City of San Diego
PUBLIC UTILITIES
Water & Wastewater

Application For Renewal of NPDES CA0107409 and 301(h) Modified Secondary Treatment Requirements

POINT LOMA OCEAN OUTFALL

Volume VII
Appendices I thru L

January 2015

THE CITY OF SAN DIEGO PUBLIC UTILITIES DEPARTMENT

Application for Renewal of NPDES CA0107409

301(h) Modified Secondary Treatment Requirements for Biochemical Oxygen Demand and Total Suspended Solids

POINT LOMA OCEAN OUTFALL &
POINT LOMA WASTEWATER TREATMENT PLANT

Submitted pursuant to
Sections 301(h) and 301(j)(5) of the Clean Water Act

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APPLICATION FOR RENEWAL OF NPDES CA0107409
301(h) MODIFIED SECONDARY TREATMENT REQUIREMENTS

Point Loma Ocean Outfall
Point Loma Wastewater Treatment Plant

VOLUME VII
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BENEFICIAL USE EVALUATION

For

CITY OF SAN DIEGO

APPLICATION FOR MODIFICATION OF SECONDARY TREATMENT REQUIREMENTS AT THE POINT LOMA TREATMENT FACILITY

To

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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INTRODUCTION

The City of San Diego is preparing an application to the San Diego Regional Water Quality Control Board (SDRWQCB) and the U. S. Environmental Protection Agency (EPA) requesting renewal of its' National Pollution Discharge Elimination System (NPDES) permit for the discharge of treated wastewater to the Pacific Ocean from the 23,760-foot-long, 320-foot deep Point Loma Ocean Outfall. The City's application requests renewal of modified secondary treatment requirements for the Point Loma discharge in accordance with provisions of Section 301(h) and Section 301(j)(5) of the Clean Water Act (EPA 2014a). The current five-year discharge permit for the modified Point Loma discharge expires in 2015 (SDRWQCB and EPA 2009). The City's Section 301 renewal application does not request any increase in currently permitted discharge flows or mass emissions. It seeks to decrease suspended solids mass emissions. Treatment and discharge operations at Point Loma have complied with all applicable state and federal standards for the protection water quality, habitat quality, marine organisms, and beneficial uses of the ocean. The proposed discharge will continue to meet or exceed these standards. This Beneficial Use Assessment was prepared as part of the City of San Diego's Section 301 renewal application.

The term "beneficial uses" refers to the various ways water is beneficial to man and the environment. State and federal water quality standards are designed to protect existing and potential beneficial uses.

The California Water Quality Control Plan for Ocean Waters (Ocean Plan) identifies beneficial uses for California ocean waters and establishes standards to protect them (SWRCB 2012a). Beneficial uses specific to the San Diego Region are designated by the San Diego Regional Water Quality Control Board in the Basin Plan (SDRWQCB 2012). The Regional Board also identifies beneficial uses in individual waste discharge orders or NPDES permits.

Fourteen beneficial uses are identified in the Point Loma Wastewater Treatment Plant NPDES permit (Table 1) (Regional Board Order No. R9-2009-0001, NPDES Permit No. 0107409 (SDRWQCB and EPA 2009)).

Table 1. Point Loma Wastewater Treatment Plant NPDES Permit Beneficial Uses.	
Water Contact Recreation (REC-1)	Recreational uses involving body contact with water, such as swimming, wading, water skiing, skin diving, windsailing, surfing, fishing from paddle craft, or other uses where ingestion of water is reasonably possible.
Non-Contact Water Recreation (REC-2)	Recreational uses involving the presence of water, but not necessarily requiring body contact, such as picnicking, sunbathing, hiking, beachcombing, sport

Table 1. Point Loma Wastewater Treatment Plant NPDES Permit Beneficial Uses.	
	fishing, pleasure boating, tide-pooling, marine life study and enjoyment.
Ocean Commercial and Non-freshwater Sport Fishing (COMM)	Commercial collection of fish and shellfish, including those collected for bait, plus sport fishing in the ocean, bays, estuaries, and similar non-freshwater areas.
Wildlife Habitat (WILD)	Provides a water or food supply (and supports a vegetative habitat) for the maintenance of wildlife.
Preservation of Rare and Endangered Species (RARE)	Provides an aquatic habitat which is necessary, at least in part, for the survival of identified rare and endangered species.
Marine Habitat (MAR)	Provides for the preservation of the marine ecosystem, including the propagation and sustenance of fish, shellfish, marine mammals, waterfowl, and marine vegetation.
Shellfish Harvesting (SHELL)	Collection of filter-feeding shellfish such as clams, oysters, and mussels for sport or commercial purposes.
Preservation and Enhancement of Biological Habitats of Special Significance (BIOL)	Waters support designated areas or habitats, including, but not limited to established refuges, parks, sanctuaries, ecological reserves or preserves, and Areas of Special Biological Significance (ASBS), where the preservation and enhancement of natural resources requires special protection.
Mariculture (MAR)	Promotes the culture of plants and animals in marine waters independent of any pollution source.
Migration of Aquatic Organisms (MIGR)	Supports and facilitates the migration of marine organisms.
Navigation (NAV)	Waters used for shipping, travel or other transportation by private, commercial or military vessels.

Table 1. Point Loma Wastewater Treatment Plant NPDES Permit Beneficial Uses.

Spawning, Reproduction and/or Early Development (SPWN)	Waters supporting high quality habitats necessary for reproduction and early development of fish and wildlife.
Aesthetic Enjoyment (AE)	The appreciation of intangible assets associated with natural settings.
Industrial Service Supply (IND)	Waters for industrial use that do not depend primarily on water quality including hydraulic conveyance and cooling water supply.

