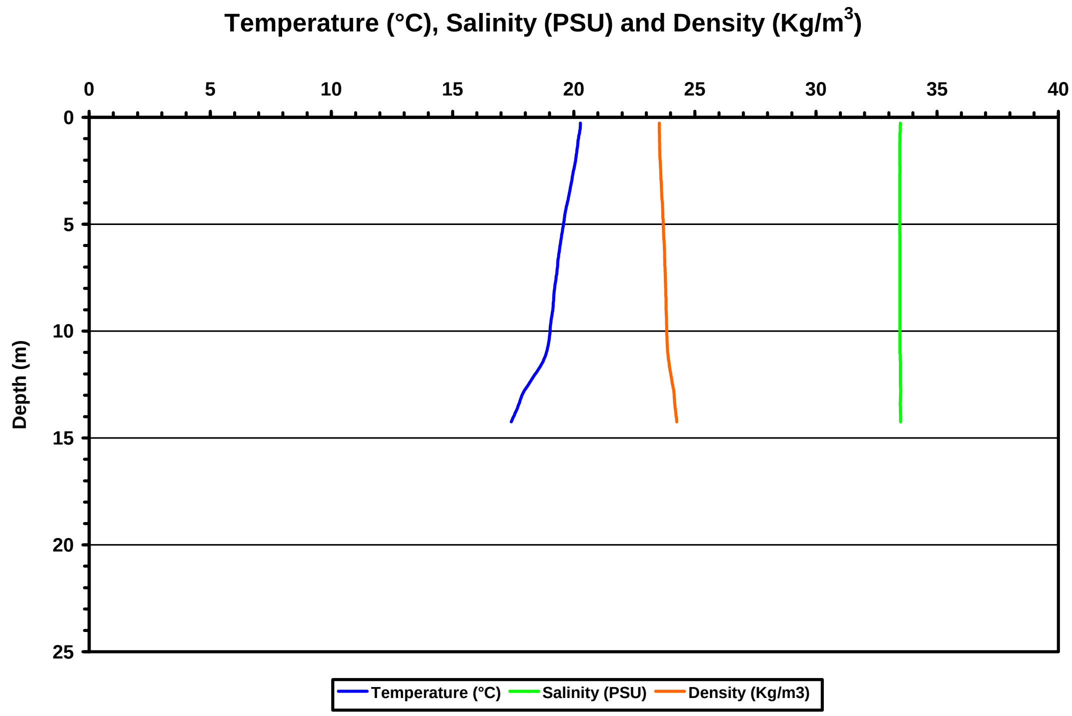


Figure B-25. Water quality profiles at Station LB – 10: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

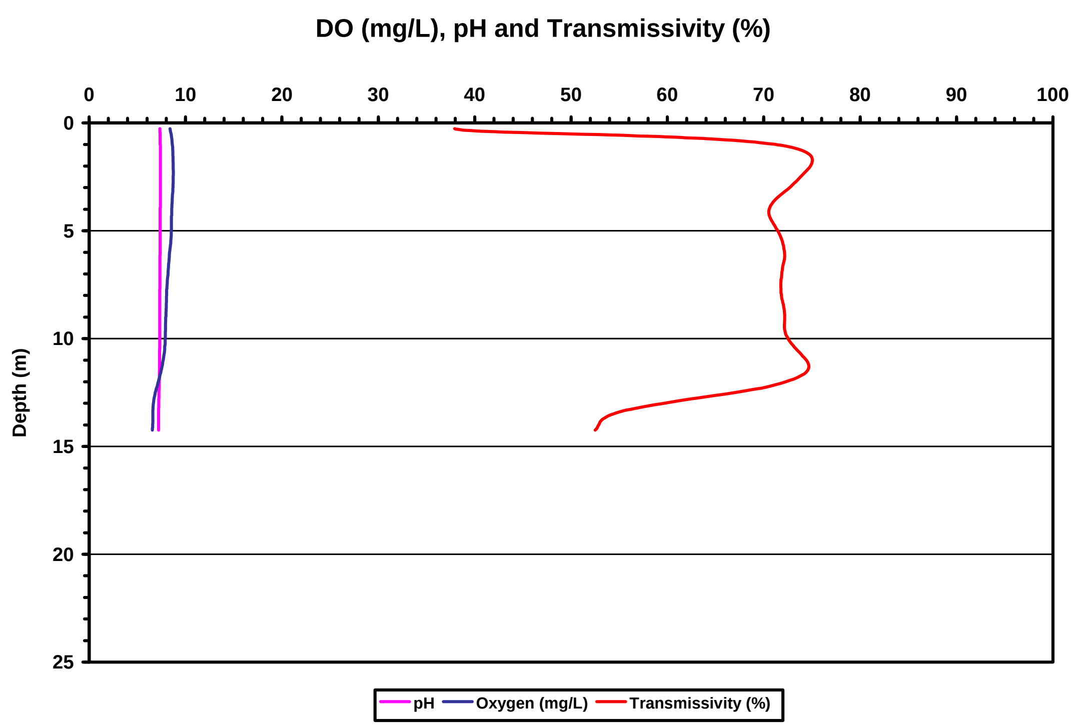
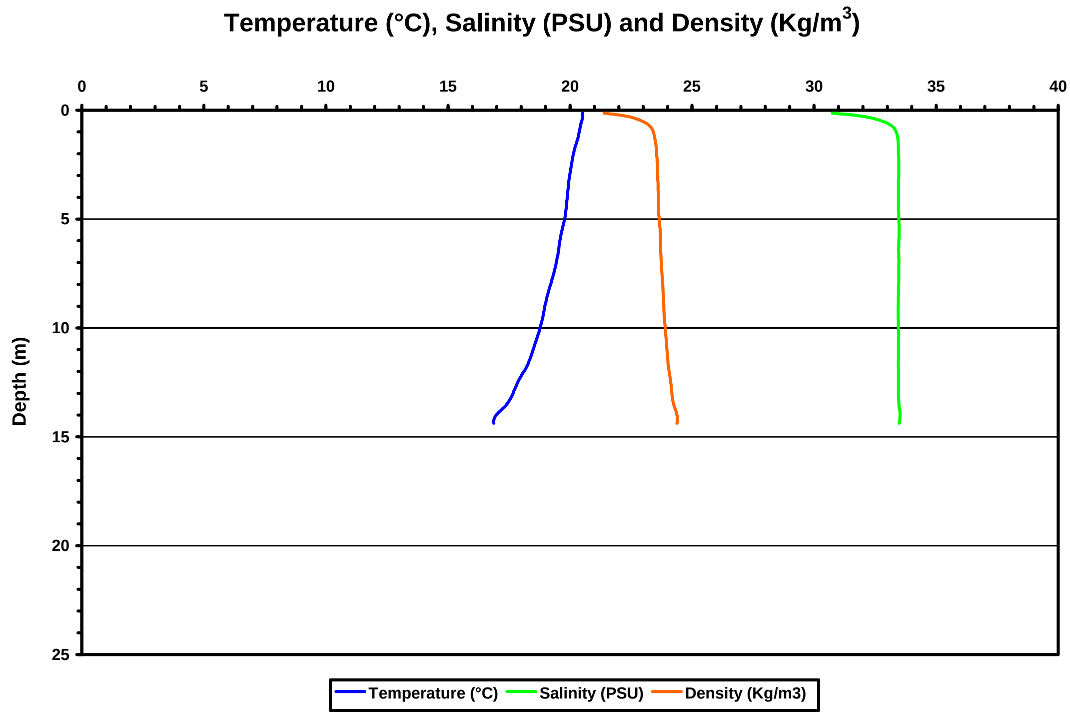


Figure B-26. Water quality profiles at Station LB – 11: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

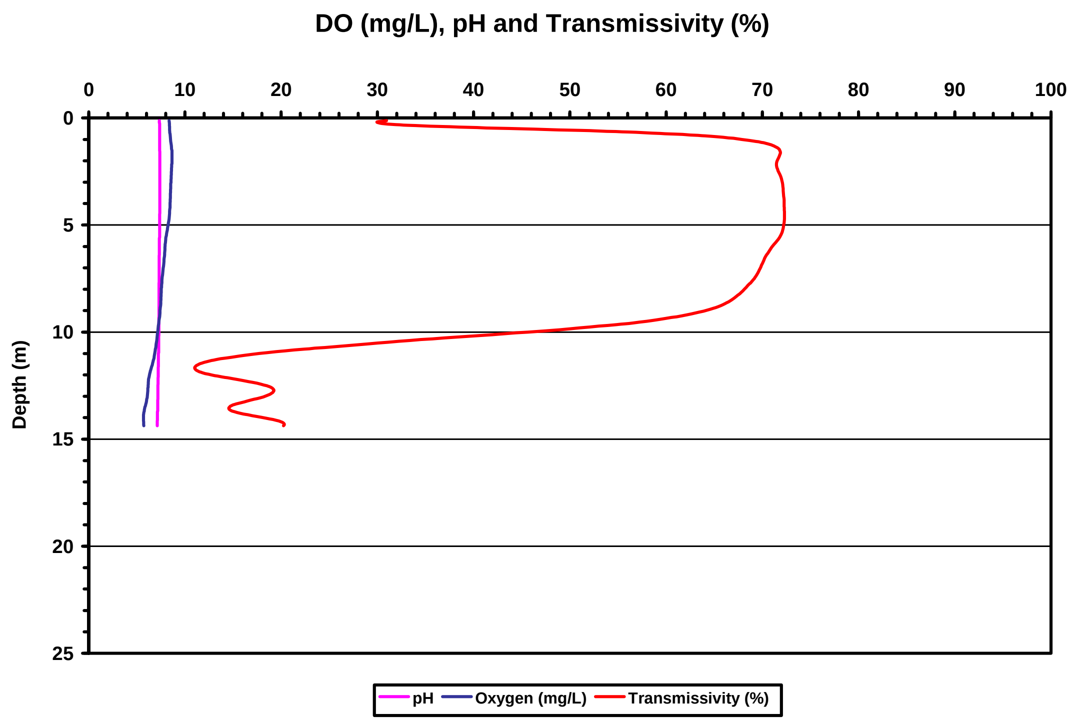
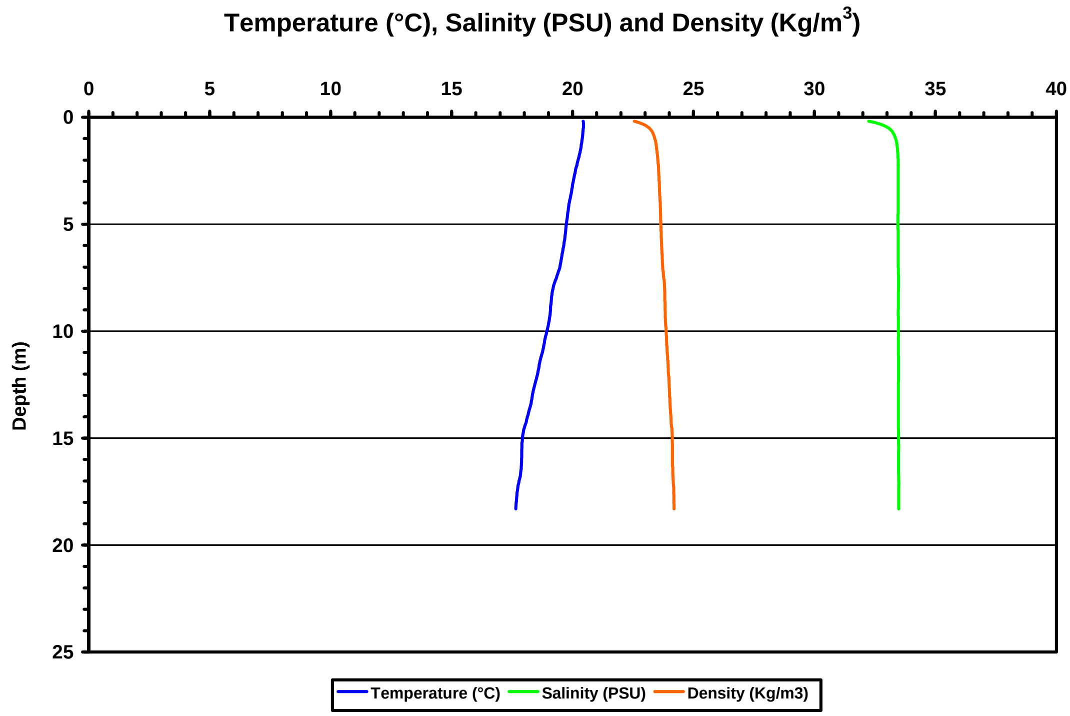


Figure B-27. Water quality profiles at Station LB – 12: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

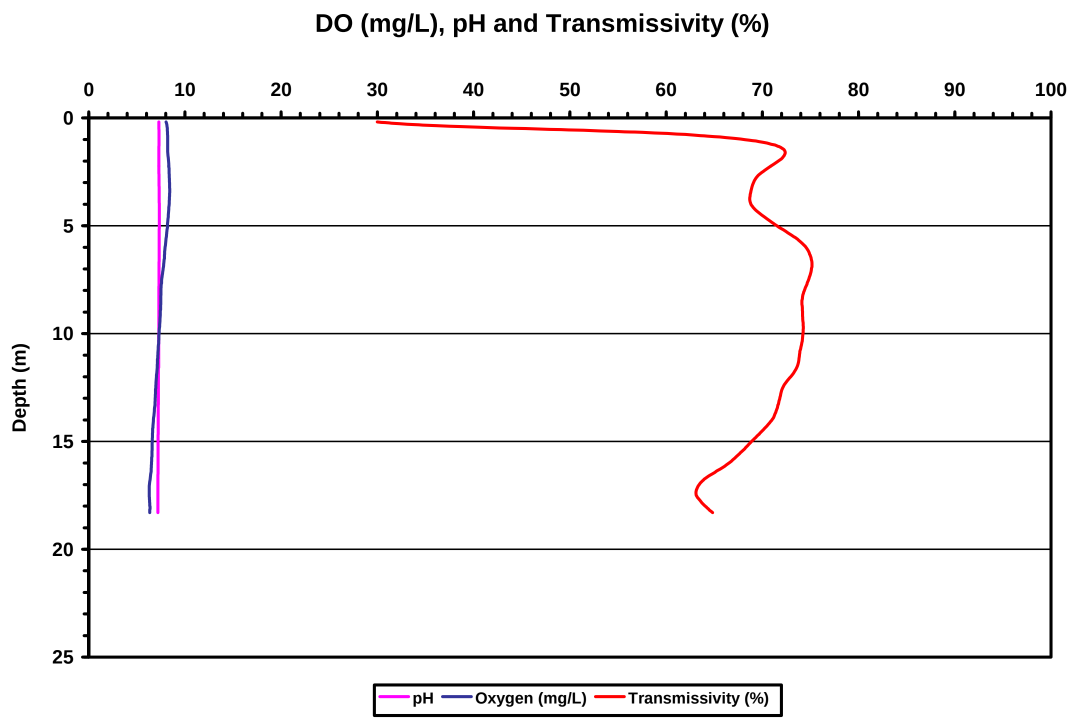
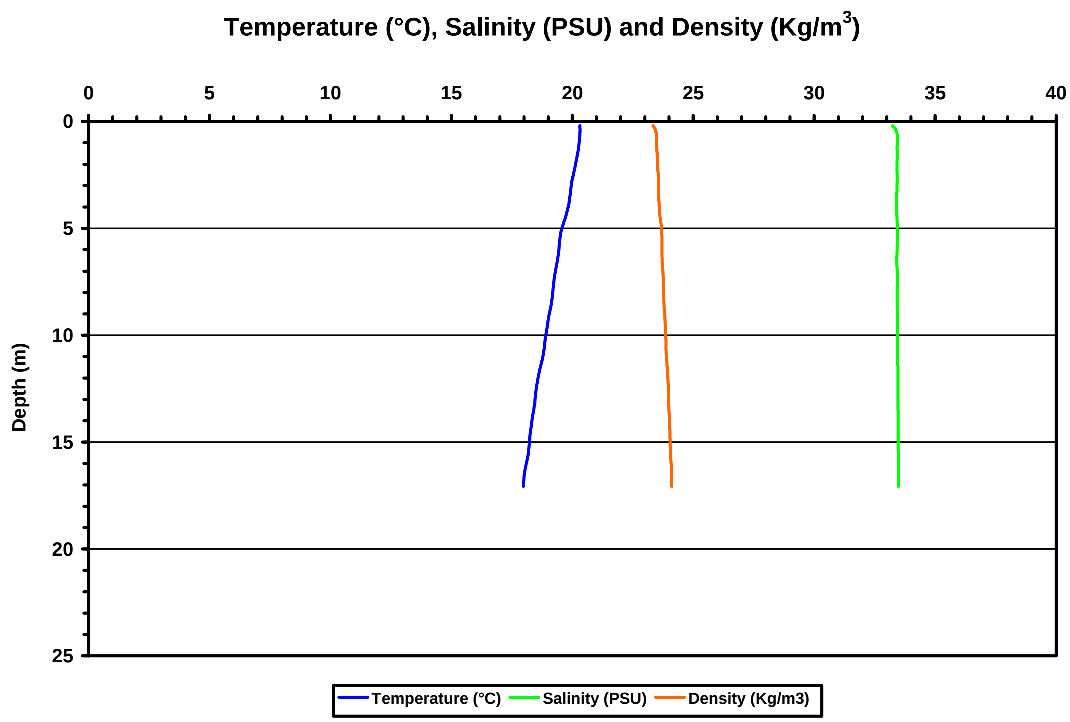


Figure B-28. Water quality profiles at Station LB – 13: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

(A)



(B)

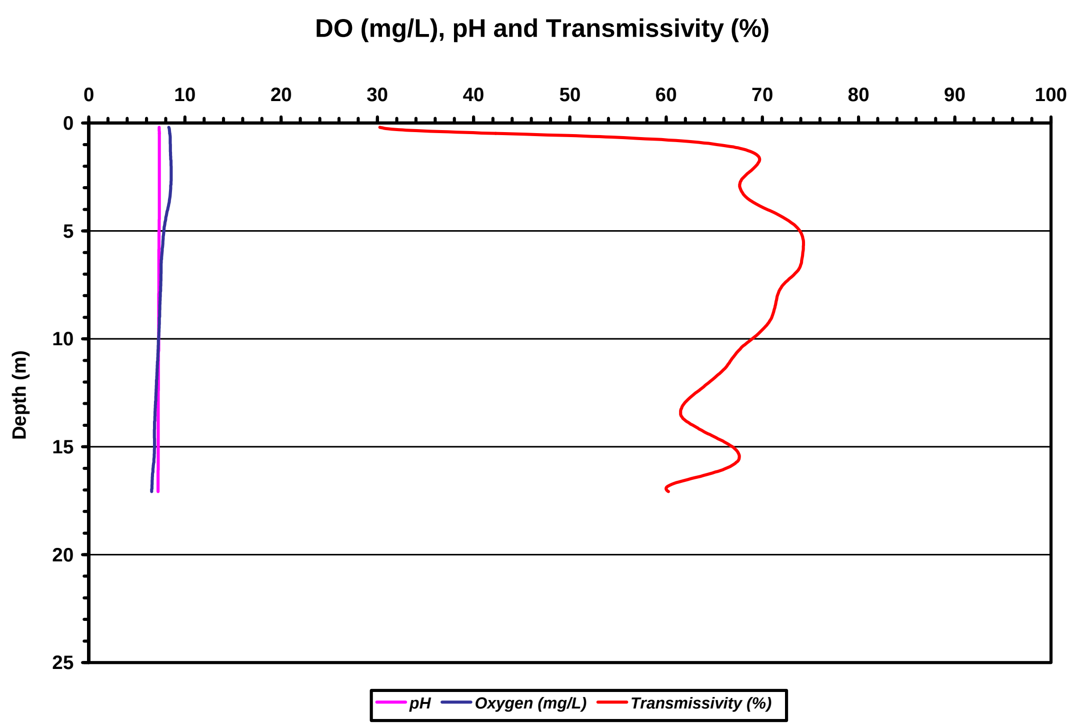


Figure B-29. Water quality profiles at Station LB – 14: (A) temperature, salinity, and density; (B) pH, DO, and transmissivity.

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APPENDIX C

FISHES

Table C-1. Combined Fish Species List by Gear Type for 2008 Baseline Study of Los Angeles and Long Beach Harbors.

Common Name	*Species*	*Otter Trawl*	*Lampara*	*Beach Seine*
Barred sand bass	*Paralabrax nebulifer*	X		
Barred surfperch	*Amphistichus argenteus*	X		
Basketweave cusk-eel	*Ophidion scrippsae*	X		
Bat ray	*Myliobatis californica*	X	X	
Bay goby	*Lepidogobius lepidus*	X		
Bay pipefish	*Syngnathus leptorhynchus*	X		X
Bigmouth sole	*Hippoglossina stomata*	X		
Black surfperch	*Embiotoca jacksoni*	X		
Blackbelly eelpout	*Lycodes pacificus*	X		
Brown rockfish	*Sebastes auriculatus*	X		
Brown smoothhound shark	*Mustelus henlei*	X	X	
California corbina	*Menticirrhus undulatus*	X		
California grunion	*Leuresthes tenuis*		X	
California halibut	*Paralichthys californicus*	X		
California lizardfish	*Synodus lucioceps*	X		
California scorpionfish	*Scorpaena guttata*	X		
California skate	*Raja inornata*	X		
California tonguefish	*Symphurus atricaudus*	X		
c-o turbot	*Pleuronichthys coenosus*	X		
Deepbody anchovy	*Anchoa compressa*	X	X	
Diamond turbot	*Pleuronichthys guttulatus*	X		X
Dwarf surfperch	*Micrometrus minimus*			X
Eelpouts	*Zoarcidae unid.*	X		
English sole	*Parophrys vetulus*	X		
Fantail sole	*Xystreurys liolepis*	X		
Giant kelpfish	*Heterostichus rostratus*	X	X	X
Gobies	*Gobiidae unid.*	X		X
Hornyhead turbot	*Pleuronichthys verticalis*	X		
Jack mackerel	*Trachurus symmetricus*		X	
Jacksmelt	*Atherinopsis californiensis*		X	
Kelp bass	*Paralabrax clathratus*	X		
Kelp pipefish	*Syngnathus californiensis*		X	
Longspine combfish	*Zaniolepis latipinnis*	X		
Northern anchovy	*Engraulis mordax*	X	X	
Ocean whitefish	*Caulolatilus princeps*		X	
Pacific barracuda	*Sphyraena argentea*		X	

Table C-1. Combined Fish Species List by Gear Type for 2008 Baseline Study of Los Angeles and Long Beach Harbors (continued).

Common Name	*Species*	*Otter Trawl*	*Lampara*	*Beach Seine*
Pacific butterfish	*Peprilus simillimus*	X		
Pacific electric ray	*Torpedo californica*	X		
Pacific mackerel	*Scomber japonicus*	X	X	
Pacific sanddab	*Citharichthys sordidus*	X		
Pacific sardine	*Sardinops sagax*	X	X	
Pacific staghorn sculpin	*Leptocottus armatus*	X		X
Pile surfperch	*Rhacochilus vacca*	X		
Pipefishes	*Syngnathus spp.*	X		
Plainfin midshipman	*Porichthys notatus*	X		
Queenfish	*Seriphus politus*	X	X	
Rockfishes	*Sebastes spp.*	X		
Rockfishes (juvenile)	*Sebastes spp. (juv.)*	X		
Roughback sculpin	*Chitonotus pugetensis*	X		
Round stingray	*Urobatis halleri*	X		
Salema	*Xenistius californiensis*	X		
Shadow goby	*Quietula y-cauda*	X		
Shiner surfperch	*Cymatogaster aggregata*	X	X	X
Shovelnose guitarfish	*Rhinobatos productus*	X		
Slough anchovy	*Anchoa delicatissima*	X		
Speckled sanddab	*Citharichthys stigmaeus*	X		
Specklefin midshipman	*Porichthys myriaster*	X		
Spiny dogfish shark	*Squalus acanthias*	X		
Spotfin croaker	*Roncador stearnsii*	X	X	
Spotted cusk-eel	*Chilara taylori*	X		
Spotted turbot	*Pleuronichthys ritteri*	X		
Thornback	*Platyrhinoidis triseriata*	X		
Topsmelt	*Atherinops affinis*	X	X	X
Vermilion rockfish	*Sebastes miniatus*	X		
Walleye surfperch	*Hyperprosopon argenteum*	X		
White croaker	*Genyonemus lineatus*	X	X	
White seabass	*Atractoscion nobilis*		X	
White surfperch	*Phanerodon furcatus*	X	X	
Yellowchin sculpin	*Icelinus quadriseriatus*	X		
Yellowfin goby	*Acanthogobius flavimanus*	X		
	Total	*62*	*20*	*7*
	Grand Total	*70*		

Table C-2. Otter Trawl Catch, Winter 2008

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
Scientific Name	*Day Survey*																		
Acanthogobius flavimanus																			
Anchoa compressa								1				1							
Atherinops affinis																			
Chilara taylori																			
Chitonotus pugetensis										1									
Citharichthys sordidus												1							
Citharichthys stigmaeus	5		1	6							4	1			2				
Cymatogaster aggregata		23	1			66	1		3		1	35							
Embiotoca jacksoni						1			2										
Engraulis mordax							12		5		97	859			311	1	74	7	1104
Genyonemus lineatus	118	1	3	1		1	3	159	1		11	5			2	99		3	6
Heterostichus rostratus		1	2					1											
Hippoglossina stomata			3																
Hyperprosopon argenteum			2																
Icelinus quadriseriatus				3	3	5		5	1						7				
Lepidogobius lepidus	1																		
Myliobatis californica		1																	
Paralabrax clathratus			2																
Paralabrax nebulifer	1			1		1	1		2			1	1		2	2			
Paralichthys californicus	2	1	4			2	5	1				1	3		1	3			
Parophrys vetulus				1															
Phanerodon furcatus		18	40	9	3		18	3	23			11		6	1	1			
Pleuronichthys guttulatus		1																	
Pleuronichthys ritteri		2				1	4				1								
Pleuronichthys verticalis				1						1	4	4			1	1			
Porichthys myriaster						3		2	3										
Porichthys notatus						1									1				
Quietula y-cauda						5													
Raja inornata											1								
Rhinobatos productus																			
Roncador stearnsii																			
Scorpaena guttata																			
Sebastes spp.	1																		
Seriphus politus	20	1	3		1		2	379			23	16				1	4	1	
Symphurus atricaudus	8		1					2											

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Syngnathus leptorhynchus																			
Syngnathus spp.												4							
Synodus lucioceps		1		1						1	1					3			
Urobatis halleri							1					1							
Xenistius californiensis																1			
Xystreurys liolepis					1					1	2								
Zaniolepis latipinnis	21							5											
	Night Survey																		
Acanthogobius flavimanus						4	2			12	5		1		1		2	3	5
Anchoa compressa																			
Atherinops affinis												1							
Chilara taylori										1		3							
Chitonotus pugetensis										1									
Citharichthys sordidus													1						
Citharichthys stigmaeus	7			24		2					3	1			4		4		1
Cymatogaster aggregata		21				6	1		6	5		5			1				
Embiotoca jacksoni																			
Engraulis mordax				2				11		1	2						21		
Genyonemus lineatus	163	38	27	73		8	33	117	2	13	161	21	132	6	113	4	139	232	54
Heterostichus rostratus		1																	
Hippoglossina stomata																			
Hyperprosopon argenteum										4									
Icelinus quadriseriatus				5	1	15		34	3	8			1	6	11		4	3	39
Lepidogobius lepidus																			
Myliobatis californica		1									2		2						
Paralabrax clathratus							1			2				2					2
Paralabrax nebulifer			3			12			4			3	1	1			1		
Paralichthys californicus		1	1			1	7	1	2	2	1	12	3		1		2	3	
Parophrys vetulus																			
Phanerodon furcatus		9	21			1	1		19	1									
Pleuronichthys guttulatus																			
Pleuronichthys ritteri		1					5					1							
Pleuronichthys verticalis	1		4	1		2		1			2	1	2		1		6	1	
Porichthys myriaster	1		1	2	3	7		7	18	19			10	37	6		9	7	63
Porichthys notatus																			
Quietula y-cauda																			
Raja inornata	1										1								
Rhinobatos productus							3				1								

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Roncador stearnsii							1												
Scorpaena guttata												1							
Sebastes spp.				1															
Seriphus politus	86	51	25	32		15	33	8		6	95	69	29	42	92		8	68	82
Symphurus atricaudus	21		2	7				9		1	3		2		2		8	1	1
Syngnathus leptorhynchus		1																	
Syngnathus spp.																			
Synodus lucioceps		1		3				2		4	1			2			1	1	5
Urobatis halleri							3					2							
Xenistius californiensis			2															4	
Xystreurys liolepis																	2	2	
Zaniolepis latipinnis	9							7											

Table C-3. Otter Trawl Catch, Spring 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	Day Survey																		
Amphistichus argenteus									1										
Anchoa delicatissima										1									
Atherinops affinis																			
Chitonotus pugetensis					1														
Citharichthys sordidus															1		30		
Citharichthys stigmaeus	9			21							3								
Cymatogaster aggregata		69		7		4				8	5	36							
Engraulis mordax														82				54	337
Genyonemus lineatus	265	2	13	7	1			28		6	7		2			29	5	1	2
Heterostichus rostratus			1																
Hyperprosopon argenteum			16													3			
Icelinus quadriseriatus				4						4					1			2	2
Lepidogobius lepidus						2										1			
Leptocottus armatus			1																
Lycodes pacificus																			
Menticirrhus undulatus																			
Myliobatis californica		3																4	
Ophidion scrippsae																			
Paralabrax nebulifer			1		3	1	2		1			3		1					
Paralichthys californicus			6		2		12			2				1				3	1
Parophrys vetulus				1	2					1									
Phanerodon furcatus		23		7	15	2	14		4	9	2		1	2			5	7	8
Platyrhinoidis triseriata																			
Pleuronichthys coenosus																			
Pleuronichthys guttulatus							2					2							
Pleuronichthys ritteri			3									1							
Pleuronichthys verticalis					1									2		1			
Porichthys myriaster			2										1	1			2	3	
Porichthys notatus													1						
Raja inornata				2						1									
Rhinobatos productus																			
Sardinops sagax								1											1
Scorpaena guttata								1											
Sebastes auriculatus								1											
Sebastes miniatus								5											

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
Sebastes spp. (juv.)			15																
Seriphus politus	297		2				1	342											
Symphurus atricaudus	16		2																
Syngnathus leptorhynchus			3					1											
Synodus lucioceps			2		1									1			1	5	1
Torpedo californica								1											
Urobatis halleri			2								1	2						1	
Xenistius californiensis																			
Xystreurys liolepis			1							1	1				1	1	1	2	
Zaniolepis latipinnis	8							5	1										
Zoarcidae unid.																			
	Night Survey																		
Amphistichus argenteus							1												
Anchoa delicatissima																			
Atherinops affinis		1																	
Chitonotus pugetensis																			
Citharichthys sordidus	14		1	23				6	1						10		3		
Citharichthys stigmaeus				3							1								
Cymatogaster aggregata		18	4		1	5	3			5		6							
Engraulis mordax	1			5		1	3	11	1	2	1	1	3	1	1		7		
Genyonemus lineatus	372	20	85	96	19	24	9	254	25	76	6	80	92	7	50	104	384	25	14
Heterostichus rostratus																			
Hyperprosopon argenteum																			
Icelinus quadriseriatus				12	7	5		2	4	12			1	8	13		3	1	5
Lepidogobius lepidus					1	8	2			2				3	7	2		6	16
Leptocottus armatus						2													
Lycodes pacificus				1	1									1					3
Menticirrhus undulatus												1							
Myliobatis californica		17					2					2							
Ophidion scrippsae															5				
Paralabrax nebulifer		1	5	2	3	10	4		4	6		1		8	3				1
Paralichthys californicus	2		6	2	1		15		2		1	4		2	2		1	3	3
Parophrys vetulus				1	3					4									
Phanerodon furcatus		6	1				8		9	2					5				
Platyrhinoidis triseriata												1							
Pleuronichthys coenosus										2									
Pleuronichthys guttulatus												2							
Pleuronichthys ritteri			2				2							2					1

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Pleuronichthys verticalis	3				1		1	2				7	1	2	3	1		2	
Porichthys myriaster	1		6	5	20	11		15	30	1			13	14	5		21	9	22
Porichthys notatus				2								1							
Raja inornata	1			1				2			1	1			1				1
Rhinobatos productus							2					2							
Sardinops sagax															2				
Scorpaena guttata												4							
Sebastes auriculatus																			
Sebastes miniatus	1		6	1									1		1	3	2		
Sebastes spp. (juv.)																			
Seriphus politus	82	100	73	13	26	64	51	33	40	58	11	27	29	145	117	44	166	195	53
Symphurus atricaudus	27		11	14	2	1		26	1			2	6	1	4	2	17	1	1
Syngnathus leptorhynchus		1	1									1							
Synodus lucioceps	1	1	3		2	2	1		1			5	3		6	3	1	5	2
Torpedo californica						1													
Urobatis halleri			1				2					2	1						
Xenistius californiensis		3	4		1														
Xystreurys liolepis	1	1	2	1		1						2			2		1	2	
Zaniolepis latipinnis	12	1	2					23								1			
Zoarcidae unid.												28						2	

Table C-4. Otter Trawl Catch, Summer 2008

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
Scientific Name	*Day Survey*																		
Acanthogobius flavimanus						1	1		4										
Amphistichus argenteus			1																
Citharichthys sordidus				3				13											
Citharichthys stigmaeus	5		2	1							2				1				
Cymatogaster aggregata		211	91				227		8			5							
Embiotoca jacksoni																			
Engraulis mordax	470		43				2142		194		2				30		1		
Genyonemus lineatus	15	30	23	5	3		5	27	12		2	77	3		4	1	107	73	
Gobioidei unid.					1														
Heterostichus rostratus																			
Hyperprosopon argenteum												1							
Icelinus quadriseriatus				1				3											
Lepidogobius lepidus															3		2		
Leptocottus armatus																			
Mustelus henlei													1					2	
Myliobatis californica			1																
Paralabrax nebulifer		2					1		3			2		1					
Paralichthys californicus		2	4				10	1	3			4		1	1		1	1	
Parophrys vetulus			1	1	1			1										1	
Peprilus simillimus																			
Phanerodon furcatus	2	106	56		6		23	1	45		2	10	1	5	7		2	14	
Platyrhinoidis triseriata		1																	
Pleuronichthys guttulatus												1							
Pleuronichthys ritteri		1					1					2							
Pleuronichthys verticalis			2					1	1		3	2		1	1		1	1	
Porichthys myriaster			1					5	1			6					2	1	
Raja inornata				2					1				1					1	
Rhacochilus vacca		1																	
Rhinobatos productus																			
Scomber japonicus																			
Scorpaena guttata																			
Seriphus politus	7	2	11				12	20			2	5	2	1			3		
Squalus acanthias													1						
Symphurus atricaudus	1		1	6			1	1				2			3		2		
Syngnathus leptorhynchus												1							

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Synodus lucioceps			3						1		2	7	1	1	2				
Urobatis halleri		1					2												
Xystreurys liolepis			1		1						1	4							
Zaniolepis latipinnis								3											
Zoarcidae unid.																			
	Night Survey																		
Acanthogobius flavimanus									11						1				
Amphistichus argenteus																			
Citharichthys sordidus	19		1	11				19		2	9	1			1		1		
Citharichthys stigmaeus				7											1				
Cymatogaster aggregata		118	131		1	1	205		3	2		4				1			
Embiotoca jacksoni		2																	
Engraulis mordax	5	31	11	22	1	1	12	4	1	8		1	24	1		1	7	2	5
Genyonemus lineatus	73	8	67	48	28	6	6	138	8	64	13	85	49	14	21	50	165	419	19
Gobioidei unid.																			
Heterostichus rostratus			1																
Hyperprosopon argenteum																			
Icelinus quadriseriatus	1				3					5			1	1	2		1	2	2
Lepidogobius lepidus					13	4	10	1	5	6			1	3		2		52	100
Leptocottus armatus									1			2							1
Mustelus henlei																			
Myliobatis californica		2																	
Paralabrax nebulifer		2	2		2	1	3		4	6				1	2		1		
Paralichthys californicus		1	5	1	3		7		1			9			1			2	3
Parophrys vetulus			1		1			1			2				1				
Peprilus simillimus								1											
Phanerodon furcatus		66	7	2	10	1	6		32	3	1	2			1			3	
Platyrhinoidis triseriata			1									1							
Pleuronichthys guttulatus							1					2							
Pleuronichthys ritteri		1					2					1							
Pleuronichthys verticalis	1		5	3			1			2		3	1		1		2		
Porichthys myriaster	2		5	1	17	2	2	5	15	3		18	6	3	1	5	9	5	22
Raja inornata										2	1	1							
Rhacochilus vacca																			
Rhinobatos productus		1																	
Scomber japonicus													1						
Scorpaena guttata								1				1			3				
Seriphus politus	7	111	231	29	6	19	27	3	25	39	3	36	30	32	34	11	16	17	20

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
Squalus acanthias																			
Symphurus atricaudus	16	1	4	3	1		2	21		2		3	6		2	1	10		
Syngnathus leptorhynchus																			
Synodus lucioceps			4						4	1		7	1		2	2	3		1
Urobatis halleri							4												
Xystreurys liolepis			1	1					1			1	3			1	1		1
Zaniolepis latipinnis								1											
Zoarcidae unid.				5							1	11	1						

Table C-5. Otter Trawl Biomass (g), Winter 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	Day Survey																		
Acanthogobius flavimanus																			
Anchoa compressa								5.9				14.0							
Atherinops affinis																			
Chilara taylori																			
Chitonotus pugetensis										8.4									
Citharichthys sordidus												20.0							
Citharichthys stigmaeus	8.7		9.0	130.0							35.0	8.0			12.0				
Cymatogaster aggregata		280.0	9.4			759.0	10.0		24.0		24.0	712.0							
Embiotoca jacksoni						53.0			142.0										
Engraulis mordax							11.3		9.4		203.5	1125.2			399.0	1.1	181.4	5.8	1726.9
Genyonemus lineatus	7376.0	100.0	245.6	174.0		7.0	250.6	672.3	4.0		1054.0	379.0			1.9	1163.3		533.0	1.4
Heterostichus rostratus		1.2	8.8					13.0											
Hippoglossina stomata			9.8																
Hyperprosopon argenteum			67.0																
Icelinus quadriseriatus				10.7	9.1	19.3		48.7	5.4						281.0				
Lepidogobius lepidus	2.0																		
Myliobatis californica		3700.0																	
Paralabrax clathratus			2.6																
Paralabrax nebulifer	205.0			110.0		15.0	142.0		264.0			1.9	55.0		324.0	88.0			
Paralichthys californicus	900.0	100.0	4266.0			53.0	512.0	500.0				21.0	875.0		120.0	2618.0			
Parophrys vetulus				8.5															
Phanerodon furcatus		1017.0	1499.0	437.0	264.0		1904.5	224.0	638.0			643.0		509.0	82.0	120.0			
Pleuronichthys guttulatus		293.0																	
Pleuronichthys ritteri		348.0				45.0	418.0				90.0								
Pleuronichthys verticalis				165.0						115.0	417.0	70.0			105.0	15.0			
Porichthys myriaster						32.9		8.5	4.3										
Porichthys notatus						3.0									0.5				

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Quietula y-cauda						0.8													
Raja inornata											875.0								
Rhinobatos productus																			
Roncador stearnsii																			
Scorpaena guttata																			
Sebastes spp.	0.7																		
Seriphus politus	140.3	7.0	5.8		1.5		91.4	974.6			1130.0	212.4				63.0	211.5	125.0	
Symphurus atricaudus	49.4		8.0					8.7											
Syngnathus leptorhynchus																			
Syngnathus spp.												10.4							
Synodus lucioceps		270.0		1.5						83.0	93.0					149.0			
Urobatis halleri							297.0					750.0							
Xenistius californiensis																3.0			
Xystreurys liolepis					210.0					200.0	430.0								
Zaniolepis latipinnis	641.0							157.0											
	Night Survey																		
Acanthogobius flavimanus						7.9	0.4			8.1	7.8		0.1		0.2		15.9	2.7	5.1
Anchoa compressa																			
Atherinops affinis												4.0							
Chilara taylori										24.0		118.0							
Chitonotus pugetensis										8.5									
Citharichthys sordidus													11.5						
Citharichthys stigmaeus	16.1			94.9		12.1					31.5	80.0			28.3		36.5		14.0
Cymatogaster aggregata		252.0				70.0	10.0		75.0	88.5		89.5			29.0				
Embiotoca jacksoni																			
Engraulis mordax				3.6				20.8		4.6	3.2						32.0		
Genyonemus lineatus	9634.0	6145.0	3583.0	1093.0		50.5	1542.0	8400.0	415.0	733.8	3954.5	1311.0	5819.0	231.6	608.1	750.0	3496.4	2336.5	1765.9
Heterostichus rostratus		12.0																	
Hippoglossina stomata																			
Hyperprosopon argenteum										55.0									
Icelinus quadriseriatus				15.6	4.5	62.5		106.2	10.6	26.5			4.8	24.6	44.5		14.7	10.9	157.6