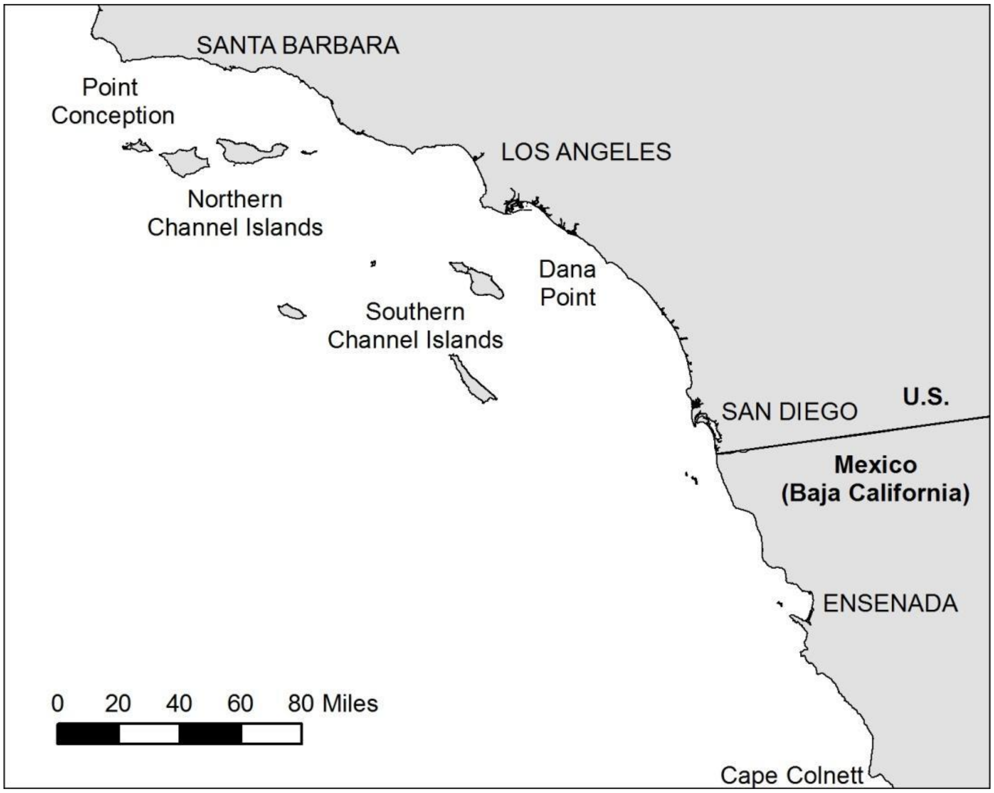
This Beneficial Use Assessment describes: 1) the existing environment at Point Loma, 2) beneficial uses in the vicinity of the Point Loma, 3) the effects of the existing Point Loma Wastewater Treatment Plant discharge on beneficial uses, and 4) the potential impacts of the proposed (future) operation of the Point Loma Wastewater Treatment Plant discharge. It also responds to the following specific questions in the renewal application: are commercial or recreational fisheries located in areas potentially affected by the discharge; have commercial or recreational fisheries been affected by the discharge; do recreational activities take place in areas potentially affected by the discharge; have recreational activities been affected by the discharge; are there any Federal, state, or local restrictions on recreational activities in the vicinity of the discharge; are endangered species present in the vicinity of the discharge; and, have endangered species been effected by the discharge?

EXISTING ENVIRONMENT

Project Area

The marine waters off the Point Loma Wastewater Treatment Plant are located in the Southern California Bight - a broad ocean embayment created by an indentation of California's coastline south of Point Conception (Figure 1). The Southern California Bight extends from Point Conception south to Cabo Colnett, Baja California, Mexico, and west to the Santa Rosa-Cortes Ridge. The continental shelf in this area has several submarine valleys and submerged mountains whose peaks form the offshore islands. Submarine ridges and troughs in the Southern California Bight generally run northwest to southeast, with the exception of the east-west trending Santa Barbara Channel.

Figure 1. Southern California Bight.



The Southern California Bights' large urban population centers and busy harbors make it one of the most heavily utilized marine ecosystems on earth, yet the Southern California Bight supports a diverse assemblage of marine life including marine algae and plants, invertebrates, fish, sea turtles, marine mammals, sea birds, and a wide variety of habitats (Dailey et al. 1993, Schiff et al. 2000, Leet et al. 2001, Allen et al. 2005, 2006, 2011, Allen and Cross 2006, California Marine Life Protection Act (CMLPA) 2009, Howard et al. 2012, Pondella et al. 2012, Ranasinghe et al. 2012, Setty et al. 2012, Southern California Coastal Water Research Project (SCCWRP) 2012, 2014), United States Department of the Navy (USDON) 2013.

Marine habitats in the Southern California Bight range from sandy beaches and rocky coasts to deep, soft- and hard-bottom areas. Intertidal zones include sandy beaches, rocky shores, tidal flats, coastal marsh, and manmade structures. There are nearly 40 tidally-influenced estuaries and lagoons with associated open water, soft bottom, tidal mud flats, and eelgrass beds.

Sandy and soft-bottom substrates dominate shorelines and subtidal habitats in the southern region. These substrates lack the relief or structural complexity of hard-bottom habitats, but support species adapted to low-relief, dynamic environments. Invertebrates and bottom-dwelling fish are the most common species in soft substrate areas.

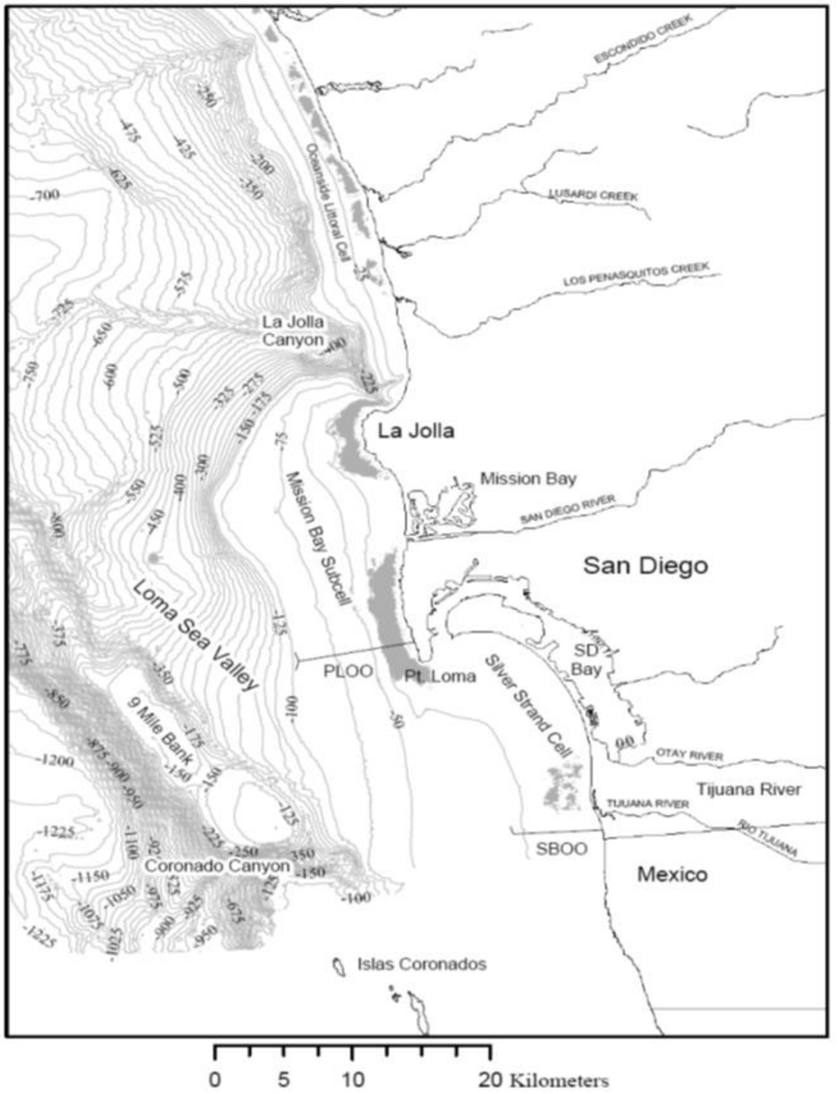
Hard-bottom habitats like rocky reefs are less common but generally have greater productivity and species diversity than soft-bottom habitats. Kelp forests are associated with shallow rock bottoms while deep-sea corals and sponges are found in deep rock habitats. Kelp forest extending through the water column form dense surface canopies and promote high productivity and diversity of marine life.

The Southern California Bights' broad continental shelf includes channels, basins, and canyons, interspersed by shallower ridges. Underwater pinnacles and rocky outcrops are important aggregation sites for fish and other species. Marine canyons contain unique deep-water communities and provide foraging areas for seabirds and marine mammals. The marine environment surrounding the Channel Islands affords a distinctive ecological setting, with nutrient-rich waters and high-relief rocky habitats fostering substantial biodiversity.

Point Loma Ocean Outfall

The Point Loma Ocean Outfall (PLOO) discharges approximately 140 million gallons per day (mgd) of treated wastewater, generated by more than 2.2 million residents and industries (with source controls) in a 450 square mile (mi^2) (1,165 square kilometers (km^2) area. The Point Loma Wastewater Treatment Plant has an overall capacity of 240 mgd. Treated wastewater is discharged through the Point Loma Ocean Outfall (PLOO) 4.5 miles (mi) (7.2 kilometers (km)) offshore at a depth of 320 feet (ft) (98 meters (m)) (Figure 2; note the grey areas off Point Loma and La Jolla represent kelp beds).

Figure 2. Location of the Point Loma Ocean Outfall.



The Point Loma Ocean Outfall is one of the longest and deepest ocean outfalls in the world. It was extended to its present location in 1993 and is buried in a trench from shore through the surf zone out to a distance of about 2,600 ft (792 m) offshore. Over the next 400 ft (123 m) the pipeline gradually emerges from the rock trench. Beyond 3,000 ft (914 m) offshore, the remainder of the 4.5 mi (7.2 km) pipeline rests on a bed of ballast rock on the sea floor. The end of the pipeline connects to a perforated "Y" diffuser section of two legs, each 2,500 ft (762 m) long. Wastewater is discharged through diffuser ports ranging in depth from 306 ft (93 m) to 320 ft (98 m). Mathematical models of outfall operation indicate a median (50th percentile) initial dilution of 338:1 at a discharge flow of 240 mgd (the maximum design flow) (see Volume I, Part 3, Chapter 4 - Large Applicant Questionnaire). The minimum month initial dilution (the initial dilution as determined assuming zero ocean currents and using the worst case density conditions from over 13,000 density data profiles) is computed at 202:1.