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Lepidogobius lepidus																			
Myliobatis californica		2000.0									770.0		2800.0						
Paralabrax clathratus							1.2			0.5				1.9					8.4
Paralabrax nebulifer			4.3			32.3			487.0			8.1	0.5	72.0			174.0		
Paralichthys californicus		370.0	400.0			270.0	286.3	4500.0	150.0	430.0	315.0	873.0	908.0		650.0		238.0	304.8	
Parophrys vetulus																			
Phanerodon furcatus		242.0	420.0			17.0	32.0		296.5	12.0									
Pleuronichthys guttulatus																			
Pleuronichthys ritteri		187.0					189.0					150.0							
Pleuronichthys verticalis	138.0		186.8	125.0		300.0		5.0			325.0	40.0	394.0		255.0		167.5	355.0	
Porichthys myriaster	9.0		0.2	5.8	4.0	68.7		22.7	27.0	59.0			29.6	36.1	10.1		41.1	21.6	188.3
Porichthys notatus																			
Quietula y-cauda																			
Raja inornata	110.0										800.0								
Rhinobatos productus							3300.0				700.0								
Roncador stearnsii							410.0												
Scorpaena guttata												50.0							
Sebastes spp.				1.4															
Seriphus politus	4021.0	773.6	776.4	121.5		87.0	1131.8	453.0		32.8	3010.0	766.8	737.0	379.9	496.0		193.8	518.4	481.0
Symphurus atricaudus	194.3		17.2	52.5				41.0		7.0	22.7		17.0		7.0		76.7	23.0	23.0
Syngnathus leptorhynchus		1.0																	
Syngnathus spp.																			
Synodus lucioceps		125.0		407.0				134.0		224.0	155.0			1414.0			175.0	87.0	1048.0
Urobatis halleri							970.0					870.0							
Xenistius californiensis			82.0															194.0	
Xystreurys liolepis																	88.0	351.0	
Zaniolepis latipinnis	298.0							210.0											

Table C-6. Otter Trawl Biomass (g), Spring 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	Day Survey																		
Amphistichus argenteus									3.0										
Anchoa delicatissima										0.4									
Atherinops affinis																			
Chitonotus pugetensis					12.0														
Citharichthys sordidus															9.0		179.5		
Citharichthys stigmaeus	18.6			174.0							32.0								
Cymatogaster aggregata		2649.0		112.0		52.0				148.0	86.0	1293.0							
Engraulis mordax														315.0				193.0	1911.0
Genyonemus lineatus	16272.0	389.0	1574.0	384.0	7.0			1186.4		567.0	930.0		255.0			2684.0	446.0	190.0	114.0
Heterostichus rostratus			2.0																
Hyperprosopon argenteum			845.0													218.0			
Icelinus quadriseriatus				20.0						18.0					5.0			10.0	9.0
Lepidogobius lepidus						8.0										1.0			
Leptocottus armatus			39.0																
Lycodes pacificus																			
Menticirrhus undulatus																			
Myliobatis californica		9700.0																68000.0	
Ophidion scrippsae																			
Paralabrax nebulifer			3.0		93.0	66.0	37.3		110.0			230.0		110.0					
Paralichthys californicus			3010.0		910.0		1941.0			492.0				470.0				5900.0	300.0
Parophrys vetulus				7.0	22.0					13.0									
Phanerodon furcatus		2594.0		316.0	589.0	76.0	2024.0		128.0	407.0	139.0		99.0	170.0			353.0	659.0	681.0
Platyrhinoidis triseriata																			
Pleuronichthys coenosus																			
Pleuronichthys guttulatus							470.0					293.0							
Pleuronichthys ritteri			197.0									153.0							
Pleuronichthys verticalis					165.0									291.0		112.0			
Porichthys myriaster			6.0										11.0	10.0			45.0	27.0	
Porichthys notatus													68.0						
Raja inornata				961.0						240.0									
Rhinobatos productus																			
Sardinops sagax								25.0											13.0
Scorpaena guttata								330.0											

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
Sebastes auriculatus								420.0											
Sebastes miniatus								263.0											
Sebastes spp. (juv.)			69.0																
Seriphus politus	5116.0		71.0				3.0	2577.0											
Symphurus atricaudus	113.0		28.0																
Syngnathus leptorhynchus			7.0					11.0											
Synodus lucioceps			336.0		7.0									192.0			54.0	1125.0	105.0
Torpedo californica								5500.0											
Urobatis halleri			1090.0								208.0	890.0						545.0	
Xenistius californiensis																			
Xystreurys liolepis			173.0							375.0	72.0				120.0	160.0	210.0	90.0	
Zaniolepis latipinnis	208.0							155.0	26.0										
Zoarcidae unid.																			
	Night Survey																		
Amphistichus argenteus							5.0												
Anchoa delicatissima																			
Atherinops affinis		35.0																	
Chitonotus pugetensis																			
Citharichthys sordidus	43.2		17.0	150.3				23.8	26.0						85.5		13.0		
Citharichthys stigmaeus				113.0							9.8								
Cymatogaster aggregata		438.0	82.0		33.0	92.0	99.0			93.0		144.0							
Engraulis mordax	7.5			25.9		6.3	12.4	69.7	2.9	7.0	5.8	4.5	16.3	6.5	5.6		38.0		
Genyonemus lineatus	20387.0	2060.0	9554.0	4632.0	1841.5	2102.5	1214.1	25443.0	4320.0	2172.6	28.0	7456.0	8794.0	1120.0	4535.1	4238.5	28904.0	3030.9	2178.4
Heterostichus rostratus																			
Hyperprosopon argenteum																			
Icelinus quadriseriatus				51.2	31.1	21.1		8.7	19.5	55.0			7.0	29.2	105.2		19.7	6.0	20.1
Lepidogobius lepidus					0.1	1.2	2.1			0.6				0.6	5.3	0.8		8.1	5.8
Leptocottus armatus						46.0													
Lycodes pacificus				2.2	72.0									62.0					121.2
Menticirrhus undulatus												220.0							
Myliobatis californica		53590.0					30450.0					4100.0							
Ophidion scrippsae															148.0				
Paralabrax nebulifer		100.0	11.2	8.5	4.3	162.6	13.0		67.7	350.0		27.0		403.0	320.4				1.0
Paralichthys californicus	1262.0		1539.0	3570.0	460.0		1821.0		232.0		510.0	365.0		800.0	345.0		450.0	2135.0	1502.0
Parophrys vetulus				17.0	59.0					60.5									
Phanerodon furcatus		222.0	40.0				298.2		421.0	43.0					169.0				
Platyrhinoidis triseriata												160.0							

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
Pleuronichthys coenosus										8.6									
Pleuronichthys guttulatus												609.0							
Pleuronichthys ritteri			67.0				155.0							320.0					84.0
Pleuronichthys verticalis	180.0				140.0		190.0	43.0				283.0	36.0	192.0	215.0	30.0		220.0	
Porichthys myriaster	9.5		31.2	13.6	60.6	56.2		140.0	75.6	4.0			118.2	30.6	24.2		240.5	60.5	102.1
Porichthys notatus				6.0								30.0							
Raja inornata	900.0			1350.0				140.0			600.0	1300.0			580.0				900.0
Rhinobatos productus							2945.0					900.0							
Sardinops sagax															62.2				
Scorpaena guttata												1025.0							
Sebastes auriculatus																			
Sebastes miniatus	3.5		25.5	5.2									2.3		5.5	13.0	6.4		
Sebastes spp. (juv.)																			
Seriphus politus	1695.6	2029.0	2329.4	321.0	612.1	883.4	3623.0	1419.0	1302.7	648.6	68.4	888.0	1638.5	2069.0	2135.4	2629.0	5954.0	5540.0	1427.9
Symphurus atricaudus	285.0		276.0	115.3	21.0	20.0		169.5	22.0			37.0	79.0	25.0	33.5	38.0	252.0	6.5	22.0
Syngnathus leptorhynchus		3.0	1.3									2.4							
Synodus lucioceps	130.0	122.0	570.0		128.0	435.0	142.0		194.0			485.0	212.0		668.0	360.0	155.0	1443.0	580.0
Torpedo californica						8000.0													
Urobatis halleri			1800.0				750.0					895.0	555.0						
Xenistius californiensis		90.0	179.0		85.0														
Xystreurys liolepis	380.0	455.0	860.0	110.0		184.0						392.0			475.0		250.0	472.0	
Zaniolepis latipinnis	332.0	26.0	45.0					645.0								27.0			
Zoarcidae unid.												114.3						5.5	

Table C-7. Otter Trawl Biomass (g), Summer 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	Day Survey																		
Acanthogobius flavimanus						5.0	10.0			20.0									
Amphistichus argenteus			130.0																
Citharichthys sordidus				40.0				80.0											
Citharichthys stigmaeus	11.6		47.0	14.0							27.0				5.2				
Cymatogaster aggregata		917.2	442.7				749.3			49.3		143.0							
Embiotoca jacksoni																			
Engraulis mordax	6200.0		35.5				2152.6			121.7	31.0				6.2		11.0		
Genyonemus lineatus	1158.0	3156.0	1738.0	467.0	273.5		1089.0	2395.0		1924.0	232.0	4146.0	293.0		89.4	230.0	1196.0	177.1	
Gobioidei unid.					0.2														
Heterostichus rostratus																			
Hyperprosopon argenteum												13.0							
Icelinus quadriseriatus				0.6				11.2											
Lepidogobius lepidus															1.6		5.5		
Leptocottus armatus																			
Mustelus henlei													900.0					2290.0	
Myliobatis californica			545.0																
Paralabrax nebulifer		372.0					7.5			221.3		200.0		100.0					
Paralichthys californicus		288.0	1200.0				2470.0	800.0		1480.0		838.0		300.0	67.0		305.0	750.0	
Parophrys vetulus			7.0	37.0	26.0			220.0										345.0	
Peprilus simillimus																			
Phanerodon furcatus	235.0	2936.5	1485.9		363.0		113.3	145.0		242.5	179.0	64.0	110.0	459.0	634.0		292.0	333.0	
Platyrhinoidis triseriata		245.0																	
Pleuronichthys guttulatus												212.0							
Pleuronichthys ritteri		250.0					230.0					135.0							
Pleuronichthys verticalis			242.0					220.0		83.0	489.0	86.0		105.0	70.0		345.0	250.0	
Porichthys myriaster			2.8					401.0		142.0		113.7					36.0	23.0	
Raja inornata				1175.0						350.0			28.0					67.0	
Rhacochilus vacca		12.0																	
Rhinobatos productus																			
Scomber japonicus																			
Scorpaena guttata																			
Seriphus politus	396.0	73.0	614.0				381.0	756.0			103.0	319.0	114.0	7.5			148.0		
Squalus acanthias													5000.0						
Symphurus atricaudus	3.6		29.0	62.5			25.0	11.0				51.0			2.1		18.0		
Syngnathus leptorhynchus												7.5							
Synodus lucioceps			535.5							235.0	80.0	794.0	64.0	73.0	16.3				
Urobatis halleri		745.0					1055.0												
Xystreurys liolepis			405.0		445.0						42.0	372.0							
Zaniolepis latipinnis								90.0											
Zoarcidae unid.																			

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
	Night Survey																		
Acanthogobius flavimanus									79.5						0.4				
Amphistichus argenteus																			
Citharichthys sordidus	103.8		22.0	84.0				119.5		32.0	127.5	75.0			5.8		5.0		
Citharichthys stigmaeus				74.0											2.8				
Cymatogaster aggregata		688.9	401.9		26.0	3.5	773.0		12.1	41.0		70.5				9.0			
Embiotoca jacksoni		36.0																	
Engraulis mordax	45.5	256.7	85.3	297.0	11.0	11.0	17.7	46.0	8.0	99.0		1.4	206.0	11.0		11.0	90.0	22.0	60.5
Genyonemus lineatus	6327.0	185.0	6065.0	1172.0	2840.6	419.5	643.6	11810.0	1605.0	2437.0	871.0	5750.0	5006.0	1739.2	3009.0	5855.0	15015.0	3379.0	2319.4
Gobioidei unid.																			
Heterostichus rostratus			2.0																
Hyperprosopon argenteum																			
Icelinus quadriseriatus	1.2				20.9					8.5			1.6	2.4	5.4		5.5	11.5	10.1
Lepidogobius lepidus					7.6	2.8	4.9	1.0	4.6	8.4			3.0	1.6		2.6		49.4	44.9
Leptocottus armatus									15.0			55.0							40.0
Mustelus henlei																			
Myliobatis californica		1045.0																	
Paralabrax nebulifer		153.0	38.0		156.0	33.0	245.0		63.5	217.0				5.5	311.0		170.0		
Paralichthys californicus		545.0	1572.0	45.0	5655.0		1041.7		255.0			970.0			1135.0			1695.0	907.0
Parophrys vetulus			3.2		22.0			500.0			13.5				4.0				
Peprilus simillimus								37.0											
Phanerodon furcatus		591.3	57.8	10.0	47.3	40.0	89.0		442.0	111.5	28.0	18.5			110.0			17.0	
Platyrhinoidis triseriata			155.0									152.0							
Pleuronichthys guttulatus							545.0					566.0							
Pleuronichthys ritteri		225.0					185.0					58.0							
Pleuronichthys verticalis	110.0		644.0	147.0			55.0			50.0		206.0	2.6		190.0		138.0		
Porichthys myriaster	71.0		54.4	8.0	106.7	12.0	46.7	49.8	99.9	23.4		496.0	104.5	7.0	115.0	123.0	240.0	85.5	177.2
Raja inornata										325.0	158.0	700.0							
Rhacochilus vacca																			
Rhinobatos productus		1445.0																	
Scomber japonicus													220.0						
Scorpaena guttata								262.0				345.0			329.0				
Seriphus politus	375.0	2115.0	6760.0	1110.0	365.0	882.0	528.5	150.0	457.7	1206.0	164.0	1041.0	2026.0	1238.2	1426.5	787.0	1035.0	1074.0	942.0
Squalus acanthias																			
Symphurus atricaudus	108.5	30.0	117.0	57.0	17.0		68.0	190.0		22.5		106.0	57.5		3.5	3.8	176.2		
Syngnathus leptorhynchus																			
Synodus lucioceps			510.0						1037.0	24.0		1001.0	106.0		212.0	242.0	231.0		295.0
Urobatis halleri							1815.0												
Xystreurys liolepis			510.0	200.0					405.0			78.0	785.0			200.0	350.0		295.0
Zaniolepis latipinnis								25.0											
Zoarcidae unid.				27.0							9.0	253.5	47.0						

Table C-8. Lampara Catch, Winter 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	Day Survey																		
Anchoa compressa																			
Atherinops affinis		1180	11	128			1				195		1						1
Atherinopsis californiensis																			
Atractoscion nobilis							1												
Engraulis mordax												151							
Genyonemus lineatus																			
Leuresthes tenuis																			
Myliobatis californica		1																	
Sardinops sagax											1								
Seriphus politus																			
Trachurus symmetricus							6												
	Night Survey																		
Anchoa compressa							1												
Atherinops affinis	10	82	17			4	24	2	9	8	74	27		6	221	3	17	15	
Atherinopsis californiensis							1				1	5							
Atractoscion nobilis																			
Engraulis mordax		3			19	26	124	1	20	57	2	168		57	16	3745	35942	206	2
Genyonemus lineatus							2					1							
Leuresthes tenuis							1												
Myliobatis californica																			
Sardinops sagax																23	83	14	
Seriphus politus		2					3					36							
Trachurus symmetricus		1					2		1	1									

Table C-9. Lampara Catch, Spring 2008

Scientific Name	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
	Day Survey																		
Anchoa compressa																			
Atherinops affinis	7	17			215		1	1	170	10		179	16	30		3	21		6
Atractoscion nobilis																			
Caulolatilus princeps																			
Engraulis mordax	1																		
Leuresthes tenuis		35																	
Myliobatis californica																			
Phanerodon furcatus																			
Roncador stearnsii							1												
Sardinops sagax																			
Scomber japonicus																			
Seriphus politus																			
Sphyraena argentea																			
Trachurus symmetricus																			
	Night Survey																		
Anchoa compressa							3												
Atherinops affinis							10				1				5	151	2		
Atractoscion nobilis							1												
Caulolatilus princeps								1											
Engraulis mordax		2		773	2317	156	70	271	515	1012	30	236	13490		27	19	483	495	156
Leuresthes tenuis	2	8	93		1	8	2	3	1	7		125	3	2			2	1	
Myliobatis californica		1											5						
Phanerodon furcatus							1												
Roncador stearnsii							2												
Sardinops sagax		1		11	3	1				10			695				7	6	
Scomber japonicus					1													1	
Seriphus politus			1				21			1						2			
Sphyraena argentea							12												
Trachurus symmetricus			1				3				20		30				1		2

Table C-10. Lampara Catch, Summer 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	*Day Survey*																		
Atherinops affinis	22	182	567		66	919	1	18	3	21	27	11		9	4		32	6	1
Atractoscion nobilis																			
Cymatogaster aggregata																			
Engraulis mordax		2242	366			1				1									
Genyonemus lineatus																			
Heterostichus rostratus			1				2												
Leuresthes tenuis		16	8		5	75	11	4		5	887							100	11
Mustelus henlei																			
Myliobatis californica		3										1							
Phanerodon furcatus		2																	
Sardinops sagax		12	2			1				1	1								
Seriphus politus							3												
Sphyraena argentea																			
Syngnathus californiensis			1																
Trachurus symmetricus		1																	
	Night Survey																		
Atherinops affinis	67	58	73	23	40	94	10	32	23	71	43	67	17	175	88	501	21	26	6
Atractoscion nobilis																		1	
Cymatogaster aggregata		337	409		7		4			1						1			
Engraulis mordax		673	583	60	234	7	866	2338	8	20		30	225		22	372	3	1985	30
Genyonemus lineatus			20				2												
Heterostichus rostratus							1												
Leuresthes tenuis		26	6			1	2	44					1			34	1		
Mustelus henlei							1												
Myliobatis californica																		17	
Phanerodon furcatus		8	45				1									1			
Sardinops sagax		11		9	248			198		1			1		2	7	154	3	3
Seriphus politus		4	26		2		26		7	3	6	5	3			6	1		1
Sphyraena argentea									2							1		4	
Syngnathus californiensis																			
Trachurus symmetricus			2		2				10			1			5	8	4	3	2

Table C-11. Lampara Biomass (g), Winter 2008

	LA01	*LA02*	*LA03*	*LA04*	*LA05*	*LA06*	*LA07*	*LA10*	*LA14*	*LA15*	*LB01*	*LB02*	*LB03*	*LB04*	*LB05*	*LB06*	*LB07*	*LB12*	*LB14*
Scientific Name	*Day Survey*																		
Anchoa compressa																			
Atherinops affinis		9022	49	4433			120				2984		125						11
Atherinopsis californiensis																			
Atractoscion nobilis							500												
Engraulis mordax												290.7							
Genyonemus lineatus																			
Leuresthes tenuis																			
Myliobatis californica		290																	
Sardinops sagax											12								
Seriphus politus																			
Trachurus symmetricus							667												
	Night Survey																		
Anchoa compressa							9												
Atherinops affinis	731.5	606.5	60.9			22	104.3	12.3	293	39.5	710	394.8		163	1625.1	44	150	289.6	
Atherinopsis californiensis							112				105	705							
Atractoscion nobilis																			
Engraulis mordax		7.8			70.7	90	157.5	1.2	36.6	164	7.5	254.3		108.3	32.5	11771.5	138069	579.5	5.5
Genyonemus lineatus							319					78							
Leuresthes tenuis							1.2												
Myliobatis californica																			
Sardinops sagax																181	572	119.4	
Seriphus politus		79					90.5					164.5							
Trachurus symmetricus		102					272		112	110									

Table C-12. Lampara Biomass (g), Spring 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	Day Survey																		
Anchoa compressa																			
Atherinops affinis	125.0	381.0			1895.6		1.3	34.0	8202.0	103.5		2613.2	449.0	795.7		83.5	228.0		177.0
Atractoscion nobilis																			
Caulolatilus princeps																			
Engraulis mordax	8.0																		
Leuresthes tenuis		810.0																	
Myliobatis californica																			
Phanerodon furcatus																			
Roncador stearnsii							645.0												
Sardinops sagax																			
Scomber japonicus																			
Seriphus politus																			
Sphyraena argentea																			
Trachurus symmetricus																			
	Night Survey																		
Anchoa compressa							11.0												
Atherinops affinis							265.8				13.0				53.0	2000.0	33.0		
Atractoscion nobilis							800.0												
Caulolatilus princeps								1.0											
Engraulis mordax		7.4		5223.7	11719.0	941.0	240.2	1316.1	2091.9	5031.5	163.2	1155.7	87467.2		145.8	115.0	3453.0	2628.3	705.2
Leuresthes tenuis	51.0	69.0	646.0		12.0	79.0	2.8	85.0	11.0	65.0		2437.0	67.5	17.5			47.0	19.0	
Myliobatis californica		845.0											8000.0						
Phanerodon furcatus							120.0												
Roncador stearnsii							1310.0												
Sardinops sagax		12.0		148.0	36.5	12.0				139.0			12935.0				93.0	93.0	
Scomber japonicus					210.0													225.0	
Seriphus politus			80.0				1453.5			100.0						238.0			
Sphyraena argentea							5650.0												
Trachurus symmetricus			105.0				359.0				745.0		1082.5				32.0		265.0

Table C-13. Lampara Biomass (g), Summer 2008

	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA10	LA14	LA15	LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB12	LB14
Scientific Name	Day Survey																		
Atherinops affinis	412.0	3166.1	1735.3		230.5	3191.7	1.8	316.4	70.0	73.3	288.1	342.0		250.0	27.5		698.0	18.8	12.0
Atractoscion nobilis																			
Cymatogaster aggregata																			
Engraulis mordax		28417.5	4019.4			2.8				1.1									
Genyonemus lineatus																			
Heterostichus rostratus			3.4				3.5												
Leuresthes tenuis		49.8	11.7		8.3	88.2	3.9	3.8		6.9	2631.0							201.3	17.1
Mustelus henlei																			
Myliobatis californica		1815.0										2245.0							
Phanerodon furcatus		153.0																	
Sardinops sagax		30.9	40.0			3.5				3.2	2.9								
Seriphus politus							190.0												
Sphyraena argentea																			
Syngnathus californiensis			15.0																
Trachurus symmetricus		16.0																	
	Night Survey																		
Atherinops affinis	386.8	1200.4	936.2	298.0	738.0	485.8	109.5	91.3	343.5	850.5	288.1	1231.5	165.0	1145.3	366.8	2387.7	144.9	488.0	72.0
Atractoscion nobilis																		335.0	
Cymatogaster aggregata		1251.2	1989.7		33.6		18.2			9.5						5.0			
Engraulis mordax		3890.7	1384.7	579.9	2244.4	32.1	1703.4	52152.7	27.5	91.8		28.8	418.4		34.0	565.0	9.1	3475.6	61.2
Genyonemus lineatus			3014.5				375.0												
Heterostichus rostratus							2.9												
Leuresthes tenuis		60.2	8.8			2.3	3.3	116.5					0.3			66.1	1.4		
Mustelus henlei							10100.0												
Myliobatis californica																		132700.0	
Phanerodon furcatus		57.6	572.5				11.0									4.0			
Sardinops sagax		24.1		194.0	2516.0			3422.0		3.0			1.7		48.5	43.0	3812.0	6.7	19.2
Seriphus politus		221.0	979.0		28.0		1204.0		124.0	83.0	181.0	65.0	81.0			274.0	13.0		65.0
Sphyraena argentea									350.0							182.0		760.0	
Syngnathus californiensis																			
Trachurus symmetricus			282.0		162.0				1180.0			170.0			328.0	533.0	339.0	149.0	155.0

Table C-14. Beach Seine Abundance and Biomass (g), All Surveys

Survey	*Station*	*Scientific Name*	*Common Name*	*Total Count*	*Total Weight*
Winter	LA01	*Syngnathus leptorhynchus*	bay pipefish	2	1.4
Winter	LA01	*Micrometrus minimus*	dwarf surfperch	1	15.0
Winter	LA01	*Heterostichus rostratus*	giant kelpfish	2	4.2
Winter	LA01	*Atherinops affinis*	topsmelt	165	679.5
Winter	LA02	*Pleuronichthys guttulatus*	diamond turbot	8	6.2
Winter	LA02	*Gobioidei unid.*	gobies	5	0.5
Spring	LA01	*Atherinops affinis*	topsmelt	8	0.8
Spring	LA02	*Pleuronichthys guttulatus*	diamond turbot	2	1.2
Spring	LA02	Gobiidae unid.	gobies	17	1.7
Spring	LA02	*Atherinops affinis*	topsmelt	930	173.1
Summer	LA01	*Cymatogaster aggregata*	shiner surfperch	1	4.3
Summer	LA01	*Atherinops affinis*	topsmelt	23	3.5
Summer	LA02	*Pleuronichthys guttulatus*	diamond turbot	1	6.0
Summer	LA02	*Leptocottus armatus*	Pacific staghorn sculpin	2	11.3
Summer	LA02	*Quietula y-cauda*	shadow goby	589	92.6
Summer	LA02	*Atherinops affinis*	topsmelt	182	25.3

APPENDIX D

ICHTHYOPLANKTON

Table D-1. Ichthyoplankton Density (#/100m^3) - Manta (Neuston), February 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
February 2008																					
Yolksac																					
	Genyonemus lineatus	white croaker													8.9						
Larvae																					
	Atherinopsidae unid.	silversides	14.5						6.1												
	Atherinopsis californiensis	jacksmelt										2.5		4.8			2.7				
	Cottidae unid.	sculpins								3.8											
	Genyonemus lineatus	white croaker			2.7																
	CIQ gobies	gobies						9.2	9.2							2.4					
	larval fish unid.	unidentified larval fishes		2.5																	
	Lepidogobius lepidus	bay goby										2.5					2.7			5.7	
	Ruscarius creaseri	roughcheek sculpin	3.6																		
Juvenile																					
	Atherinops affinis	topsmelt																			
		TOTAL LARVAE	*18.1*	*2.5*	*2.7*	*0.0*	*0.0*	*9.2*	*15.3*	*7.6*	*0.0*	*5.0*	*0.0*	*4.8*	*8.9*	*2.4*	*5.4*	*0.0*	*0.0*	*5.7*	*0.0*
Eggs																					
	Citharichthys spp. (eggs)	sanddab eggs		5.0	2.7				30.7	7.7											
	fish eggs (damaged)	damaged fish eggs unid.		2.5											29.5		2.7	13.8		2.9	2.1
	fish eggs (undeveloped)	undeveloped fish eggs	83.6	166.0	117.2	1,602.6	241.0	9.2	3,008.9	446.3	14.2	1,424.0	450.1	257.7	797.6	100.4	371.7	61.9	1,000.4	343.8	183.1
	fish eggs unid.	unidentified fish eggs			2.7								5.1	16.9		2.4			8.4		2.1
	Labridae/Serranidae unid. (eggs)	wrasse eggs													29.5						
	Paralichthyidae unid. (eggs)	sand flounder eggs			10.9		6.5	61.4			9.8					7.3	8.1				
	Pleuronichthys spp. (eggs)	turbot eggs	3.6		2.7	18.9	3.3			23.1		19.7				56.3			4.2		18.5
	poss. *Paralichthys californicus* (eggs)	poss. California halibut																		8.6	
	poss. Sciaenidae unid. (eggs)	possible croaker eggs												14.5			2.7			25.8	
	Sciaenidae unid. (eggs)	croaker eggs							30.7	15.4			10.2		29.5	4.9	5.4	41.3	12.6		10.3
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	3.6	15.1			3.3	1.8	214.9	19.2		27.1	10.2	33.7		2.4					39.1
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs																61.9	50.2		
		TOTAL EGGS	90.8	188.6	136.2	1,621.5	254.1	11.0	3,346.6	511.7	14.2	1,480.6	475.6	322.8	886.1	173.7	390.6	178.9	1,075.8	381.1	255.2

Table D-2. Ichthyoplankton Density (#/100m^3) - Manta (Neuston), April 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Yolksac																	1.9				
	Bathymasteridae unid.	ronquils																			
	Clupeiformes unid.	herrings and anchovies								6.4											
	Engraulidae unid.	anchovies			1.7																
	Genyonemus lineatus	white croaker				1.8			1.9					4.3							
	Leuresthes tenuis	California grunion		1.8																	
	Rhinogobiops nicholsi	blackeye goby								1.6											
	Sciaenidae unid.	croakers								1.6											
Larvae																					
	Artedius spp.	sculpins		3.6																	
	Atherinops affinis	topsmelt							3.9												
	Atherinopsidae unid.	silversides			1.7				1.9									27.8			
	Bathymasteridae unid.	ronquils		5.4																	
	Citharichthys stigmaeus	speckled sanddab	2.7																		
	Clinocottus analis	wooly sculpin																9.3			
	Cottidae unid.	sculpins		1.8	3.5																
	Gibbonsia spp.	kelpfishes																		1.9	
	Gobiesox spp.	clingfishes														1.6					
	CIQ gobies	gobies		5.2				5.8			3.3				2.1	3.3					
	Hypsoblennius spp.	combtooth blennies	5.4	1.8	12.2	1.8			36.6	12.8				15.0	2.8	36.2	3.8	101.8	20.0	34.6	22.6
	larval fish unid.	unidentified larval fishes							1.9	1.6											
	larval fish fragment	unidentified larval fishes								3.5		1.9									
	Lepidogobius lepidus	bay goby		3.6									5.9			1.6					2.3
	Leuresthes tenuis	California grunion			8.7																6.8
	Orthonopias triacis	snubnose sculpin														3.3					
	Ruscarius creaseri	roughcheek sculpin	2.7	3.6		1.8															
	Sebastes spp.	rockfishes		1.8																	
	Stenobrachius leucopsarus	northern lampfish	2.7	1.8																	
	Typhlogobius californiensis	blind goby		3.6						1.6			2.0	4.3							
	Zaniolepis frenata	shortspine combfish		1.8																	
		TOTAL LARVAE	*13.5*	*30.6*	*36.5*	*5.4*	*0.0*	*0.0*	*53.9*	*25.6*	*3.3*	*0.0*	*7.9*	*25.7*	*2.8*	*46.0*	*5.7*	*138.9*	*20.0*	*36.5*	*31.7*
Eggs																					
	Citharichthys spp. (eggs)	sanddab eggs	24.1	3.6								2.5	76.7	47.3	14.1	1.6	37.7		30.0	3.8	4.5
	Engraulis mordax (eggs)	northern anchovy eggs	56.2	8.9		5.4				16.0		2.5					5.7				

	fish eggs (undeveloped)	undeveloped fish eggs	1,290.5	557.6	2,786.0	692.7	187.1		5,745.1	1,585.8	61.2	640.5	775.0	356.7	817.7	70.8	434.0	5,827.9	410.0	53.8	245.8
	Paralichthyidae unid. (eggs)	sand flounder eggs	10.7			9.0													3.3		
	Paralichthys californicus (eggs)	California halibut eggs													14.1						
	Pleuronichthys spp. (eggs)	turbot eggs	50.9			3.6	19.4			16.0	13.2	34.4	3.9	2.1		6.6	1.9				9.0
	Sciaenidae unid. (eggs)	croaker eggs	5.4				2.2						11.8	43.0	56.4	1.6	3.8		10.0	1.9	4.5
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	96.4	26.8		39.5	4.3		115.7	48.1		14.7	33.4	36.5		1.6	35.9	185.0	26.7		6.8
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs		1.8																	
		TOTAL EGGS	*1,534.2*	*598.7*	*2,786.0*	*750.2*	*213.0*	*0.0*	*5,860.8*	*1,665.9*	*74.4*	*694.6*	*900.8*	*485.6*	*902.3*	*82.2*	*519.0*	*6,012.9*	*480.0*	*59.5*	*270.6*

Table D-3. Ichthyoplankton Density (#/100m^3) - Manta (Neuston), July 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Yolksac																					
	CIQ gobies	gobies									9.4										
	larvae, unidentified yolksac	unidentified yolksac larvae		8.0		2.1						1.7			6.2		1.2	1.6			
	Paralichthys californicus	California halibut																3.3			
	Sciaenidae unid.	croakers		8.0																	
	Sphyraena argentea	Pacific barracuda																		2.5	
Larvae																					
	Atherinopsidae unid.	silversides					2.0						3.3							2.5	
	Citharichthys stigmaeus	speckled sanddab													4.1			9.9			
	CIQ gobies	gobies	1.9	4.0					41.4	3.4	4.7		1.7	18.1							
	Hypsoblennius spp.	combtooth blennies	108.2	21.9		4.3			5.6	30.6	11.0	6.8	67.7	27.2	8.2	31.5	2.3	6.6	5.9	753.9	27.5
	Hypsypops rubicundus	garibaldi								1.7			3.3						2.0		
	larval fish unid.	unidentified larval fishes		9.9						1.7							3.5	1.6			
	larval fish fragment	unidentified larval fishes		4.0																2.5	
	Lepidogobius lepidus	bay goby									1.6		8.3				7.0			5.1	
	Leuresthes tenuis	California grunion																	3.9		2.3
	Lythrypnus spp.	gobies								1.7											
	Paraclinus integripinnis	reef finspot									4.7										
	Paralichthys californicus	California halibut												3.0				1.6			
	Pomacentridae unid.	damselfishes											3.3			2.3		9.9			
	Rhinogobiops nicholsi	blackeye goby		2.0	1.8					3.4											
Juvenile																					
	Atherinops affinis	topsmelt	7.5	2.0	3.6			5.8		3.4			1.7						7.9		
	Atherinopsis californiensis	jacksmelt		13.9	3.6					5.1											
	Heterostichus rostratus	giant kelpfish												3.0							
	Lepidogobius lepidus	bay goby															1.2				
	Leuresthes tenuis	California grunion	11.2	109.4	25.0		2.0	2.9	3.8	5.1			8.3		11.3			14.8	5.9		
	Syngnathus spp.	pipefishes															1.2				
		TOTAL LARVAE	*128.8*	*183.1*	*34.0*	*6.4*	*4.0*	*8.7*	*50.8*	*56.1*	*31.4*	*8.5*	*97.6*	*51.3*	*18.5*	*45.1*	*16.4*	*49.3*	*25.6*	*766.5*	*29.8*
Eggs																					
	Citharichthys spp. (eggs)	sanddab eggs	11.2	57.7	26.8	87.4	2.0			54.4			16.5	3.0	20.5		69.9		19.7	32.9	6.9
	Engraulidae unid. (eggs)	anchovy eggs	3.7																		
	Engraulis mordax (eggs)	northern anchovy eggs	1.9														11.6				
	fish eggs (undeveloped)	undeveloped fish eggs	518.7	149.2	112.6	364.6	452.3	717.6	167.3	292.6	351.9	137.2	188.1	392.9	1,907.7	153.0	302.8	435.5	2,210.8	660.3	502.6

	fish eggs unid.	unidentified fish eggs			5.4								8.3		20.5	2.3	23.3	4.9			4.6
	Labridae/Paralichthyidae (eggs)	fish eggs	1.9	8.0	8.9	2.1				5.1		1.7	11.6	3.0	20.5	2.3	11.6			7.6	6.9
	Paralichthyidae unid. (eggs)	sand flounder eggs												3.0							
	Pleuronichthys spp. (eggs)	turbot eggs	5.6	2.0		4.3		2.9		3.4			3.3						19.7	5.1	
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	9.3	6.0	10.7	10.7	14.1	20.3		40.8		10.2	34.7	9.1	20.5	13.5	81.5	8.2	315.8	65.8	16.1
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs	3.7	15.9	16.1	23.5		5.8		71.4	1.6		8.3			6.8		3.3	197.4	43.0	25.2
		TOTAL EGGS	*556.0*	*238.8*	*180.5*	*492.6*	*468.4*	*746.6*	*167.3*	*467.7*	*353.5*	*149.1*	*270.8*	*411.0*	*1,989.7*	*177.9*	*500.7*	*451.9*	*2,763.4*	*814.7*	*562.3*

Table D-4. Ichthyoplankton Density (#/100m^3) - Oblique (Midwater), February 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Yolksac																					
	Genyonemus lineatus	white croaker		1.2	1.2	4.3	2.2	5.0						1.1	2.1				1.9	2.8	2.0
	CIQ gobies	gobies							2.9												
	Sciaenidae unid.	croakers						.9													
Larvae																					
	Acanthogobius flavimanus	yellowfin goby						4.7	53.6		26.8		2.3		5.2	1.1			1.9		3.1
	Artedius lateralis	smoothhead sculpin											1.2			1.1				.9	
	Atherinopsis californiensis	jacksmelt																	.9		
	Bathymasteridae unid.	ronquils								1.1						1.1				.9	
	Blennioidei unid.	blennies														1.1					
	Clinocottus analis	wooly sculpin		2.4					1.0					1.1		1.1		.9			1.0
	Cottidae unid.	sculpins			3.6			.9		2.2			1.2		2.1		1.2				
	Genyonemus lineatus	white croaker						.9	1.0				2.3		5.2		2.4	1.8	3.7		
	Gibbonsia spp.	kelpfishes							1.9											.9	
	Gillichthys mirabilis	longjaw mudsucker								1.1							1.2		.9	.9	
	Gobiesox rhessodon	California clingfish							12.7												
	CIQ gobies	gobies		8.3	10.7	3.2	35.9	13.2	320.7	8.7	66.4	6.0	13.9	21.8	17.8	29.0	35.2	10.0	5.6	21.5	50.1
	Heterostichus rostratus	giant kelpfish									1.1										
	Icelinus spp.	sculpins					1.1														1.0
	Ilypnus gilberti	cheekspot goby							1.0												
	larval fish unid.	unidentified larval fishes				1.1	3.3	1.9			2.1										
	Lepidogobius lepidus	bay goby				1.1	5.4	4.7	5.8	1.1	8.6	2.0	7.0	3.4	4.2	25.6	7.3	5.4	4.7	11.2	18.4
	Leptocottus armatus	Pacific staghorn sculpin											1.2								
	Orthonopias triacis	snubnose sculpin					1.1		1.9	1.1				1.1					.9		1.0
	Pleuronichthys guttulatus	diamond turbot										1.0							.9		
	Pleuronichthys spp.	turbots												1.1							
	Ruscarius creaseri	roughcheek sculpin			2.4					1.1									.9		
	Stenobrachius leucopsarus	northern lampfish				1.1	1.1							1.1							
	Syngnathidae unid.	pipefishes														1.1					
	Zaniolepis frenata	shortspine combfish								1.1											
		TOTAL LARVAE	*0.0*	*11.9*	*17.9*	*10.8*	*50.1*	*27.2*	*402.5*	*17.5*	*105.0*	*14.0*	*29.1*	*30.7*	*36.6*	*61.2*	*47.3*	*18.1*	*22.3*	*39.1*	*76.6*
Eggs																					
	Citharichthys spp. (eggs)	sanddab eggs	3.7	7.1	2.4				1.9	3.3			1.2				1.2				
	fish eggs (damaged)	damaged fish eggs unid.						4.7								6.7					
	fish eggs (undeveloped)	undeveloped fish eggs	43.7	142.4	82.2	177.9	457.3	97.8	263.2	110.4	126.3	254.4	239.0	156.9	1,131.8	188.5	454.3	118.0	447.1	328.2	206.5

	fish eggs unid.	unidentified fish eggs						1.9		1.1		2.0		13.8			1.2		.9		
	Labridae unid. (eggs)	wrasse eggs											1.2				1.2				
	Paralichthyidae unid. (eggs)	sand flounder eggs		4.7	7.1	2.1		.9		16.4		1.0			52.4		12.1				
	Pleuronectiformes unid. (eggs)	flatfish eggs											1.2								
	Pleuronichthys spp. (eggs)	turbot eggs	1.2	1.2		2.1				6.6		4.0		1.1							2.0
	poss. Sciaenidae unid. (eggs)	possible croaker eggs		2.4					4.9									29.1		15.0	2.0
	poss. *Xystreurys liolepis* (eggs)	poss. fantail sole eggs																.9			
	Sciaenidae unid. (eggs)	croaker eggs										8.0	3.5			12.3		2.7	8.4		7.2
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	2.5	10.7		9.6		18.8	6.8	1.1	23.5	18.0	3.5	14.9							1.0
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs																	8.4		
		TOTAL EGGS	*51.1*	*168.5*	*91.7*	*191.7*	*457.3*	*124.1*	*276.8*	*138.9*	*149.8*	*287.4*	*249.6*	*186.7*	*1,184.2*	*207.5*	*470.0*	*150.7*	*464.8*	*343.2*	*218.7*

Table D-5. Ichthyoplankton Density (#/100m^3) - Oblique (Midwater), April 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Yolksac																					
	Genyonemus lineatus	white croaker	2.1			1.1				1.0			1.3								
	CIQ gobies	gobies																			1.0
	larvae, unidentified yolksac	unidentified yolksac larvae												3.2							
	Lepidogobius lepidus	bay goby														2.1					
	Rhinogobiops nicholsi	blackeye goby								1.0											
Larvae																					
	Acanthogobius flavimanus	yellowfin goby									7.3										
	Artedius lateralis	smoothhead sculpin						.9													
	Atherinops affinis	topsmelt							1.4												
	Atherinopsis californiensis	jacksmelt															1.0				
	Bathymasteridae unid.	ronquils	1.0		1.2					2.0							1.0				
	Chitonotus/Icelinus	sculpins				1.1															
	Clinidae unid.	kelp blennies			1.2																
	Clinocottus analis	wooly sculpin		1.1					1.4	1.0				1.1			1.0				
	Clupeiformes unid.	herrings and anchovies												1.1							
	Cottidae unid.	sculpins	1.0		6.1					1.0							1.0		2.2		
	Engraulidae unid.	anchovies															2.0				
	Engraulis mordax	northern anchovy	1.0								1.0								2.2		
	Genyonemus lineatus	white croaker	1.0											1.1			1.0	2.6			2.0
	Gibbonsia spp.	kelpfishes	1.0						18.3												
	Gillichthys mirabilis	longjaw mudsucker									2.1										
	Gobiesocidae unid.	clingfishes	2.1																		
	Gobiesox spp.	clingfishes			7.3				18.3								1.0	1.3		1.2	1.0
	CIQ gobies	gobies	2.1	1.1	15.9	2.2	2.3	9.1	50.7	3.0	66.0	2.6	1.3	8.6		13.7	6.1	24.9	4.3	29.9	10.1
	Hexagrammidae unid.	greenlings							1.4												
	Hypsoblennius spp.	combtooth blennies	1.0	3.2		1.1		.9	18.3	3.0	1.0	1.3		48.2	1.0	6.3	6.1	3.9	1.1	40.3	4.1
	Icelinus quadriseriatus	yellowchin sculpin																	1.1		
	Icelinus spp.	sculpins						.9										1.3			
	Ilypnus gilberti	cheekspot goby							2.8												
	larval fish unid.	unidentified larval fishes		2.2	2.4			.9	1.4	5.1							1.0	5.3			1.0
	larval fish fragment	unidentified larval fishes		1.1	1.2	2.2	1.1		5.6			1.3									
	Lepidogobius lepidus	bay goby			2.4		1.1	3.6	14.1		2.1					11.6	5.1	3.9	10.8	4.6	11.1
	Leptocottus armatus	Pacific staghorn sculpin			1.2																
	Leuresthes tenuis	California grunion			14.7																

	Oligocottus / Clinocottus	sculpins								1.0											
	Orthonopias triacis	snubnose sculpin	1.0	1.1	12.2	2.2											1.0	1.3			1.0
	Oxylebius pictus	painted greenling	1.0																		
	Pomacentridae unid.	damselfishes								1.0											
	Rathbunella spp.	ronquils					1.1														
	Rhinogobiops nicholsi	blackeye goby		1.1						1.0											
	Ruscarius creaseri	roughcheek sculpin	2.1			1.1				6.1			1.3				1.0		1.1		
	Sebastes spp.	rockfishes								2.0											
	Stenobrachius leucopsarus	northern lampfish	3.1	1.1	1.2	2.2	1.1											5.3			
	Typhlogobius californiensis	blind goby		2.1						2.0				2.1			1.0				
	Zaniolepis frenata	shortspine combfish	1.0		1.2					7.1			1.3								
		TOTAL LARVAE	*20.5*	*14.1*	*68.2*	*13.2*	*6.7*	*16.3*	*133.7*	*37.3*	*79.5*	*5.2*	*5.2*	*65.4*	*1.0*	*33.7*	*29.3*	*49.8*	*22.8*	*76.0*	*31.3*
Eggs																					
	Atherinops affinis (eggs)	topsmelt eggs														1.1					
	Citharichthys spp. (eggs)	sanddab eggs	10.5										6.7	70.7		1.1	6.1	1.3	5.4		6.1
	Engraulidae unid. (eggs)	anchovy eggs	21.0																		
	Engraulis mordax (eggs)	northern anchovy eggs	31.5	21.3						3.0		5.3	4.0	1.1				6.6	7.6		
	fish eggs (undeveloped)	undeveloped fish eggs	776.2	4,112.9	734.8	1,968.2	191.7	432.4	4,334.4	789.1	455.9	356.5	505.6	288.3	466.1	110.9	299.4	250.7	615.1	36.8	252.1
	fish eggs unid.	unidentified fish eggs								1.0				4.3							
	Paralichthyidae unid. (eggs)	sand flounder eggs			24.5					8.1				7.5					10.8		
	Pleuronichthys spp. (eggs)	turbot eggs				21.5	3.4	8.2		1.0	8.4	5.3	2.7			3.2	6.1		4.3		4.1
	Sciaenidae unid. (eggs)	croaker eggs	10.5				4.5		14.1				5.4	33.2	30.4		5.1	14.4	4.3	4.6	2.0
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs		42.6			2.3	3.6	28.1			14.5	10.7	60.0	10.1	2.1	5.1		15.1	1.2	3.0
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs					3.4														
		TOTAL EGGS	*849.7*	*4,176.8*	*756.3*	*1,989.7*	*205.3*	*444.2*	*4,376.6*	*802.2*	*464.3*	*381.6*	*535.1*	*465.1*	*506.6*	*118.4*	*321.8*	*273.0*	*662.6*	*42.6*	*267.3*

Table D-6. Ichthyoplankton Density (#/100m^3) - Oblique (Midwater), July 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Yolksac																					
	Gibbonsia spp.	kelpfishes			1.0																
	CIQ gobies	gobies					1.9	1.9			13.6										
	larvae, unidentified yolksac	unidentified yolksac larvae		5.5	1.0					1.1											
	Lepidogobius lepidus	bay goby						1.0		1.1					1.0						
	Paralichthys californicus	California halibut													1.0						
	Perciformes unid.	order Perciformes fishes										.9									
	Pleuronectoidei unid.	flatfishes																		1.0	
	Sciaenidae unid.	croakers		3.3														1.1			
Larvae																					
	Bathymasteridae unid.	ronquils																1.1			
	Blennioidei unid.	blennies	1.0																		
	Clinocottus analis	wooly sculpin									.9										
	Cottidae unid.	sculpins	1.0																		
	Engraulis mordax	northern anchovy					.9	1.0	10.0	2.1			1.0					1.1	2.0	1.0	
	Gobiesocidae unid.	clingfishes								3.2				8.7	2.9			104.1	1.0	14.3	
	CIQ gobies	gobies	3.1	50.8	54.0	10.3	30.7	35.2	3,061.2	75.5	190.8	7.0	3.1	72.6	12.7	21.3	3.1	176.5	8.0	51.6	1.1
	Hypsoblennius spp.	combtooth blennies	16.6	173.5	26.5	56.0	5.6	45.6	10.0	50.0	12.7	23.8	89.4	180.1	53.5	127.0	40.9	133.7	290.2	291.4	120.5
	Hypsypops rubicundus	garibaldi															1.0				
	Icelinus quadriseriatus	yellowchin sculpin																1.1			
	Labrisomidae unid.	labrisomid blennies														.9					
	larval fish unid.	unidentified larval fishes	1.0	5.5	4.1			1.0	59.8				1.0		1.0			9.9	2.0	1.9	
	larval fish fragment	unidentified larval fishes			1.0		.9	1.0			4.5	.9			1.9			4.4			
	Lepidogobius lepidus	bay goby	10.4				7.5	13.3		1.1	61.5	5.3	10.4	4.8	8.8	41.7	7.3	36.2	12.0	22.9	8.7
	Lythrypnus spp.	gobies									.9							1.1			
	Neoclinus spp.	fringeheads	2.1																		
	Orthonopias triacis	snubnose sculpin				1.1						.9								1.0	
	Paraclinus integripinnis	reef finspot						1.0								.9	1.0	4.4	4.0	1.0	
	Paralabrax spp.	sea basses		1.1																	
	Paralichthyidae unid.	sand flounders												5.8							
	Pleuronectiformes unid.	flatfishes											1.0								
	Pomacentridae unid.	damselfishes								1.1			1.0								
	Porichthys myriaster	specklefin midshipman																1.1			
	Porichthys notatus	plainfin midshipman																1.1			

	Rhinogobiops nicholsi	blackeye goby								1.1	.9										
	Syngnathus spp.	pipefishes			2.0																1.1
	Zaniolepis frenata	shortspine combfish																		1.0	
		TOTAL LARVAE	*35.2*	*239.7*	*89.6*	*67.4*	*47.5*	*101.0*	*3,141.0*	*136.3*	*285.8*	*38.8*	*106.9*	*272.0*	*82.8*	*191.8*	*53.3*	*476.9*	*319.2*	*387.1*	*131.4*
<u>Eggs</u>																					
	Citharichthys spp. (eggs)	sanddab eggs	3.1	85.1	20.4	11.4				60.6			3.1	8.7			9.4		9.0	2.9	2.2
	Engraulidae unid. (eggs)	anchovy eggs	2.1										1.0								
	fish eggs (undeveloped)	undeveloped fish eggs	183.0	152.5	73.3	201.1	22.4	72.3	99.7	235.0	55.2	14.1	269.3	50.3	110.0	59.3	100.7	58.1	171.7	85.0	221.5
	fish eggs unid.	unidentified fish eggs			6.1	2.3							2.1	1.9	3.9	.9	4.2		1.0		2.2
	Labridae/Paralichthyidae (eggs)	fish eggs		2.2	1.0		1.9						6.2		1.0		5.2	2.2	5.0	1.0	1.1
	Paralichthyidae unid. (eggs)	sand flounder eggs	1.0																		
	Pleuronichthys spp. (eggs)	turbot eggs	11.4	1.1	1.0	4.6	.9	2.9		8.5		7.9	1.0		1.9		4.2		3.0		1.1
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	4.2	12.2	2.0	8.0	3.7	6.7		17.0	2.7	1.8	6.2	1.0	16.5	.9	19.9	3.3	4.0	5.7	1.1
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs		14.4	16.3	13.7	.9	28.5		73.4	4.5	7.0	20.8		2.9	8.3	6.3		6.0	14.3	19.5
		TOTAL EGGS	*204.8*	*267.5*	*120.1*	*241.1*	*29.8*	*110.4*	*99.7*	*394.5*	*62.4*	*30.8*	*309.7*	*61.9*	*136.2*	*69.4*	*149.9*	*63.6*	*199.7*	*108.9*	*248.7*

Table D-7. Ichthyoplankton Density (#/100m³) - Benthic (Epibenthic), February 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Yolksac																					
	Genyonemus lineatus	white croaker										1.1	1.2								
	CIQ gobies	gobies							1.2												
	larvae, unidentified yolksac	unidentified yolksac larvae												2.1							
	Sciaenidae unid.	croakers													1.0						
Larvae																					
	Acanthogobius flavimanus	yellowfin goby					7.3		39.4		34.0		1.2	1.0	7.2	8.5	4.6		4.0	3.0	9.2
	Artedius lateralis	smoothhead sculpin								1.0									2.0		
	Bathymasteridae unid.	ronquils			1.0										1.0			2.2	1.0	1.0	3.1
	Blennioidei unid.	blennies														1.1				3.0	
	Chaenopsidae unid.	tube blennies															1.1				
	Clinidae unid.	kelp blennies			1.0				1.2												
	Clinocottus analis	wooly sculpin				1.0			1.2	1.0					2.0				1.0	5.0	1.0
	Cottidae unid.	sculpins		3.7				1.0							1.0	3.2					
	Genyonemus lineatus	white croaker								1.0	1.9			1.0		1.1		1.1			1.0
	Gibbonsia spp.	kelpfishes							1.2					1.0			1.1		1.0		
	Gillichthys mirabilis	longjaw mudsucker						1.0			1.9	1.1			1.0	2.1	2.3			1.0	2.1
	Gobiesocidae unid.	clingfishes												2.1							3.1
	Gobiesox spp.	clingfishes							8.6			1.1	1.2			1.1				5.0	
	CIQ gobies	gobies	1.5	7.4	5.1	5.0	59.6	15.0	184.5	19.7	279.9	4.4	13.2	22.6	95.3	109.1	38.9	10.9	21.8	113.7	26.7
	Heterostichus rostratus	giant kelpfish		2.5																	
	Icelinus quadriseriatus	yellowchin sculpin														1.1					
	Icelinus spp.	sculpins					1.0													1.0	
	larval fish unid.	unidentified larval fishes					1.0	11.0	3.7		1.0									1.0	3.1
	larval fish fragment	unidentified larval fishes						2.0					1.2								1.0
	Lepidogobius lepidus	bay goby				4.0	4.2	4.0		10.4	9.7	4.4	4.8	3.1	27.7	40.2	6.9	8.7	16.8	35.9	15.4
	Myctophidae unid.	lanternfishes							1.2												
	Orthonopias triacis	snubnose sculpin		1.2			1.0	3.0	2.5	1.0	1.0	2.2		1.0		4.2	2.3		3.0	4.0	2.1
	Pleuronectidae unid.	righteye flounders				1.0															
	Pleuronichthys guttulatus	diamond turbot													1.0		1.1			1.0	
	Rathbunella spp.	ronquils				1.0										2.1					
	Ruscarius creaseri	roughcheek sculpin		8.6		2.0								1.0	3.1						1.0
	Sebastes spp.	rockfishes													1.0						
	Stenobrachius leucopsarus	northern lampfish					1.0	2.0						1.0							

<u>Juvenile</u>																					
	Heterostichus rostratus	giant kelpfish			1.0																
		TOTAL LARVAE	*1.5*	*23.4*	*8.1*	*14.0*	*75.1*	*39.0*	*244.7*	*34.1*	*329.4*	*14.3*	*22.8*	*35.9*	*141.3*	*173.8*	*58.3*	*22.9*	*50.6*	*174.6*	*68.8*
<u>Eggs</u>																					
	Citharichthys spp. (eggs)	sanddab eggs	3.0	9.8			1.0		2.5	2.1			1.2								
	fish eggs (damaged)	damaged fish eggs unid.																		2.0	
	fish eggs (undeveloped)	undeveloped fish eggs	26.6	111.6	59.6	175.9	220.6	65.8	415.6	51.9	181.7	210.9	145.9	83.0	305.4	71.0	300.7	3,257.5	594.4	64.8	217.5
	fish eggs unid.	unidentified fish eggs					1.0		2.5								2.2				
	Genyonemus lineatus (eggs)	white croaker eggs																			1.0
	Paralichthyidae unid. (eggs)	sand flounder eggs		2.5					7.4	8.3	2.9	12.1			4.1		1.1				
	Paralichthys californicus (eggs)	California halibut eggs											2.4								
	Pleuronichthys spp. (eggs)	turbot eggs		1.2		2.0		8.0		2.1		5.5									
	poss. Sciaenidae unid. (eggs)	possible croaker eggs												8.2						5.0	
	Sciaenidae unid. (eggs)	croaker eggs				1.0						2.2	1.2		9.2	2.1	4.6				9.2
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	4.4	4.9	8.1	6.0	38.7	15.0	11.1		17.5	8.8		5.1							
		TOTAL EGGS	*34.0*	*130.0*	*67.7*	*184.9*	*261.3*	*88.8*	*439.1*	*64.4*	*202.1*	*239.5*	*150.7*	*96.3*	*318.7*	*73.1*	*308.6*	*3,257.5*	*594.4*	*71.8*	*227.7*

Table D-8. Ichthyoplankton Density (#/100m^3) - Benthic (Epibenthic), April 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB4*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Yolksac																					
	Atherinops affinis	topsmelt														1.0					
	Atherinopsidae unid.	silversides							2.2												
	Engraulidae unid.	anchovies												1.3							
	Genyonemus lineatus	white croaker												2.6	5.5						
	Gibbonsia spp.	kelpfishes							2.2												
	larvae, unidentified yolksac	unidentified yolksac larvae				1.1								5.1							
	Lepidogobius lepidus	bay goby											1.2								
	Lyopsetta exilis	slender sole								.9											
	Sciaenidae unid.	croakers												3.8							
Larvae																					
	Alloclinus holderi	island kelpfish			1.1																
	Anchoa spp.	bay anchovies							1.1												
	Artedius lateralis	smoothhead sculpin						1.1	1.1					1.3				1.1			
	Artedius spp.	sculpins				1.1															
	Bathymasteridae unid.	ronquils	.9	1.1		1.1				1.8			3.6					2.2			1.1
	Clinocottus analis	wooly sculpin			1.1	1.1				.9									2.4		
	Cottidae unid.	sculpins	.9		5.4				1.1	.9					1.1			2.2			
	Engraulis mordax	northern anchovy								.9			1.2	2.6		1.0			2.4	1.0	
	Genyonemus lineatus	white croaker		1.1				1.1		.9		1.1		2.6		1.9	1.0		2.4	1.0	1.1
	Gibbonsia spp.	kelpfishes			2.2	2.1			10.9			1.1		2.6							
	Gillichthys mirabilis	longjaw mudsucker						1.1			4.8										
	Gobiesocidae unid.	clingfishes										1.1								1.0	
	Gobiesox spp.	clingfishes			7.6				13.0	.9			2.4	2.6		6.8	1.9	3.3	2.4	2.0	1.1
	CIQ gobies	gobies	2.7	1.1	13.0	3.2	6.3	3.2	118.3	.9	67.3		3.6	11.5	6.6	13.6	6.8	28.8	13.2	26.4	11.3
	Heterostichus rostratus	giant kelpfish			1.1																
	Hypsoblennius spp.	combtooth blennies				1.1			4.3		1.0		7.3	7.7	1.1	6.8	2.9			1.0	3.4
	Icelinus quadriseriatus	yellowchin sculpin																			2.3
	Icelinus spp.	sculpins																1.1			
	larval fish unid.	unidentified larval fishes		1.1		4.3						1.1	1.2			1.0		2.2	2.4	2.0	
	larval fish fragment	unidentified larval fishes						1.1		.9		1.1									
	Lepidogobius lepidus	bay goby					1.0	7.4	11.9	.9	5.8	7.4	4.8	2.6	2.2	5.8	1.0		20.4	8.8	21.4
	Leptocottus armatus	Pacific staghorn sculpin			4.3																
	Leuresthes tenuis	California grunion			20.6																

	Liparis spp.	snailfishes								.9											
	Neoclinus spp.	fringeheads								.9											
	Oligocottus / Clinocottus	sculpins		1.1	1.1																
	Orthonopias triacis	snubnose sculpin		2.2	7.6	4.3	1.0			6.3		1.1	1.2			3.9	2.9	1.1	1.2		
	Parophrys vetulus	English sole				1.1				.9											
	Pleuronichthys verticalis	hornyhead turbot				1.1															
	Rhinogobiops nicholsi	blackeye goby								.9											
	Ruscarius creaseri	roughcheek sculpin	4.5			5.3				8.1			1.2		1.1			1.1	2.4		1.1
	Sciaenidae unid.	croakers											1.2								
	Sebastes spp.	rockfishes				1.1				.9											
	Stenobrachius leucopsarus	northern lampfish	1.8			5.3				1.8		1.1	1.2	1.3			1.0		2.4	1.0	
	Typhlogobius californiensis	blind goby				1.1			1.1					7.7							
	Zaniolepis frenata	shortspine combfish	.9			2.1			1.1	1.8			4.8				1.0		1.2	1.0	
		TOTAL LARVAE	*11.7*	*7.7*	*65.1*	*36.5*	*8.3*	*15.0*	*168.3*	*32.4*	*78.9*	*14.0*	*34.9*	*55.3*	*18.7*	*41.8*	*18.5*	*43.1*	*52.8*	*45.2*	*42.8*
<u>Eggs</u>																					
	Atherinops affinis (eggs)	topsmelt eggs														1.9					
	Citharichthys spp. (eggs)	sanddab eggs						2.1				10.6	6.1	25.7	1.1	1.0			1.2	2.9	2.3
	Engraulis mordax (eggs)	northern anchovy eggs	9.0		10.8		10.4	2.1					2.4		2.2		1.0	4.4	8.4		
	fish eggs (undeveloped)	undeveloped fish eggs	890.3	677.4	1,050.7	2,173.2	490.3	583.9	716.1	5,363.5	426.6	783.4	416.5	410.5	658.5	54.4	231.2	95.3	506.8	91.8	234.5
	fish eggs unid.	unidentified fish eggs																		1.0	
	Paralichthyidae unid. (eggs)	sand flounder eggs			10.8	74.6			65.1						19.7	1.0					
	Pleuronichthys spp. (eggs)	turbot eggs				63.9		3.2		53.7					1.1	5.8	19.4		3.6		6.8
	Sciaenidae unid. (eggs)	croaker eggs											1.2	38.5	2.2	1.9	3.9	3.3	2.4		1.1
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs		10.9				5.3	10.9		1.9	10.6	10.9	12.8	4.4	4.9	4.9		3.6	3.9	6.8
		TOTAL EGGS	*899.3*	*688.3*	*1,072.3*	*2,311.7*	*500.7*	*596.6*	*792.1*	*5,417.2*	*428.5*	*804.6*	*437.1*	*487.5*	*689.2*	*70.9*	*260.4*	*103.0*	*526.0*	*99.6*	*251.5*

Table D-9. Ichthyoplankton Density (#/100m^3) - Benthic (Epibenthic), July 2008

Stage	Taxon	Common Name	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA10	LA14	LA15	LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB12	LB14
Yolksac																					
	Gibbonsia spp.	kelpfishes		1.2																	
	CIQ gobies	gobies					1.0	14.8			50.4				1.0						1.0
	Icelinus quadriseriatus	yellowchin sculpin																	.9		
	larvae, unidentified yolksac	unidentified yolksac larvae				.8								1.1							
	Lepidogobius lepidus	bay goby								2.6							.9				
	Paralichthyidae unid.	sand flounders																.9			
Larvae																					
	Chaenopsidae unid.	tube blennies								.9										.9	
	Clinidae unid.	kelp blennies		1.2																	
	Clinocottus analis	wooly sculpin		1.2																	
	Clupeiformes unid.	herrings and anchovies																		.9	
	Engraulidae unid.	anchovies																		.9	
	Engraulis mordax	northern anchovy	1.0			.8				.9	2.1		2.5		1.0		2.7		.9	1.8	3.0
	Gibbonsia spp.	kelpfishes		2.4					1.0				1.3								
	Gobiesocidae unid.	clingfishes		8.3						1.7			115.3	19.9	9.8	2.9	4.5	28.0	.9	327.1	
	Gobiesox spp.	clingfishes	1.9																		
	CIQ gobies	gobies	5.7	452.0	28.2	9.9	158.1	90.6	941.2	27.6	602.3	9.3	50.7	23.2	23.5	51.4	21.8	117.4	12.0	836.1	11.0
	Hypsoblennius spp.	combtooth blennies	7.6	61.8	18.1	50.2	3.1	13.8	32.5	20.7	9.2	7.5	35.5	87.2	23.5	40.9	21.8	23.3	49.0	101.3	32.0
	Hypsypops rubicundus	garibaldi																1.9			
	Icelinus quadriseriatus	yellowchin sculpin					1.0	2.0			2.1					3.8				1.8	1.0
	Labrisomidae unid.	labrisomid blennies											1.3					2.8			
	larval fish unid.	unidentified larval fishes		40.4	3.4	1.5	1.0	6.9	25.6	.9	2.1	1.9	12.7	1.1			5.9	4.7		28.7	
	larval fish fragment	unidentified larval fishes		14.3			3.1		11.8						1.0	1.0				30.5	
	Lepidogobius lepidus	bay goby	38.1	1.2		.8		63.0		16.4		1.9	49.4		33.3	38.1	37.3	26.1	10.2		48.0
	Lythrypnus spp.	gobies						1.0		.9											
	Orthonopias triacis	snubnose sculpin					1.0														
	Paraclinus integripinnis	reef finspot	1.9					1.0								1.9				.9	
	Perciformes unid.	order Perciformes fishes												1.1							
	Pleuronichthys spp.	turbots											1.3	1.1							
	Porichthys notatus	plainfin midshipman								.9											
	Rhinogobiops nicholsi	blackeye goby						1.0	1.0		1.0							.9	.9		
	Ronquilus jordani	northern ronquil	1.0																		

Juvenile																					
	Heterostichus rostratus	giant kelpfish		1.2																	
		TOTAL LARVAE	*57.2*	*585.2*	*49.7*	*64.0*	*168.3*	*194.1*	*1,013.1*	*73.5*	*669.2*	*20.6*	*270.0*	*134.7*	*93.1*	*140.0*	*94.4*	*206.0*	*74.8*	*1,330.9*	*96.0*
Eggs																					
	Citharichthys spp. (eggs)	sanddab eggs	5.7	1.2	21.5	6.1				24.2				3.3				.9	11.1		
	Engraulidae unid. (eggs)	anchovy eggs	1.9							1.7											
	Engraulis mordax (eggs)	northern anchovy eggs	1.0																		
	fish eggs (undeveloped)	undeveloped fish eggs	100.1	21.4	36.2	116.4	8.2	43.3	31.5	76.0	24.7	12.1	119.1	24.3	48.1	17.1	33.6	42.9	73.9	27.8	42.0
	fish eggs unid.	unidentified fish eggs		8.3	6.8	1.5			7.9	1.7			1.3	1.1							2.0
	Labridae/Paralichthyidae (eggs)	fish eggs	1.9					2.0	1.0	1.7	1.0	.9	3.8		1.0	1.0	3.6				2.0
	Paralichthyidae unid. (eggs)	sand flounder eggs												6.6							
	Pleuronichthys spp. (eggs)	turbot eggs	29.6			4.6		2.0		13.0		10.3	1.3		2.0	1.9			8.3		1.0
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	5.7		1.1	6.1	4.1	12.8		15.6	2.1	2.8	7.6		8.8	3.8	9.1	.9	8.3	2.7	3.0
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs		3.6	3.4	14.5	1.0	37.4	1.0	42.3	39.1	.9	15.2		4.9	9.5	11.8	5.6	18.5	8.1	15.0
		TOTAL EGGS	*145.9*	*34.5*	*69.0*	*149.2*	*13.3*	*97.5*	*41.4*	*176.2*	*66.9*	*27.0*	*148.3*	*35.3*	*64.8*	*33.3*	*58.1*	*50.3*	*120.1*	*38.6*	*65.0*

Table D-10. Ichthyoplankton Density (#/100m^3) – CalCOFI-type tows (Oblique), April 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA4*	*LA5*	*LA6*	*LB1*	*LB2*	*LB3*	*LB5*	*LB6*
Yolksac												
	CIQ gobies	gobies										.8
	Pleuronichthys spp.	turbots										.8
	Sciaenidae unid.	croakers			1.2							
	Zaniolepis spp.	combfishes	.8	.8	1.7							
Larvae												
	Artedius lateralis	smoothhead sculpin			.6							
	Bathymasteridae unid.	ronquils		2.5	1.7		.8					1.5
	Chromis punctipinnis	blacksmith			.6							
	Cottidae unid.	sculpins		.8					1.2			1.5
	Engraulis mordax	northern anchovy			.6			2.0				
	Gillichthys mirabilis	longjaw mudsucker					.8				1.0	
	Gobiesocidae unid.	clingfishes	1.6	.8			.8	1.0	8.2			1.5
	Gobiesox spp.	clingfishes			.6							
	CIQ gobies	gobies	1.6	2.5		6.4	7.5	10.2	5.9	1.0		29.3
	Heterostichus rostratus	giant kelpfish										.8
	Hypsoblennius spp.	combtooth blennies	.8	2.5	1.2		1.5	1.0	15.2	3.9	12.5	6.2
	Icelinus spp.	sculpins			.6							
	larval fish unid.	unidentified larval fishes		.8								2.3
	larval fish fragment	unidentified larval fishes					.8					
	Lepidogobius lepidus	bay goby	1.6		5.8	2.4	3.0	5.1	1.2		1.0	3.9
	Lythrypnus spp.	gobies					.8					
	Orthonopias triacis	snubnose sculpin		2.5	.6			1.0				
	Oxylebius pictus	painted greenling						1.0				
	Ruscarius creaseri	roughcheek sculpin	.8		.6						1.0	
	Sciaenidae unid.	croakers			.6	.8		2.0	1.2			
	Sebastes spp.	rockfishes		1.6	.6							
	Typhlogobius californiensis	blind goby		.8					4.7			.8
		TOTAL LARVAE	***7.2***	***15.6***	***17.0***	***9.6***	***16.0***	***23.3***	***37.6***	***4.9***	***15.5***	***49.4***
Eggs												
	Citharichthys spp. (eggs)	sanddab eggs	16.4					10.2	46.8	19.3	6.7	
	Engraulis mordax (eggs)	northern anchovy eggs	65.7	8.2	11.5				3.5			3.9
	fish eggs (damaged)	damaged fish eggs unid.										.8
	fish eggs (undeveloped)	undeveloped fish eggs	1,175.2	516.4	1,841.5	478.4		470.9	223.7	2,095.2	387.9	176.4
	fish eggs unid.	unidentified fish eggs					352.1				1.0	
	Pleuronichthys spp. (eggs)	turbot eggs	16.4		5.8	3.2	2.3				3.8	
	Sciaenidae unid. (eggs)	croaker eggs	16.4		5.8		1.5		5.9	38.6	4.8	.8
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	57.5	24.6	57.7	4.8	2.3	30.7	100.7	9.7	9.6	13.1
	Trachurus symmetricus (eggs)	jack mackerel eggs					1.5					
		TOTAL EGGS	*1,347.6*	*549.2*	*1,922.3*	*486.4*	*359.7*	*511.8*	*380.6*	*2,162.8*	*413.8*	*195.0*

Table D-11. Ichthyoplankton Density (#/100m^3) - CalCOFI-type tows (Oblique), July 2008

Stage	*Taxon*	*Common Name*	*LA1*	*LA2*	*LA4*	*LA5*	*LA6*	*LB1*	*LB2*	*LB3*	*LB5*	*LB6*
Yolksac												
	CIQ gobies	gobies				3.4						
	larvae, unidentified yolksac	unidentified yolksac larvae		1.2	2.0							
	Sciaenidae unid.	croakers									.9	
Larvae												
	Cottidae unid.	sculpins					1.1					
	Engraulis mordax	northern anchovy					1.1				.9	1.0
	Gobiesocidae unid.	clingfishes	1.1						.9	1.0		5.9
	CIQ gobies	gobies	3.4	25.4	10.0	83.6	17.9		32.2	11.5	1.8	72.9
	Hypsoblennius spp.	combtooth blennies	13.4	157.2	79.7	7.9	28.4	34.4	72.6	65.8	64.7	144.9
	Hypsypops rubicundus	garibaldi	1.1								.9	2.0
	Icelinus quadriseriatus	yellowchin sculpin	1.0									
	larval fish unid.	unidentified larval fishes				1.1	1.1	2.1	3.7			
	larval fish fragment	unidentified larval fishes		1.2		1.1			.9	1.0		1.0
	Lepidogobius lepidus	bay goby	6.7		4.0	24.9	22.1		.9	16.7	8.3	20.7
	Paraclinus integripinnis	reef finspot							.9	1.0		
	Paralichthys californicus	California halibut							1.8			
	Rhinogobiops nicholsi	blackeye goby									.9	
	Syngnathus spp.	pipefishes		1.2	1.0	1.1		1.1		1.0		2.0
		TOTAL LARVAE	25.7	186.2	96.7	123.1	71.7	37.6	113.9	98.0	78.4	251.4
Eggs												
	Anchoa spp. (eggs)	bay anchovy eggs							.9			
	Citharichthys spp. (eggs)	sanddab eggs	7.8	38.1	8.0		1.1		1.8	2.1	4.6	
	Engraulis mordax (eggs)	northern anchovy eggs	2.2									
	fish eggs (damaged)	damaged fish eggs unid.										1.0
	fish eggs (undeveloped)	undeveloped fish eggs	209.3	168.8	164.3	3.4	45.3	109.6	132.4	75.2	61.0	43.4
	fish eggs unid.	unidentified fish eggs								2.1	12.9	
	Labridae/Paralichthyidae (eggs)	fish eggs	4.5	11.6	1.0		1.1		6.4	5.2	9.2	3.0
	Oxyjulis californica (eggs)	senorita eggs	1.1					1.1	2.8	1.0		
	Paralichthyidae unid. (eggs)	sand flounder eggs									3.7	
	Pleuronichthys spp. (eggs)	turbot eggs	40.3	2.3			4.2	4.3	1.8			
	Sciaenidae unid. (eggs)	croaker eggs	1.1	5.8	10.0		2.1				6.3	2.8
	Sciaenidae/Paralichthyidae unid. (eggs)	fish eggs	7.8	5.8	22.9	2.3	20.0	4.3	2.8			1.8
	Sciaenidae/Paralichthyidae/ Labridae unid. (eggs)	fish eggs				1.1						
		TOTAL EGGS	274.1	232.4	206.2	6.8	73.8	119.3	148.9	91.9	96.0	47.4

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APPENDIX E

INFAUNA

Table E-1. Infauna Species, Winter 2008

Taxon	*LA-1*	*LA-10*	*LA-11*	*LA-12*	*LA-13*	*LA-14*	*LA-15*	*LA-2*	*LA-3*	*LA-4*	*LA-5*	*LA-6*	*LA-7*	*LA-8*	*LA-9*	*LB-1*	*LB-10*	*LB-11*	*LB-12*	*LB-13*	*LB-14*	*LB-2*	*LB-3*	*LB-4*	*LB-5*	*LB-6*	*LB-7*	*LB-8*	*LB-9*
Crustaceans																													
Alienacanthomysis macropsis							8																						
Ampelisca brachycladus																2													
Ampelisca brevisimulata																													
Ampelisca careyi																													
Ampelisca cristata cristata														2															
Ampelisca cristata microdentata		2													2	3		2				42							
Ampelisca spp.														2			2												
Amphideutopus oculatus								8	18	7			13			7		3		7		10			2				
Ampithoe plumulosa																													
Anoplodactylus erectus																													
Betaeus ensenadensis														7															
Betaeus longidactylus																													
Caecognathia crenulatifrons	3	2								8	5				2	2		3		8			2				7		
Caprella natalensis								2																					
Caprella simia																													
Corophium heteroceratum				2				23	12	2			27	12	2	5	5	7		3		20			2		3		
Crangon alaskensis										2																			
Crangon nigricauda																													
Eochelidium spp. A		2		7	10	23	2		2		12	3	15		2		5	3		2	2								
Eualus lineatus																													
Euphilomedes carcarodonta			2					50	2		2	2	7			7				2		8					2	2	7
Eusarsiella thominx								2																					
Foxiphalus golfensis								10										2											
Foxiphalus obtusidens								2																					
Grandidierella japonica						10																							
Hemiproto spp. A																													
Heterophoxus ellisi													13	3															
Hippomedon spp.																													
Leptochelia dubia								12																					
Listriella diffusa								3																					
Listriella goleta	2	5						2		8		10	7	13			5	7			3	2	5		3		3		13

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Malacoplax californiensis								2																				2	
Mayerella acanthopoda								2																					
Monocorophium acherusicum								2																					
Monocorophium insidiosum																													
Mysidopsis intii																	3			2		3					2		
Nebalia pugettensis-complex																													
Neomysis kadiakensis																													
Neotrypaea gigas	2	7		2	2		2	5		7	20	5	5	12	5	2	3	3		3	17	2	7		10	2	20	3	12
Oxyurostylis pacifica								2	2																				
Pacifacanthomysis nephrophthalma				2											2														
Paramicrodeutopus schmitti																													
Photis brevipes									3																				
Photis californica								3																					
Pinnixa franciscana								2								3		3				2	2				3		
Pinnixa schmitti																													
Pinnotheridae unid.																			3										
Podocerus brasiliensis																													
Pyromaia tuberculata		2											2																
Rudilemboides stenopropodus																													
Scleroplax granulata	2	7								15			20	15	2	7	2	3	3	5	5	3	7		7		7		3
Westwoodilla tone		2											2	2						2					2	2			
Zeuxo normani					2																								
Echinoderms																													
Amphiodia digitata								2					2			2													
Amphiodia psara																													
Amphiodia urtica	2		2											2								3							8
Amphipholis squamata		2											2																
Leptosynapta spp.																2													
Ophiuroconis bispinosa																													
Molluscs																													
Acteocina inculta								2																					
Alvania spp.											2																		

Taxon	*LA-1*	*LA-10*	*LA-11*	*LA-12*	*LA-13*	*LA-14*	*LA-15*	*LA-2*	*LA-3*	*LA-4*	*LA-5*	*LA-6*	*LA-7*	*LA-8*	*LA-9*	*LB-1*	*LB-10*	*LB-11*	*LB-12*	*LB-13*	*LB-14*	*LB-2*	*LB-3*	*LB-4*	*LB-5*	*LB-6*	*LB-7*	*LB-8*	*LB-9*
Axinopsida serricata																					2								
Caesia perpinguis																													
Chaetodermatidae unid.																	2												
Compsomyax subdiaphana	5											2					2								2			2	
Cooperella subdiaphana								2	2																				
Crassostrea gigas					2																								
Crepidula onyx					10																								
Cryptomya californica											3					5				5	2					2	2		2
Cylichna diegensis	2																												
Ensis myrae																						2							
Epitonium sawinae																													
Gadila aberrans	7	2																				5				2			5
Gastropteron pacificum																													
Glossaulax reclusianus																													
Hima mendica																													
Kellia suborbicularis																													
Laevicardium substriatum																													
Leptopecten latiauratus								2							2					2									
Lucinisca nuttalli																													2
Lyonsia californica								2								2													
Macoma nasuta																													
Macoma yoldiformis								2	3							5					2	3							2
Mactrotoma californica					2																								
Modiolus rectus																													
Mytilus galloprovincialis					2																								
Nassarius perpinguis					2																								
Neaeromya compressa																											2		2
Nuculana taphria	30		3	3				2	5				2									2				3			15
Nutricola spp.																													
Odostomia spp.	2																												
Olivella baetica																													2
Parvaplustrum spp. A																													
Parvilucina tenuisculpta	5								2						2														
Periploma discus		2	2													2		2	2									2	2
Petricola spp.																													