The deep discharge and high initial dilution traps discharged diluted wastewater at a depth of more than 130 ft (40 m) below the ocean surface (Rogowski et al. 2012) (see Appendix F – Pt. Loma Plume Behavior and Tracking Studies, Appendix H – Coastal Remote Sensing 5-yr Retrospective). This keeps the outfall plume below the euphotic zone (the zone in which light penetrates) and away from the near-shore environment (Rogowski et al. 2013, City of San Diego (COSD) 2014). Another favorable feature of the Point Loma Ocean Outfall is the location of the discharge near the break in the mainland shelf (Figure 2). The shelf drops precipitously immediately offshore from the diffuser facilitating plume dispersal.

The pipeline and diffusers with their supporting bed of ballast rock form an artificial reef. The pipe and rock, covered with encrusted organisms (tube worms, anemones, barnacles) provide food and shelter to a variety of fish and invertebrates. This artificial habitat covers an area of about 22 acres (9 hectares) off Point Loma (assuming a 36 ft (11 m) width of pipe and ballast rock) (Wolfson and Glinski 1986).

Besides the Point Loma Ocean Outfall, there are a number of other anthropogenic inputs to the continental shelf between La Jolla, California and the Mexico Border (Parnell and Riser 2012). These include tidal discharge, rainfall runoff, and storm drain flows from San Diego Bay and Mission Bay. The watershed of San Diego Bay covers about 450 mi^2 (1,165 km^2) and includes Otay and Sweetwater Rivers as well as Telegraph Canyon, Chollas, Switzer, and Paradise Creeks (City of San Diego 2008). Mission Bay and the San Diego River also have an extensive watershed (440 mi^2 (1,140 km^2)) and contribute large flows to the ocean. Figure 3 (from Ocean Imaging 2012) shows an example of the extensive turbidity plumes originating from Mission Bay, San Diego Bay, and other coastal sources following a major rainfall event.

Figure 3. Turbidity Plumes after Major Rainfall.

San Diego Bay is on the California state's list of impaired water bodies, with sediments having high concentrations of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (SWRCB 2010), Environmental Protection Agency (EPA) 2010). Some areas of the bay are listed as impaired as a result of elevated coliform (fecal indicator bacteria) levels. A rough estimate of San Diego Bay's daily water exchange is 24,000 mgd, approximately 130 times the volume of flow from the Point Loma Ocean Outfall (Bartlett et al. 2004).

Portions of Mission Bay have been identified by the State Water Resources Control Board as water-quality limited because of elevated concentrations of coliforms (SWRCB 2010). Other parts of the bay are also impaired as a result of elevated concentrations of heavy metals. A rough estimate of the Mission Bay water exchange rate (not including San Diego River output) is 3,600 mgd, or roughly 20 times the volume of flow from the Point Loma Ocean Outfall (Bartlett et al. 2004).

Six beaches in San Diego County have been listed as bacteria-impaired water bodies (CMLPA (California Marine Life Protection Act) 2009, SDRWQCB 2010, EPA 2010) - all are located downstream of major watersheds (SDRWQCB 2013). Ocean Beach is the closest of these beaches to the Point Loma Ocean Outfall, at a distance of seven miles away. San Diego River flows, dogs on the beach, and re-growth of indicator bacteria in wave-stranded kelp appear to be responsible for the prevailing impairment.

Fecal material from dogs and birds has also been associated with bacterial exceedances that may impact nearshore water quality (Wright et al. 2009, Griffith et al. 2010, 2013, Araújo et al. 2014).

Further south, the Tijuana River and Estuary have historically been a source of significant contamination of the ocean in the San Diego area. The watershed that flows into them is about 1,731 mi^2 (4,483 km^2) in area; nearly three quarters of this watershed is in Mexico. The City of Tijuana has had limited sewage treatment facilities, with resulting overflows that have drained into the River and Estuary. The Tijuana River and Estuary have elevated water and sediment levels of metals such as lead, zinc, copper, chromium (Pb, Zn, Cu, and Cr), and PCBs (Bartlett et al. 2004). These concentrations increased significantly in the 1990s, coinciding with the introduction and expansion of the maquiladora (industrialization) program in Mexico.