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Philine auriformis		2																	2							2	2		
Philine spp. A													2					2					2			2		2	
Protothaca laciniata																				3									5
Raeta undulata																				3			2						
Rhamphidonta retifera										3																			
Rictaxis punctocaelatus		2		2	3																	3			2		2	2	2
Rochefortia compressa																													
Rochefortia grippi													3														2		
Rochefortia tumida	2		5					2	2						3														2
Saxicavella nybakkeni	17																									2	2		5
Saxidomus nuttalli																													
Siliqua lucida																													
Solamen columbianum																													
Solen rostriformis																													
Solen sicarius																													
Tagelus subteres		2						3					5																
Tellina cadieni		3	2																										
Tellina meropsis																													
Tellina modesta								2								2													2
Theora lubrica		15	12	23					27	2			55	5	5		2	32	2			3	12		2			5	2
Thyasira flexuosa				2			3				3				3				3	3	5		2		3				2
Trachycardium quadragenarium																													
Tubulanus polymorphus																													
Turbonilla spp.																						2						2	3
Venerupis phillippinarum					2																								
Vitrinella oldroydi												3					2				2								
Volvulella panamica		2	2									2				2		2	2								3		2
Other Minor Phyla																													
Carinoma mutabilis																													
Ceriantharia spp.			2		3																								
Edwardsia juliae	2									15																			7
Edwardsia olguini																							2			2			
Glottidia albida																													2
Limnactiniidae spp. A			2																										
Lineus bilineatus																													2

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Listriolobus pelodes	3		2								2															2	2		
Micrura spp.		2							2		2	2					2	2		3		2					5	3	3
Organic fragment																													2
Thysanocardia nigra																													
Tubulanus cingulatus		2	3		5					3							2						2						
Tubulanus nothus																													
Tubulanus polymorphus	2	2	7	2	2	3						2					2	2		3				3	5		3		2
Zygeupolia rubens																													
Polychaetes																													
Acmira horikoshii																2													
Amaeana occidentalis			2													2													
Ampharete labrops			2																										
Amphicteis scaphobranchiata	2		2			3												3		2		2				2			
Anoplodactylus erectus													3																
Aphelochaeta monilaris		2			2												10	2	2							2	2		
Aphelochaeta petersenae										2	3	5					22	27	2	3	7		2		8	2			2
Aphelochaeta spp. SD5											2									2				17					
Apoprionospio pygmaea													2																
Armandia brevis						3																			2				
Boccardia basilaria										3	12																		
Capitella capitata-complex																													
Caulleriella pacifica																								3					
Chaetozone corona					2					2	5					2		3		2	2	5	2		5				
Chaetozone hartmanae																													
Chone bimaculata																													
Cirriformia spp. SD1					5																								
Cossura candida				3													3	10								2	20		
Cossura spp. A	3	7	5	8	20		2	98	2		2	13	12	3		7	7	15	7	8	5	2	18		7	12	3	3	2
Diopatra ornata																													
Diopatra tridentata	2									2																2			
Diplocirrus sp. SD1																											3		
Dipolydora bidentata																													
Dipolydora socialis								2			2				2	2													
Drilonereis falcata																													
Drilonereis spp.																				2							2		2

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Euchone limnicola						3			7				22	2				5					10						
Euclymeninae spp. A																3									2			5	5
Eulalia californiensis																													
Eumida longicornuta																									2				
Eunice americana																													
Eupolymnia heterobranchia																													
Exogone lourei						3																							
Glycera americana			2		2		2	2		3					2				3	3		2	3		2	2	3		2
Glycera nana			2																								2		3
Glycinde armigera								2		2																			
Goniada littorea													2									2							
Gyptis brunnea																										2			
Halosydna johnsoni																													
Harmothoe imbricata-complex					3																								
Hesperonoe laevis									2																	3	2		
Laonice cirrata		2			2		12			2		2			5	2	5	5		2					3			2	3
Leitoscoloplos pugettensis	7	7	2		28			3			2			2	2	8	3				3	3	2	3	3		5	3	13
Lepidasthenia berkeleyae																3													
Levinsenia gracilis								15																					
Lumbrineris californiensis													2																
Lumbrineris cruzensis																													
Lumbrineris japonica	2															2								7	2				2
Lumbrineris ligulata																													
Lysippe spp. A			2												2														
Malmgreniella macginitiei	5		2									2			2				3	3			2		2			2	2
Marphysa disjuncta												3																2	
Marphysa stylobranchiata																										2			
Mediomastus spp.		8											5			2		5		2	2			7					2
Megalomma pigmentum							2																						
Melinna oculata																													
Metasychis disparidentatus																										2			
Monticellina cryptica																		2								2	2		
Monticellina siblina		2	2		33	3	15	7	2	20	8	7				5		28		3	2	3	10	7	10		8	8	

Taxon	*LA-1*	*LA-10*	*LA-11*	*LA-12*	*LA-13*	*LA-14*	*LA-15*	*LA-2*	*LA-3*	*LA-4*	*LA-5*	*LA-6*	*LA-7*	*LA-8*	*LA-9*	*LB-1*	*LB-10*	*LB-11*	*LB-12*	*LB-13*	*LB-14*	*LB-2*	*LB-3*	*LB-4*	*LB-5*	*LB-6*	*LB-7*	*LB-8*	*LB-9*
Myxicola spp.																													
Naineris dendritica					2																								
Neanthes acuminata-complex																													
Nephtys caecoides								5	2	2																	2		
Nephtys cornuta				2									3	2															
Nephtys ferruginea			2					2																				2	
Nereis procera	2	2	2					2		3		5			2	5	2			2	7		3		7	3	3	2	5
Nicolea spp. A									2																				
Ninoe tridentata																													
Notocirrus californiensis																													2
Notomastus spp. A	3				5							2								2							2	2	5
Ophiodromus pugettensis																													
Owenia collaris																													2
Paramage scutata	5	5	3		3							7											12		5	2	3		
Parandalia fauveli												2			2				2										
Paraprionospio alata	3		7				5			8	2					2		2		12		3	12		5			8	5
Pectinaria californiensis																2					2	2				2			2
Petaloclymene pacifica					2		3																			2			
Pherusa capulata					2																								
Pherusa papillata					2																								
Phisidia sanctaemariae																													
Pholoe glabra			3													2										3		2	3
Phyllodoce longipes								3																					
Pilargis berkeleyi																	2	2											
Pista agassizi																													
Pista moorei																													
Pista percyi	7	12	12	2	2	3				2		2								3				7			3	3	8
Pista wui												13			7	2			7	2	3		7		5	3	2		5
Platynereis bicanaliculata																													
Podarkeopsis glabra																2		2					2		2				
Poecilochaetus johnsoni													2														2		
Poecilochaetus spp. A	2		2								2															2	8		2
Polycirrus californicus																												2	
Polycirrus spp. A																													
Polydora spp.										2																			

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Praxillella pacifica	2															2													2
Prionospio (Prionospio) jubata		2	5		7							2			2			5		10	2		2		10		2	2	2
Prionospio heterobranchia													2																
Prionospio lighti					2			2			3		2																
Protomedeia articulata-complex													5																
Pseudopolydora paucibranchiata									3				2					2											
Scalibregma californicum																													
Schistomeringos annulata		3			7	30																		3					
Scoletoma erecta																													
Scoletoma spp. A	2							2						2		2	3			2		10					3	2	
Scoletoma spp. B				2												2					2								
Scoletoma spp. C					2	3								3		2												2	
Scoloplos acmeceps																2						2							
Scyphoproctus oculatus																													
Sigambra tentaculata	3	2		2						2					2									7			8		2
Sige spp. A																													
Spiochaetopterus costarum			2															2		2							2	2	
Spiophanes berkeleyorum				10	2		17		2	3	22	7				2	10	7		8			3		2		8		5
Spiophanes bombyx								7																					
Spiophanes duplex	2			3	2		8		2	8	2		2	2	2			5	2	7			5	7	7		3	3	7
Sthenelais fusca																												2	
Sthenelais tertiaglabra																													
Sthenelanella uniformis		5																											
Streblosoma crassibranchia												5								2									
Streblosoma spp. 1												2																	
Streblosoma spp. B	15			2						22	5				2	8			2				15		5	3	5	23	20
Syllis (Ehlersia) hyperioni		2																											
Tenonia priops								2																				2	
Terebellides californica	2	2																										2	2
Typosyllis hyperioni																													

Table E-2. Infauna Species, Summer 2008

Taxon	*LA-1*	*LA-10*	*LA-11*	*LA-12*	*LA-13*	*LA-14*	*LA-15*	*LA-2*	*LA-3*	*LA-4*	*LA-5*	*LA-6*	*LA-7*	*LA-8*	*LA-9*	*LB-1*	*LB-10*	*LB-11*	*LB-12*	*LB-13*	*LB-14*	*LB-2*	*LB-3*	*LB-4*	*LB-5*	*LB-6*	*LB-7*	*LB-8*	*LB-9*
Crustaceans																													
Alienacanthomysis macropsis		2					2	2		8		3			2	2													
Ampelisca brachycladus																													
Ampelisca brevisimulata																												2	
Ampelisca careyi																			2		2								
Ampelisca cristata cristata													2			3						28							
Ampelisca cristata microdentata																													
Amphideutopus oculatus			3				3	8	90	12			63		2	5	25	2	2			35	5	12			2		2
Ampithoe plumulosa						2																							
Anoplodactylus erectus													2																
Betaeus ensenadensis																						3							
Betaeus longidactylus														2	2														
Caecognathia crenulatifrons		2	15	2							8	2	3			2		13	12	2		2		2	2				
Caprella natalensis																													
Caprella simia				2																			2	3					
Corophium heteroceratum				2					3				25	102			2	2				23			2				
Crangon alaskensis					2										2														
Crangon nigricauda																			2						2				
Eochelidium spp. A			8	58	8			5	10	3		2	15	5	2			3			3		8	5			2		
Eualus lineatus																							2						
Euphilomedes carcarodonta			13	13			13	45	25			2	8	15	2	10			2	2		30					2	2	17
Eusarsiella thominx																													
Foxiphalus golfensis																													
Foxiphalus obtusidens																													
Grandidierella japonica						23																		33					
Hemiproto spp. A			2							2	2	8	2											3					
Heterophoxus ellisi												2	40	3															
Hippomedon spp.													2																
Leptochelia dubia																													
Listriella diffusa								2																					
Listriella goleta	5	2		2			12		13	7	7	2	2	5			7		3	8	3		5				3		2
Malacoplax californiensis																													

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Mayerella acanthopoda																													
Monocorophium acherusicum																													
Monocorophium insidiosum													5																
Mysidopsis intii				2			2	2		2								3	5								2		
Nebalia pugettensis-complex						800	2						2																
Neomysis kadiakensis										3										5									
Neotrypaea gigas		5								2	13	3	2	12		8	5	2	2	2	5	5	2		2	2	3		2
Oxyurostylis pacifica		2							5																				2
Pacifacanthomysis nephrophthalma																													
Paramicrodeutopus schmitti													35																
Photis brevipes													2									17							
Photis californica																						2							
Pinnixa franciscana	5									2							2		2		2							2	3
Pinnixa schmitti		2																											
Pinnotheridae unid.																													
Podocerus brasiliensis													2																
Pyromaia tuberculata																		2						2					
Rudilemboides stenopropodus																				2				7					
Scleroplax granulata		5			7		38			2	8	2	25	10		3	12	2	5			12			5	3	5		
Westwoodilla tone																2	2		3	3	3		8			2	2	2	3
Zeuxo normani												3												42					
Echinoderms																													
Amphiodia digitata									5													2		2					2
Amphiodia psara																2													
Amphiodia urtica	10	2	3	2											5							2					3	5	13
Amphipholis squamata			3				3					3	10											5					
Leptosynapta spp.																						2							
Ophiuroconis bispinosa																										2			
Molluscs																													
Acteocina inculta									2										2										
Alvania spp.																													
Axinopsida serricata																													3
Caesia perpinguis					2																								

Taxon	*LA-1*	*LA-10*	*LA-11*	*LA-12*	*LA-13*	*LA-14*	*LA-15*	*LA-2*	*LA-3*	*LA-4*	*LA-5*	*LA-6*	*LA-7*	*LA-8*	*LA-9*	*LB-1*	*LB-10*	*LB-11*	*LB-12*	*LB-13*	*LB-14*	*LB-2*	*LB-3*	*LB-4*	*LB-5*	*LB-6*	*LB-7*	*LB-8*	*LB-9*
Chaetodermatidae unid.																													
Compsomyax subdiaphana										2	5				3				2			2							2
Cooperella subdiaphana								7	3		2		8		2							12							3
Crassostrea gigas																													
Crepidula onyx																													
Cryptomya californica											7			3	2	3	2			2		3			2				
Cylichna diegensis																													2
Ensis myrae																													
Epitonium sawinae																													2
Gadila aberrans		3	2										2		17	3										5		8	7
Gastropteron pacificum															2														
Glossaulax reclusianus																													2
Hima mendica																								2					
Kellia suborbicularis	7															2				2	2						3		
Laevicardium substriatum													2																
Leptopecten latiauratus																													
Lucinisca nuttalli																													
Lyonsia californica								5	22	2	2		2									2							
Macoma nasuta													3																
Macoma yoldiformis									7	2			3									12		2				3	7
Mactrotoma californica								63	38	2			5									33							
Modiolus rectus																				2									
Mytilus galloprovincialis												2																	
Nassarius perpinguis																													
Neaeromya compressa																													
Nuculana taphria	7							7	10				3		2							8				3		3	7
Nutricola spp.								2							2														
Odostomia spp.	2																							2					
Olivella baetica																													
Parvaplustrum spp. A				13																									
Parvilucina tenuisculpta	2																												2
Periploma discus	3		3									2			5			2		2									
Petricola spp.																								2					
Philine auriformis	2	2			2						2	5			2	2	2			2	2					2	2		
Philine spp. A	5	2																	2	2	2		2	2					2

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Protothaca laciniata																													
Raeta undulata							2			2		2	2							2					2				
Rhamphidonta retifera																													
Rictaxis punctocaelatus	3	7		2	7		2				2				2														3
Rochefortia compressa												2			2		2	2					2						
Rochefortia grippi									5																				
Rochefortia tumida		3		3				3	2	2		2			2		5					2		2	2			2	3
Saxicavella nybakkeni																													2
Saxidomus nuttalli													3												2				
Siliqua lucida																						2							
Solamen columbianum																												2	
Solen rostriformis																						2							
Solen sicarius									3	5			5									12			5	2			
Tagelus subteres													2																
Tellina cadieni	2																												
Tellina meropsis													2		2							7		2					
Tellina modesta								12	13													3							
Theora lubrica	2	25	3	53	175		98	5	10		15	63	87	7	35	8	27	22	32	17	28	13	13		7	18	7	33	
Thyasira flexuosa									2			2			2						2		5		8	3			
Trachycardium quadragenarium				2																									
Tubulanus polymorphus												3			2														
Turbonilla spp.																												2	
Venerupis phillippinarum																													
Vitrinella oldroydi		3									2																		
Volvulella panamica	5		2												5	2	2				2					3	2		10
Other Minor Phyla																													
Carinoma mutabilis							3															2		2	3				
Ceriantharia spp.					2																			3					
Edwardsia juliae										12																			
Edwardsia olguini																									2				
Glottidia albida																													
Limnactiniidae spp. A																													
Lineus bilineatus	2																												
Listriolobus pelodes																													

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Micrura spp.																													
Organic fragment																													
Thysanocardia nigra												2																	
Tubulanus cingulatus					2							2													2		2		
Tubulanus nothus												2							2										
Tubulanus polymorphus	2	5	3	2	5		2	2		3							2	2		3	2		2	3		2		2	
Zygeupolia rubens									3																	2			
Polychaetes																													
Acmira horikoshii			2				2															2							
Amaeana occidentalis							2								2														
Ampharete labrops			2		3		2	2	2	5	5	5								3		5	2	2				2	
Amphicteis scaphobranchiata							2			2		10			5					2				5			2		
Anoplodactylus erectus																													
Aphelochaeta monilaris			2		3							2							2				3	2	7	2	2	2	2
Aphelochaeta petersenae			2	2			2		2	3	7	8					13	5			7		8	10	5	2		2	2
Aphelochaeta spp. SD5																								10					
Apoprionospio pygmaea																						2							
Armandia brevis						2																							
Boccardia basilaria																												2	
Capitella capitata-complex						23																							
Caulleriella pacifica																													
Chaetozone corona					5		2		2	5	2	2									2	8	2			2			2
Chaetozone hartmanae			2																										
Chone bimaculata																		2											
Cirriformia spp. SD1																													
Cossura candida																	8	2	17			2			8	15	2		
Cossura spp. A	3			12	57		5	10	13	2		68	20	7		10	5		2		5	25	8	10	7	3	2		5
Diopatra ornata															3							2					2		
Diopatra tridentata							2			2						2	2						3		13		2		
Diplocirrus sp. SD1																													
Dipolydora bidentata												2					5												
Dipolydora socialis					2							2	2					2											
Drilonereis falcata																											3		2
Drilonereis spp.																													

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Euchone limnicola				8	13		8	2	2	23		30	33	3				3	2				25	8	2			2	
Euclymeninae spp. A												2																	
Eulalia californiensis			2																										
Eumida longicornuta																												2	
Eunice americana												2																	
Eupolymnia heterobranchia			2							2																			
Exogone lourei																								5					
Glycera americana	2	2	3	2						2		2			2	2		2			2		2	2		2		3	5
Glycera nana			2				2					2					3												
Glycinde armigera																								2					
Goniada littorea																						3							
Gyptis brunnea		2																											
Halosydna johnsoni						2																							
Harmothoe imbricata-complex						2																							
Hesperonoe laevis																		2											2
Laonice cirrata	5		3						2	3					5	10	2	2		2			3			12		2	2
Leitoscoloplos pugettensis	2	3			5		3					2			3	2	2							20	7		2		7
Lepidasthenia berkeleyae																													
Levinsenia gracilis												2																	
Lumbrineris californiensis																													
Lumbrineris cruzensis	2																												
Lumbrineris japonica										2					2									2				3	
Lumbrineris ligulata												3					2												
Lysippe spp. A		2	2				2								2										3				
Malmgreniella macginitiei	2	2	2				2								3		2		3	2	2					2	3	2	
Marphysa disjuncta												3					3								2			2	
Marphysa stylobranchiata																													
Mediomastus spp.					2							5	2	5								5		2					
Megalomma pigmentum			3				5				2	5						2											
Melinna oculata												12			2									2					
Metasychis disparidentatus										2																			
Monticellina cryptica												3																	
Monticellina siblina			2		17		22		18	18		5	2					12	2	2	12	15	40	3	5	2	2	7	
Myxicola spp.												2																	

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Naineris dendritica																													
Neanthes acuminata-complex						5																							
Nephtys caecoides		2											3												2	2			
Nephtys cornuta					2																			2					
Nephtys ferruginea															2			2								2			
Nereis procera																													
Nicolea spp. A																													
Ninoe tridentata																													2
Notocirrus californiensis																													
Notomastus spp. A			2								2													2	2		3	2	3
Ophiodromus pugettensis						2																							
Owenia collaris																													
Paramage scutata	2	12	3		2		7			2	5	18			17			3	2	20	2						10		2
Parandalia fauveli																													
Paraprionospio alata	2		2				2		2	5		2	2		2	2		2		2		3				2	3	2	
Pectinaria californiensis								2											2										3
Petaloclymene pacifica							7						5			5						3		8	5				5
Pherusa capulata																													
Pherusa papillata																													
Phisidia sanctaemariae										2																			
Pholoe glabra				2																								2	
Phyllodoce longipes							2																						
Pilargis berkeleyi																													
Pista agassizi		8	2	5	45		18			10	32	28			15		2			20			2	20	8	5	27	5	
Pista moorei												2																	
Pista percyi																													
Pista wui	5	3	5	2	12		10		2	7	12	27			5	2	10	7	2	5	3		5	3	7	3	12	10	3
Platynereis bicanaliculata									2																				
Podarkeopsis glabra																	2		2										
Poecilochaetus johnsoni																													
Poecilochaetus spp. A						2						2			2												2		
Polycirrus californicus																													
Polycirrus spp. A			2							2																			
Polydora spp.																													

Taxon	LA-1	LA-10	LA-11	LA-12	LA-13	LA-14	LA-15	LA-2	LA-3	LA-4	LA-5	LA-6	LA-7	LA-8	LA-9	LB-1	LB-10	LB-11	LB-12	LB-13	LB-14	LB-2	LB-3	LB-4	LB-5	LB-6	LB-7	LB-8	LB-9
Praxillella pacifica																						2							2
Prionospio (Prionospio) jubata										2					2									2				2	
Prionospio heterobranchia						2						2			2														
Prionospio lighti																													
Protomedeia articulata-complex																													
Pseudopolydora paucibranchiata				20	13		2	3	13	2		2	132	125								2		5					
Scalibregma californicum																									2				
Schistomeringos annulata						20						3												7					
Scoletoma erecta						2																		5					
Scoletoma spp. A	2	3			2		3	3	5	2					2		8	2	2	2	2	20		2		2	2		7
Scoletoma spp. B	2												2		2			2				2		3	3			3	2
Scoletoma spp. C					2									8											2				
Scoloplos acmeceps																													
Scyphoproctus oculatus																								2					
Sigambra tentaculata										2	5	2			2					2	2		3	3					
Sige spp. A							2																						
Spiochaetopterus costarum																		2				2							
Spiophanes berkeleyorum			2				3	5		5	15	7	3		2	2		2		3		3	5	2		3			7
Spiophanes bombyx																		2											
Spiophanes duplex			2		2			3		10				3			2	10	2	5		10	10	3	2	2	5	3	3
Sthenelais fusca																													
Sthenelais tertiaglabra												2																	
Sthenelanella uniformis																													
Streblosoma crassibranchia							2					10			2					2				2				5	
Streblosoma spp. 1																								2					
Streblosoma spp. B	7		7		5		70		22	3	90	2	3		2	2	2	5	2	2		10	27		2	8	7	5	15
Syllis (Ehlersia) hyperioni																													
Tenonia priops			2				2		2	2					2												2		2
Terebellides californica	17						7		2	5	2				7												2		
Typosyllis hyperioni												2																	

Table E-3. Otter Trawl, Winter 2008

Taxon	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB04*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
DAY SAMPLES																			
Crustaceans																			
Betaeus longidactylus																			
Crangon alaskensis					3	60		1	32										
Crangon nigricauda																			
Crangon nigromaculata			1	2			4	6	22		37	31	15		14		2		
Heptacarpus palpator																			
Heptacarpus spp.	136			1				33					1						1
Heptacarpus stimpsoni																			
Loxorhynchus crispatus													1						
Loxorhynchus grandis																			
Oregonia gracilis		3				9													
Pagurus spilocarpus																			
Panulirus interruptus			1								6	4							
Penaeus californiensis	35												2		2	5			
Portunus xantusii			2			2		2								1			
Pyromaia tuberculata				1				5	35				1						
Sicyonia ingentis	6		3	1		2		1			2		1		6	29		1	
Sicyonia penicillata																			
Echinoderms																			
Ophiothrix spiculata																			
Parastichopus californicus																			
Molluscs																			
Aplysia californica		1																	
Compsomyax subdiaphana																			
Dendronotus iris																			
Navanax inermis			2													1			
Pectinidae unid.																			
Philine alba																			
Philine spp.	1		2			1													
Triopha maculata	1																		
Venerupis phillippinarum																			

Taxon	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB04*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Other Minor Phyla																			
Porifera unid. (encrusting)																			
Styela spp.																			
NIGHT SAMPLES																			
Crustaceans																			
Betaeus longidactylus			1																
Crangon alaskensis																			
Crangon nigricauda				8		11		24	69		401	4			35	11	5	1	13
Crangon nigromaculata	65	14	37	103		2	44	111	26		39	301	64		233	1	122	56	110
Heptacarpus palpator																			6
Heptacarpus spp.		1		2		183	8	4				10							
Heptacarpus stimpsoni									5		9				30	2			
Loxorhynchus crispatus																			
Loxorhynchus grandis		1															1		
Oregonia gracilis																			
Pagurus spilocarpus												1							
Panulirus interruptus			1				1					12	1					1	
Penaeus californiensis													1						
Portunus xantusii	1	23	365	14	1	11		9			13	1	39		1		6	2	3
Pyromaia tuberculata		1		3	4	24	1		1		16		5		7	14		30	7
Sicyonia ingentis	108	1		7		2		69			5	4			22	7	14	4	
Sicyonia penicillata	3											18					12		2
Echinoderms																			
Ophiothrix spiculata							1				1								
Parastichopus californicus																	1		
Molluscs																			
Aplysia californica																			
Compsomyax subdiaphana											1								
Dendronotus iris						1													
Navanax inermis							1									1			
Pectinidae unid.																1			
Philine alba	4		1																
Philine spp.																			1

Taxon	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB04*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Triopha maculata																			
Venerupis phillippinarum											2								
Other Minor Phyla																			
Porifera unid. (encrusting)																1			
Styela spp.											1								

Table E-4. Otter Trawl, Spring 2008

Taxon	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA10	LA14	LA15	LB1	LB2	LB3	LB04	LB5	LB6	LB7	LB12	LB14
DAY SAMPLES																			
Crustaceans																			
Brachyura unid.			1																
Callianassa californiensis																			
Crangon alaskensis						2													
Crangon nigricauda							5				1							1	
Crangon nigromaculata	16															1	7		
Eualus lineatus																			
Heptacarpus spp.																			
Heterocrypta occidentalis																			
Pagurus armatus																			
Palaemon macrodactylus																			
Pandalus danae																			
Pandalus spp.			1																
Panulirus interruptus											5	1							
Penaeus californiensis										1									
Pinnotheridae unid.																			1
Portunus xantusii		1	17														1		
Pyromaia tuberculata	1		1	1	2			2		1									
Sicyonia ingentis	26		1	1				3			1		9	1	6	1	29	5	9
Echinoderms																			
Astropecten armatus																			
Ophiothrix spiculata																			
Parastichopus californicus																			
Parastichopus parvimensis																		1	
Patiria miniata						1													
Pisaster brevispinus																			
Strongylocentrotus franciscanus																			
Strongylocentrotus purpuratus										1									
Molluscs																			
Acanthodoris rhodoceras					1														
Aplysia californica						2													

Taxon	LA1	LA2	LA3	LA4	LA5	LA6	LA7	LA10	LA14	LA15	LB1	LB2	LB3	LB04	LB5	LB6	LB7	LB12	LB14
Caesia perpinguis																			
Dendronotus iris					1														
Euspira lewisii	1			1															
Hima mendica																			
Nassarius fossatus					1														
Navanax inermis							1							1					
Peltodoris nobilis														1					
Philine spp.																	1		
Pleurobranchaea californica																			
Rossia pacifica																			
Triopha maculata						1													
Other Minor Phyla																			
Boltenia villosa																			
Molgula sp.																			
Porifera unid. (encrusting)																			
Styela spp.																			
NIGHT SAMPLES																			
Crustaceans																			
Brachyura unid.		1																	
Callianassa californiensis						2													
Crangon alaskensis		1			5	11		4		19			8	4	4	3		3	37
Crangon nigricauda	57													11	34				136
Crangon nigromaculata		2	74	39	1	2	28	7	3	36	34	10	120		54	186	124	16	
Eualus lineatus			4																
Heptacarpus spp.			2	1			3			1			14	1		5			31
Heterocrypta occidentalis	1																		
Pagurus armatus													1						
Palaemon macrodactylus									1										
Pandalus danae			1																
Pandalus spp.			1									1							
Panulirus interruptus		1				1	3				3	1			1				
Penaeus californiensis																			
Pinnotheridae unid.																			

Taxon	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB04*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
Portunus xantusii		2	109	4		22	2		2	9		32		1	10	8	1		
Pyromaia tuberculata	1			3	7	2			2	4				2	2				12
Sicyonia ingentis	101		3	16		3		234			4		21	17		10	273	3	11
Echinoderms																			
Astropecten armatus	1																		
Ophiothrix spiculata										2									
Parastichopus californicus														1					
Parastichopus parvimensis															4			1	2
Patiria miniata									1										
Pisaster brevispinus	1																		
Strongylocentrotus franciscanus			1					1											
Strongylocentrotus purpuratus																			
Molluscs																			
Acanthodoris rhodoceras																1			
Aplysia californica																			
Caesia perpinguis	1			1														1	
Dendronotus iris																			
Euspira lewisii																			
Hima mendica																		1	
Nassarius fossatus																			
Navanax inermis									1						1				1
Peltodoris nobilis																			
Philine spp.				1															8
Pleurobranchaea californica													1						
Rossia pacifica									1										
Triopha maculata	1				1	1													
Other Minor Phyla																			
Boltenia villosa						2													
Molgula sp.																			1
Porifera unid. (encrusting)										1									
Styela spp.	1								6					2					

Table E-5. Otter Trawl, Summer 2008

Taxon	*LA1*	*LA2*	*LA3*	*LA4*	*LA5*	*LA6*	*LA7*	*LA10*	*LA14*	*LA15*	*LB1*	*LB2*	*LB3*	*LB04*	*LB5*	*LB6*	*LB7*	*LB12*	*LB14*
DAY SAMPLES																			
Crustaceans																			
Alpheus spp.																			
Callianassa californiensis				7	1	14													
Crangon alaskensis																			
Crangon nigricauda								1			1	3	2					1	
Crangon nigromaculata				3		1		4									14		
Heptacarpus spp.						1					7				31				
Heterocrypta occidentalis	1																		
Isocheles pilosus																			
Metacarcinus anthonyi		4											1						
Opisthopus transversus																			
Palaemon macrodactylus																			
Penaeus californiensis						1								1					
Portunus xantusii			2	1	2	1													
Pyromaia tuberculata			1	1	6	2			1				2				1		
Sicyonia ingentis													2						
Sicyonia penicillata				1		1		1					3	1				1	
Echinoderms																			
Lytechinus anamesus													1				1		
Ophiothrix spiculata				2															
Parastichopus californicus														2					
Pisaster brevispinus	1																		
Strongylocentrotus purpuratus																			
Molluscs																			
Aplysia californica																			
Caesia perpinguis																			
Conus spp.		7																	
Hima mendica																			
Navanax inermis														1					
Octopus bimaculatus																			

Octopus sp.														1					
Philine spp.																		2	
Polycera atra																			1
Siliqua spp.				2	1	2													
Other Minor Phyla																			
Molgula spp.																			1
Porifera unid. (encrusting)																			
sea pen												1							
Styela spp.				3															
NIGHT SAMPLES																			
Crustaceans																			
Alpheus spp.					1														
Callianassa californiensis																			
Crangon alaskensis																		19	
Crangon nigricauda	2		1		11									4		9	37		
Crangon nigromaculata		2	64	32	46	11	12	13	11	11		47	55		17			67	
Heptacarpus spp.			1		4				2			2	4	1	2	1	22	7	
Heterocrypta occidentalis																			
Isocheles pilosus											1								
Metacarcinus anthonyi												1					1	1	
Opisthopus transversus										1									
Palaemon macrodactylus																	1		
Penaeus californiensis																			
Portunus xantusii			7	1	2	3	1		3	1		1			3	1	1		
Pyromaia tuberculata	1			1	1	2	1			2		2	4		1	2	1		
Sicyonia ingentis	8							47	2	1			4				1		
Sicyonia penicillata				7				1		2			4	4	4	2	11		
Echinoderms																			
Lytechinus anamesus																			
Ophiothrix spiculata																			
Parastichopus californicus																		1	
Pisaster brevispinus			1																
Strongylocentrotus purpuratus																	2		

Molluscs																			
Aplysia californica									1										
Caesia perpinguis												1							
Conus spp.																			
Hima mendica						1													
Navanax inermis															1				
Octopus bimaculatus																	1		
Octopus sp.																			
Philine spp.			2		2	1			2	4							1		
Polycera atra																			
Siliqua spp.																			
Other Minor Phyla																			
Molgula spp.																			
Porifera unid. (encrusting)									1										
sea pen																			
Styela spp.				5		5			15					5				4	

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APPENDIX F

RIPRAP

Table F-1. Total Abundance of Riprap Organisms, Winter 2008

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	*U*	*M*	*L*	*U*	*M****	*L****	*U*	*M*	*L*	*U*	*M*	*L****	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Acmaeidae	2																							
Actiniaria								2																
Aegires albopunctatus			1																					
Alia carinata		3						4						2	1		1			2	2		1	1
Amathia sp																	1							
Amathimysis trigibba																					1			
Ammothella biunguiculata																					3			
Ampelisca lobata			80																					
Amphibalanus amphitrite			5																					
Amphibalanus improvisus		1																						
*Amphipholis squamata**		1						32	39					2	2		65	19		35	102			
Amphiporus sp		3	1																					
Amphiuridae		1												1										
Ampithoe plumulosa																				1	1		3	
Ampithoe sp		1							1					1										
Ancula sp																				1				
Anthopleura elegantissima	6							1																
Anthopleura sp	1																							
Anthuridae																					1			
Aoroides secundus																	1	7						
Aoroides sp																		1						
Apolochus barnardi																				1			1	1
Apolochus picadurus														1										
Armandia brevis																		1						1
Ascidiacea								4																
Astrangia jaimei			1																					
Balanidae		4					2																	
Balanus crenatus										2														
Balanus glandula	54			177												144			176			25		
Balanus trigonus							1	8									1			2	11	1	3	3

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M****	*L****	*U*	*M*	*L*	*U*	*M*	*L****	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Barleeia sp																					4			
Bemlos concavus																	2	1						
Bispira sp 2 (Fitzhugh)								3												7	7			
Boccardia sp														1	1									
*Boccardiella hamata**																	1							
Boccardiella sp														1										
Brachyura															1									
Brania breviphangea																				1				
Brania heterocirra														1										
Calliostoma gemmulatum		1																						
Capitella capitata Cmplx																		1						
*Caprella californica**		19	42											60	9			8			1		20	13
Caprella equilibra			7																					
Caprella mendax															1									
*Caprella natalensis**														28										
*Caprella penantis**		2																					39	1
*Caprella simia***		16	8											40	22		4	14		11	15		13	51
Caprella sp		6	9											20	6			3			3		12	17
Caprella verrucosa			1											22	1					2	1			
Chone minuta								2									4			4	9	1	6	11
Chthamalus fissus	79			39						155			37			394			251					
*Ciona intestinalis***								4																
Ciona sp		2	5					1									4			4	12			
Ciralana diminuta																	2							
Cirratus sp																				2	1			
Cirriformia sp																		1						
Cirriformia sp LA1																								1
Cirriformia sp SD1																		1						
Cirripedia																	1							1
Clymenella sp																	3			5	9			
Collisella limatula				1																				
Collisella pelta	1						1																	
Collisella scabra	9			19						36			6			15			11					

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M****	*L****	*U*	*M*	*L*	*U*	*M*	*L****	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Collisella sp	1																							
Corynactis californica		16																						
Crassodoma gigantea																	1				1			
*Crassostrea virginica***							2																	
Crepidula onyx							2	4	3								11	9						1
Crepidula perforans		3																						
Crepidula sp																	2							
Crepidula sp		2																						
Crepipatella dorsata		13	42					6	6					6	59		10	5		46	27			4
Crepipatella lingulata								1																
Crisia sp			2											1	1						1			
Cumella californica															3									2
Cumella sp																								1
Cyanoplax hartwegii	1																							
Cypraea spadicea																		1						
Demonax sp		1							2											4	1			
Diadumene spp																	2							
*Dipolydora bidentata**			1																					
*Dipolydora socialis**									1											3	2			
Dissiminassa dissimilis																	5				1			
Dodecaceria concharum															59		1							
Duetella venenosa		1																			1			
Dynamenella dilitata		2																						
Dynamenella glabra	6	1														2	1							
Dynamenella sheareri																	2		25					
Dynamenella sp				2														3	10					
Ectoprocta																					1		1	
Elasmopus antennatus		14	5																					
Elasmopus holgurus			2																					
Elassocumella sp LB1														1										
Ericthonius brasiliensis		56	1											19			1	6					1	3
Ericthonius sp																					1			
Euclymeninae			1											1						2	4			

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	*U*	*M*	*L*	*U*	*M****	*L****	*U*	*M*	*L*	*U*	*M*	*L****	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Euclymeninae sp A																					1			
Eudistylia vancouveri																		1						
Eulalia aviculaseta														1										
Eulalia quadrioculata														1							1			
*Exogone lourei**		1												1	4		2	3		13	8		1	1
Exogone sp A		7	4					1						3										
Fabia subquadrata																	1							
Filicrisia sp		1																						
Fissurella volcano																					1			
Gammaropsis sp														1										
Gammaropsis thompsoni		14	8											5	7					5	3		2	
Gastropoda		1													2									1
Gnathia steveni																					1			
*Grandidierella japonica***									1															
Halosydna brevisetosa		3	1				1										2			2	3			
Haminoea vesicula																								1
*Harmothoe imbricata Cmplx**		1						2	1								2							
Hiatella arctica		6	13					2	6					1	4		5			7				
Hydroides pacificus		1	4				4	1						5	2		10			2	3	5		
Ianiropsis sp			1																					
Iselica ovoidea								10										1						
Jassa falcata			1																					
*Jassa slatleryi**														4										
Jassa sp																		2						
Jassa staudei														2										
Joeropsis dubia		6	6											1			1	1		1	1			
Kellia suborbicularis			1																					
Lacuna unifasciata										1														
Lasaea adansoni	4	1		7						2						20			72					
Lepidozona pectinulata									1															
Leptochelia dubia		1	3												1					3	11		1	
Leptopecten latiauratus									2															2

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	U	M	L	U	M***	L***	U	M	L	U	M	L***	U	M	L	U	M	L	U	M	L	U	M	L
Leucothoe alata																	13							
Liljeborgia geminata								3	2						3		3	1			1		1	3
Lineidae		1																						
Lineus nr atrocaeruleus		1																						
Lithophaga plumula								1	1								4							
Littorina planaxis				1																				
Littorina scutulata																4								
Littorina sp																1								
Lumbrineridae									1															
*Lumbrineris inflata**																					2			
Maera sp																								2
Megabalanus californicus			2	4																				
Megastraea undosa																							2	
Microjassa litotes																							1	1
Mitrella aurantiaca																					1			
Modiolus capax									1															
*Monocorophium acherusicum***		10	7																		1		1	
Monocorophium sp		1																						
Mopalia muscosa	1						1																	
Mysidacea																	1							
Mytilidae		1																						
*Mytilus galloprovincialis***	7	2					19	17	1	8					1		7	6	22	3	10	12		1
Myxicola sp								1																
Naineris dendritica		1																						
Naineris sp																								1
Nasageneia quinsana			4																					
Nassarina penicillata														3						3	4			
Neanthes caudata																	3	1						
Nematoda			1																					
Neoamphitrite robusta									3															
Nereididae																		1						
Nereis mediator																						1		

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M****	*L****	*U*	*M*	*L*	*U*	*M*	*L****	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Nereis procera		2																						
Nereis sp		1																						
*Nicolea sp A***								2	1					3						27	36		5	4
Nutricola sp																				4	1			
Ocenebra gracillima		1																						
Ocenebra sp		1																			1			
Odostomia sp																				1	1			
Oerstedia dorsalis		1												3										
*Ophiactis simplex**			2											3	20		13	7		3	4			
*Ophiodromus pugettensis**								1									1			2				
Ophiothrix spiculata			3												1									
Ostreidae																	1							
Pachycheles rudis		7																						
Paleanotus bellis		1													1								1	
Palola paloloides		2	3																	2	4			
Paracerceis sculpta									1								2							
Paracyathus stearnsii			2																					
Paradexamine sp SD1																								2
Paramicrodeutopus schmitti														5						1	1			
Paranemertes peregrina		1																						
Paranthura elegans		1						2	1								4	4		1	1			
Perampithoe sp														1										
Phaenoplana longipenis														1										
Phascolosoma agassizii		1																						
Phascolosoma agassizii								1									1							
Pherusa neopapillata																								1
Philobrya setosa																				5	1			
Pholoide asperus									1						1		1							
Phoronida		1	2																					
Phoronis sp																				18				
Photis bifurcata		6	3											1	5					1	1			

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M****	*L****	*U*	*M*	*L*	*U*	*M*	*L****	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Photis sp		10	5												3						3			
Photis sp 1		368	122				1							4	2					3	2		10	2
Phoxocephalidae		1																						
Phyllodoce medipapillata			1																		1			
Pionosyllis sp		1												1										
Platidia hornii									33								2				1			
Platyhelminthes														1										
Platynereis bicanaliculata														1	2									
Plexauridae									1															
*Podocerus brasiliensis**		2												5	5		1	1						
*Podocerus cristatus**		2	2											1										
Polycirrus californicus								1																
*Polydora armata**																	1							
*Polydora limicola**		6	2					1						1			3				4			
Polydora sp														3	1					1	3			
Polydora sp 1														1										
Polydora spongicola							2	1																
Polynoidae																		1						
Polynoinae																								1
Polyopthalmus pictus																							2	2
Pontogeneia intermedia		1	1																					
Porifera																					1			
Protocirrinereis																		1						
Protocirrineris sp														2	1			2						
Protocirrineris sp B																					1			
Protohyale frequens	5							2		50									1					
Pseudopotamilla occellata		31						2									2			3	2			
Pseudopotamilla socialis		47												1						23	12			
Pseudopotamilla sp		17							1								4			17	38		1	
Pterocirrus montereyensis																							2	
Pteropurpura festiva														1	1									
Pugettia sp															1									1
Quadrimaera vigota		1	3																					

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	U	M	L	U	M***	L***	U	M	L	U	M	L***	U	M	L	U	M	L	U	M	L	U	M	L
Sabellinae																	1			31	19			
Scionides dux		1																						
Scyphoproctus oculatus																		3		1	1			
Serpula vermicularis																					1			
Serpulorbis squamigerus															10									
Siriella pacifica							1																	
*Sphaerosyllis californiensis**														1	8									
Spio sp																							1	
Spionidae																								1
Spirorbidae																				2				
Stenothoe estacola		4	5											1										
Stenothoides bicoma			1											1										
Stenula modosa																					1			
Streblosoma sp 1								3	1								5			7	1		1	
Strongylocentrotus purpuratus								1			1							1						
Styela montereyensis								1									5	1					2	
Styela sp								1	2						1		4			7	5		6	
Stylochus nr franciscanus																							1	
Stylochus sp								1																
Syllidae (epitoke)																				1				
Syllis (Syllis) gracilis		10	11					7	2								16			2	9			
Synapseudes intumescens		1	3																					
Tanystylum californicum		1	1																	1	5			
Tegula gallina														5	2									
Tetraclita rubescens	41									54									5					
*Tetrastemma nigrifrons**														2										
Thorlaksonius sp														1										
Tubulanus polymorphus														2										
Typosyllis aciculata																					1			
Typosyllis adamanteus	1																				1	1		
*Typosyllis nipponica***														4	2					5	2	2	16	6

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M***	*L***	*U*	*M*	*L*	*U*	*M*	*L***	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Typosyllis sp																						1		
Uromunna ubiquita								3									1							
Zeuxo normani		6						1						7	3			3		6	7	2	4	3
Zuexo paranormani																			2				5	
*Zygonemertes virescens**																				2				
Cryptogenic (Total Number of Species)	**0**	**8**	**5**	**0**	**0**	**0**	**0**	**4**	**3**	**0**	**0**	**0**	**0**	**11**	**6**	**0**	**9**	**5**	**0**	**6**	**7**	**0**	**3**	**3**
Non-indigenous (Total Number of Species)	**1**	**3**	**2**	**0**	**0**	**0**	**2**	**3**	**3**	**1**	**0**	**0**	**0**	**3**	**3**	**0**	**2**	**2**	**1**	**4**	**5**	**2**	**4**	**4**

* Cryptogenic species (origin unknown), ** Non-indigenous species (introduced), *** Sample not collected;
Note numbers are total of two replicates;
U = Upper Intertidal Zone; M = Middle Zone (Lower Intertidal); L = Lower Zone (Subtidal)

Table F-2. Total Abundance of Riprap Organisms, Summer 2008

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
(Rictaxis) punctocaelatus												1												
Acanthina spirata														1										
Accedomoera vagor															10		6							
Acmaeidae																			1					
Aegires albopunctatus			1																					
Aeolidioidea		1																						
Alia carinata					1			1							1		7			2	1		1	1
Alia tuberosa											1	2												
Alvinia purpurea			2								1													
Ammothella menziesi			4																					
Ammothella tuberculata														2										
Ampelisca lobata			8									1												
Ampelisca sp			2																					
Amphibalanus amphitrite							2																	
*Amphipholis squamata**		24				16		201	195		1	2		36	4		75	99		95	35		20	82
Amphiporus sp															2									
Amphitritinae								3	2			4												1
Ampithoe lacertosa						3					2						1							
Ampithoe plumulosa																	3							
Ampithoe sp								1			6			1										
Ancula lentiginosa																				1				
Anoplodactylus sp								1																
Anoplodactylus viridintestinalis			4			1		1	1		1						1							
Anthuridae		1																1						
Aoroides exilis								2			2			1			16	3						
Aoroides inermis					5			1									3							
Aoroides secundus						12																		
Aoroides sp					1			1				1					4	5						
Apolochus barnardi											1	3		1	4									
Arctonoe pulchra		1																						
Armandia brevis			3									7								1	2			1

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Ascidia sp		31	16			4	35	58	3			11		16	10		22	7			25		18	48
Astrangia jaimei						1																		
Autolytus sp				1	2				1						3					2	1			
Axiothella rubrocincta	3													3	2		26			1	13			
Balanus crenatus	81			40									3			25								
Balanus glandula							174			6														
Balanus sp					2																			
Balanus trigonus					21	5		12									3							
Barleeia sp			1								2	5								5	2		6	1
Bispira sp	1					2		3							4									
Bispira sp 2																				5	2			2
Bispira sp 2	1		7		1			10	2															
Boccardia proboscidea							25			1		1			2									
Boccardia pugettensis										4														
Boccardia sp															4									
Boccardia tricuspa														2										
*Boccardiella hamata**			5									1												
Bowerbankia sp									1															
Bowerbankia sp												2												
Brania brevipharyngea									1															
Brania californiensis			1			1	1	3							2						2		1	
Brania heterocirra									1															
Bugula sp																					1			
Candelabrum sp															1									
Capitella capitata Cmplx																		1						
*Caprella californica**		40	3		1						48			44	141		12	1						
Caprella gracilior												3												
Caprella mendax		30	4								26	3		6	7									
*Caprella mutica***						1											9	2						
*Caprella penantis**											23	2		8				1						
*Caprella simia***		23	35		21	221	4	217	36		48	124	1	182	83		47	39						
Caprella sp		13	7			17	1	22	10		54	37		30	54	1	15	10						
Caprella verrucosa		1	1											6	33									

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L
Carazziella sp						1																		
Chone ecaudata	12		2			8		5	8			2		2	2		21	1			6		20	9
Chthamalus fissus	126			108						133			374			42								
Cirratulidae						1						1												
Cirratulus spectabilis	10							2							1						2			
Cirriformia sp						3																		
Colisella digitalis													1			3			2					
Collisella	1	1			3	1																		
Collisella (ochracea)									1															
Collisella limatula				1																				
Collisella scabra	10									21														
Conus californicus			1												1									
Corynactis californicus		30																						
Crassadoma gigantea																								1
Crassodoma gigantea						1																		
*Crassostrea sp.***									2															
Crepidula onyx							2	6									10	4			1			
Crepidula perforans						3																		
Crepidula sp					2		5	1				1												
Crepipatella lingulata		7	10			6	9	5				4		3	21		5	11		1	11			9
Crisia sp			1																					
Cryptomya californica												1												
Cumella californica		4	45								3	31		3	23									
Cumella sp			1																					
*Cumella vulgaris**			5								1	3		2	2									
Cyanoplax hartwegii										1														
Demonax cf rugosus	37	6						1	6					3	1		1			2	2			
Demonax sp	15	2	1																					
Dendrochiton thamnoporus					1							1		1			1							1
Deutella californica			4												1									
Deutella venenosa			3																					
Diadumene sp							20	14						1										

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Diodora aspera								1																
*Dipolydora socialis**			3				1							1										
Dissiminass dissimilis								10	3															
Dissiminassa dissimilis															2			2						
Dodecaceria concharum					1	2								3	3		1	1						
Doridoidea											1													
Dorvillea (Schistomeringos) annulata			1															4						
Dynamenella glabra							2	1																
Dynamenella sheareri				4												6								
Dynamenella sp				2										1										
Elasmopus antennatus		26	9											1	17		22							
Elasmopus bampo																	3							
Elasmopus serricatus		2													6		2							
Elasmopus sp		5													7		11	2						
Emplectonema gracile		1																						
Enchiridium punctatum			1																					
Enopla														1			2							
*Eochelidium sp A***																		1						
Ericthonius brasiliensis		228	2								1			5	2		9							
Ericthonius rubricornis																	1							
Eualus lineatus															2			1						
Euclymeninae	4		3									1					4	1			1			
Eudistylia polymorpha	3								2															
Eulalia californiensis			1									1									2			
Eulalia quadrioculata												1		1										
Eumida longicornuta														1										
Eupolymnia heterobranchia					1																			
Eurydice caudata				4			1																	
*Exogone lourei**	23	4	44		1	10	3	26	11		1	20		9	8		24	4		2	10		4	11
Fabriciinae																					1			
Fissurella volcano																				1				

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L
Gammaropsis thompsoni		271	59				1				1	14		54	72		9							
Gnathia steveni												3												
Golfingia margaritacea																				1				
*Grandidierella japonica***						1		1									20	13						
Halosydna johnsoni			1												1		2				1			1
Harmothoe hirsuta			1		1	2			8															
*Harmothoe imbricata Cmplx**	1				5	7		19				2			1		4	3		1	2			1
Harmothoe sp	1								1															
*Hemiproto sp A**																		6						
Hesionidae					1																			
Hiatella arctica		1	5			2	18			1		3		2	3		1	2			11		1	5
Hippolyte californiensis														1										
Hydroides pacificus	3	1			1	2	21	3			2	19		3			26	1		2	3		20	6
Ianiropsis analoga					2	3			1								4	1						
Iphimedia rickettsi		3	7												6									
Ischnochitonidae														1										
Iselica ovoidea			1				8	7						1			1							
Janirilata occidentalis														1	7									
*Jassa slatteryi**											5			5	11									
Joeropsis dubia		10	15			4					4	1		9	14		4	2						
Kellia suborbicularis							1										1				1			1
Lasaea adansoni	1			16															1					
Lepidinotinae														1										
Lepidinotus sp					1	1																		
Lepidonotus sp																					1			
*Leptochelia dubia**		55	7	1								12		6	16		8	11						
Leptochiton rugatus							1																	
Leptopecten latiauratus			2			1	1					1					1							
Leptoplanidae														1										
Leucapinella callomarginata							1																	
Leucothoe alata						1		10	1															

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L
Liljeborgia geminata														3	1		3							
Lithophaga plumula							4																	
Littorina planaxis													8									3		
Littorina scutulata	1												3						12			1		
Lottia gigantea																					1			
*Lumbrineris inflata**	1																							
Macoma nasuta																		1						
Maera similis						1		9	11						1									
Mediomastus spp																		4						
Megabalanus californicus					3																			
Melinna oculata			1																					
Melita sp LA1							49		3															
Molgula sp			2			1	7	3						1							2		2	2
*Monocorophium acherusicum**		59	7		6	2		14			20	1		3	3		4							
Monocorophium sp		7			1			3	1		3													
Mopalia muscosa					1	1			1															
Mopalia sp								1		1														
Mysidacea															1									
Mytilidae		1	1									1						1			4			
*Mytilus galloprovincialis***		1				1	21	33	67		3	4					13				10		2	5
Myxicola sp A								1	2								1				2			
Naineris dendritica	2					2								1									1	1
Nassarina penicillata		1	1								2	3								3	2			
Neoamphitrite robusta						2			1															
Neomysis kadiakensis											1													
Neosabellaria cementarium			1														1			1				
Nereiphylla sp																					1			
Nereis mediator							1								2		4			1			1	
*Nicolea sp A***	2							9	2								3			2			3	2
Notomastus hemipodus																	1							
Novafabricia brunnea			12	1		9		1													5			

	LARR-1			LARR-2			LARR-3			LARR-4			LBRR-1			LBRR-2			LBRR-3			LBRR-4		
Species	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L	U	M	L
Nucella emarginata			1																				1	
Nutricola sp			1								4	7												
Nutricola tantilla																				2	1			
Odontosyllis phosphorea			2																					
Odostomia navisa															14									
Odostomia sp															2			2			2			
Oerstedia dorsalis						1														4	1		2	
*Ophiactis simplex**			5			2						1		6	2		13	4		14	18		13	
*Ophiodromus pugettensis**									2								1							
Oriopsis gracilis	30	57	26																					
Oriopsis sp															3									
Ostreidae						3																		
Paleanotus bellis			3		1		3	2	1						1		1				3		3	1
Paleonemertea															1									
Palola paloloides			1																					
Pancolus californiensis			15																					
Paracerceis sculpta																	46	9						
Paradexamine sp A											2						1	2						
Paramicrodeutopus schmitti														20										
Paranemertes californica		2																			3		2	
Paranthura elegans		3	4			3		1	1								14	5						
Petaloconchus montereyensis			1				1																	
Petricola hertzana							5				1	1		1				1						1
Phascolion sp			2								1													
Phascolosoma agassizii						2	6																	
Pherusa inflata															2									6
Pherusa papillata			1					1	11						1		1							
Pholoides aspersus			1			4		1	3					1	1									
Phoronida		407	5			13						5		7	2			1			14			
Photis bifurcata		10	41								2	1		10	26									
Photis sp		16	9				1					5		3	14									

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Photis sp 1		389	114								16	18		47	91									
Phyllodoce medipapillata			1																					
Pionosyllis sp					1																			
Platidia hornii						1	14								2									
Platynereis bicanaliculata			1		4		1		1			1											1	3
*Podocerus brasiliensis**		12	3								17	6												
*Podocerus cristatus**			3																					
Podocopida												1			1			2						
Pododesmus cepio							1	1										1						
Podoscerus brasiliensis														8	12		1							
Podoscerus cristatus															4		8							
Podoscerus sp															4									
Polycirrus californicus								3	2															1
Polydora armata					1	1																		
*Polydora cornuta**									1															
Polydora hoplura						2	28																	
*Polydora limicola**	4	43	4	1	9	7	17		1		2	3		17			5						4	
Polydora sp	6	6	4	1	7	2	30	2	1		5	13		4							1			
*Polydora websteri**	2	11	5				5																	
Pontogeneia intermedia			1																					
Postasterope barnesi			4									3												
Prionospio (Prionospio) heterobrancia												4					1							
Protocirrineris sp						2						5		3				1						
Protohyale frequens	7			6						3			3											
Protothaca sp												3												
*Pseudopolydora paucibranchiata**						2						2					19	21						
Pseudopotamilla occellata	3	4							2															
Pseudopotamilla socialis	59	13						3	17		3			56			8			8	65		3	
Pseudopotamilla sp	36	2				15		3	2					41							12			
Pseudopotamilla sp 1 Fitzhugh	2																							
Psolidae			5																					

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Pugettia gracilis											1	4												
Quadrimaera vigota		16	7																					
Rhabdocoela		2																						
Rudilemboides stenopropodus																	1	20						
Sabellaria gracilis			1																					
Sabellinae	12				1	3		1							2						15			
Saxidomus sp												2												
Scionides dux									3															
Sclerocheilus acirratus						1																		
Scrupocellaria sp																					1			
Scyphoproctus oculatus																		28		3				
Serpulidae																							1	
Serpulorbis squamigerus														1	2		2							
Sipuncula																				1				
Siriella pacifica									1															
*Sphaerosyllis californiensis**			4			1		6	2			4		3	8						6			2
Spionidae							4					3												
Spionidae (P)			5		37	14					6	3												
Spirorbidae					48													3					74	1
Stenothoe estacola		5	5					11	3						3									
Streblosoma sp 1																	1							
Strongylocentrotus sp												1		7	7									
Styela sp		2	8		1	3	9	13	1															
Styela clava																	1							
Styela montereyensis							1																	
Styela nr. canopus															6						2			4
*Styela plicata***																		1						
Styela sp																	1	1			1		13	4
Styela truncata																	5							
Stylochus sp																	1							1
*Syllis gracilis**	11	3	17			5		10	22		1	3					12			4	10			

	LARR-1			*LARR-2*			*LARR-3*			*LARR-4*			*LBRR-1*			*LBRR-2*			*LBRR-3*			*LBRR-4*		
Species	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*	*U*	*M*	*L*
Synapseudes intumescens			10																					
Tanystylum californicum			1					1	1															
Tethygeneia opata		7																						
Tetraclita rubescens	1									28														
*Tetrastemma nigrifrons**																							1	
Thelepus setosus								2	3															
*Theora lubrica***																		3						
*Thormora johnstoni**					1																			
Tritella sp			2								3													
Turbonilla sp			1																					
Turridae															1									
*Typosyllis elongata**	1						5																	
*Typosyllis fasciata**		2					19																	
*Typosyllis nipponica***														1						20	3		7	
Typosyllis sp			1		1	3	5	1	4			1					1				2			
Typosyllis sp 1	5	7						14	4												1			
Typosyllis sp 2	1																							
Typosyllis sp 3														3										
Typosyllis sp 4																				5				
Uromunna ubiquita			2									1					2	1						
Volvarina taeniolata			1																					
*Zeuxo normani**		4	1		20	19	4	76	9	3	10	3		20	25		21	13						
*Zygonemertes virescens**			5									4												
Cryptogenic (Total Number of Species)	7	12	17	2	8	12	8	8	10	1	12	17	1	14	12	0	14	12	0	5	5	0	5	4
Non-indigenous (Total Number of Species)	1	1	0	0	0	2	1	3	2	0	1	1	0	1	0	0	3	4	0	2	2	0	3	2

* Cyptogenic species (origin unknown), ** Non-indigenous species (introduced);
Note numbers are total of two replicates;
U = Upper Intertidal Zone; M = Middle Zone (Lower Intertidal); L = Lower Zone (Subtidal)

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APPENDIX G

KELP AND MACROALGAE

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
4/14/2008	2	T1	DH	5-10	20-30	*Dictyota*	10	purple urchin, pisaster, kelletia, muricea, opaleye, garibaldi, kelp bass
4/14/2008	2	T1	JE	5-10	20-30	*Dictyota*	10	
4/14/2008	2	T5	DH	0-5	5-15	*Colpomenia*	1	purple urchin, red urchin, pisaster, megathuron, nudibranch, muricea, lophogorgia
4/14/2008	2	T5	DH	0-5	5-15	*Egregia*	1	
4/14/2008	2	T5	DH	5-10	15-23	*Colpomenia*	1	
4/14/2008	2	T5	DH	5-10	15-23	*Dictyota*	1	
4/14/2008	2	T5	DH	10-15	23-30	*Dictyota*	1	
4/14/2008	2	T5	JE	5-10	15-23	*Dictyota*	1	
4/14/2008	2	T5	JE	10-15	23-30	*Dictyota*	1	
4/14/2008	2	T8	DH	5-10	12-25	*Pachydictyon*	1	
4/14/2008	2	T8	DH	5-10	12-25	*Sargassum*	1	
4/14/2008	2	T8	DH	5-10	12-25	*Undaria*	1	
4/14/2008	2	T8	DH	10-15	25-33	*Pachydictyon*	1	
4/14/2008	2	T8	JE	0-5	0-12	*Undaria*	5	
4/14/2008	2	T8	JE	5-10	12-25	*Pachydictyon*	5	
4/14/2008	2	T8	JE	5-10	12-25	*Sargassum*	5	
4/14/2008	2	T7	DH	0-5	0-10	*Chondracanthus*	2	
4/14/2008	2	T7	DH	0-5	0-10	*Colpomenia*	10	
4/14/2008	2	T7	DH	0-5	0-10	*Ulva*	20	
4/14/2008	2	T7	DH	0-5	0-10	*Undaria*	10	
4/14/2008	2	T7	DH	5-10	10-16	*Chondracanthus*	5	
4/14/2008	2	T7	DH	5-10	10-16	*Colpomenia*	2	
4/14/2008	2	T7	DH	5-10	10-16	*Ulva*	5	
4/14/2008	2	T7	DH	5-10	10-16	*Undaria*	1	
4/14/2008	2	T7	DH	5-10	10-16	*Leathesia*	1	
4/14/2008	2	T7	DH	10-15	16-20	*Chondracanthus*	5	
4/14/2008	2	T7	DH	10-15	16-20	*Colpomenia*	5	
4/14/2008	2	T7	DH	10-15	16-20	*Undaria*	5	
4/14/2008	2	T7	DH	10-15	16-20	*Leathesia*	1	
4/14/2008	2	T7	JE	0-5	0-10	*Colpomenia*	10	
4/14/2008	2	T7	JE	0-5	0-10	*Ulva*	20	
4/14/2008	2	T7	JE	5-10	10-16	*Colpomenia*	20	
4/14/2008	2	T7	JE	5-10	10-16	*Ulva*	10	
4/14/2008	2	T7	JE	5-10	10-16	*Undaria*	5	

Date	Survey	Site	Observer	Location on Transect (m)	Depth Range (ft)	Species	Percent Cover	Macroinvertebrates and Fishes Observed
4/14/2008	2	T7	JE	10-15	16-20	*Ulva*	5	
4/14/2008	2	T7	JE	10-15	16-20	*Undaria*	1	
4/14/2008	2	T11	DH	0-5	0-12	*Chondracanthus*	1	
4/14/2008	2	T11	DH	0-5	0-12	*Rhodomenia*	5	
4/14/2008	2	T11	DH	0-5	0-12	*Sargassum*	90	
4/14/2008	2	T11	DH	0-5	0-12	*Ulva*	5	
4/14/2008	2	T11	DH	0-5	0-12	*Undaria*	5	
4/14/2008	2	T11	DH	5-10	12-20	*Chondracanthus*	1	
4/14/2008	2	T11	DH	5-10	12-20	*Rhodomenia*	5	
4/14/2008	2	T11	DH	5-10	12-20	*Sargassum*	90	
4/14/2008	2	T11	DH	5-10	12-20	*Ulva*	5	
4/14/2008	2	T11	DH	10-15	20-25	*Dictyota*	2	
4/14/2008	2	T11	DH	10-15	20-25	*Halymenia*	2	
4/14/2008	2	T11	DH	10-15	20-25	*Sargassum*	10	
4/14/2008	2	T11	DH	15-20	25-30	*Dictyota*	1	
4/14/2008	2	T11	DH	15-20	25-30	*Halymenia*	5	
4/14/2008	2	T11	JE	0-5	0-12	*Sargassum*	90	
4/14/2008	2	T11	JE	0-5	0-12	*Ulva*	?	
4/14/2008	2	T11	JE	0-5	0-12	*Undaria*	15	
4/14/2008	2	T11	JE	5-10	12-20	*Sargassum*	50	
4/14/2008	2	T11	JE	5-10	12-20	*Ulva*	5	
4/14/2008	2	T11	JE	10-15	20-25	*Halymenia*	10	
4/14/2008	2	T11	JE	10-15	20-25	*Undaria*	1	
4/14/2008	2	T11	JE	15-20	25-30	*Halymenia*	5	
4/14/2008	2	T11	JE	15-20	25-30	*Rhodomenia*	5	
4/14/2008	2	T6	DH	5-10	12-22	*Dictyota*	1	
4/14/2008	2	T6	DH	10-15	22-29	*Dictyota*	1	
4/15/2008	2	T10	DH	0-5	0-5	*Colpomenia*	15	
4/15/2008	2	T10	DH	0-5	0-5	*Ulva*	20	
4/15/2008	2	T10	DH	0-5	0-5	*Undaria*	20	
4/15/2008	2	T10	DH	0-5	0-5	*Eelgrass*	20	
4/15/2008	2	T10	DH	5-10	5-10	*Ulva*	5	
4/15/2008	2	T10	DH	5-10	5-10	*Undaria*	5	
4/15/2008	2	T10	DH	5-10	5-10	*Chondracanthus*	1	
4/15/2008	2	T10	DH	10-15	10-17	*Rhodomenia*	5	
4/15/2008	2	T10	DH	10-15	10-17	*Undaria*	5	
4/15/2008	2	T10	DH	15-20	17-21	*Chondracanthus*	1	
4/15/2008	2	T10	DH	15-20	17-21	*Halymenia*	1	
4/15/2008	2	T10	DH	15-20	17-21	*Rhodomenia*	1	

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
4/15/2008	2	T10	WK	0-5	0-5	*Colpomenia*	10	bat star, pisaster, urchin, nudibranch
4/15/2008	2	T10	WK	0-5	0-5	*Dictyota*	5	
4/15/2008	2	T10	WK	0-5	0-5	*Sargassum*	50	
4/15/2008	2	T10	WK	0-5	0-5	*Ulva*	10	
4/15/2008	2	T10	WK	0-5	0-5	*Eelgrass*	5	
4/15/2008	2	T10	WK	5-10	5-10	*Chondracanthus*	10	
4/15/2008	2	T10	WK	5-10	5-10	*Ulva*	10	
4/15/2008	2	T10	WK	10-15	10-17	*Halymenia*	10	
4/15/2008	2	T10	WK	10-15	10-17	*Prionitis*	1	
4/15/2008	2	T10	WK	10-15	10-17	*Undaria*	10	
4/15/2008	2	T13	DH	0-5	0-5	*Ulva*	5	aplysia, tube anemome, nudibranch, brown scuz=ectocarpoid "fuzz"
4/15/2008	2	T13	DH	5-10	5-10	*Undaria*	1	
4/15/2008	2	T13	DH	10-15	10-16	*Colpomenia*	5	
4/15/2008	2	T13	DH	10-15	10-16	*Undaria*	5	
4/15/2008	2	T13	DH	15-20	16-20	*Undaria*	1	
4/15/2008	2	T13	WK	0-5	0-5	*Ulva*	20	nudibranch, seahorse
4/15/2008	2	T13	WK	5-10	5-10	*Halymenia*	20	
4/15/2008	2	T13	WK	10-15	10-16	*Undaria*	2	
4/15/2008	2	T2	DH	0-5	0-12	*Colpomenia*	5	
4/15/2008	2	T2	DH	0-5	0-12	*Dictyota*	10	
4/15/2008	2	T2	DH	0-5	0-12	*Macrocystis*	10	
4/15/2008	2	T2	DH	5-10	12-20	*Dictyopteris*	10	
4/15/2008	2	T2	DH	5-10	12-20	*Dictyota*	10	
4/15/2008	2	T2	DH	5-10	12-20	*Macrocystis*	5	
4/15/2008	2	T2	DH	5-10	12-20	*Pachydictyon*	10	
4/15/2008	2	T2	DH	5-10	12-20	*Undaria*	1	
4/15/2008	2	T2	DH	10-15	20-24	*Dictyota*	5	
4/15/2008	2	T2	DH	10-15	20-24	*Macrocystis*	5	
4/15/2008	2	T2	WK	0-5	0-12	*Dictyopteris*	70	limpit, nudibranch, blue perch, purple urchin, red urchin, sea cucumber
4/15/2008	2	T2	WK	0-5	0-12	*Halymenia*	50	
4/15/2008	2	T2	WK	0-5	0-12	*Macrocystis*	50	
4/15/2008	2	T2	WK	0-5	0-12	*Sargassum*	20	
4/15/2008	2	T2	WK	5-10	12-20	*Dictyota*	90	

Date	Survey	Site	Observer	Location on Transect (m)	Depth Range (ft)	Species	Percent Cover	Macroinvertebrates and Fishes Observed
4/15/2008	2	T2	WK	5-10	12-20	*Macrocystis*	50	
4/15/2008	2	T17	DH	0-5	0-8	*Egregia*	30	
4/15/2008	2	T17	DH	0-5	0-8	*Macrocystis*	90	
4/15/2008	2	T17	DH	0-5	0-8	*Sargassum*	15	
4/15/2008	2	T17	DH	0-5	0-8	*Undaria*	40	
4/15/2008	2	T17	DH	5-10	8-17	*Macrocystis*	70	
4/15/2008	2	T17	DH	5-10	8-17	*Undaria*	25	
4/15/2008	2	T17	DH	10-15	17-20	*Egregia*	5	
4/15/2008	2	T17	DH	10-15	17-20	*Macrocystis*	10	
4/15/2008	2	T17	DH	10-15	17-20	*Undaria*	5	
4/15/2008	2	T17	WK	0-5	0-8	*Macrocystis*	80	turbot, sea cucumber
4/15/2008	2	T17	WK	0-5	0-8	*Sargassum*	10	
4/15/2008	2	T17	WK	0-5	0-8	*Undaria*	1	
4/15/2008	2	T19	DH	0-5	0-16	*Colpomenia*	5	nudibranch, hornyhead turbot, nudibranch (photos)
4/15/2008	2	T19	DH	0-5	0-16	*Ulva*	10	
4/15/2008	2	T19	DH	0-5	0-16	*Undaria*	50	
4/15/2008	2	T19	DH	5-10	16-23	*Undaria*	5	
4/15/2008	2	T19	WK	0-5	0-16	*Colpomenia*	1	perch, bat star, nudibranch
4/15/2008	2	T19	WK	0-5	0-16	*Sargassum*	5	
4/15/2008	2	T19	WK	0-5	0-16	*Ulva*	10	
4/15/2008	2	T19	WK	0-5	0-16	*Undaria*	90	
4/15/2008	2	T19	WK	5-10	16-23	*Ulva*	80	
4/15/2008	2	T19	WK	5-10	16-23	*Undaria*	20	
4/15/2008	2	T12	DH	0-5	0-15	*Colpomenia*	30	bat star, aplysia, mussels
4/15/2008	2	T12	DH	0-5	0-15	*Dictyota*	5	
4/15/2008	2	T12	DH	0-5	0-15	*Sargassum*	2	
4/15/2008	2	T12	DH	0-5	0-15	*Ulva*	30	
4/15/2008	2	T12	DH	0-5	0-15	*Undaria*	5	
4/15/2008	2	T12	DH	5-10	15-22	*Halymenia*	5	
4/15/2008	2	T12	DH	5-10	15-22	*Rhodomenia*	5	
4/15/2008	2	T12	DH	5-10	15-22	*Ulva*	10	
4/15/2008	2	T12	DH	5-10	15-22	*Undaria*	15	
4/15/2008	2	T12	DH	10-15	22-29	*Halymenia*	1	
4/15/2008	2	T12	DH	10-15	22-29	*Rhodomenia*	1	
4/15/2008	2	T12	DH	10-15	22-29	*Undaria*	1	

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
4/15/2008	2	T12	WK	0-5	0-15	*Colpomenia*	5	bat star, sea hare
4/15/2008	2	T12	WK	0-5	0-15	*Rhodomenia*	50	
4/15/2008	2	T12	WK	0-5	0-15	*Ulva*	20	
4/15/2008	2	T12	WK	0-5	0-15	*Undaria*	5	
4/15/2008	2	T12	WK	5-10	15-22	*Halymenia*	10	
4/15/2008	2	T12	WK	5-10	15-22	*Rhodomenia*	30	
4/15/2008	2	T12	WK	10-15	22-29	*Undaria*	4	
4/15/2008	2	T15	DH	0-5	0-12	*Egregia*	20	pisaster, lobster, kelletia, archidoris, barred sand bass, striped surfperch
4/15/2008	2	T15	DH	0-5	0-12	*Macrocystis*	90	
4/15/2008	2	T15	DH	5-10	12-25	*Macrocystis*	85	
4/15/2008	2	T15	DH	10-15	25	*Macrocystis*	15	
4/15/2008	2	T15	WK	0-5	0-12	*Egregia*	20	
4/15/2008	2	T15	WK	0-5	0-12	*Macrocystis*	20	
4/15/2008	2	T15	WK	5-10	12-25	*Macrocystis*	20	
4/15/2008	2	T15	WK	10-15	25	*Macrocystis*	5	
4/16/2008	2	T3	DH	0-5	0-7	*Colpomenia*	10	
4/16/2008	2	T3	DH	0-5	0-7	*Corallina*	10	
4/16/2008	2	T3	DH	0-5	0-7	*Macrocystis*	35	
4/16/2008	2	T3	DH	0-5	0-7	*Sargassum*	5	
4/16/2008	2	T3	DH	0-5	0-7	*Undaria*	5	
4/16/2008	2	T3	DH	5-10	7-13	*Macrocystis*	5	
4/16/2008	2	T3	WK	0-5	0-7	*Colpomenia*	10	giant starfish, lobster
4/16/2008	2	T3	WK	0-5	0-7	*Macrocystis*	50	
4/16/2008	2	T3	WK	0-5	0-7	*Sargassum*	10	
4/16/2008	2	T20	DH	0-5	0-10	*Colpomenia*	10	black surfperch, round stingray, pisaster
4/16/2008	2	T20	DH	0-5	0-10	*Corallina*	20	
4/16/2008	2	T20	DH	0-5	0-10	*Macrocystis*	50	
4/16/2008	2	T20	DH	0-5	0-10	*Sargassum*	10	
4/16/2008	2	T20	DH	0-5	0-10	*Undaria*	50	
4/16/2008	2	T20	DH	0-5	0-10	*Ectocarpoid fuzz*	20	
4/16/2008	2	T20	DH	5-10	10-17	*Colpomenia*	10	
4/16/2008	2	T20	DH	5-10	10-17	*Macrocystis*	70	
4/16/2008	2	T20	DH	5-10	10-17	*Undaria*	10	
4/16/2008	2	T20	DH	5-10	10-17	*Ectocarpoid fuzz*	50	
4/16/2008	2	T20	DH	10-15	17-25	*Macrocystis*	70	

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
4/16/2008	2	T20	DH	10-15	17-25	*Undaria*	20	
4/16/2008	2	T20	DH	15-20	25-33	*Macrocystis*	15	
4/16/2008	2	T20	WK	0-5	0-10	*Colpomenia*	20	whelk, bat star, red urchin, purple urchin
4/16/2008	2	T20	WK	0-5	0-10	*Corallina*	50	
4/16/2008	2	T20	WK	0-5	0-10	*Egregia*	5	
4/16/2008	2	T20	WK	0-5	0-10	*Macrocystis*	10	
4/16/2008	2	T20	WK	0-5	0-10	*Sargassum*	10	
4/16/2008	2	T20	WK	0-5	0-10	*Ulva*	40	
4/16/2008	2	T20	WK	5-10	10-17	*Egregia*	10	
4/16/2008	2	T20	WK	5-10	10-17	*Macrocystis*	80	
4/16/2008	2	T20	WK	10-15	17-25	*Macrocystis*	20	
4/16/2008	2	T18	DH	0-5	0-13	*Ulva*	30	
4/16/2008	2	T18	DH	0-5	0-13	*Undaria*	2	
4/16/2008	2	T18	DH	5-10	13-21	*Halymenia*	1	
4/16/2008	2	T18	DH	5-10	13-21	*Ulva*	1	
4/16/2008	2	T18	DH	5-10	13-21	*Undaria*	1	
4/16/2008	2	T18	DH	10-15	21-26	*Ulva*	1	
4/16/2008	2	T18	WK	0-5	0-13	*Dictyota*	1	bat star
4/16/2008	2	T18	WK	0-5	0-13	*Halymenia*	2	
4/16/2008	2	T18	WK	0-5	0-13	*Ulva*	20	
4/16/2008	2	T18	WK	0-5	0-13	*Undaria*	1	
4/16/2008	2	T16	DH	0-5	0-13	*Chondracanthus*	10	
4/16/2008	2	T16	DH	0-5	0-13	*Egregia*	20	
4/16/2008	2	T16	DH	0-5	0-13	*Macrocystis*	25	
4/16/2008	2	T16	DH	0-5	0-13	*Sargassum*	10	
4/16/2008	2	T16	DH	0-5	0-13	*Undaria*	10	
4/16/2008	2	T16	DH	5-10	13-19	*Macrocystis*	5	
4/16/2008	2	T16	DH	5-10	13-19	*Undaria*	2	
4/16/2008	2	T16	DH	5-10	13-19	*Brown1*	2	
4/16/2008	2	T16	DH	5-10	13-19	*Brown2*	2	
4/16/2008	2	T16	DH	10-15	19-22	*Macrocystis*	20	
4/16/2008	2	T16	DH	10-15	19-22	*Undaria*	10	
4/16/2008	2	T16	DH	15-20	22-25	*Halymenia*	5	
4/16/2008	2	T16	DH	15-20	22-25	*Macrocystis*	10	
4/16/2008	2	T16	DH	15-20	22-25	*Sargassum*	2	
4/16/2008	2	T16	DH	15-20	22-25	*Undaria*	5	
4/16/2008	2	T16	DH	20-25	25-27	*Halymenia*	2	
4/16/2008	2	T16	DH	20-25	25-27	*Macrocystis*	10	

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4/16/2008	2	T16	DH	20-25	25-27	*Undaria*	1	
4/16/2008	2	T16	WK	0-5	0-13	*Colpomenia*	5	starfish, perch, limpit
4/16/2008	2	T16	WK	0-5	0-13	*Dictyota*	5	
4/16/2008	2	T16	WK	0-5	0-13	*Macrocystis*	8	
4/16/2008	2	T16	WK	0-5	0-13	*Sargassum*	5	
4/16/2008	2	T16	WK	0-5	0-13	*Brown1*	2	
4/16/2008	2	T16	WK	0-5	0-13	*Brown2*	2	
4/16/2008	2	T16	WK	5-10	13-19	*Macrocystis*	5	
4/16/2008	2	T16	WK	5-10	13-19	*Sargassum*	10	
4/16/2008	2	T16	WK	10-15	19-22	*Dictyota*	10	
4/16/2008	2	T16	WK	10-15	19-22	*Macrocystis*	10	
4/16/2008	2	T16	WK	10-15	19-22	*Undaria*	5	
4/16/2008	2	T16	WK	15-20	22-25	*Dictyota*	10	
4/16/2008	2	T16	WK	15-20	22-25	*Macrocystis*	10	
4/16/2008	2	T16	WK	15-20	22-25	*Sargassum*	10	
4/16/2008	2	T16	WK	15-20	22-25	*Undaria*	10	
4/16/2008	2	T16	WK	20-25	25-27	*Macrocystis*	10	
4/16/2008	2	T16	WK	20-25	25-27	*Sargassum*	1	
4/16/2008	2	T4	DH	0-5	0-10	*Macrocystis*	45	
4/16/2008	2	T4	DH	0-5	0-10	*Sargassum*	2	
4/16/2008	2	T4	DH	5-10	10-15	*Macrocystis*	10	
4/16/2008	2	T4	DH	5-10	10-15	*Rhodomenia*	1	
4/16/2008	2	T4	DH	10-15	15-25	*Dictyota*	1	
4/16/2008	2	T4	DH	10-15	15-25	*Macrocystis*	5	
4/16/2008	2	T4	WK	0-5	0-10	*Dictyota*	5	starfish
4/16/2008	2	T4	WK	0-5	0-10	*Macrocystis*	10	
4/16/2008	2	T4	WK	0-5	0-10	*Sargassum*	1	
4/16/2008	2	T4	WK	5-10	10-15	*Macrocystis*	10	
4/16/2008	2	T9	DH	0-5	0-5	*Codium*	5	
4/16/2008	2	T9	DH	0-5	0-5	*Colpomenia*	1	
4/16/2008	2	T9	DH	0-5	0-5	*Sargassum*	10	
4/16/2008	2	T9	DH	0-5	0-5	*Ulva*	10	
4/16/2008	2	T9	DH	0-5	0-5	*Eelgrass*	10	
4/16/2008	2	T9	DH	0-5	0-5	*Red*	3	
4/16/2008	2	T9	DH	5-10	5-12	*Colpomenia*	1	
4/16/2008	2	T9	DH	5-10	5-12	*Sargassum*	1	
4/16/2008	2	T9	DH	5-10	5-12	*Ulva*	2	
4/16/2008	2	T9	WK	0-5	0-5	*Colpomenia*	10	
4/16/2008	2	T9	WK	0-5	0-5	*Sargassum*	20	

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4/16/2008	2	T9	WK	0-5	0-5	*Ulva*	50	
4/16/2008	2	T14	DH	0-5	0-7	*Colpomenia*	20	pisaster, asterina, kelp bass, purple urchin, parastichopus, black surfperch, round stingray
4/16/2008	2	T14	DH	5-10	7-13	*Dictyota*	20	
4/16/2008	2	T14	DH	5-10	7-13	*Macrocystis*	50	
4/16/2008	2	T14	DH	10-15	13-20	*Dictyota*	20	
4/16/2008	2	T14	DH	10-15	13-20	*Macrocystis*	50	
4/16/2008	2	T14	DH	15-20	20-29	*Macrocystis*	20	
4/16/2008	2	T14	DH	20-25	29-35	*Dictyota*	1	
4/16/2008	2	T14	WK	0-5	0-7	*Colpomenia*	5	purple urchin, garibaldi, calico, sea cucumber, keyhole limpit, starfish
4/16/2008	2	T14	WK	0-5	0-7	*Dictyota*	2	
4/16/2008	2	T14	WK	5-10	7-13	*Dictyota*	30	
4/16/2008	2	T14	WK	5-10	7-13	*Macrocystis*	10	
4/16/2008	2	T14	WK	10-15	13-20	*Dictyota*	20	
4/16/2008	2	T14	WK	10-15	13-20	*Macrocystis*	10	
4/16/2008	2	T14	WK	15-20	20-29	*Macrocystis*	10	
10/20/2008	4	T14	DH	0-5	0-16	*Colpomenia*	1	lobster, purple urchin, parastichopus, kelp bass, garabaldi, pisaster, barred surfperch, pile perch, seniorita
10/20/2008	4	T14	DH	0-5	0-16	*Dictyota*	3	
10/20/2008	4	T14	DH	0-5	0-16	*Egregia*	1	
10/20/2008	4	T14	DH	5-10	16-20	*Colpomenia*	1	
10/20/2008	4	T14	DH	5-10	16-20	*Dictyota*	1	
10/20/2008	4	T14	DH	5-10	16-20	*Egregia*	2	
10/20/2008	4	T14	DH	5-10	16-20	*Macrocystis*	1	
10/20/2008	4	T14	DH	10-15	20-26	*Macrocystis*	5	
10/20/2008	4	T14	DH	15-20	26-35	*Macrocystis*	2	
10/20/2008	4	T14	DH	20-25	35-42	*no species*	0	
10/20/2008	4	T14	DH	25-26	42	*no species*	0	
10/20/2008	4	T14	JE	0-5	0-16	*Dictyota*	10	
10/20/2008	4	T14	JE	5-10	16-20	*Dictyota*	10	