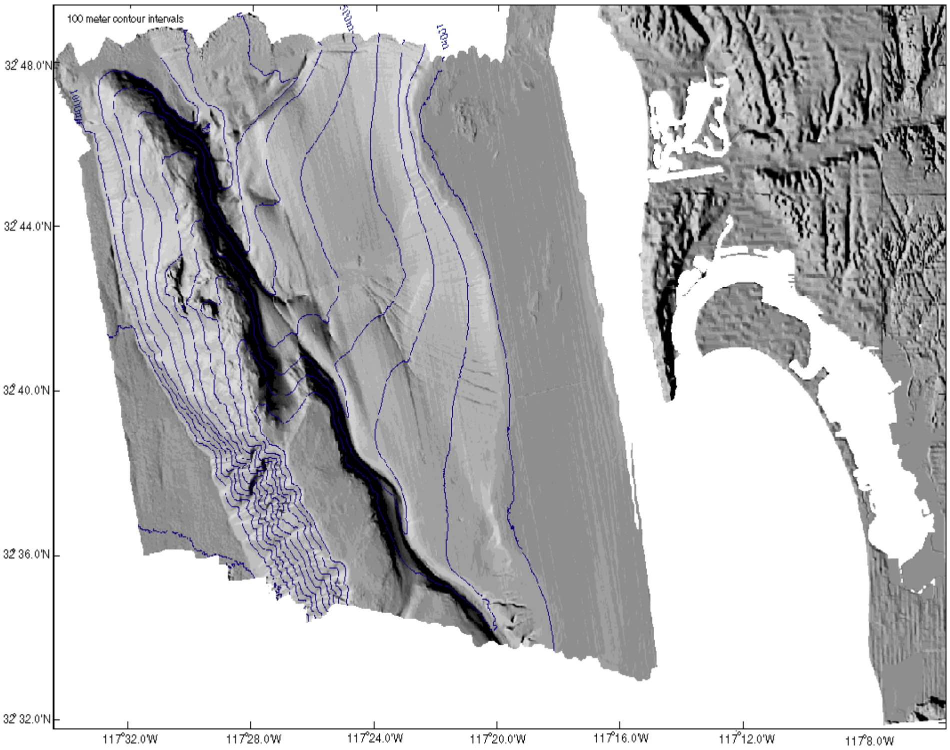
Offshore, the EPA-designated LA-5 dredge disposal site is located 3.7 mi (6 km) south southwest of the Point Loma Ocean Outfall. The LA-5 site ranges in depth from 328-410 ft (100-125 m) and was designed as a "non-dispersive" disposal site. Waste material is intended to remain stationary by virtue of being deep enough to limit resuspension by wave motion. The source of the material dumped at LA-5 is primarily sediments dredged from San Diego Bay. Because the material at LA-5 is from San Diego Bay, which has contaminated sediments, it is likely that sediments at the dredge disposal site are also contaminated (Parnell et al. 2008). The results of a multibeam sonar survey indicate that waste material is not all located within the designated disposal area (Bartlett et al. 2004). A total of 252 mounds were observed outside the disposal site, many of which were elliptical, indicating that material was dumped while vessels were underway. Dredged material dumped inshore of the disposal site may not remain stationary. The LA-5 site is just offshore of a 165 ft (50 m) scarp, therefore, mounds dumped inshore of the site are much shallower than intended. Resuspension from the shallower mounds constitutes another source of contamination that could influence water quality and biological conditions in the vicinity of Point Loma. These unsanctioned dumps could elevate sample contamination in the area that is unrelated to the Point Loma Ocean Outfall discharge.

Oceanographic Conditions

Bathymetry

Point Loma's shoreline is primarily rocky reef with an occasional cobble or sand pocket beach. The principal feature of the nearshore marine environment is a large, six mile-long (10 km) kelp bed extending from the tip of Point Loma to the Mission Bay/San Diego River Jetty (Figure 2). The kelp bed grows on a pavement-like mudstone/sandstone terrace from depths of about 25 ft (7.6 m) to about 90 ft (27 m) between 1/2 mi (0.8 km) from shore and 1 mi (1.6 km) from shore. The terrace is incised by shallow surge channels and covered in parts by cobbles and boulders. The terrace edge, the remnant of a now submerged seacliff, lies in 100 ft (30 m) depths. Here the bottom relief increases and pinnacles and large boulders rise above the fine gray bottom sands (California Department of Fish and Game (CDFG) 1968). In Figure 4 below, the demarcation between the white nearer shore areas and the darker gray offshore waters corresponds roughly to this break (off Point Loma only). This also corresponds with the outer limit of the kelp bed, or about 90 ft (27 m) depth.

Figure 4. Seafloor Bathymetry off San Diego, California.



Map from: USGS 1998. Note: Each minute of latitude on the vertical axis represents 1 nautical mile.

Beyond the outer edge of the kelp bed, about 1 nautical mile (nm) from shore, the seafloor gradually slopes downward (at an angle of about 1.5 %) out to a shelf break at 350 ft, just outside of the 100 m contour line. Beyond the 100 m contour, the seafloor declines at an angle of 4% across the shelf break, then continues its gradual slope for another five miles out to a depth of 1,000 ft (305 m). This shelf area consists largely of unconsolidated bottom sediments.