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10/20/2008	4	T14	JE	10-15	20-26	*Macrocystis*	5	
10/20/2008	4	T14	JE	15-20	26-35	*Macrocystis*	5	
10/20/2008	4	T5	DH	0-5	5-9	*Corallina*	5	barred sand bass, bat ray, chromis, purps, pisaster, pile perch, black surfperch
10/20/2008	4	T5	DH	0-5	5-9	*Egregia*	5	
10/20/2008	4	T5	DH	5-10	9-18	*Egregia*	1	
10/20/2008	4	T5	DH	5-10	9-18	*Sargassum*	1	
10/20/2008	4	T5	DH	10-15	18-26	*Colpomenia*	1	
10/20/2008	4	T5	DH	10-15	18-26	*Macrocystis*	1	
10/20/2008	4	T5	DH	10-15	18-26	*Sargassum*	1	
10/20/2008	4	T5	DH	15-20	26-34	*Corallina*	1	
10/20/2008	4	T5	JE	0-5	5-9	*Corallina*	10	
10/20/2008	4	T5	JE	0-5	5-9	*Egregia*	5	
10/20/2008	4	T5	JE	5-10	9-18	*Colpomenia*	5	
10/20/2008	4	T5	JE	5-10	9-18	*Dictyota*	5	
10/20/2008	4	T5	JE	10-15	18-26	*Corallina*	10	
10/20/2008	4	T5	JE	10-15	18-26	*Dictyota*	1	
10/20/2008	4	T5	JE	10-15	18-26	*Egregia*	1	
10/20/2008	4	T5	JE	10-15	18-26	*Macrocystis*	1	
10/20/2008	4	T5	JE	10-15	18-26	*Sargassum*	2	
10/20/2008	4	T5	JE	15-20	26-34	*Corallina*	1	
10/20/2008	4	T5	JE	15-20	26-34	*Dictyota*	1	
10/20/2008	4	T1	DH	0-5	5-11	*Egregia*	3	purple urchins, red urchins, black surfperch, pisaster, seniorita, kelp bass, barred sand bass, pile perch, blacksmith
10/20/2008	4	T1	DH	0-5	5-11	*Macrocystis*	2	
10/20/2008	4	T1	DH	5-10	11-20	*Dictyota*	1	
10/20/2008	4	T1	DH	5-10	11-20	*Macrocystis*	1	
10/20/2008	4	T1	DH	10-15	20-29	*Dictyota*	1	
10/20/2008	4	T1	DH	10-15	20-29	*Macrocystis*	2	
10/20/2008	4	T1	DH	15-20	29-38	*Macrocystis*	1	
10/20/2008	4	T1	JE	0-5	5-11	*Egregia*	1	
10/20/2008	4	T1	JE	5-10	11-20	*Corallina*	1	
10/20/2008	4	T1	JE	10-15	20-29	*Dictyota*	1	
10/20/2008	4	T1	JE	10-15	20-29	*Macrocystis*	1	

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10/20/2008	4	T1	JE	15-20	29-38	*no species*	0	
10/20/2008	4	T4	DH	0-5	4-13	*Corallina*	20	kelp bass, hermit crabs, sculpin, pisaster, parastichopus
10/20/2008	4	T4	DH	0-5	4-13	*Egregia*	3	
10/20/2008	4	T4	DH	0-5	4-13	*Macrocystis*	50	
10/20/2008	4	T4	DH	0-5	4-13	*Sargassum*	5	
10/20/2008	4	T4	DH	0-5	4-13	*Ectocarpoid fuzz*	5	
10/20/2008	4	T4	DH	5-10	13-18	*Chondracanthus*	3	
10/20/2008	4	T4	DH	5-10	13-18	*Dictyota*	1	
10/20/2008	4	T4	DH	5-10	13-18	*Macrocystis*	2	
10/20/2008	4	T4	DH	10-15	18-20	*Chondracanthus*	1	
10/20/2008	4	T4	DH	10-15	18-20	*Dictyota*	1	
10/20/2008	4	T4	DH	10-15	18-20	*Macrocystis*	1	
10/20/2008	4	T4	DH	15-18	20-21	*no species*	0	
10/20/2008	4	T4	JE	0-5	4-13	*Chondracanthus*	50	
10/20/2008	4	T4	JE	0-5	4-13	*Corallina*	20	
10/20/2008	4	T4	JE	0-5	4-13	*Macrocystis*	50	
10/20/2008	4	T4	JE	5-10	13-18	*Chondracanthus*	10	
10/20/2008	4	T4	JE	5-10	13-18	*Dictyota*	5	
10/20/2008	4	T4	JE	5-10	13-18	*Macrocystis*	10	
10/20/2008	4	T4	JE	10-15	18-20	*Corallina*	50	
10/20/2008	4	T4	JE	10-15	18-20	*Dictyota*	1	
10/20/2008	4	T4	JE	10-15	18-20	*Macrocystis*	1	
10/20/2008	4	T4	JE	15-18	20-21	*no species*	0	
10/20/2008	4	T2	DH	0-5	4-13	*Chondracanthus*	40	garabaldi, kelp bass, pisaster, purple urchins, sea fans
10/20/2008	4	T2	DH	0-5	4-13	*Colpomenia*	1	
10/20/2008	4	T2	DH	0-5	4-13	*Macrocystis*	10	
10/20/2008	4	T2	DH	5-10	13-22	*Chondracanthus*	40	
10/20/2008	4	T2	DH	10-13	22-24	*Chondracanthus*	3	
10/20/2008	4	T2	JE	0-5	4-13	*Chondracanthus*	50	
10/20/2008	4	T2	JE	0-5	4-13	*Dictyota*	10	
10/20/2008	4	T2	JE	0-5	4-13	*Macrocystis*	10	
10/20/2008	4	T2	JE	0-5	4-13	*Ulva*	2	
10/20/2008	4	T2	JE	5-10	13-18	*Chondracanthus*	50	
10/20/2008	4	T2	JE	5-10	13-18	*Dictyota*	2	
10/20/2008	4	T2	JE	5-10	13-18	*Macrocystis*	2	

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10/20/2008	4	T2	JE	10-15	18-20	*Chondracanthus*	15	
10/20/2008	4	T17	DH	0-5	5-10	*Colpomenia*	10	
10/20/2008	4	T17	DH	0-5	5-10	*Corallina*	10	
10/20/2008	4	T17	DH	0-5	5-10	*Dictyota*	10	
10/20/2008	4	T17	DH	0-5	5-10	*Macrocystis*	1	
10/20/2008	4	T17	DH	0-5	5-10	*Sargassum*	10	
10/20/2008	4	T17	DH	0-5	5-10	*Undaria*	1	
10/20/2008	4	T17	DH	0-5	5-10	*Cystosiera*	1	
10/20/2008	4	T17	DH	5-10	10-14	*Corallina*	1	
10/20/2008	4	T17	DH	5-10	10-14	*Dictyota*	5	
10/20/2008	4	T17	DH	5-10	10-14	*Macrocystis*	5	
10/20/2008	4	T17	DH	5-10	10-14	*Sargassum*	15	
10/20/2008	4	T17	DH	5-10	10-14	*Cystosiera*	1	
10/20/2008	4	T17	DH	10-15	14-24	*Undaria*	1	
10/20/2008	4	T17	JE	0-5	5-10	*Chondracanthus*	25	
10/20/2008	4	T17	JE	0-5	5-10	*Colpomenia*	5	
10/20/2008	4	T17	JE	0-5	5-10	*Dictyota*	25	
10/20/2008	4	T17	JE	0-5	5-10	*Macrocystis*	5	
10/20/2008	4	T17	JE	0-5	5-10	*Sargassum*	10	
10/20/2008	4	T17	JE	0-5	5-10	*Ulva*	1	
10/20/2008	4	T17	JE	0-5	5-10	*Undaria*	2	
10/20/2008	4	T17	JE	5-10	10-14	*Chondracanthus*	5	
10/20/2008	4	T17	JE	5-10	10-14	*Dictyota*	10	
10/20/2008	4	T17	JE	5-10	10-14	*Macrocystis*	2	
10/20/2008	4	T17	JE	5-10	10-14	*Sargassum*	5	
10/20/2008	4	T17	JE	5-10	10-14	*Undaria*	5	
10/20/2008	4	T17	JE	10-15	14-24	*Chondracanthus*	5	
10/20/2008	4	T17	JE	10-15	14-24	*Macrocystis*	1	
10/20/2008	4	T9	DH	0-5	3-9	*Chondracanthus*	1	
10/20/2008	4	T9	DH	0-5	3-9	*Sargassum*	2	
10/20/2008	4	T9	DH	0-5	3-9	*Ulva*	1	
10/20/2008	4	T9	DH	0-5	3-9	*Eelgrass*	1	
10/20/2008	4	T9	DH	5-8	9-13	*Chondracanthus*	1	
10/20/2008	4	T9	DH	5-8	9-13	*Sargassum*	1	
10/20/2008	4	T9	JE	0-5	3-9	*Sargassum*	30	
10/20/2008	4	T16	DH	0-5	5-11	*Chondracanthus*	2	
10/20/2008	4	T16	DH	0-5	5-11	*Dictyota*	5	
10/20/2008	4	T16	DH	0-5	5-11	*Egregia*	20	
10/20/2008	4	T16	DH	0-5	5-11	*Gymnogongrus*	20	

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
10/20/2008	4	T16	DH	0-5	5-11	*Macrocystis*	30	
10/20/2008	4	T16	DH	0-5	5-11	*Undaria*	1	
10/20/2008	4	T16	DH	5-10	11-14	*Chondracanthus*	2	
10/20/2008	4	T16	DH	5-10	11-14	*Dictyota*	5	
10/20/2008	4	T16	DH	5-10	11-14	*Gymnogongrus*	1	
10/20/2008	4	T16	DH	5-10	11-14	*Macrocystis*	30	
10/20/2008	4	T16	DH	5-10	11-14	*Sargassum*	1	
10/20/2008	4	T16	DH	5-10	11-14	*Undaria*	5	
10/20/2008	4	T16	DH	10-15	14-18	*Chondracanthus*	2	
10/20/2008	4	T16	DH	10-15	14-18	*Dictyota*	5	
10/20/2008	4	T16	DH	10-15	14-18	*Gymnogongrus*	1	
10/20/2008	4	T16	DH	10-15	14-18	*Macrocystis*	10	
10/20/2008	4	T16	DH	10-15	14-18	*Sargassum*	1	
10/20/2008	4	T16	DH	10-15	14-18	*Undaria*	5	
10/20/2008	4	T16	DH	15-20	18-21	*Dictyota*	3	
10/20/2008	4	T16	DH	15-20	18-21	*Macrocystis*	5	
10/20/2008	4	T16	DH	15-20	18-21	*Sargassum*	1	
10/20/2008	4	T16	DH	15-20	18-21	*Undaria*	1	
10/20/2008	4	T16	DH	20-25	21	*Dictyota*	1	
10/20/2008	4	T16	DH	20-25	21	*Macrocystis*	1	
10/20/2008	4	T16	DH	20-25	21	*Undaria*	1	
10/20/2008	4	T16	DH	25-30	21-26	*Dictyota*	1	
10/20/2008	4	T16	DH	25-30	21-26	*Macrocystis*	1	
10/20/2008	4	T16	DH	25-30	21-26	*Undaria*	1	
10/20/2008	4	T16	JE	0-5	5-11	*Chondracanthus*	25	
10/20/2008	4	T16	JE	0-5	5-11	*Dictyota*	25	
10/20/2008	4	T16	JE	0-5	5-11	*Macrocystis*	15	
10/20/2008	4	T16	JE	0-5	5-11	*Pachydictyon*	5	
10/20/2008	4	T16	JE	5-10	11-14	*Chondracanthus*	20	
10/20/2008	4	T16	JE	5-10	11-14	*Dictyota*	20	
10/20/2008	4	T16	JE	5-10	11-14	*Macrocystis*	20	
10/20/2008	4	T16	JE	5-10	11-14	*Undaria*	5	
10/20/2008	4	T16	JE	10-15	14-18	*Dictyota*	5	
10/20/2008	4	T16	JE	10-15	14-18	*Macrocystis*	10	
10/20/2008	4	T16	JE	10-15	14-18	*Undaria*	2	
10/20/2008	4	T16	JE	15-20	18-21	*Chondracanthus*	5	
10/20/2008	4	T16	JE	15-20	18-21	*Dictyota*	5	
10/20/2008	4	T16	JE	15-20	18-21	*Macrocystis*	8	
10/20/2008	4	T16	JE	20-25	21	*Macrocystis*	3	

Date	Survey	Site	Observer	Location on Transect (m)	Depth Range (ft)	Species	Percent Cover	Macroinvertebrates and Fishes Observed
10/20/2008	4	T16	JE	20-25	21	*Undaria*	1	
10/20/2008	4	T16	JE	25-30	21-26	*Chondracanthus*	10	
10/20/2008	4	T16	JE	25-30	21-26	*Macrocystis*	2	
10/20/2008	4	T20	DH	0-5	4-10	*Colpomenia*	5	pisaster, opaleye, kelp bass, seniorita, megathura, nudibranch, sculpin
10/20/2008	4	T20	DH	0-5	4-10	*Corallina*	15	
10/20/2008	4	T20	DH	0-5	4-10	*Dictyota*	15	
10/20/2008	4	T20	DH	0-5	4-10	*Macrocystis*	30	
10/20/2008	4	T20	DH	0-5	4-10	*Undaria*	10	
10/20/2008	4	T20	DH	5-10	10-14	*Colpomenia*	1	
10/20/2008	4	T20	DH	5-10	10-14	*Corallina*	5	
10/20/2008	4	T20	DH	5-10	10-14	*Dictyota*	1	
10/20/2008	4	T20	DH	5-10	10-14	*Macrocystis*	30	
10/20/2008	4	T20	DH	5-10	10-14	*Undaria*	20	
10/20/2008	4	T20	DH	10-15	14-24	*Colpomenia*	2	
10/20/2008	4	T20	DH	10-15	14-24	*Macrocystis*	10	
10/20/2008	4	T20	DH	10-15	14-24	*Undaria*	10	
10/20/2008	4	T20	DH	15-16	24-26	*Undaria*	1	
10/20/2008	4	T20	JE	0-5	4-10	*Chondracanthus*	20	
10/20/2008	4	T20	JE	0-5	4-10	*Colpomenia*	3	
10/20/2008	4	T20	JE	0-5	4-10	*Corallina*	25	
10/20/2008	4	T20	JE	0-5	4-10	*Dictyota*	15	
10/20/2008	4	T20	JE	0-5	4-10	*Macrocystis*	15	
10/20/2008	4	T20	JE	0-5	4-10	*Undaria*	1	
10/20/2008	4	T20	JE	5-10	10-14	*Chondracanthus*	20	
10/20/2008	4	T20	JE	5-10	10-14	*Colpomenia*	3	
10/20/2008	4	T20	JE	5-10	10-14	*Dictyota*	3	
10/20/2008	4	T20	JE	5-10	10-14	*Macrocystis*	10	
10/20/2008	4	T20	JE	5-10	10-14	*Undaria*	8	
10/20/2008	4	T20	JE	10-15	14-24	*Chondracanthus*	2	
10/20/2008	4	T20	JE	10-15	14-24	*Colpomenia*	5	
10/20/2008	4	T20	JE	10-15	14-24	*Macrocystis*	4	
10/20/2008	4	T20	JE	10-15	14-24	*Undaria*	2	
10/20/2008	4	T20	JE	15-16	24-26	*no species*	0	
10/21/2008	4	T6	DH	0-5	5-13	*Colpomenia*	10	
10/21/2008	4	T6	DH	0-5	5-13	*Sargassum*	15	
10/21/2008	4	T6	DH	5-10	13-22	*Colpomenia*	2	

Date	Survey	Site	Observer	Location on Transect (m)	Depth Range (ft)	Species	Percent Cover	Macroinvertebrates and Fishes Observed
10/21/2008	4	T6	DH	5-10	13-22	*Sargassum*	5	
10/21/2008	4	T6	DH	5-10	13-22	*Cystosiera*	1	
10/21/2008	4	T6	DH	10-15	22-29	*Colpomenia*	1	
10/21/2008	4	T6	DH	10-15	22-29	*Macrocystis*	1	
10/21/2008	4	T6	DH	10-15	22-29	*Undaria*	1	
10/21/2008	4	T6	DH	15-20	29-39	*Cystosiera*	1	
10/21/2008	4	T6	JE	0-5	5-13	*Colpomenia*	5	
10/21/2008	4	T6	JE	0-5	5-13	*Corallina*	1	
10/21/2008	4	T6	JE	0-5	5-13	*Dictyota*	1	
10/21/2008	4	T6	JE	0-5	5-13	*Sargassum*	12	
10/21/2008	4	T6	JE	5-10	13-22	*Colpomenia*	4	
10/21/2008	4	T6	JE	5-10	13-22	*Dictyota*	3	
10/21/2008	4	T6	JE	10-15	22-29	*Dictyota*	1	
10/21/2008	4	T6	JE	10-15	22-29	*Undaria*	3	
10/21/2008	4	T6	JE	10-15	22-29	*Ectocarpoid fuzz*	15	
10/21/2008	4	T6	JE	15-20	29-39	*Dictyota*	1	
10/21/2008	4	T6	JE	15-20	29-39	*Undaria*	1	
10/21/2008	4	T6	JE	15-20	29-39	*Ectocarpoid fuzz*	5	
10/21/2008	4	T15	DH	0-5	4-10	*Codium*	10	
10/21/2008	4	T15	DH	0-5	4-10	*Corallina*	60	
10/21/2008	4	T15	DH	0-5	4-10	*Dictyota*	5	
10/21/2008	4	T15	DH	0-5	4-10	*Macrocystis*	30	
10/21/2008	4	T15	DH	0-5	4-10	*Pachydictyon*	2	
10/21/2008	4	T15	DH	0-5	4-10	*Sargassum*	2	
10/21/2008	4	T15	DH	0-5	4-10	*Undaria*	1	
10/21/2008	4	T15	DH	5-10	10-18	*Corallina*	5	
10/21/2008	4	T15	DH	5-10	10-18	*Macrocystis*	60	
10/21/2008	4	T15	DH	5-10	10-18	*Undaria*	2	
10/21/2008	4	T15	DH	10-15	18-28	*Macrocystis*	50	
10/21/2008	4	T15	DH	15-20	28-39	*Macrocystis*	2	
10/21/2008	4	T15	JE	0-5	4-10	*Chondracanthus*	10	
10/21/2008	4	T15	JE	0-5	4-10	*Colpomenia*	15	
10/21/2008	4	T15	JE	0-5	4-10	*Corallina*	20	
10/21/2008	4	T15	JE	0-5	4-10	*Dictyota*	20	
10/21/2008	4	T15	JE	0-5	4-10	*Macrocystis*	10	
10/21/2008	4	T15	JE	0-5	4-10	*Ulva*	2	
10/21/2008	4	T15	JE	5-10	10-18	*Chondracanthus*	8	
10/21/2008	4	T15	JE	5-10	10-18	*Corallina*	25	
10/21/2008	4	T15	JE	5-10	10-18	*Macrocystis*	20	

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
10/21/2008	4	T15	JE	10-15	18-28	*Chondracanthus*	5	
10/21/2008	4	T15	JE	10-15	18-28	*Macrocystis*	10	
10/21/2008	4	T15	JE	10-15	18-28	*Ectocarpoid fuzz*	25	
10/21/2008	4	T15	JE	15-20	28-39	*Ectocarpoid fuzz*	10	
10/21/2008	4	T8	DH	0-5	4-12	*Codium*	1	
10/21/2008	4	T8	DH	0-5	4-12	*Colpomenia*	1	
10/21/2008	4	T8	DH	0-5	4-12	*Sargassum*	5	
10/21/2008	4	T8	DH	0-5	4-12	*Ulva*	1	
10/21/2008	4	T8	DH	0-5	4-12	*Ectocarpoid fuzz*	5	
10/21/2008	4	T8	DH	5-10	12-23	*Sargassum*	5	
10/21/2008	4	T8	DH	5-10	12-23	*Ulva*	2	
10/21/2008	4	T8	DH	5-10	12-23	*Ectocarpoid fuzz*	5	
10/21/2008	4	T8	DH	10-15	23-34	*Ulva*	1	
10/21/2008	4	T8	DH	10-15	23-34	*Ectocarpoid fuzz*	5	
10/21/2008	4	T8	DH	15-18	34-39	*no species*	0	
10/21/2008	4	T8	JE	0-5	4-12	*Sargassum*	10	
10/21/2008	4	T8	JE	0-5	4-12	*Ulva*	10	
10/21/2008	4	T8	JE	0-5	4-12	*Ectocarpoid fuzz*	5	
10/21/2008	4	T8	JE	5-10	12-23	*Chondracanthus*	3	
10/21/2008	4	T8	JE	5-10	12-23	*Dictyota*	1	
10/21/2008	4	T8	JE	5-10	12-23	*Sargassum*	1	
10/21/2008	4	T8	JE	5-10	12-23	*Undaria*	1	
10/21/2008	4	T8	JE	5-10	12-23	*Ectocarpoid fuzz*	5	
10/21/2008	4	T8	JE	10-15	23-34	*Chondracanthus*	5	
10/21/2008	4	T8	JE	10-15	23-34	*Ectocarpoid fuzz*	10	
10/21/2008	4	T8	JE	15-18	34-39	*Chondracanthus*	1	
10/21/2008	4	T8	JE	15-18	34-39	*Ectocarpoid fuzz*	2	
10/21/2008	4	T8	DH	0-5	3-10	*Colpomenia*	10	
10/21/2008	4	T8	DH	0-5	3-10	*Sargassum*	40	
10/21/2008	4	T8	DH	0-5	3-10	*Ulva*	5	
10/21/2008	4	T8	DH	0-5	3-10	*Ectocarpoid fuzz*	1	
10/21/2008	4	T8	DH	5-10	10-18	*Sargassum*	5	
10/21/2008	4	T8	DH	5-10	10-18	*Ulva*	2	
10/21/2008	4	T8	DH	10-13	18-22	*Sargassum*	2	
10/21/2008	4	T8	JE	0-5	3-10	*Colpomenia*	2	
10/21/2008	4	T8	JE	0-5	3-10	*Sargassum*	30	
10/21/2008	4	T8	JE	0-5	3-10	*Ulva*	10	
10/21/2008	4	T8	JE	0-5	3-10	*Ectocarpoid fuzz*	10	
10/21/2008	4	T8	JE	5-10	10-18	*Corallina*	3	

Date	Survey	Site	Observer	Location on Transect (m)	Depth Range (ft)	Species	Percent Cover	Macroinvertebrates and Fishes Observed
10/21/2008	4	T8	JE	5-10	10-18	*Dictyota*	3	
10/21/2008	4	T8	JE	5-10	10-18	*Sargassum*	10	
10/21/2008	4	T8	JE	5-10	10-18	*Ulva*	8	
10/21/2008	4	T8	JE	10-13	18-22	*Ectocarpoid fuzz*	5	
10/21/2008	4	T11	DH	0-5	3-11	*Chondracanthus*	10	
10/21/2008	4	T11	DH	0-5	3-11	*Colpomenia*	15	
10/21/2008	4	T11	DH	0-5	3-11	*Sargassum*	15	
10/21/2008	4	T11	DH	0-5	3-11	*Ulva*	10	
10/21/2008	4	T11	DH	5-10	11-17	*Chondracanthus*	10	
10/21/2008	4	T11	DH	5-10	11-17	*Colpomenia*	1	
10/21/2008	4	T11	DH	5-10	11-17	*Sargassum*	20	
10/21/2008	4	T11	DH	5-10	11-17	*Ulva*	10	
10/21/2008	4	T11	DH	10-15	17-25	*Chondracanthus*	5	
10/21/2008	4	T11	DH	10-15	17-25	*Sargassum*	5	
10/21/2008	4	T11	DH	10-15	17-25	*Ulva*	1	
10/21/2008	4	T11	DH	15-20	25-32	*Chondracanthus*	3	
10/21/2008	4	T11	DH	15-20	25-32	*Sargassum*	2	
10/21/2008	4	T11	DH	15-20	25-32	*Ulva*	1	
10/21/2008	4	T11	JE	0-5	3-11	*Colpomenia*	5	
10/21/2008	4	T11	JE	0-5	3-11	*Sargassum*	50	
10/21/2008	4	T11	JE	0-5	3-11	*Ulva*	10	
10/21/2008	4	T11	JE	5-10	11-17	*Chondracanthus*	10	
10/21/2008	4	T11	JE	5-10	11-17	*Sargassum*	20	
10/21/2008	4	T11	JE	5-10	11-17	*Ulva*	20	
10/21/2008	4	T11	JE	10-15	17-25	*Chondracanthus*	15	
10/21/2008	4	T11	JE	10-15	17-25	*Sargassum*	10	
10/21/2008	4	T11	JE	10-15	17-25	*Ulva*	7	
10/21/2008	4	T11	JE	15-20	25-32	*Chondracanthus*	12	
10/21/2008	4	T11	JE	15-20	25-32	*Sargassum*	6	
10/21/2008	4	T12	DH	0-5	3-15	*Colpomenia*	2	
10/21/2008	4	T12	DH	0-5	3-15	*Sargassum*	10	
10/21/2008	4	T12	DH	5-10	15-23	*Chondracanthus*	5	
10/21/2008	4	T12	DH	5-10	15-23	*Sargassum*	5	
10/21/2008	4	T12	DH	10-13	23-25	*Chondracanthus*	5	
10/21/2008	4	T12	JE	0-5	3-15	*Colpomenia*	5	
10/21/2008	4	T12	JE	0-5	3-15	*Sargassum*	15	
10/21/2008	4	T12	JE	0-5	3-15	*Ectocarpoid fuzz*	15	
10/21/2008	4	T12	JE	5-10	15-23	*Chondracanthus*	2	
10/21/2008	4	T12	JE	5-10	15-23	*Dictyota*	4	

Date	Survey	Site	Observer	Location on Transect (m)	Depth Range (ft)	Species	Percent Cover	Macroinvertebrates and Fishes Observed
10/21/2008	4	T12	JE	5-10	15-23	*Ectocarpoid fuzz*	10	
10/21/2008	4	T12	JE	10-13	23-25	*Ectocarpoid fuzz*	4	
10/21/2008	4	T13	DH	0-5	4-12	*Colpomenia*	1	
10/21/2008	4	T13	DH	0-5	4-12	*Sargassum*	40	
10/21/2008	4	T13	DH	0-5	4-12	*Ulva*	2	
10/21/2008	4	T13	DH	0-5	4-12	*Undaria*	2	
10/21/2008	4	T13	DH	5-10	12-19	*Chondracanthus*	2	
10/21/2008	4	T13	DH	5-10	12-19	*Sargassum*	2	
10/21/2008	4	T13	DH	5-10	12-19	*Undaria*	5	
10/21/2008	4	T13	DH	5-10	12-19	*Enteromorpha*	1	
10/21/2008	4	T13	DH	10-15	19-23	*Chondracanthus*	1	
10/21/2008	4	T13	DH	10-15	19-23	*Undaria*	2	
10/21/2008	4	T13	DH	15-19	23-26	*Chondracanthus*	1	
10/21/2008	4	T13	DH	15-19	23-26	*Undaria*	1	
10/21/2008	4	T13	JE	0-5	4-12	*Colpomenia*	1	
10/21/2008	4	T13	JE	0-5	4-12	*Sargassum*	40	
10/21/2008	4	T13	JE	0-5	4-12	*Ulva*	5	
10/21/2008	4	T13	JE	0-5	4-12	*Undaria*	2	
10/21/2008	4	T13	JE	0-5	4-12	*Ectocarpoid fuzz*	5	
10/21/2008	4	T13	JE	5-10	12-19	*Chondracanthus*	10	
10/21/2008	4	T13	JE	5-10	12-19	*Colpomenia*	1	
10/21/2008	4	T13	JE	5-10	12-19	*Sargassum*	15	
10/21/2008	4	T13	JE	5-10	12-19	*Ulva*	2	
10/21/2008	4	T13	JE	5-10	12-19	*Undaria*	2	
10/21/2008	4	T13	JE	10-15	19-23	*Chondracanthus*	5	
10/21/2008	4	T13	JE	10-15	19-23	*Ulva*	1	
10/21/2008	4	T13	JE	10-15	19-23	*Undaria*	3	
10/21/2008	4	T13	JE	10-15	19-23	*Ectocarpoid fuzz*	1	
10/21/2008	4	T13	JE	15-20	23-26	*Sargassum*	5	
10/21/2008	4	T13	JE	15-20	23-26	*Undaria*	10	
10/22/2008	4	T19	DH	0-5	4-14	*Ectocarpoid fuzz*	70	
10/22/2008	4	T19	DH	0-5	4-14	*Eelgrass*	2	
10/22/2008	4	T19	DH	5-10	14-21	*Chondracanthus*	1	
10/22/2008	4	T19	DH	5-10	14-21	*Ectocarpoid fuzz*	10	
10/22/2008	4	T19	DH	5-10	14-21	*Eelgrass*	5	
10/22/2008	4	T19	DH	10-12	21-24	*Ectocarpoid fuzz*	1	
10/22/2008	4	T19	JE	0-5	4-14	*Sargassum*	25	
10/22/2008	4	T19	JE	0-5	4-14	*Ectocarpoid fuzz*	50	
10/22/2008	4	T19	JE	5-10	14-21	*Undaria*	3	

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
10/22/2008	4	T19	JE	5-10	14-21	*Ectocarpoid fuzz*	5	
10/22/2008	4	T19	JE	10-13	21-24	*no species*	0	
10/22/2008	4	T18	DH	0-5	3-13	*Colpomenia*	2	
10/22/2008	4	T18	DH	0-5	3-13	*Sargassum*	10	
10/22/2008	4	T18	DH	0-5	3-13	*Ulva*	5	
10/22/2008	4	T18	DH	5-10	13-21	*Sargassum*	1	
10/22/2008	4	T18	DH	5-10	13-21	*Ulva*	1	
10/22/2008	4	T18	DH	5-10	13-21	*Undaria*	1	
10/22/2008	4	T18	DH	10-15	21-29	*no species*	0	
10/22/2008	4	T18	JE	0-5	3-13	*Chondracanthus*	15	
10/22/2008	4	T18	JE	0-5	3-13	*Colpomenia*	5	
10/22/2008	4	T18	JE	0-5	3-13	*Sargassum*	15	
10/22/2008	4	T18	JE	0-5	3-13	*Ulva*	3	
10/22/2008	4	T18	JE	5-10	13-21	*Chondracanthus*	8	
10/22/2008	4	T18	JE	5-10	13-21	*Colpomenia*	1	
10/22/2008	4	T18	JE	5-10	13-21	*Sargassum*	5	
10/22/2008	4	T18	JE	5-10	13-21	*Ulva*	1	
10/22/2008	4	T18	JE	10-15	21-29	*Chondracanthus*	2	
10/22/2008	4	T10	DH	0-5	3-7	*Sargassum*	5	
10/22/2008	4	T10	DH	0-5	3-7	*Ulva*	2	
10/22/2008	4	T10	DH	0-5	3-7	*Undaria*	1	
10/22/2008	4	T10	DH	0-5	3-7	*Ectocarpoid fuzz*	30	
10/22/2008	4	T10	DH	5-10	7-10	*Sargassum*	2	
10/22/2008	4	T10	DH	5-10	7-10	*Ectocarpoid fuzz*	30	
10/22/2008	4	T10	DH	5-10	7-10	*Eelgrass*	30	
10/22/2008	4	T10	DH	10-15	10-15	*Sargassum*	1	
10/22/2008	4	T10	DH	10-15	10-15	*Ectocarpoid fuzz*	50	
10/22/2008	4	T10	DH	15-20	15-22	*Sargassum*	1	
10/22/2008	4	T10	DH	15-20	15-22	*Ectocarpoid fuzz*	20	
10/22/2008	4	T10	DH	20-25	22-30	*Ectocarpoid fuzz*	20	
10/22/2008	4	T10	JE	0-5	3-7	*Sargassum*	20	
10/22/2008	4	T10	JE	0-5	3-7	*Ulva*	10	
10/22/2008	4	T10	JE	0-5	3-7	*Ectocarpoid fuzz*	75	
10/22/2008	4	T10	JE	5-10	7-10	*Sargassum*	1	
10/22/2008	4	T10	JE	5-10	7-10	*Ectocarpoid fuzz*	50	
10/22/2008	4	T10	JE	5-10	7-10	*Eelgrass*	50	
10/22/2008	4	T10	JE	10-15	10-15	*Ectocarpoid fuzz*	40	
10/22/2008	4	T10	JE	15-20	15-22	*Chondracanthus*	40	
10/22/2008	4	T10	JE	15-20	15-22	*Ulva*	5	

Date	*Survey*	*Site*	*Observer*	*Location on Transect (m)*	*Depth Range (ft)*	*Species*	*Percent Cover*	*Macroinvertebrates and Fishes Observed*
10/22/2008	4	T10	JE	15-20	15-22	*Ectocarpoid fuzz*	40	
10/22/2008	4	T10	JE	20-25	22-30	*Chondracanthus*	5	
10/22/2008	4	T10	JE	20-25	22-30	*Ectocarpoid fuzz*	50	
10/22/2008	4	T3	DH	na	na	*no species*	0	No visibility - no data
10/22/2008	4	T3	JE	na	na	*no species*	0	No visibility - no data

Species	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*	*T7*	*T8*	*T9*	*T10*	*T11*	*T12*	*T13*	*T14*	*T15*	*T16*	*T17*	*T18*	*T19*	*T20*
Chondracanthus		X		X			X	X	X	X	X	X	X		X	X	X	X	X	X
Codium								X	X						X					
Colpomenia		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Corallina	X		X	X	X	X		X							X		X			X
Cystosiera						X											X			
Dictyopteris		X																		
Dictyota/Pachydicton	X	X		X	X	X		X		X	X	X		X	X	X	X	X		X
Ectocarpoid fuzz				X		X		X		X		X	X		X				X	X
Eelgrass									X	X									X	
Egregia	X			X	X									X	X	X	X			X
Enteromorpha													X							
Gymnogongrus																X				
Halymenia		X								X	X	X	X			X		X		
Leathesia							X													
Macrocystis	X	X	X	X	X	X								X	X	X	X			X
Prionitis										X										
Rhodomenia				X						X	X	X								
Sargassum		X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X
Ulva		X					X	X	X	X	X	X	X		X		X	X	X	X
Undaria		X	X			X	X	X		X	X	X	X		X	X	X	X	X	X
Unidentified brown alga																X				
Unidentified red alga									X											

APPENDIX H

BIRDS

APPENDIX H-1

AVIAN ECOLOGICAL GUILDS

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Table H-1. Avian Ecological Guilds Observed December 2007 to November 2008 in the Ports of Long Beach and Los Angeles

GUILD 1 - SMALL SHOREBIRDS		GUILD 3 - WADING/MARSH BIRDS	
Charadriidae (Plovers and Relatives)		**Ardeidae (Herons and Egrets)**	
Black-bellied Plover	*Pluvialis squatarola*	Great Blue Heron	*Ardea herodias*
Killdeer	*Charadrius vociferus*	Great Egret	*Casmerodius albus*
		Snowy Egret	*Egretta thula*
Scolopacidae (Sandpipers and Relatives)		Cattle Egret	*Bubulcus ibis*
Spotted Sandpiper	*Actitis macularia*	Green Heron	*Butorides virescens*
Surfbird	*Aphriza virgata*	Black-crowned Night-Heron	*Nycticorax nycticorax*
Ruddy Turnstone	*Arenaria interpres*		
Black Turnstone	*Arenaria melanocephala*		
Sanderling	*Calidris alba*		
Wandering Tattler*	*Catoptrophorus semipalmatus*		
Western Sandpiper	*Calidris mauri*		
Least Sandpiper	*Calidris minutilla*		
* this species was included as a Large Shorebird for 2000-2001 (MEC 2002) surveys but is the same size as Black-bellied Plover, Killdeer and Surfbird			
GUILD 2 - LARGE SHOREBIRDS		**GUILD 4 - AERIAL FISH FORAGERS**	
Haematopodidae (Oystercatchers)		**Alcedinidae**	
American Oystercatcher	*Haematopus palliatus*	Belted Kingfisher	*Ceryle alcyon*
Black Oystercatcher	*Haematopus bachmani*		
		Pelicanidae	
Recurvirostridae (Avocets and Stilts)		California Brown Pelican	*Pelecanus occidentalis californicus*
Black-necked Stilt	*Himantopus mexicanus*		
		Laridae, subfamily Sterninae (Terns)	
Scolopacidae (Sandpipers and Relatives)		Caspian Tern	*Sterna caspia*
Long-billed Curlew	*Numenius americanus*	Royal Tern	*Sterna maxima*
Marbled Godwit	*Limosa fedoa*	Elegant Tern	*Sterna elegans*
Red-necked Phalarope	*Phalaropus lobatus*	Forstern's Tern	*Sterna forsteri*
Whimbrel	*Numenius phaeopus*	California Least Tern	*Sterna antillarum browni*
Willet	*Catoptrophorus semipalmatus*	Black Skimmer	*Rynchops niger*
		Stercoraridae (Jaegers and Skuas)	
		Parasitic Jaeger	

GUILD 5 - WATERFOWL	
Gaviidae (Loons)	
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Podicipedidae (Grebes)	
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*
Phalacrocoracidae (Cormorants)	
Double-crested Cormorant	*Phalacrocorax auritus*
Brandt's Cormorant	*Phalacrocorax penicillatus*
Pelagic Cormorant	*Phalacrocorax pelagicus*
Anatidae (Swans, Geese, and Ducks)	
Brant	*Branta bernicla*
Domestic Duck	*Anas domesticus*
Mallard	*Anas platyrhynchos*
American Green-winged Teal	*Anas crecca*
Blue-winged Teal	*Anas discors*
Canvasback	*Aythya valisineria*
Lesser Scaup	*Aythya affinis*
Ruddy Duck	*Oxyura jamaicensis*
Long-tailed Duck	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Red-breasted Merganser	*Mergus serrator*
Black Scoter	*Melanitta nigra*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Rallidae (Rails, Gallinules, and Coots)	
American Coot	*Fulica americana*
Alcidae (Auks, Murres, and Puffins)	
Common Murre	

GUILD 6 - GULLS	
Laridae (Gulls)	
Bonaparte's Gull	*Larus philadelphia*
Heermann's Gull	*Larus heermanni*
Mew Gull	Larus canus
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Thayer's Gull	*Larus thayeri*
Western Gull	*Larus occidentalis*
Glaucous-winged Gull	*Larus glaucescens*

GUILD 7 - RAPTORS	
Accipitridae (Hawks)	
Osprey	*Pandion haliaetus*
Cooper's Hawk	Accipiter cooperii
Red-tailed Hawk	*Buteo jamaicensis*
Falconidae (Falcons)	
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Cathartidae (Vultures)	
Turkey Vulture	*Cathartes aura*

GUILD 8 - UPLAND BIRDS		GUILD 8 - UPLAND BIRDS (continued)	
Columbidae (Pigeons and Doves)		**Sturnidae (Starlings)**	
Rock Dove	*Columba livia*	European Starling	*Sturnus vulgaris*
Mourning Dove	*Zenaida macroura*		
Eurasian Collared-Dove	*Streptopelia decaocto*	**Parulidae (Wood-Warblers)**	
		Yellow-rumped Warbler	*Dendroica coronata*
Trochilidae (Hummingbirds)	*Calypte anna*		
Anna's Hummingbird		**Emberizidae (Warblers, Sparrows, Blackbirds and Relatives)**	
		White-crowned Sparrow	*Zonotrichia leucophrys*
Tyrannidae (Tyrant Flycatchers)		Western Meadowlark	*Sturnella neglecta*
Black Phoebe	*Sayornis nigricans*	Great-tailed Grackle	*Quiscalus mexicanus*
Say's Phoebe	*Sayornis saya*		
		Icteridae (Blackbirds, Cowbirds and Orioles)	
Corvidae--jays, crows		Bullock's Oriole	*Icterus bullockii*
American Crow	*Corvus brachyrhynchos*		
Common Raven	*Corvus corax*	**Fringillidae (Finches)**	
		House Finch	*Carpodacus mexicanus*
Hirundinidae (Swallows)		Lesser Goldfinch	*Carduelis psaltria*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*		
Cliff Swallow	*Hirundo pyrrhonota*	**Passeridae (Weavers)**	
Barn Swallow	*Hirundo rustica*	House Sparrow	*Passer domesticus*
Mimidae (Mockingbirds and Thrashers)			
Northern Mockingbird	*Mimus polyglottos*		