Thermocline

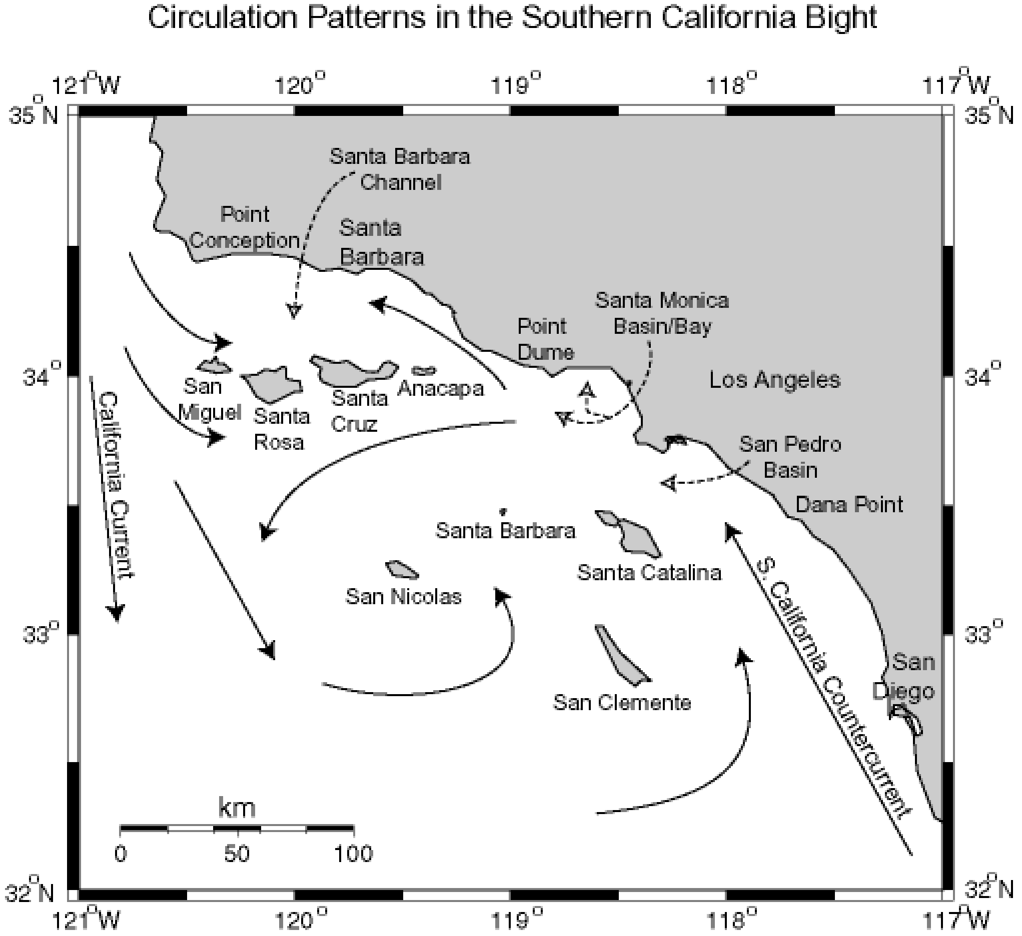
In the ocean, the thermocline, a vertical transition zone of rapidly changing temperature divides the upper layer of warmer water from the colder, deeper water (Noble 2009, California State University Long Beach (CSULB) 2014). Because density is controlled largely by temperature, the thermocline coincides with the pycnocline, a vertical zone of rapidly changing density. The density gradient across the pycnocline causes resistance to vertical mixing, restricting exchange between the surface waters and the deeper, colder waters. This phenomenon is referred to as water column stratification.

Seasonality is responsible for the main stratification patterns observed in the coastal waters off San Diego and the rest of southern California (Rogowski et al. 2012, 2013). Relatively warm waters and a more stratified water column are typically present during the dry season from May to September while cooler waters and weaker stratification characterize ocean conditions during the wet season from October to April. Winter storms bring higher winds, rain, and waves that result in a well-mixed, non-stratified water column (Hickey 1993). Surface waters begin to warm by late spring and are then subjected to increased surface evaporation. Once the water column becomes stratified, minimal mixing conditions typically remain throughout the summer and into early fall. Toward the end of the year, surface water cooling along with increased storm frequency returns the water column to well-mixed conditions. Interannual variations in the depth of the thermocline appear to be correlated with long-term climatic changes, El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and North Pacific Gyre Oscillation (NPGO) (Benjamin and Carton 1999, Schwing et al. 2002, Bjorkstedt et al. 2013, Miller et al. 2013).

Water Circulation

The cold California Current is the major surface current in the Southern California Bight (Figure 5). This broad, slowly meandering, south-moving current extends from Vancouver, Canada to the southern tip of Baja California, Mexico from shore to several hundred miles offshore (Perry et al. 2007, Noble 2009). In deep waters offshore of the continental shelf, flows are southward all year round; however, over the continental shelf, southward flows occur only in spring, summer, and fall. During winter months, flow over the shelf reverses, and water moves northward as the Southern California Countercurrent. The transitions between northward and southward flows on the shelf occur seasonally, in March/April and October/November, thus are termed the "spring transition and fall transition”.

Figure 5. Circulation Patterns in the Southern California Bight.



(After Hickey, B. M., 1992, Progress in Oceanography, V30: 37-115)

Below the thermocline, the California Undercurrent flows northward with speeds ranging from 3 to 25 centimeters per second (cm/sec); the maximum water velocity occurs at a depth of 60 m (NRC 1990). This northward flow opposes the California Current at the surface and spans the entire mid-latitude eastern boundary of the North Pacific (Pierce et al. 2000). The California Undercurrent is typically found inshore of the California Current and is composed of water originating in the Equatorial Pacific (Noble 2009). The flow of the California Undercurrent is relatively weak; its maximum strength occurs during the summer months and a secondary maximum occurs in the winter (Hickey 1993, Perry et al. 2007). This water mass can be delineated from deep water contained farther offshore in the California Current because the water of the California Undercurrent contains higher nutrient concentrations and lower dissolved oxygen concentrations.

Deepwater circulation can be divided into three seasonal patterns (CSULB 2013). From December to February, flow is strengthened and partially displaces the California Current to the west. From March to June, along-shore winds strengthen and drive the surface waters to create upwelling of deep cold water to the surface along the coast. The shift offshore creates a condition in which the California Current intensifies in localized areas due to bottom topography and current strength. July to November the California Current dominates, weakening the California Undercurrent (Perry et al. 2007). In general, the water contained in the California Undercurrent does not reach the surface. However, during periods of weak California Current flow (winter months or during an El Niño event), the California Undercurrent may reach the surface offshore of Los Angeles, join the California Countercurrent and flow as far north as Vancouver Island, Canada.

Upwelling

Upwelling is a wind driven, dynamic process that brings nutrient-rich deep water to the surface and nutrient-poor surface waters offshore through the interaction of currents, density, or bathymetry (Noble 2009). In wind driven upwelling, warmer surface waters are transported perpendicular to the direction of the wind. Deep, cold water moves vertically into the euphotic zone to replace the nutrient-poor surface water that was transported offshore.