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APPENDIX H-2

NUMBER OF INDIVIDUALS BY SPECIES PER SURVEY

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Table H-2. December A 2007 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Coot	4				1			1																							2	
American Crow	14							1			2						3			2			2	2								2
Belted Kingfisher	6				1			1												2								1			1	
Black Oystercatcher	2															2																
Black Phoebe	1																														1	
Black-bellied Plover	179				168	9							2																			
Black-crowned Night-Heron	3				2																				1							
Brandt's Cormorant	639			7	4				11	31	57		366			16				8	125		9	1	2			2				
Brown Pelican	786		43	32	20				9	279		6	171		1	114	6	10	1	4	5		11					2				72
Bufflehead	34	17	12		1		3										1															
California Gull	107	2				1								1	9			1	1	2	9			2	77				1			1
Caspian Tern	4										3							1														
Clark's Grebe	10	1					2		3		2										2											
Common Raven	5								1											1			2									1
Double-crested Cormorant	275	11	4	1	32	1	13		3	4	3	1	35			62	10	2		6	24				5	4		7	1		3	43
Eared Grebe	44	14			7	2	2										3				4		2		1	1		1		3	4	
Forster's Tern	2		1			1																										
Glaucous-winged Gull	5							1								1				1	2											
Great Blue Heron	51	1			8		4	1	1		2			1		1	1			2	6		1	1	4	2	2	4	3	1	2	3
Great-tailed Grackle	2																								2							
Green Heron	3																									1		2				
Heermann's Gull	411	12	7	20	19		1	13	2	8	9		111			35	1	4		17	9		10	4			2		4	4		119
Herring Gull	11				1			3								3			3				1									
Horned Grebe	2										1									1												
House Finch	4								4																							
Killdeer	3																														3	
Least Sandpiper	8					2																									6	
Lesser Scaup	31	2			5		19																								5	
Long-billed Curlew	2				1	1																										
Long-tailed Duck	1																				1											
Marbled Godwit	3	1			2																											
Mew Gull	260																				258		2									
Northern Mockingbird	2																								2							
Osprey	3					1								1						1												
Pelagic Cormorant	4								1											2	1											
Pied-billed Grebe	6				1												1				2					1					1	
Red-tailed Hawk	5					1																	1	1	2							
Ring-billed Gull	41	17			4			3												9			3				2		1	1		1
Rock Dove	167		1		18	31					16						12			9			5		40	6		18	6		5	
Royal Tern	51	2									49																					
Ruddy Duck	6	6																														

Species	*Totals*	*Zones*																													
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Sanderling	20				4		1				1		4			10																
Snowy Egret	5				1			1															1		1						1	
Spotted Sandpiper	2																														2	
Surf Scoter	1505		44	38	104	6	41	7	13		94	4			7		42		618		487											
Surfbird	22												22																			
Wandering Tattler	1												1																			
Western Grebe	591		32		27	3	8	6	286		188	6		7	5		2		9	1	6				2				2			1
Western Gull	1361	26	24	61	186		1	28	4	43	33		224	4	18	56	5	1	3	15	47		66	46	145	2	14	1	6	15	1	286
Whimbrel	3		1			1										1																
Willet	6		1		1	2										1					1											
Yellow-rumped Warbler	4										2																				2	

Table H-3. December B 2007 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Coot	15	1																													14	
American Crow	12	2			2												5								2						1	
Belted Kingfisher	3						1																1				1					
Black Oystercatcher	2			2																												
Black Scoter	2																		1		1											
Black Turnstone	2									2																						
Black-bellied Plover	57						47						10																			
Black-crowned Night-Heron	6													1							3				2							
Brandt's Cormorant	1882		1	5	2		1	1	9	2	37			39	1558		5	4	1		198	1	2	1	2			1	3	1		8
Brown Pelican	300		5	18	11		4	6	2	13	2	3	98			34		26		2	3		7		1			1		2		62
Bufflehead	39	28	7				4																									
California Gull	635	57	2				9	4	2		6		2			2		2		1		1	20	13	511				1	2		
Caspian Tern	7	1									5							1														
Clark's Grebe	29						4		11		8								1		5											
Common Raven	4								2														2									
Double-crested Cormorant	242	2	10	19	13		55	3	2		36		3			1	4		1		12		11		18			1	3	2	7	39
Eared Grebe	45	3		4	5	4	9				5										5	2	4	1	3							
European Starling	75																								75							
Forster's Tern	25						5			10	7							3														
Glaucous-winged Gull	7	2						1											1	1					2							
Great Blue Heron	60		2	1	3	1	6	7	1	1	3		2	1		2	1	3	1	1	10		2		3	2		1	1		1	4
Green Heron	1																									1						
Heermann's Gull	474	59	2		50			18	1	4	2		4	1		5	13	28		43	22	7	9	3	22	5	5			22		149
Herring Gull	8							1								1				1	1		2	1	1							
Horned Grebe	10	3	1																		1				1						4	
House Finch	75								75																							
House Sparrow	2																												2			
Lesser Goldfinch	3										3																					
Lesser Scaup	28	2				1	21																								4	
Long-billed Curlew	3						3																									
Long-tailed Duck	1																				1											
Marbled Godwit	2						2																									
Merlin	1													1																		
Mew Gull	53	1																			52											
Mourning Dove	1										1																					
Osprey	1									1																						
Parasitic Jaeger	1											1																				
Pelagic Cormorant	8				1		1														3	2						1				
Peregrine Falcon	1																							1								
Pied-billed Grebe	11	1			2		1										1		1				3			2						
Red-breasted Merganser	2																					2										
Red-tailed Hawk	1					1																										
Ring-billed Gull	111	67	2		1			2										8	3	2	2	5	1		3					9		6

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Rock Dove	378		22		9	89	10				40						16			3	26	13	6		2	16	6	11	12	18	66	13
Royal Tern	38								1		36							1														
Ruddy Duck	2						2																									
Sanderling	32	2					1			13			14			2																
Snowy Egret	8				5						2												1									
Spotted Sandpiper	2																														2	
Surf Scoter	1770		62	26	6	31	126	150	38		74	1					52	8	132		1035	29										
Surfbird	4									2			2																			
Western Grebe	690		26		4	9	29	6	233		208	14			2		12	5	9	3	119	3			5				1			2
Western Gull	2550	92	43	23	479		54	91	3	38	21	1	35	3	4	39	8	28	6	66	46	32	202	29	740	2	26	3	12	135		289
Whimbrel	5						3						1									1										
Willet	3			2																1												
Yellow-rumped Warbler	3										2																				1	

Table H-4. January A 2008 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Coot	9	5				1																									3	
American Crow	25	9															4				1	1							10			
Belted Kingfisher	6	1																					1		2						2	
Black Oystercatcher	10												2			6	2															
Black Scoter	1																				1											
Black Turnstone	4															2	2															
Black-bellied Plover	80	1					35						44																			
Black-crowned Night-Heron	2				1																1											
Brandt's Cormorant	415		41		10		1	4	25		29	7	51	5	3	11	164	29		6	10	1	12		2						1	3
Brown Pelican	858		24	37	23		2	1	20		2	1	61	1	2	44	547	9		2	3	1	11	1				1	1	1		63
Bufflehead	41	17	5			2	15																								2	
California Gull	50						1				1				4			2			14				8	14			4		1	1
Canvasback	1					1																										
Caspian Tern	13	10									2							1														
Clark's Grebe	26					1	5		10		6	1									3											
Common Loon	1																1															
Double-crested Cormorant	319		22	1	11	1	25		1		36		5	1		3	39	17		5	41		20	12	18			9	3	3	6	40
Eared Grebe	82	5		3	8	6	25	3	12		3										9	2	2		2			1			1	
Forster's Tern	3														1			2														
Glaucous-winged Gull	7				1										1										5							
Great Blue Heron	57	2	6		6		8	5	1		2		2			1	1	1		2	2	1	1	2	1		1	2	4	1	4	1
Great Egret	1																														1	
Great-tailed Grackle	2																								2							
Green Heron	2																											1	1			
Heermann's Gull	491	30	6	12	85		9	25				1	17	2	1	26	22	38		27	23	20	4	5	2	6			3	5		122
Herring Gull	2	2																														
Horned Grebe	12		1	1		1	1		1												1		2		1				3			
House Finch	4																												2		2	
Least Sandpiper	12	12																														
Lesser Scaup	37	1					31																								5	
Long-tailed Duck	1																				1											
Marbled Godwit	8	1					7																									
Mew Gull	97	1							2							1					93											
Northern Mockingbird	3																								3							
Osprey	2		1																	1												
Parasitic Jaeger	1								1																							
Pelagic Cormorant	9							1						1			1			1	3	2										
Pied-billed Grebe	11				1	2															1				4	1			2			
Red-breasted Merganser	2																				2											
Red-tailed Hawk	2																								2							
Ring-billed Gull	49	16	7				1	2					1			1					2		2				1			2		14
Rock Dove	397	37	10		19	151	21				28						4			9	13	2		27		13	6	29	9		14	5
Royal Tern	53	5									48																					

Species	Totals	Zones																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Ruddy Duck	16					2	12																								2	
Sanderling	31	3	2								3		10			2	11															
Snowy Egret	8							5																	1						1	1
Spotted Sandpiper	2																					1									1	
Surf Scoter	2717		65	32	4	38	161	449	34		65	3			4		12			2	1529	91							228			
Thayer's Gull	1															1																
Turkey Vulture	1																								1							
Western Grebe	557	2	7	1	5	7	45	3	229		114	8	1	2	4		12	7		5	64	32	1						6			2
Western Gull	1229	40	29	56	98		5	20	2		21	5	30	3	13	31	58	9		27	106	37	65	17	283	2	2	2	13	30		225
Whimbrel	4						3									1																
White-winged Scoter	3																				2								1			
Willet	18	4	2				9														2	1										
Yellow-rumped Warbler	1										1																					

Table H-5. January B 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Coot	19	17																			1		1									
American Crow	13		1		2			1									2		2		4				1							
Belted Kingfisher	4	1				1																	1								1	
Black Oystercatcher	14		11														3															
Black Phoebe	1													1																		
Black Skimmer	94		94																													
Black-bellied Plover	3												3																			
Black-crowned Night-Heron	2																								1						1	
Brandt's Cormorant	1053		31	61	2		4	1	20	7	16			35	706	140		2		4	9	1	2		1	1			1		1	8
Brown Pelican	244	5	49	13	28		3	1	13	7	2		8		5	29		3		2			6						1	5		64
Bufflehead	25	14	4				6																								1	
California Gull	93										2			2				2				1	3	1	82							
Canvasback	2					2																										
Caspian Tern	5	1	2								2																					
Clark's Grebe	17								9		5		1				1			1												
Common Loon	1										1																					
Common Raven	7																				2		2			1				2		
Double-crested Cormorant	247	7	9		12		39	5			28			1		3	8	1	1	8	27		6	14	23			4	1	6	7	37
Eared Grebe	44	9	1		4	2	9	1	3		1								1		2	3	2		4						2	
European Starling	4		2											2																		
Glaucous-winged Gull	14															1			1	2	2	1	1	1	3							2
Great Blue Heron	63	1	6		5	1	7	8	1	1	2								2	1	7	2	5		3	3		1	1	1	2	3
Heermann's Gull	199		9	2	35			8	2	2	1			7		4	1	3	3	15	19	4	10		9		3		1	2		59
Herring Gull	4											1													2						1	
Horned Grebe	3						1													1					1							
House Finch	2																					1									1	
Least Sandpiper	11																11															
Lesser Scaup	17	1					14	1																							1	
Mallard	3																								3							
Marbled Godwit	3						3																									
Mew Gull	115	31								1	2										79		2									
Northern Mockingbird	2		1																						1							
Northern Rough-winged Swallow	1							1																								
Osprey	1					1																										
Pelagic Cormorant	12						1				1			1						2	3	3	1									
Pied-billed Grebe	13	1					7										2						1		1	1						
Red-tailed Hawk	3										1												1		1							
Ring-billed Gull	70	14	6	1	1			8			1				1		3	1		8	1	2				1	1	2	3	5	1	10
Rock Dove	311	9	18		49	85	9				7									5	21				25	24		21	2		31	5
Royal Tern	75		17				14				39	2			2			1														
Ruddy Duck	6						4																								2	
Sanderling	24	7	10							2	1		2			2																
Say's Phoebe	1	1																														

Species	*Totals*	*Zones*																																		
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Snowy Egret	18		2		3		2	3			1												1		4					1		1
Spotted Sandpiper	2																					1									1	
Surf Scoter	1565	6	66	39	4	35	83	303	26		43	4	1		3		5	1	14	273	577	76	6									
Surfbird	1												1																			
Wandering Tattler	1									1																						
Western Grebe	414		2	1	3	19	29	9	151		75	23		1	6		8	17	10	3	41	5	6		4			1				
Western Gull	2036	22	28	80	88		11	44	10	25	20		29	5	1	33	12	24	30	41	51	39	278	85	520	7	9	5	45	22	9	463
Whimbrel	2					1																	1									
White-crowned Sparrow	3																								3							
White-winged Scoter	1																				1											
Willet	14	1	1	3	1	1	5		1											1												
Yellow-rumped Warbler	1																														1	

Table H-6. February A 2008 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Coot	23	18																									1		1		3	
American Crow	10	2			2															1												5
Anna's Hummingbird	1		1																													
Belted Kingfisher	7		1		1		3																1								1	
Black Oystercatcher	6															6																
Black Scoter	1																				1											
Black-bellied Plover	63	1								1			61																			
Black-crowned Night-Heron	5																					1			4							
Brandt's Cormorant	575		1		4		1	1	13		62	11	18	10	36	7	9				388		3					1			2	8
Brant	6										6																					
Brown Pelican	212	3	4	4	4					31			27			40					1		2									96
Bufflehead	20	14	2				3																								1	
California Gull	25																2								23							
Caspian Tern	10		10																													
Clark's Grebe	14						1		4			4			1			2			1								1			
Common Raven	6																			2										3		1
Cooper's Hawk	2						1																									1
Double-crested Cormorant	243		11		20		44	13			27		11	4		4	6	1	2	1	24	1	9	1	7	3	1	7		3	9	34
Eared Grebe	38	3		3	1		21														1	3			4				1		1	
European Starling	19		3																	16												
Glaucous-winged Gull	12	1																	1	1	2	1		1	4							1
Great Blue Heron	48	1	1		3		6	9	3	1	1		2	1					1	1	3	1	4	1	1	1		2	1	1	1	2
Great Egret	1																								1							
Green Heron	2							1																				1				
Heermann's Gull	127	37	23	16				2		1				1		1	1	1	3	3	2	5	1		1					1		28
Horned Grebe	2																								1		1					
House Finch	14							2			8																				4	
Killdeer	45	6																													39	
Least Sandpiper	33						8												1						24							
Lesser Scaup	32		6				26																									
Long-billed Curlew	1						1																									
Mallard	1	1																														
Mew Gull	204	2																			197	2			2				1			
Mourning Dove	4				1																										3	
Osprey	4	1								1													2									
Pacific Loon	1	1																														
Pelagic Cormorant	6													2						1	3											
Pied-billed Grebe	11	2															2						2		1		2		2			
Ring-billed Gull	65	8	6					1	1		3	1		1	1		2	1		8	2	1		9		1		1	2	1		15
Rock Dove	286		7		14		100				7									4	4	8	15	12	13	27		20		1	7	47
Royal Tern	13		12												1																	
Ruddy Duck	6	1					5																									

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Sanderling	22			1						4	3		10			4																
Snowy Egret	15				3		5											4							2							1
Spotted Sandpiper	5																			2											3	
Surf Scoter	1212		37	6	21		122	180	20		32	2	4				13		18	345	307	105										
Surfbird	8									4			2			2																
Wandering Tattler	2									1			1																			
Western Grebe	395		18		5		22	11	86		106	6		8	9		5	35	8	3	52	8	5		7						1	
Western Gull	1465	41	24	37	34		5	38	28	22	8	4	58	17	5	39	8	8	19	20	85	28	189	31	281	2	4	3	9	43	3	372
Whimbrel	3						1													2												
White-winged Scoter	1																				1											
Willet	8				1		4						1							2												
Yellow-rumped Warbler	1																			1												

Table H-7. February B 2008 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Coot	6	2			2																										2	
American Crow	22	6									5								1		5	2	2		1							
Belted Kingfisher	6																			1			3		1						1	
Black Oystercatcher	14		1	1					1	2			4			5																
Black Skimmer	68		68																													
Black Turnstone	4												3			1																
Black-bellied Plover	34												34																			
Black-crowned Night-Heron	9		1																		1	1	3		2						1	
Brandt's Cormorant	1535	1			1		5	2	2	617	20	2	763	1	37	22	6	8		1	30	6	4		2							5
Brown Pelican	198		13	13	1					129		1	5	1		11	3	3														18
Bufflehead	19	11	2				6																									
California Gull	10		2																			1			6						1	
Caspian Tern	10	4	6																													
Clark's Grebe	7										2						1				1		1	1	1							
Cliff Swallow	40					40																										
Common Loon	2										2																					
Common Raven	14							3												1					2				1		6	1
Double-crested Cormorant	228	3	2		12		45	7			32					2	2	1	2	3	12	2	6	24	22	5	3	2	1	1	5	34
Eared Grebe	53	4	1		1	10	8		7		1	2								1	2	7	1		5						3	
European Starling	8		3		1														4													
Glaucous-winged Gull	6												1				1															4
Great Blue Heron	57	1	5		7	3	4	7		1	2		1	1		1				1	1	2	4	5	4			1		2		4
Great Egret	2																								1						1	
Great-tailed Grackle	1																								1							
Heermann's Gull	24	6	5	2				1		1				1			2															6
Horned Grebe	2								1																1							
House Finch	13				2															3			2								6	
House Sparrow	4										4																					
Least Sandpiper	50										1		4			2									41						2	
Lesser Scaup	25	2					22																								1	
Long-billed Curlew	1					1																										
Mallard	14					2																2	2		8							
Marbled Godwit	1					1																										
Mew Gull	85																				81				4							
Mourning Dove	3								3																							
Northern Mockingbird	2																								2							
Osprey	2								1																						1	
Pelagic Cormorant	14						1													1	10	1	1									
Peregrine Falcon	3		1																					1					1			
Pied-billed Grebe	5						1										2								1			1				
Ring-billed Gull	53	5	5					12			3			3	1			1		3	2		1	8		1				2	1	5
Rock Dove	353	3	4		46	85					3									2	10	10	44	14	16	21	2	18	48	6	15	6
Royal Tern	2		2																													
Ruddy Duck	3	1					2																									
Ruddy Turnstone	1									1																						

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Sanderling	21	3	2							3			9			4																
Snowy Egret	24		4		2			7			5						2						1		1			1				1
Spotted Sandpiper	3					1																									2	
Surf Scoter	1401	4	18	2	21	13	142	104	19	3	63	10			2		13		28	373	439	146	1									
Surfbird	3												1			2																
Wandering Tattler	2				1											1																
Western Grebe	311		4	3	3	4	5	25	21		21	29	2	3	59		49	5	2	5	37	22	6	1			1		4			
Western Gull	1036	45	48	21	43	14	6	54	8	33	29	2	14	21	6	9	12	8	11	63	43	10	33	20	44	7	4		12	20	9	387
Whimbrel	12					1			2	1			1	2		4	1															
White-crowned Sparrow	1																														1	
White-winged Scoter	1																				1											
Willet	15	1	1	1	2	7					1					1						1										
Yellow-rumped Warbler	2																														2	

Table H-8. March A 2008 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Coot	20	18																													2	
American Crow	16	4			2	2					3						3		1	1												
Barn Swallow	3																								3							
Belted Kingfisher	3	1	1																						1							
Black Oystercatcher	17												13			4																
Black Turnstone	20		3	3						1			2			11																
Black-bellied Plover	2					1							1																			
Black-crowned Night-Heron	4																								3							1
Brandt's Cormorant	1310		9	6	1		3	4	1	75	14	650	465	4	19	1	3	12		1	34		4			1						3
Brown Pelican	421			121	2	1	6	2		34	1		119		16	65	4	6			4											40
Bufflehead	29	23	5			1																										
California Gull	79	1	1																		74				2			1				
Caspian Tern	27	24	1				1	1																								
Clark's Grebe	10					1			3		2			1	2										1							
Common Loon	1										1																					
Common Raven	10						1														3	1		2	1		2					
Double-crested Cormorant	207	4	3		12		38	3	2		3			3		6	4	3	1	1	12		1	39	30	3		4	7	3		25
Eared Grebe	42	2	2		2	4	14				4							1			2	3	2		5				1			
European Starling	11	1			3						2										4										1	
Glaucous-winged Gull	15			2					1				1						1	3	1				3							3
Great Blue Heron	54		5	1	11	1	3	4	1	2	1		1	1				1	2	1	2	2	1	9	2	2				1		
Great Egret	3																							1	1						1	
Green Heron	1																						1									
Heermann's Gull	16			4	1								7				1															3
Herring Gull	1															1																
Horned Grebe	1						1																									
House Finch	3																			3												
Least Sandpiper	30												1												29							
Lesser Scaup	22		9				13																									
Long-billed Curlew	1					1																										
Mallard	11					2											4		2			2			1							
Marbled Godwit	7	5				2																										
Mew Gull	41																1				40											
Mourning Dove	3		2		1																											
Northern Mockingbird	2																								2							
Osprey	1																							1								
Pelagic Cormorant	7												1	1							4		1									
Peregrine Falcon	1																							1								
Pied-billed Grebe	5						2																				1	2				
Ring-billed Gull	46	11	3			1		6						2				1	3	1	10	1	3						2			2
Rock Dove	386		23		69	114	7				11			2						5	3		21		52	16	2	14	20		9	18
Royal Tern	7	2			4										1																	

Species	Totals	Zones																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Ruddy Turnstone	3		2										1																			
Sanderling	78	36	2	2						10			13			15																
Snowy Egret	13	1			1		2				1														6		1				1	
Spotted Sandpiper	3																			1											2	
Surf Scoter	1314		56	7	28	19	128	79	41	2	23	2			1		10		37	182	515	184										
Surfbird	51		8	1						2			2			38																
Wandering Tattler	4									1			1			2																
Western Grebe	420		7		3	9	24	12	46		68	60		4	44		22	10	5	1	91	13			1							
Western Gull	2070	53	33	59	33		14	37	41	23	19		38	11	13	47	10	12	14	49	51	147	57	40	532	3	17	3	23	17		674
Western Meadowlark	2								2																							
Whimbrel	19	6				1		3		1				3		3			1	1												
White-winged Scoter	2																			1	1											
Willet	8		1		1	3										1			1													1
Yellow-rumped Warbler	2																														2	

Table H-9. March B 2008 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Crow	10	2																	1		1		4		2							
Barn Swallow	10		2		2																		1		1			2	2			
Belted Kingfisher	5				1	1														1					1						1	
Black Oystercatcher	7									2			4			1																
Black Turnstone	13									5			4			4																
Black-bellied Plover	2												2																			
Black-crowned Night-Heron	6																					3			3							
Brandt's Cormorant	1520		6	93			12		1	822	27		64	8	5	52	11	397			17								1			4
Brown Pelican	551	14	5	176	5	2	6		1	123			44	3	2	35	27				2											106
Bufflehead	21	17	3			1																										
California Gull	116														1										108							7
Caspian Tern	52	51							1																							
Clark's Grebe	22					4			7			3	1				4								1					1	1	
Cliff Swallow	1																														1	
Common Loon	2										1						1															
Common Raven	7																						2	1						2	2	
Double-crested Cormorant	188	6	3	1	20		26	3			2					4	7		1		12		2	55	5	2					1	38
Eared Grebe	34					5	14		2		1									2	1	3	3		2						1	
Elegant Tern	63			19							2			3			31	5			1											2
European Starling	8																			1		1	4		2							
Glaucous-winged Gull	7																								4							3
Great Blue Heron	64	1	6		9	1	6	5	2		2			3						2	8	1	1	12	2				2		1	
Green Heron	2																						1					1				
Heermann's Gull	17		2	5						7																				1		2
Horned Grebe	1						1																									
House Finch	11										3											1	4								3	
Lesser Scaup	5		2				3																									
Long-billed Curlew	1						1																									
Mallard	26					4					2			7					4	4	2	2			1							
Marbled Godwit	5						5																									
Mew Gull	9																				8				1							
Mourning Dove	1																						1									
Northern Mockingbird	1																								1							
Northern Rough-winged Swallow	1																								1							
Osprey	1								1																							
Pelagic Cormorant	13						1			2		1		1						1	6			1								
Peregrine Falcon	1																								1							
Pied-billed Grebe	4						2																		1						1	
Ring-billed Gull	44	15	6					1			1			5			2		2		2		1					1	1	2	1	4
Rock Dove	365		17		27	97	7	7			8								2	2	40	6	7	39	6	20	3	12	5		33	27
Royal Tern	7		1				1							5																		

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Ruddy Turnstone	2			1												1																
Sanderling	61	39								9			6			7																
Snowy Egret	10						1	5																	2					1	1	
Spotted Sandpiper	1																														1	
Surf Scoter	1196		66	21	32	12	124	82	28		48	6					14		15	154	569	24		1								
Surfbird	20			4						2			2			12																
Western Grebe	1209	3	17	1	7	6	25	9	196		66	99		79			541	1	8	9	129	7		1	5							
Western Gull	2103	36	42	150	45		12	33	8	21	12		30	52	4	9	36	80	10	67	35	4	19	4	436	5	3	15	5	8		922
Whimbrel	9						1						2			3				1	1	1										
Willet	9	1		1			1						3			1	1					1										
Yellow-rumped Warbler	1																					1										

Table H-10. April A 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																															
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Coot	16	14																							1						1	
American Crow	9	2	1						1																1	1						3
Barn Swallow	25		4		1			2						2							1				9			4				2
Black Oystercatcher	7		2							2			1			2																
Black Turnstone	10								2				6			2																
Black-crowned Night-Heron	7							1															1	1	3							1
Brandt's Cormorant	640		16		2		2	3	2	35	33	1	57	3	3	63	7	30	1		382											
Brown Pelican	124	4	13	4	3	1	8	1		32			12		2	8	1				6	2										27
Bufflehead	2	2																														
California Gull	97														1										96							
Caspian Tern	22	5	2	1			3		2		2				1			2		2			1							1		
Clark's Grebe	112		25	1		1	1		2		29								3	4	46											
Common Raven	14							2															2	1			7			2		
Double-crested Cormorant	145	4	1	1	6		15	2		1	2					1	2		1		7	8	2	79	7		1				2	3
Eared Grebe	40	3	1			2	23		1		1	1					1				1	3			3							
Elegant Tern	60	15	7				21		3	2			2		2	2		4					2									
European Starling	15		3								2									2	1		1		4			2				
Forster's Tern	3	2	1																													
Glaucous-winged Gull	3				1			1																	1							
Great Blue Heron	52		6	1	5	1	6	9						1					1	4	3			11						1	1	2
Green Heron	2																									2						
Heermann's Gull	8			1						3			2			2																
House Finch	14								4		4										4				2							
House Sparrow	1																						1									
Killdeer	2								2																							
Least Sandpiper	73	18		31									1								23											
Lesser Goldfinch	1							1																								
Long-tailed Duck	1	1																														
Mallard	19	2	2			3					3						1				2	1	2					1				2
Mourning Dove	6				2				2																2							
Northern Mockingbird	1																								1							
Osprey	2																						1	1								
Parasitic Jaeger	1																	1														
Pelagic Cormorant	2									1											1											
Peregrine Falcon	1																						1									
Pied-billed Grebe	3																								3							
Red-tailed Hawk	2	1				1																										
Ring-billed Gull	97	49	30	1			1		1			2			1			5		1					5					1		
Rock Dove	379		18		15	87		4			17						2			5	14	114	4	20	19	16	2	21	3	6	9	3
Royal Tern	6		5				1																									
Ruddy Turnstone	1			1																												

Species	*Totals*	*Zones*																													
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Sanderling	93		89										3			1																
Snowy Egret	13					1	5	6													1											
Surf Scoter	490		18	8	16		71	16	17		34	20			1	2		1	3	146	112	25										
Surfbird	14		4	4									4				2															
Western Grebe	1502		17	9	4	7	4	8	259		494	51		13	16		13	5	131	16	439	14			2							
Western Gull	768	32	51	27	47			38	7	21	25	20	29	4	5	37	11	4	13	50	60	21	19	5	63	1	2		2	12	2	160
Whimbrel	103															1	1				1			100								
White-winged Scoter	1																			1												
Willet	11	3	1			4								1			2															

Table H-11. May A 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																																	
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Crow	7	2	3																		1				1							
Barn Swallow	27	2	10								1										1		2		1	4		2	4			
Black Oystercatcher	14									1			7			4			2													
Black-crowned Night-Heron	2																								2							
Brandt's Cormorant	1092		28	4	50			28	1	338	3	7	56	5	56	14	1	8		2	485	3	2									1
Brown Pelican	2886	2	271	204	816	26	10	14	2	1188	3	2	201	1	1	46	7	2	1	1	1		4	2	1			3	1		1	75
Caspian Tern	54	7	1	1	1		16	10			1				2		1				3	1	4							2		4
Clark's Grebe	3		2								1																					
Common Raven	10							2												3					1	1				1	2	
Domestic Duck	4																									4						
Double-crested Cormorant	161	10	3	2			2	1		3			3			1	1				4		2	118	2			2			2	5
Elegant Tern	531	1	16		7		115	252	69	4	33	7	7		12		2	5	1													
European Starling	10	2	2																		2		2		2							
Forster's Tern	10	2											1			3	2		2													
Great Blue Heron	52		7		4	1	2	6						1			3		1		5	3	1	14	1		2	1				
Heermann's Gull	101	2	2	7	34			3	1	36			7			2																7
House Finch	9							2													5				2							
House Sparrow	1																						1									
Killdeer	1								1																							
Least Tern	58	3					12		25								9	1	2						6							
Mallard	7					2															2				1							2
Mourning Dove	2								2																							
Osprey	2					1													1													
Pelagic Cormorant	1								1																							
Peregrine Falcon	6																						2	2					2			
Ring-billed Gull	25	19	3																						3							
Rock Dove	233	5	8			65					11									5	6		6	17	36	8	2	18	10	8	17	11
Snowy Egret	7	1					2	1			1														1						1	
Surf Scoter	51		6		2		13	1			10								5		14											
Wandering Tattler	2			1													1															
Western Grebe	74		3						30		36						1				4											
Western Gull	1380	217	137	20	251	5	31	57	6	88	14	10	17	7	4	10	5	6	6	50	19	8	15	5	231	7	18		9	10	1	116

Table H-12. June A 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Crow	14	6			5														1		2											
American Kestrel	1																						1									
Barn Swallow	41	9	9	1	5																		3		3				7	2		2
Black Oystercatcher	11									1			7			3																
Black-crowned Night-Heron	1							1																								
Brandt's Cormorant	779		43	10	1			1	322	131	19	3	2	11	2	6	5	2			217	1				1			1		1	
Brown Pelican	489	2		81	12	1	35	1	2	174	11	2	38		1	70	2	3			20			1	3			2	1		1	26
Caspian Tern	65					1	18	27			2											3	3		6		1			1	1	2
Clark's Grebe	1							1																								
Cliff Swallow	14																															14
Common Loon	1		1																													
Common Raven	9				1		2													2					2		1			1		
Double-crested Cormorant	134	9	1	2	2		2	2			5		1										4	89	5		1	1	2		7	1
Elegant Tern	2482	7	4		6	27	190	2098	21	4	23	14	2	16	4		6	31	6	6	3	4	5					1				4
European Starling	8		6																							2						
Great Blue Heron	24		1		3		5	3						1						1	2		1	3				1	1	1		1
Heermann's Gull	107		1	9			1	6	24	35	2	1	5			11																12
House Finch	2																								2							
House Sparrow	10				9																				1							
Least Tern	14			4	1		2		1								2	2			1					1						
Mallard	2																		2													
Northern Rough-winged Swallow	2		2																													
Osprey	1													1																		
Pelagic Cormorant	3														1						1		1									
Peregrine Falcon	1																						1									
Ring-billed Gull	3	3																														
Rock Dove	279		16		32	100	9	3			8									3	12				52	7		7	9		14	7
Royal Tern	4		3				1																									
Snowy Egret	4						1				1											1			1							
Surf Scoter	28		3		1		8														16											
Western Grebe	80	1					1				77																					1
Western Gull	1191	148	55	34	79	1	1	28	98	36	27	2	7	11	3	16	5	4	15	56	33	2	25	5	288	2	5		24	25	1	155
Whimbrel	2			2																												

Table H-13. July A 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Crow	12	9			1																											2
Barn Swallow	102	1	78				1							4			2				2		3		2			3	1			5
Black Oystercatcher	33			4					2	4			13	2		8																
Black Phoebe	1		1																													
Black Turnstone	8			4						1			1			1															1	
Black-bellied Plover	2						2																									
Black-crowned Night-Heron	5				1																1				2	1						
Brandt's Cormorant	640	1	207	13			3		58	52	37	10	4	2	10	2	15	17		1	204	2			1	1						
Brown Pelican	512	2	28	18	27	4	29	5	2	177			41			66	4	5	3		23		9		1			10	1	1	2	54
Bullock's Oriole	1																			1												
Caspian Tern	108	5	1		1		37	46			4	5	1	1	1			1		1			2					1				1
Clark's Grebe	7								7																							
Common Raven	4										2														2							
Double-crested Cormorant	105	2			2		2	3	2								1				8	1	62		5			2	7	1	4	3
Elegant Tern	3166	24	29	9	9	4	###	531	22	13	20	11	1	27	5	5	9	37	4	12	10	3			1				2	1	2	8
Great Blue Heron	42		3	1	3	1	5	2	1				1	1					1	1	3	3	3		4		3	2	3		1	
Green Heron	2																											1	1			
Heermann's Gull	874	120	51	72	13	1	20	33	145	152	7	1	47	12	1	31	23	5	35	22	3	6	5		5	3		1		3		57
House Finch	7		5						2																							
Least Tern	27	8		1					8	3						1		3	2				1									
Mourning Dove	3						2																		1							
Osprey	2						1							1																		
Pacific Loon	1		1																													
Pelagic Cormorant	4																				3	1										
Pied-billed Grebe	2																								2							
Ring-billed Gull	2	1	1																													
Rock Dove	333	11	1		15	169		2			13			5							8	6	1		38	22		4			25	13
Royal Tern	3						3																									
Snowy Egret	7		1				1		1													1			2						1	
Spotted Sandpiper	1																						1									
Surf Scoter	49		5				5				15								2		22											
Surfbird	24		3	6					1	4			9			1																
Wandering Tattler	2												1				1															
Western Grebe	134								95		38						1															
Western Gull	1653	105	99	41	56	1	7	42	21	39	27	3	10	5	9	53	15	1	19	179	55	16	47		220	3	121	11	8	28	2	410
Whimbrel	8												2	5		1																
Willet	5						1						3			1																

Table H-14. August A 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Crow	9	6			2																1											
Barn Swallow	16		6						2														3		2				2			1
Black Oystercatcher	30		2	1						2			8			14	3															
Black Turnstone	29			2					1	5			3			18																
Black-bellied Plover	26					14							12																			
Black-crowned Night-Heron	4		1		1																		1		1							
Brandt's Cormorant	442		92	9	1		2	2	72	18	51	14		8	3	1		10		10	144		2			1						2
Brown Pelican	700	18	9	96	31	14	47	20	2	158	5	1	36	1	2	47	1	2	1	5	46	2	17		1			16	1	1	2	118
Caspian Tern	51			1	1		32	4			2			3			1		1	1	2		1		2							
Common Raven	8																3							2	3							
Double-crested Cormorant	144		1		2		4	1	1		4	1		2		1	1				37		6	39	18	5		1	2		10	8
Elegant Tern	1203	4	18	6	5	8	953	151			10	7	4	4	3		9	13			8											
European Starling	20										18								2													
Forster's Tern	1	1																														
Great Blue Heron	44	1	2	1	5	2	2	2					1	1			1		2	2	3	2	3		2			5	3		1	3
Heermann's Gull	751	68	68	40	14			164	82	20	6	1	32			86	5	3	12	8	13	1	9	13	16		7		1	16		66
House Finch	3								2																1							
House Sparrow	1																						1									
Long-billed Curlew	1					1																										
Mourning Dove	2	1																							1							
Osprey	3													2					1													
Pacific Loon	1		1																													
Pelagic Cormorant	5																				4	1										
Pied-billed Grebe	1						1																									
Rock Dove	278				16	110					13						3			6	8	3			45	28		7	8	2	7	22
Royal Tern	7						5	1				1																				
Snowy Egret	4	1					2																		1							
Spotted Sandpiper	2																														2	
Surf Scoter	37		3				11				5								4		14											
Surfbird	26			1						5			2			18																
Wandering Tattler	5									1			1			3																
Western Grebe	152								1		148								3													
Western Gull	1056	91	58	43	41	1	8	51	34	14	38	4	32	11	7	36	7	7	9	45	40	9	52	55	97	5	19	2	12	51	2	175
Western Sandpiper	1																														1	
Whimbrel	13		1			11											1															
Willet	19	4				11	1						1			2																

Table H-15. August B 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Crow	21	7	2		4		1												3		1		1									2
Anna's Hummingbird	2																														2	
Barn Swallow	23		4		2						8												2		5							2
Belted Kingfisher	2				1															1												
Black Oystercatcher	34		4	2						1			6			21																
Black Skimmer	1						1																									
Black Turnstone	22		2	1						1			8			10																
Black-bellied Plover	36					1	27						8																			
Black-crowned Night-Heron	3				1																				1							1
Brandt's Cormorant	546	1	1	2	4			5	345	1	12		15	3	20			22		3	108	1	1	1	1							
Brown Pelican	839		17	22	40	7	31	15	251		10	1	125	27	11	64	7	2	4	6	31		16		8	1		17		1	1	124
California Gull	1											1																				
Caspian Tern	35	5					9	5		1	2			1	1		1			1	2				4		1					2
Common Loon	1		1																													
Common Raven	12	2			1						1			1						1				2	1					2	1	
Double-crested Cormorant	187	4	1	3			26	1	1	1	25			1		2	1	1		3	40	1	4	28	10	5	1	5	6			17
Elegant Tern	419	12	10	6	3		53	217	9	1	28	19	5		4	4	4	30			1	4									1	8
European Starling	7																		5						2							
Great Blue Heron	42	2	4	1	8	3	2	1									1			2			5	1	3	1		2	3	1	2	
Heermann's Gull	1463	14	61	25	8		8	110	782	83	1	3	107	1	3	42	7	11	14	20	2	15	14	2	5		16	6	7	10	5	81
House Finch	4								2																2							
House Sparrow	1																						1									
Least Sandpiper	3															3																
Long-billed Curlew	1						1																									
Mourning Dove	2																								2							
Osprey	3						1							1								1										
Pelagic Cormorant	5		1																		3	1										
Peregrine Falcon	4						1	2																				1				
Pied-billed Grebe	1																								1							
Red-necked Phalarope	1					1																										
Ring-billed Gull	2							1																	1							
Rock Dove	355		20		4	179					7			2			6				8	5	4		35	18		55		2	10	
Royal Tern	1							1																								
Ruddy Turnstone	2															2																
Snowy Egret	9	1					2	1	1									1							2		1					
Spotted Sandpiper	1																														1	
Surf Scoter	10		4								6																					
Surfbird	35												13			22																
Western Grebe	69								67												2											
Western Gull	1445	100	92	57	44	1	9	88	134	19	38	6	35	13	21	18	51	7	6	21	50	10	41	4	111	5	17	2	14	33	1	397

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Whimbrel	6			1			1		1							3																
Willet	10	1					4						2			3																

Table H-16. September A 2008 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Crow	17	1						2			3			1			5		2						3							
Barn Swallow	8		6						2																							
Belted Kingfisher	1							1																								
Black Oystercatcher	19		1										5			13																
Black Skimmer	29		9					1						14			4		1													
Black Turnstone	17									9						8																
Black-bellied Plover	20					5				1			14																			
Black-crowned Night-Heron	7			1	1																1			3	1							
Blue-winged Teal	1												1																			
Brandt's Cormorant	444		195	2	3				102	41	28	16	2	4	1			9			31		4	2	2	1						1
Brown Pelican	475	7	36	50	21		14	8	5	124	7		3	1		49	2	4	1	7	18		4	1	3		1	12				97
Caspian Tern	17		1				1	8		1		3		1			2															
Clark's Grebe	3										3																					
Common Raven	13					1		2			2								2			1	1		2						1	1
Cooper's Hawk	1																															1
Double-crested Cormorant	166	5	3	3	7		18	7			6			1		3	6	5		1	15	1	5	24	18	13				3	1	21
Eared Grebe	6																				6											
Elegant Tern	69	13	22	9			3	7					1			1		9		1									1			2
European Starling	18																				4				14							
Great Blue Heron	49	3	5	3	3	1	2		1		1						1		1	1	6	3	3		3	1	1	2	4	1	1	2
Green Heron	6				3																							1				2
Heermann's Gull	614	37	95	31	13		6	42	50	12	4	1	5	6	1	36	14	7	23	17	32	17	13	4	17	1	1		15	26		88
House Finch	5								5																							
Long-billed Curlew	1						1																									
Mallard	6																								6							
Marbled Godwit	4		1			2	1																									
Mourning Dove	16																				12				4							
Osprey	6					1								2					1	1		1										
Pelagic Cormorant	5																				4				1							
Peregrine Falcon	2													1											1							
Red-necked Phalarope	3		1					2																								
Red-tailed Hawk	1					1																										
Ring-billed Gull	6	5																							1							
Rock Dove	284	27	12		15	76	7				9			5						6	11		2		31	13	3	11	30		3	23
Royal Tern	3						2						1																			
Snowy Egret	8		1			1		4																	2							
Spotted Sandpiper	3																														3	
Surf Scoter	5		3				2																									
Surfbird	3												1			2																
Wandering Tattler	5				1					2			1				1															

Species	*Totals*	*Zones*																													
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Western Grebe	166		6						74		73	2									11											
Western Gull	1323	138	90	34	109	8	52	67	25	18	18	10	17	7	3	16	29	8	8	33	88	21	50	41	183	4	6	4	16	24	3	193
Western Sandpiper	3																					3										
Whimbrel	5								1	1						2						1										
Willet	7	1	1		1		4																									

Table H-17. September B 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Crow	24	3					1	1									8		4	1					5						1	
American Oystercatcher	1							1																								
Belted Kingfisher	5						1													1					2						1	
Black Oystercatcher	27							2					4			21																
Black Phoebe	2																													1	1	
Black Turnstone	9									2			1			6																
Black-bellied Plover	27						11						16																			
Black-crowned Night-Heron	6				3																				2							1
Brandt's Cormorant	200		3				1	1	14	67	26	12		12	12	1		5			8	3	33	1	1							
Brown Pelican	519	10	26	22	4	1	7	18	2	182	8		38	2		98	8	2	1	8	25		11				1	9	1		3	32
California Gull	4																			1			2		1							
Caspian Tern	2								2																							
Common Raven	3																								1		1	1				
Double-crested Cormorant	281	7	26	1	9		17	17			40			7	1	3	42		12	6	30		6		1	5		9	10		5	27
Eared Grebe	2	1															1															
Elegant Tern	607	246	14	2	1	1	31	7	1	35	235	2	2		16	11		1									2					
European Starling	8																								8							
Great Blue Heron	43	1	1		7	2	4	2	1		1			1		1	3		1	1	2	2	3		2			1	2		3	2
Green Heron	3																									1		1	1			
Heermann's Gull	686	31	41	15	7			99	8	88	45	2	21	8	7	93	32	6	19	36	33	13	7	2	2		9	3	8	5		46
House Finch	4																				4											
Killdeer	2					2																										
Long-billed Curlew	1						1																									
Marbled Godwit	3						3																									
Mourning Dove	6																								6							
Osprey	3					1													1	1												
Pelagic Cormorant	4												1								2	1										
Pied-billed Grebe	2																								1						1	
Red-tailed Hawk	1					1																										
Rock Dove	310	5	4		24	64	2	3			62			3			3			8	3		2		39	6	10	15	18	2	29	8
Royal Tern	16										6	1	1	1	1		6															
Ruddy Turnstone	3															3																
Say's Phoebe	1		1																													
Snowy Egret	8		2		1			1															1		2						1	
Spotted Sandpiper	7						1	1																					1		4	
Surf Scoter	3		2				1																									
Western Grebe	184								74		105							3		1					1							
Western Gull	1677	92	76	125	20		19	70	9	57	34	13	51	7	15	69	78	13	7	17	131	51	179	90	172	12	3	8	14	6	1	238
Whimbrel	4						1		1				1			1																
Willet	15	4	1		1		5									4																

Table H-18. October A 2008 Survey, Number of Individuals in Each Zone

Species	Totals	Zones																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
American Coot	7	3																													4	
American Crow	18	6	1																			2	1		1	2					2	3
American Kestrel	1																							1								
Barn Swallow	2			2																												
Belted Kingfisher	4																			1									1		2	
Black Oystercatcher	15							4		1	1					8	1															
Black Phoebe	2													1																	1	
Black Skimmer	3													1			2															
Black Turnstone	6									1						5																
Black-bellied Plover	50					41							9																			
Black-crowned Night-Heron	4		1																			1			2							
Brandt's Cormorant	546	69	105	12	1			63	68		76		45	19	38	3	7	5			27	2	1		2	3						
Brown Pelican	548	15	25	26	15	3	4	77	15	102	10	3	83	7		54	9	3	3	3	31	1	16	1	1		1	9				31
California Gull	22		1					4	2		2				1					1		1	1		7							2
Caspian Tern	2										2																					
Cattle Egret	1												1																			
Clark's Grebe	4								4																							
Common Murre	1																		1													
Common Raven	13																						2					2	4		1	4
Double-crested Cormorant	219	1	6	4	7		37	12			22			7		2	1		5		30		5	17	8	4	1	11		1	4	34
Eared Grebe	19	8	11																													
Elegant Tern	63	9	6		3		7	21			6			1	1		2		5													2
European Starling	8	4	3											1																		
Great Blue Heron	50		1	1	5	1	7			1	2		2				3		2	7		2	4		4	1	1		1		1	4
Great Egret	5									3															1				1			
Green Heron	3																								1			2				
Green-winged Teal	2								2																							
Heermann's Gull	762	4	88	12	21		3	186	23	24	47	15	49	15	4	21	47	7	25	28	10	11	18	7	14	1	3		25	7	2	45
House Finch	3								3																							
Killdeer	1																														1	
Long-billed Curlew	1					1																										
Mallard	2																								2							
Marbled Godwit	5						2						3																			
Mew Gull	1										1																					
Mourning Dove	2																						2									
Osprey	6						1							1		1			1			1	1									
Parasitic Jaeger	1											1																				
Pelagic Cormorant	4															1					1	2										
Peregrine Falcon	1																			1												
Pied-billed Grebe	5					3																			2							
Red-tailed Hawk	2					1																			1							
Ring-billed Gull	14	4	1	1				1														6			1							
Rock Dove	375		8		26	67					9								4	13	6		21		40	20		13	26		107	15

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Royal Tern	2											1			1																	
Ruddy Duck	7						7																									
Ruddy Turnstone	1															1																
Sanderling	2															2																
Snowy Egret	14				1		1	4											3	1					2	2						
Spotted Sandpiper	4																			1								1			2	
Surf Scoter	2		1				1																									
Surfbird	1															1																
Western Grebe	316					2	11	2	234		63						2						2									
Western Gull	1557	133	117	47	21	4	27	241	9	17	33	20	19	8	13	32	7	16	6	34	67	47	119	25	252	5	5	1	26	15	1	190
Whimbrel	2															2																
Willet	16	4	2				3						1			6																
Yellow-rumped Warbler	2																														2	

Table H-19. October B 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Crow	55	12	3		2	6		2									15		5						3	1						6
American Kestrel	2																							1							1	
Belted Kingfisher	3		1																						1						1	
Black Oystercatcher	4													3		1																
Black Phoebe	2																			1											1	
Black Turnstone	3															3																
Black-bellied Plover	64						54						9			1																
Black-crowned Night-Heron	5				1																	1			2						1	
Brandt's Cormorant	726	1	3	13	1			1	77	44	307	11	118	68	10	13		9			39	5	2		3	1						
Brown Pelican	407	2	9	30	37		12	48	9	79	5	3	39	6		42	4	9	2	1	17	5	6					1				41
Bufflehead	1																								1							
California Gull	85	1								1	2		2	3	1				5	26	14	3	20		6							1
Caspian Tern	1	1																														
Clark's Grebe	5	1							3								1															
Common Raven	7					1															2		1				3					
Double-crested Cormorant	312	7	23	3	36	2	10	15	2		91			4	2		5		1		21		8	4	15	7		11	12		1	32
Eared Grebe	54	8	2			14	23		3																2		1				1	
Elegant Tern	46	22	1		2						1			3	3		5	4	4		1											
Eurasian Collared Dove	2																								2							
Glaucous-winged Gull	1												1																			
Great Blue Heron	41		2		4	2	7	1	1		2						1			1	2	2	4		5		1	1		1	2	2
Great Egret	1																								1							
Green Heron	2																								1				1			
Heermann's Gull	607	42	57	40	17			93	17	23	8	1	19	8	5	34	28	9	11	41	30	3	22	3	30		2		18		7	39
House Finch	10																				2				1						7	
House Sparrow	4				3														1													
Lesser Scaup	4						2										2															
Long-billed Curlew	1					1																										
Marbled Godwit	5					5																										
Mew Gull	1													1																		
Mourning Dove	1				1																											
Northern Mockingbird	1																								1							
Osprey	3							1		1				1																		
Parasitic Jaeger	1											1																				
Pelagic Cormorant	7		1	1																	3	2										
Pied-billed Grebe	1																							1								
Ring-billed Gull	52	47	1	1				3																								
Rock Dove	331		4		19	50	6				9			2						10	12		1	13	59	9		18	35		47	37
Royal Tern	7								1		1	1		3	1																	
Ruddy Duck	6						5										1															
Sanderling	1															1																

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Snowy Egret	13						1	3										1												8		
Spotted Sandpiper	7																			1					1				1		4	
Surf Scoter	63		47				10				6																					
Surfbird	1															1																
Wandering Tattler	1															1																
Western Grebe	492	2	6			5	10	2	215		105	1		20			25	2	1		94	2	1									1
Western Gull	1595	88	92	56	42	1	41	81	13	33	101	12	55	23	15	28	12	9	23	77	48	62	279	18	194	2	8	2	23	24	4	129
Whimbrel	2					1								1																		
Willet	15	3			1		6							1		3						1										
Yellow-rumped Warbler	3																				1										2	

Table H-20. November A 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																																
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Coot	12															1									2			1		8		
American Crow	9	2			2																										1	4
American Kestrel	1																								1							
Belted Kingfisher	4				1	1		2																								
Black Oystercatcher	7			1					2	1			3																			
Black Phoebe	3													1																	2	
Black Turnstone	1															1																
Black-bellied Plover	52			1			43									8																
Black-crowned Night-Heron	4				1																	1			2							
Bonaparte's Gull	1																								1							
Brandt's Cormorant	414			10	3		1	1	74	24	19	5	29	28	70	84	1	46			6	3	5	1	2			1				1
Brown Pelican	439		5	33	47		11	24	39	142	4	3	13	14		11	2	15	3	2	10		9	1	1			4			1	45
Bufflehead	11	3	5				3																									
California Gull	111										2		1	1			1	10		76	5	1	7		7							
Caspian Tern	1	1																														
Clark's Grebe	13		1			1			5		1										5											
Common Loon	1																1															
Common Raven	11																					4			1				4		2	
Double-crested Cormorant	304	9	9	3	72		14	11		6	62		2	3		3	6		4		13		4		26	1		13		1	5	37
Eared Grebe	39	2			1	4	18				12														2							
Elegant Tern	25	6	11														5	3														
European Starling	14				2									3																		9
Forster's Tern	3	2	1																													
Glaucous-winged Gull	1																						1									
Great Blue Heron	45		2		4	2	4	3		1	2						4		1	1	5	1	5	1	2		1	2	1	1		2
Green Heron	2								1																				1			
Heermann's Gull	471	1	27	22	11		1	47	78	26	9	3	3	23	1		28	33	14	17	26	9	7	2	6	2	8		32	2	4	29
Herring Gull	1																						1									
House Finch	9		1		1																				1						6	
Killdeer	10																														10	
Long-billed Curlew	1					1																										
Marbled Godwit	3					3																										
Northern Mockingbird	3		1																						2							
Osprey	4															1	1							1								1
Pacific Loon	1																	1														
Parasitic Jaeger	1											1																				
Pelagic Cormorant	11							1							1						4	5										
Pied-billed Grebe	3																						1		2							
Red-tailed Hawk	2					1																			1							
Ring-billed Gull	7	3		1				2																	1							
Rock Dove	273		15		19	53	5				9						9			1	10		9	5	23	17	3	5	12		31	47
Royal Tern	7		5											1	1																	
Ruddy Turnstone	1															1																
Sanderling	6															6																

Species	Totals	Zones																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Say's Phoebe	1								1																							
Snowy Egret	5					1			1																1						1	1
Spotted Sandpiper	5																				2										3	
Surf Scoter	92		17	7		7	3		5		35										18											
Thayer's Gull	1																				1											
Wandering Tattler	1													1																		
Western Grebe	620	6	17		6	22	42	6	401		16			7							83	3	4		1		3					3
Western Gull	1645	2	84	243	28	3	21	125	13	29	24	23	10	1	8	29	5	98	7	18	87	62	228	15	264	8	17	8	28	20	3	134
Whimbrel	4					3				1																						
White-crowned Sparrow	1																														1	
Willet	3			1												2																

Table H-21. November B 2008 Survey, Number of Individuals in Each Zone

Species	*Totals*	*Zones*																														
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
American Coot	12																								5						7	
American Crow	10	2			1												1		1			2	2		1							
Belted Kingfisher	3		1		1																										1	
Black Oystercatcher	9												1			7	1															
Black Phoebe	1																			1												
Black Turnstone	2					1										1																
Black-bellied Plover	43						34			2			2		4	1																
Black-crowned Night-Heron	4		1																			1			2							
Black-necked Stilt	1																								1							
Brandt's Cormorant	2325		3	326	4	1	1	2	240	17	75	6	23	50	1455	12	4	60	1		38	3			2	2						
Brown Pelican	484	5	19	70	43		7	30	20	74	9	4	25	8	16	30	15	9	2	5	15		9	1	1	1	1	9	3	2	2	49
Bufflehead	22	8					11																		3							
California Gull	55				3			2	1					2	4		1	5		1		1	1		21	13						
Caspian Tern	1																		1													
Clark's Grebe	17						2		4		5										6											
Common Loon	3										2											1										
Common Raven	10							3	1																				3		1	2
Cooper's Hawk	1					1																										
Double-crested Cormorant	321	11	19	15	62		5	19		3	50			11	1	5	8		2	3	8		5	5	30			9	4	2		44
Eared Grebe	37	9	2			13	3		1		1												1		4		3					
Elegant Tern	27	2			2		3				12			5				1	1													1
European Starling	9																				9											
Forster's Tern	2	2																														
Glaucous-winged Gull	5																		1	1		1	1	1								
Great Blue Heron	56		3		5	2	7	4	1	1	1			1		1	4		2	3	6	1	4		3			1	1	2	1	2
Green Heron	3																											1	2			
Heermann's Gull	919	55	42	164	21	1	3	155	72	43	10	5	14	19	7	61	56	16	7	29	35	9	16	14	8	5			5	5		42
Herring Gull	4		1										1			1																1
Horned Grebe	1						1																									
House Finch	4								2																2							
House Sparrow	4																		4													
Least Sandpiper	87					47	34																								6	
Lesser Scaup	7						7																									
Long-billed Curlew	1					1																										
Mallard	1						1																									
Marbled Godwit	7	1				6																										
Mew Gull	7																				6				1							
Mourning Dove	2																								2							
Osprey	4					1								2		1																
Pacific Loon	2										1	1																				
Pelagic Cormorant	11														1				1		6	1	1	1								
Peregrine Falcon	1																						1									
Pied-billed Grebe	4						2																		2							
Red-breasted Merganser	3	1																											1			1
Red-tailed Hawk	2					1																				1						
Ring-billed Gull	97	38	7	1	2			6				6	1	2			3			5	9				3				4	3		7

Species	Totals	Zones																													
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Rock Dove	301		1		12	98	3				14			5					4		1		2	5	59	18		19	7		22	31
Royal Tern	71		1					2	1		55	1	3		3		1				2											2
Ruddy Duck	21					13	8																									
Sanderling	9												5			4																
Snowy Egret	11							6		2	2														1							
Spotted Sandpiper	6																			2					1			1			2	
Surf Scoter	612		73	183		27	52	3	13		126	1		2				1			131											
Surfbird	3								3																							
Western Grebe	1668	1	97	38	3	16	41	183	519		489	8		16	44	3	44	27	8		118	1	1		10					1		
Western Gull	1719	122	62	95	44		112	89	24	41	42	9	62	7	6	42	9	10	5	22	80	38	133	55	297	10	8	5	18	61	4	207
Whimbrel	6					2			1					1		1	1															
Willet	13	2		1		8							1									1										
Yellow-rumped Warbler	2																														2	

Table H-22. Caspian, Elegant, and Least Tern Observations for Foraging Behavior Only

CASPIAN TERN — OBSERVATIONS FOR FORAGING BEHAVIOR ONLY																									
Date	*Zone*																								*Grand Total*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*10*	*11*	*13*	*14*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*27*	*29*	*32*	*33*	*34*	
1/11/2008														1											1
3/1/2008	1																								1
3/15/2008						1																			1
3/21/2008								1																	1
4/10/2008								2	2			1													5
4/11/2008			1			3								2								1			7
5/22/2008			1										1												2
5/23/2008				1		4	10											1	4			2		4	26
6/20/2008					1	1	1											3	1	3		1	1		12
7/25/2008	1								1	1	1					1									5
7/26/2008							11																		11
8/14/2008													1				2								3
8/15/2008				1		1														2					4
8/27/2008													1			1	1								3
8/28/2008						1	2													1	1				5
9/11/2008		1								1															2
9/12/2008							1																		1
11/7/2008	1																								1
11/21/2008															1										1
12/28/2008														1											1
Grand Total	3	1	2	2	1	11	25	3	3	2	1	1	3	4	1	2	3	4	5	6	1	4	1	4	93

ELEGANT TERN — OBSERVATIONS FOR FORAGING BEHAVIOR ONLY																											
Date	*Zone*																										*Grand Total*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*29*	*30*	*31*	*33*	*34*	
3/21/2008																31				1								32
3/22/2008			13														5											18
4/10/2008																	4											4
4/11/2008	3	3				6																						12
5/22/2008	1							20								2	3	1										27
5/23/2008				7		88	91																					186
6/19/2008		2							4	23	1	2		2		6	4	5	6									55
6/20/2008				3	27	150															4	4		1				189
7/25/2008	19	1	7					2		11		1	2	5		2	1	2	9									62
7/26/2008					4	1	495																			2		502
8/14/2008	4	9	6							6				2		1	3			8								39
8/15/2008					8	21	12																					41
8/27/2008		5								3	19				2	4	9			1	3							46
8/28/2008						3																				1		4
9/11/2008	6	6	9														4		1									26
9/12/2008																									1			1
9/25/2008	2	9												16														27
9/26/2008							7																2					9
10/9/2008						7	7																				1	15
10/10/2008	7	6								1				1														15
10/23/2008													3	1		4												8
10/24/2008				1																								1
11/7/2008	1																2											3
11/23/2008						3																						3

LEAST TERN — OBSERVATIONS FOR FORAGING BEHAVIOR ONLY												
Date	*Zone*											*Grand Total*
	1	*3*	*6*	*8*	*19*	*20*	*21*	*23*	*25*	*27*	*28*	
5/22/2008	3			9	1							13
5/23/2008			11							6		17
6/19/2008		4		1	2							7
6/20/2008			1					1			1	3
7/25/2008	8			8		1	2					19
7/26/2008									1			1
Grand Total	11	4	12	18	3	1	2	1	1	6	1	60

APPENDIX I

MARINE MAMMALS

Table I-1. 2008 Biological Baseline Study Marine Mammal Observations

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Bottlenose Dolphin	Lampara	22-Jul-08	3	LA4	NS	
Bottlenose Dolphin	Birds	31-Jan-08	JAN-B	20	12	
Bottlenose Dolphin	Birds	29-Feb-08	FEB-B	8	10	
Bottlenose Dolphin	Birds	29-Feb-08	FEB-B	9	10	
Bottlenose Dolphin	Birds	14-Mar-08	MAR-A	19	6	
Bottlenose Dolphin	Birds	22-Mar-08	MAR-B	3	4	
Bottlenose Dolphin	Birds	25-Sep-08	SEP-B	13	3	
Bottlenose Dolphin	Birds	25-Sep-08	SEP-B	20	12	
Bottlenose Dolphin	Birds	07-Nov-08	NOV-A	13	5	
Bottlenose Dolphin	Birds	07-Nov-08	NOV-A	20	6	
Ca. Sea Lion	Lampara	19-Jan-08	1	LB5	1	
Ca. Sea Lion	Lampara	19-Jan-08	1	LA6	4	
Ca. Sea Lion	Lampara	11-Apr-08	2	LB6	4	on buoy
Ca. Sea Lion	Lampara	23-Jul-08	3	LA2	1	
Ca. Sea Lion	Otter Trawl	11-Jan-08	1	LB2	10-12	on buoy
Ca. Sea Lion	Otter Trawl	12-Jan-08	1	LA10	20-25	
Ca. Sea Lion	Otter Trawl	16-Jan-08	1	LA1	NS	on buoy
Ca. Sea Lion	Otter Trawl	3-Apr-08	2	LB6	3	
Ca. Sea Lion	Otter Trawl	4-Apr-08	2	LA10	1	
Ca. Sea Lion	Otter Trawl	7-Apr-08	2	LA1	1	
Ca. Sea Lion	Otter Trawl	8-Apr-08	2	LA3	NS	
Ca. Sea Lion	Otter Trawl	11-Jul-08	3	LA1	NS	
Ca. Sea Lion	Otter Trawl	12-Jul-08	3	--	2	By Coast Guard building
Ca. Sea Lion	Birds	14-Dec-07	DEC-A	2	4	
Ca. Sea Lion	Birds	14-Dec-07	DEC-A	2	2	
Ca. Sea Lion	Birds	14-Dec-07	DEC-A	8	2	
Ca. Sea Lion	Birds	14-Dec-07	DEC-A	10	1	
Ca. Sea Lion	Birds	14-Dec-07	DEC-A	10	2	
Ca. Sea Lion	Birds	14-Dec-07	DEC-A	14	3	
Ca. Sea Lion	Birds	14-Dec-07	DEC-A	19	2	
Ca. Sea Lion	Birds	17-Dec-07	DEC-A	2	2	
Ca. Sea Lion	Birds	17-Dec-07	DEC-A	4	22	

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Ca. Sea Lion	Birds	17-Dec-07	DEC-A	6	2	
Ca. Sea Lion	Birds	17-Dec-07	DEC-A	25	1	
Ca. Sea Lion	Birds	17-Dec-07	DEC-A	27	2	
Ca. Sea Lion	Birds	17-Dec-07	DEC-A	31	2	
Ca. Sea Lion	Birds	17-Dec-07	DEC-A	34	2	
Ca. Sea Lion	Birds	27-Dec-07	DEC-B	2	1	
Ca. Sea Lion	Birds	27-Dec-07	DEC-B	4	13	
Ca. Sea Lion	Birds	27-Dec-07	DEC-B	25	2	
Ca. Sea Lion	Birds	27-Dec-07	DEC-B	27	3	
Ca. Sea Lion	Birds	27-Dec-07	DEC-B	28	1	
Ca. Sea Lion	Birds	27-Dec-07	DEC-B	34	11	
Ca. Sea Lion	Birds	28-Dec-07	DEC-B	10	2	
Ca. Sea Lion	Birds	28-Dec-07	DEC-B	14	8	
Ca. Sea Lion	Birds	28-Dec-07	DEC-B	20	2	
Ca. Sea Lion	Birds	28-Dec-07	DEC-B	22	1	
Ca. Sea Lion	Birds	10-Jan-08	JAN-A	10	1	
Ca. Sea Lion	Birds	10-Jan-08	JAN-A	14	1	
Ca. Sea Lion	Birds	10-Jan-08	JAN-A	20	2	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	2	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	2	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	4	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	4	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	4	3	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	4	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	25	3	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	27	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	27	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	31	1	
Ca. Sea Lion	Birds	11-Jan-08	JAN-A	34	10	
Ca. Sea Lion	Birds	31-Jan-08	JAN-B	10	2	
Ca. Sea Lion	Birds	31-Jan-08	JAN-B	15	2	
Ca. Sea Lion	Birds	31-Jan-08	JAN-B	20	1	
Ca. Sea Lion	Birds	31-Jan-08	JAN-B	23	1	
Ca. Sea Lion	Birds	31-Jan-08	JAN-B	23	1	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	1	1	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	1	1	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	2	1	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	4	1	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	4	1	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	20	5	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	27	3	
Ca. Sea Lion	Birds	01-Feb-08	JAN-B	34	2	
Ca. Sea Lion	Birds	15-Feb-08	FEB-A	2	2	

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Ca. Sea Lion	Birds	15-Feb-08	FEB-A	8	1	
Ca. Sea Lion	Birds	15-Feb-08	FEB-A	10	1	
Ca. Sea Lion	Birds	15-Feb-08	FEB-A	14	4	
Ca. Sea Lion	Birds	15-Feb-08	FEB-A	15	2	
Ca. Sea Lion	Birds	15-Feb-08	FEB-A	20	2	
Ca. Sea Lion	Birds	15-Feb-08	FEB-A	20	3	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	4	30	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	4	6	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	4	2	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	6	1	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	7	1	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	20	1	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	25	1	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	27	1	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	31	1	
Ca. Sea Lion	Birds	16-Feb-08	FEB-A	34	16	around fishing boat docks
Ca. Sea Lion	Birds	29-Feb-08	FEB-B	8	1	
Ca. Sea Lion	Birds	29-Feb-08	FEB-B	20	2	
Ca. Sea Lion	Birds	29-Feb-08	FEB-B	22	1	
Ca. Sea Lion	Birds	29-Feb-08	FEB-B	23	2	assume OW; not recorded
Ca. Sea Lion	Birds	29-Feb-08	FEB-B	25	1	assume OW; not recorded
Ca. Sea Lion	Birds	01-Mar-08	FEB-B	4	47	
Ca. Sea Lion	Birds	01-Mar-08	FEB-B	6	1	
Ca. Sea Lion	Birds	01-Mar-08	FEB-B	31	1	
Ca. Sea Lion	Birds	01-Mar-08	FEB-B	32	1	assume OW; not recorded
Ca. Sea Lion	Birds	01-Mar-08	FEB-B	34	23	
Ca. Sea Lion	Birds	14-Mar-08	MAR-A	2	6	
Ca. Sea Lion	Birds	14-Mar-08	MAR-A	2	1	
Ca. Sea Lion	Birds	14-Mar-08	MAR-A	8	1	
Ca. Sea Lion	Birds	14-Mar-08	MAR-A	10	1	
Ca. Sea Lion	Birds	14-Mar-08	MAR-A	20	4	
Ca. Sea Lion	Birds	15-Mar-08	MAR-A	4	1	
Ca. Sea Lion	Birds	15-Mar-08	MAR-A	4	38	
Ca. Sea Lion	Birds	15-Mar-08	MAR-A	7	1	
Ca. Sea Lion	Birds	15-Mar-08	MAR-A	27	3	
Ca. Sea Lion	Birds	15-Mar-08	MAR-A	34	10	
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	8	1	
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	10	1	
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	10	2	
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	13	1	
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	20	1	
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	20	5	

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	21	1	
Ca. Sea Lion	Birds	21-Mar-08	MAR-B	23	1	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	2	1	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	4	31	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	14	1	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	20	2	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	20	2	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	27	3	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	31	1	
Ca. Sea Lion	Birds	22-Mar-08	MAR-B	34	24	
Ca. Sea Lion	Birds	10-Apr-08	APR	10	2	
Ca. Sea Lion	Birds	10-Apr-08	APR	11	2	
Ca. Sea Lion	Birds	10-Apr-08	APR	14	1	
Ca. Sea Lion	Birds	10-Apr-08	APR	14	2	
Ca. Sea Lion	Birds	10-Apr-08	APR	19	1	
Ca. Sea Lion	Birds	10-Apr-08	APR	20	1	
Ca. Sea Lion	Birds	10-Apr-08	APR	23	1	
Ca. Sea Lion	Birds	10-Apr-08	APR	24	1	EATING A MULLET
Ca. Sea Lion	Birds	10-Apr-08	APR	24	2	
Ca. Sea Lion	Birds	11-Apr-08	APR	4	2	
Ca. Sea Lion	Birds	11-Apr-08	APR	6	1	
Ca. Sea Lion	Birds	11-Apr-08	APR	20	2	
Ca. Sea Lion	Birds	11-Apr-08	APR	20	4	
Ca. Sea Lion	Birds	11-Apr-08	APR	20	1	
Ca. Sea Lion	Birds	11-Apr-08	APR	28	1	
Ca. Sea Lion	Birds	11-Apr-08	APR	34	14	
Ca. Sea Lion	Birds	22-May-08	MAY	2	5	
Ca. Sea Lion	Birds	22-May-08	MAY	2	3	BAIT BARGE
Ca. Sea Lion	Birds	22-May-08	MAY	8	8	
Ca. Sea Lion	Birds	22-May-08	MAY	14	1	
Ca. Sea Lion	Birds	22-May-08	MAY	20	1	
Ca. Sea Lion	Birds	22-May-08	MAY	20	3	
Ca. Sea Lion	Birds	23-May-08	MAY	4	9	
Ca. Sea Lion	Birds	23-May-08	MAY	4	16	
Ca. Sea Lion	Birds	23-May-08	MAY	6	1	
Ca. Sea Lion	Birds	23-May-08	MAY	7	1	
Ca. Sea Lion	Birds	23-May-08	MAY	32	1	
Ca. Sea Lion	Birds	23-May-08	MAY	34	8	
Ca. Sea Lion	Birds	19-Jun-08	JUN	2	1	
Ca. Sea Lion	Birds	19-Jun-08	JUN	2	8	
Ca. Sea Lion	Birds	19-Jun-08	JUN	10	1	
Ca. Sea Lion	Birds	19-Jun-08	JUN	13	1	
Ca. Sea Lion	Birds	19-Jun-08	JUN	14	1	
Ca. Sea Lion	Birds	19-Jun-08	JUN	14	4	

Common Name	Survey Type	Date	Survey	Station/ Zone	Number	Comments
Ca. Sea Lion	Birds	19-Jun-08	JUN	15	4	
Ca. Sea Lion	Birds	19-Jun-08	JUN	20	4	
Ca. Sea Lion	Birds	19-Jun-08	JUN	20	5	
Ca. Sea Lion	Birds	20-Jun-08	JUN	4	1	
Ca. Sea Lion	Birds	20-Jun-08	JUN	4	1	
Ca. Sea Lion	Birds	20-Jun-08	JUN	6	4	
Ca. Sea Lion	Birds	20-Jun-08	JUN	7	1	
Ca. Sea Lion	Birds	20-Jun-08	JUN	34	5	
Ca. Sea Lion	Birds	25-Jul-08	JUL	2	5	
Ca. Sea Lion	Birds	25-Jul-08	JUL	2	1	
Ca. Sea Lion	Birds	25-Jul-08	JUL	2	6	
Ca. Sea Lion	Birds	25-Jul-08	JUL	8	1	
Ca. Sea Lion	Birds	25-Jul-08	JUL	10	2	
Ca. Sea Lion	Birds	25-Jul-08	JUL	13	1	
Ca. Sea Lion	Birds	25-Jul-08	JUL	15	7	
Ca. Sea Lion	Birds	25-Jul-08	JUL	19	1	
Ca. Sea Lion	Birds	25-Jul-08	JUL	20	2	
Ca. Sea Lion	Birds	25-Jul-08	JUL	20	7	
Ca. Sea Lion	Birds	25-Jul-08	JUL	20	6	
Ca. Sea Lion	Birds	25-Jul-08	JUL	22	1	
Ca. Sea Lion	Birds	26-Jul-08	JUL	4	2	
Ca. Sea Lion	Birds	26-Jul-08	JUL	4	2	
Ca. Sea Lion	Birds	26-Jul-08	JUL	4	1	
Ca. Sea Lion	Birds	26-Jul-08	JUL	4	5	
Ca. Sea Lion	Birds	26-Jul-08	JUL	4	3	
Ca. Sea Lion	Birds	26-Jul-08	JUL	6	1	
Ca. Sea Lion	Birds	26-Jul-08	JUL	6	2	
Ca. Sea Lion	Birds	26-Jul-08	JUL	7	1	
Ca. Sea Lion	Birds	26-Jul-08	JUL	27	1	
Ca. Sea Lion	Birds	26-Jul-08	JUL	34	8	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	2	5	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	2	4	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	14	6	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	15	3	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	20	3	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	20	2	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	20	10	
Ca. Sea Lion	Birds	14-Aug-08	AUG-A	23	2	
Ca. Sea Lion	Birds	15-Aug-08	AUG-A	4	2	
Ca. Sea Lion	Birds	15-Aug-08	AUG-A	4	10	
Ca. Sea Lion	Birds	15-Aug-08	AUG-A	7	6	
Ca. Sea Lion	Birds	15-Aug-08	AUG-A	24	1	
Ca. Sea Lion	Birds	15-Aug-08	AUG-A	27	1	
Ca. Sea Lion	Birds	15-Aug-08	AUG-A	34	12	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	2	13	

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	10	1	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	11	1	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	14	6	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	14	1	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	15	8	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	20	1	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	20	9	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	20	8	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	20	7	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	21	1	
Ca. Sea Lion	Birds	27-Aug-08	AUG-B	23	1	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	4	2	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	4	8	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	4	1	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	4	4	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	6	2	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	7	3	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	7	1	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	25	1	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	27	1	
Ca. Sea Lion	Birds	28-Aug-08	AUG-B	34	9	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	1	2	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	2	6	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	2	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	2	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	10	6	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	11	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	11	6	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	14	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	14	8	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	15	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	15	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	20	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	20	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	20	6	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	20	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	22	1	
Ca. Sea Lion	Birds	11-Sep-08	SEP-A	23	1	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	4	1	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	4	1	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	4	7	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	4	3	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	4	2	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	4	2	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	7	1	

Common Name	Survey Type	Date	Survey	Station/ Zone	Number	Comments
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	7	1	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	7	2	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	7	1	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	26	1	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	27	2	
Ca. Sea Lion	Birds	12-Sep-08	SEP-A	34	8	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	2	7	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	2	2	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	2	6	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	2	2	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	2	2	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	2	1	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	10	14	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	11	2	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	11	2	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	12	2	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	14	7	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	14	1	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	20	1	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	20	2	
Ca. Sea Lion	Birds	25-Sep-08	SEP-B	20	14	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	4	2	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	4	7	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	4	2	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	4	1	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	4	1	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	4	2	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	7	1	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	7	6	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	28	1	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	30	1	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	31	1	
Ca. Sea Lion	Birds	26-Sep-08	SEP-B	34	9	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	4	18	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	4	3	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	4	1	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	4	8	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	7	4	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	7	2	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	7	2	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	7	1	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	7	11	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	25	4	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	27	1	
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	30	1	

Common Name	Survey Type	Date	Survey	Station/ Zone	Number	Comments
Ca. Sea Lion	Birds	09-Oct-08	OCT-A	34	10	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	2	2	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	2	13	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	2	1	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	10	2	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	10	12	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	10	2	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	10	1	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	14	2	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	14	2	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	14	6	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	20	3	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	20	14	
Ca. Sea Lion	Birds	10-Oct-08	OCT-A	20	1	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	2	13	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	10	1	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	10	1	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	10	4	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	11	1	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	13	2	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	14	6	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	20	2	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	20	12	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	20	2	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	23	1	
Ca. Sea Lion	Birds	23-Oct-08	OCT-B	23	1	
Ca. Sea Lion	Birds	24-Oct-08	OCT-B	4	1	
Ca. Sea Lion	Birds	24-Oct-08	OCT-B	4	46	
Ca. Sea Lion	Birds	24-Oct-08	OCT-B	4	2	
Ca. Sea Lion	Birds	24-Oct-08	OCT-B	7	8	
Ca. Sea Lion	Birds	24-Oct-08	OCT-B	34	8	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	4	2	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	4	2	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	4	2	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	4	1	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	7	2	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	7	1	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	25	4	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	30	1	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	31	1	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	33	1	
Ca. Sea Lion	Birds	06-Nov-08	NOV-A	34	8	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	2	3	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	8	1	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	10	2	

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	10	2	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	10	1	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	11	1	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	11	2	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	11	2	YOUNG
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	13	1	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	14	6	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	20	4	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	20	5	
Ca. Sea Lion	Birds	07-Nov-08	NOV-A	20	11	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	2	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	2	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	2	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	2	5	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	8	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	9	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	9	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	10	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	10	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	10	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	10	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	11	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	12	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	13	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	13	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	14	2	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	14	5	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	20	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	20	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	20	1	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	20	4	
Ca. Sea Lion	Birds	21-Nov-08	NOV-B	20	2	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	4	1	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	4	6	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	4	2	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	4	19	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	4	2	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	4	2	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	4	4	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	7	5	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	7	2	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	7	2	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	7	3	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	31	1	
Ca. Sea Lion	Birds	23-Nov-08	NOV-B	34	3	

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Common dolphin	Birds	10-Jan-08	JAN-A	20	8	
Harbor seal	Otter Trawl	11-Jan-08	1	LA1	1	
Harbor seal	Otter Trawl	12-Jan-08	1	LA10	NS	
Harbor seal	Otter Trawl	16-Jan-08	1	LA1	NS	on buoy
Harbor Seal	Birds	14-Dec-07	DEC-A	8	12	
Harbor Seal	Birds	14-Dec-07	DEC-A	9	9	
Harbor Seal	Birds	14-Dec-07	DEC-A	13	1	
Harbor Seal	Birds	17-Dec-07	DEC-A	4	1	
Harbor Seal	Birds	27-Dec-07	DEC-B	5	2	
Harbor Seal	Birds	28-Dec-07	DEC-B	8	15	
Harbor Seal	Birds	10-Jan-08	JAN-A	8	13	
Harbor Seal	Birds	10-Jan-08	JAN-A	15	1	
Harbor Seal	Birds	31-Jan-08	JAN-B	8	22	
Harbor Seal	Birds	01-Feb-08	JAN-B	5	1	
Harbor Seal	Birds	01-Feb-08	JAN-B	6	1	
Harbor Seal	Birds	15-Feb-08	FEB-A	8	17	
Harbor Seal	Birds	15-Feb-08	FEB-A	9	1	
Harbor Seal	Birds	29-Feb-08	FEB-B	8	12	
Harbor Seal	Birds	01-Mar-08	FEB-B	5	2	assume Zone 6 and OW, not recorded
Harbor Seal	Birds	14-Mar-08	MAR-A	8	19	
Harbor Seal	Birds	21-Mar-08	MAR-B	8	9	
Harbor Seal	Birds	21-Mar-08	MAR-B	9	1	
Harbor Seal	Birds	10-Apr-08	APR	8	22	
Harbor Seal	Birds	10-Apr-08	APR	8	1	
Harbor Seal	Birds	11-Apr-08	APR	1	1	
Harbor Seal	Birds	11-Apr-08	APR	7	1	
Harbor Seal	Birds	22-May-08	MAY	8	6	
Harbor Seal	Birds	22-May-08	MAY	15	1	
Harbor Seal	Birds	19-Jun-08	JUN	8	15	
Harbor Seal	Birds	19-Jun-08	JUN	20	1	
Harbor Seal	Birds	25-Jul-08	JUL	8	12	
Harbor Seal	Birds	25-Jul-08	JUL	9	1	
Harbor Seal	Birds	14-Aug-08	AUG-A	10	9	
Harbor Seal	Birds	27-Aug-08	AUG-B	8	14	
Harbor Seal	Birds	27-Aug-08	AUG-B	9	1	
Harbor Seal	Birds	11-Sep-08	SEP-A	8	1	
Harbor Seal	Birds	11-Sep-08	SEP-A	8	4	
Harbor Seal	Birds	11-Sep-08	SEP-A	8	7	
Harbor Seal	Birds	25-Sep-08	SEP-B	8	3	
Harbor Seal	Birds	25-Sep-08	SEP-B	8	4	
Harbor Seal	Birds	25-Sep-08	SEP-B	12	1	
Harbor Seal	Birds	10-Oct-08	OCT-A	8	12	
Harbor Seal	Birds	10-Oct-08	OCT-A	8	1	

Common Name	*Survey Type*	*Date*	*Survey*	*Station/ Zone*	*Number*	*Comments*
Harbor Seal	Birds	10-Oct-08	OCT-A	9	2	
Harbor Seal	Birds	23-Oct-08	OCT-B	8	8	
Harbor Seal	Birds	07-Nov-08	NOV-A	8	14	
Harbor Seal	Birds	07-Nov-08	NOV-A	13	1	
Harbor Seal	Birds	21-Nov-08	NOV-B	8	19	
Harbor Seal	Birds	21-Nov-08	NOV-B	8	2	

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