Winds that promote upwelling are generally strong along the California coastline; upwelling in this region occurs throughout the year with the strongest upwelling in the spring and summer months (Schwing et al. 2000, Perry et al. 2007). In the Southern California Bight, upwelling tends to be limited to late winter and early spring due to a reduction in wind stress. Coastal upwelling appears to be the dominant process affecting the physical and ecological structure of eastern boundary current systems, including the California Current System. Coastal upwelling substantially affects regional and local oceanic circulation, thermohaline structure and stability, and water mass exchange between the coastal and deep ocean waters. Intense upwelling has been correlated to recruitment success for commercially important fish stocks in coastal California waters.

Biological Conditions

Marine life can be conveniently grouped into categories that reflect their spatial position in the ocean. Pelagic species occupy the water column. Epibenthic species live above the bottom, and benthic species live on the bottom or in the sediments. A general description of the food chain follows, beginning with the smallest organisms and ending with the largest.

Plankton

Plankton float or drift passively with currents and form the base of the oceanic food web. Plankton include a wide variety of bacteria (bacterioplankton), plant-like organisms and algae (phytoplankton), and animals (zooplankton) including fish larvae (ichthyoplankton). Although most planktonic species are microscopic, the term plankton is not synonymous with small size; some jellyfish can be as large as 10 ft (3 m) in diameter. Phytoplankton aggregate near the surface. They are grazed on by zooplankton, ichthyoplankton, and small fishes which in turn are consumed by larger fishes, birds, mammals, and man.

Phytoplankton

Marine phytoplankton are microscopic, single celled plants that use sunlight and chlorophyll to photosynthesize organic matter. Phytoplankton in the ocean's surface layers produce most of the organic matter in the sea and are crucial to overall ocean productivity. The distribution of most marine organisms is linked to phytoplankton productivity.

In general, phytoplankton are patchily distributed, occurring in regions with optimal conditions for growth. Nearshore ocean waters typically have a higher nutrient content and foster greater primary productivity and plankton biomass than open ocean waters.

In the Southern California Bight, waters from both the north and the south mix and promote increased phytoplankton abundance and diversity (Hardy 1993, Schiff et al. 2000, Kim et al. 2009). Over 280 species of phytoplankton have been reported there (Eppley 1986). The diversity of phytoplankton species in the region reflects the transition from subarctic waters in the north to more subtropical waters in the south. Highest levels of productivity occur in the spring/summer months with the lowest levels of production occurring during the winter months.

Along the California coast, there is a decrease in phytoplankton production in the surface waters during El Niño conditions due in part to a decrease of upwelling strength (Kahru and Mitchell 2000, Hernández de la Torre et al. 2004). This causes the chlorophyll maximum to occur deeper in the water column (McGowan 1984, Bjorkstedt et al. 2013, Chenillat et al. 2013). In addition, El Niño conditions weaken the California Current and tend to favor an increase in subtropical species (Leet et al. 2001). Following an El Niño, coastal phytoplankton abundance increases to long-term average levels (Lavaniegos et al. 2003, Hernández de la Torre et al. 2004). Conversely, La Niña conditions cause a shift towards more subarctic phytoplankton species (Goes et al. 2001).

Marine phytoplankton populations can undergo periods of explosive growth in response to favorable environmental conditions. These events are called algal blooms. Like other coastal regions, southern California can experience rapid population growths of phytoplankton. Some species of phytoplankton can produce potentially harmful toxins that can affect wildlife including birds, fish, shellfish, and mammals (Scholin et al. 2000, Gulland et al. 2002, Kudela et al. 2003, Brodie et al. 2006, Kim et al. 2009, Carter et al. 2013, Schnetzer et al. 2013).

The first recognized toxic algal bloom occurred in Monterey Bay in 1991 resulting in the deaths of pelicans and cormorants that had consumed sardines containing high levels of domoic acid from the phytoplankton species *Pseudo-nitzschia* (SCCWRP 2013). Domoic acid is a water-soluble neurotoxin that accumulates in filter-feeding organisms including shellfish and planktivorous fish such as anchovy and sardine. Humans consuming domoic acid-contaminated seafood experience Amnesic Shellfish Poisoning whose symptoms can include vomiting, confusion, memory loss, coma and even death. Although fatal Amnesic Shellfish Poisoning cases in humans are rare, domoic acid poisoning has caused large-scale mortality in marine animal populations including sea lions and seabirds, and domoic acid-related shellfish closures along U. S. coasts have caused significant economic loss (National Oceanic and Atmospheric Administration (NOAA) 2014a).

In 1998, a *Pseudo-nitzschia* bloom in Monterey was followed by over 400 sea lion carcasses appearing on shore exhibiting signs of neurological damage from eating infected sardines. A harmful red tide event in 2007 caused by *Cochlodinium* killed abalone at the Monterey Abalone Company, costing almost $60,000 in damage (CDFW 2013a). Algal blooms may also be detrimental because the size of the bloom along with other environmental conditions may lead to depletion of oxygen levels in the water.

When algal blooms are harmful to humans or biological resources they are called Harmful Algal Blooms (HABs). These harmful algae are generally present year round in the water column in very small amounts, but only become a problem for humans and animals when the phytoplankton populations reach particularly high levels. Algal blooms and HABs are often visible due to pigments produced by the phytoplankton and may also be referred to as “red tides”.

Blooms of harmful algal species can pose serious public health threats and have substantial economic impact. Harmful Algal Blooms occurring in U.S. marine waters are estimated to have an average annual cost of $82 million due to impacts on public health, tourism, and the seafood industry (NOAA 2014a).

Algal blooms occur in coastal waters in response to a variety of environmental conditions, including; temperature, nutrients, light intensity, and currents. Algal blooms appear to be increasing in frequency and intensity in the Southern California Bight. The Southern California Bight receives large amounts of natural nutrients via upwelling, but is also subject to anthropogenic input from atmospheric deposition, urban runoff, and wastewater effluents. Research using satellite imagery from 1997-2007 found that blooms occur consistently in the spring and early summer during upwelling periods (Howard et al. 2012). However, some specific areas in the Southern California Bight had chronic blooms including the Santa Barbara Channel, the San Pedro Shelf, Santa Monica Bay, South San Diego, and the Ensenada, Mexico coast. These chronic algal blooms were in coastal waters with longer residence times and were co-located with major rivers and wastewater outfalls (Howard et al. 2012, Seubert et al. 2013). Studies are currently underway investigating the degree to which anthropogenic nutrients contribute to algal blooms in the Southern California Bight.

Zooplankton

Zooplankton do not photosynthesize, but instead, rely upon phytoplankton as a source of food. They are taxonomically and structurally diverse, ranging in size from microscopic unicellular organisms to large multicellular organisms. Zooplankton may be herbivorous (consuming plants), carnivorous (consuming animals), detrivorous (consuming dead organic material), or omnivorous (consuming a mixed diet). Examples of zooplankton include foraminifera, pteropods, copepods, and myctophid fish.

Along the California coast the abundance of zooplankton is correlated with the strength of the California Current such that high levels of flow result in high zooplankton biomass (Dawson and Pieper 1993). Zooplankton biomass tends to reach its maximum in the summer months, coinciding with peak krill (*Euphausia*) biomass. The high abundance of euphasiids attracts whales to congregate and feed off the California and Mexico coastlines (Burtenshaw et al. 2004).

In the Southern California Bight, El Niño and La Niña conditions affect the distribution of zooplankton (Suntsov et al. 2012). During strong El Niño events, macrozooplankton biomass declines substantially (Roemmich and McGowan 1995, McGowan et al. 1998). During the 1998 El Niño event, the macrozooplankton biomass was lower than ever documented in the 1951 to 1998 record (Hayward 2000). Southern, warm-water species become more abundant during El Niño events and northern, cool-water species decline.

During La Niña conditions, macrozooplankton biomass is anomalously high and subarctic species are more abundant (Schwing et al. 2000). Increased upwelling during a La Niña event can negatively impact the recruitment of benthic nearshore organisms (urchins, barnacles, and crabs); these organisms are dependent on relaxed upwelling conditions to transport planktonic larvae onshore for settlement (Schwing et al. 2000).

Nekton

Nekton are organisms that swim freely, are generally independent of currents, and, range in size from microscopic to gigantic, such as whales. Nekton include invertebrates (e.g., squid) and vertebrates (marine mammals, sea turtles and fish). Nekton are discussed in the following sections on essential fish habitrat, commercial and recreational fisheries, and endangered species.

Marine Habitats and Ecology

The Southern California Bight is influenced by two major oceanic currents: the southward-flowing, cold-water California Current and the northward-flowing, warm-water California Countercurrent (Perry et al. 2007, CSULB 2013). These currents mix in the Southern California Bight and strongly influence patterns of ocean water circulation, sea temperatures, and distributional trends of marine flora and fauna along the southern California coast and Channel Islands (Dailey et al. 1993, Schiff et al. 2000, Horn and Allen 1978, Leet et al. 2001, Horn et al. 2006, Miller and Schiff 2012, Ranasinghe et al. 2012, Setty et al. 2012, Koslow et al. 2013).

High species richness is a product of the region's complex oceanographic topography and the convergence of multiple, influential water masses (Noble 2009). These include (1) large scale climate processes such as the ENSO, PDO, and NPGO that can affect long-term trends (Bjorkstedt et al. 2013, NOAA 2013), (2) the California Current System coupled with local gyres that transport distinct water masses into and out of the Southern California Bight throughout the year, and (3) seasonal changes in local weather patterns. Relatively warm waters and a more stratified water column are typically present during the dry season from May to September while cooler waters and weaker stratification characterize ocean conditions during the wet season from October to April. Winter storms bring higher winds, rain, and waves creating a well-mixed, non-stratified water column. Surface waters begin to warm by late spring and are then subjected to increased surface evaporation. Once the water column becomes stratified, minimal mixing conditions typically remain throughout the summer and into early fall. Toward the end of the year, surface water cooling along with increased storm frequency returns the water column to well-mixed conditions.

The Southern California Bight is home to more than 5,000 species of marine invertebrates, over 480 species of marine fish, five species of sea turtles, 39 species of marine mammals, and 195 species of coastal and offshore birds (Dailey et al. 1993, Schiff et al. 2000, Leet et al. 2001, Allen et al. 2005, 2006, 2011, Allen and Cross 2006, CMLPA 2009, Ranasinghe et al. 2012, Setty et al. 2012, SCCWRP 2012, 2014). The diversity of marine life is greatest in southern California and declines to the north through the region (Horn and Allen 1978, Horn et al. 2006). The Point Loma area is located within a transitional zone between subarctic and subtropical water masses. Point Conception, California (34.5º North (N)) is the distinguished biogeographical boundary between subtropical species (i.e., species with preferences of temperatures above 50-68º Fahrenheit (F) (10º to 20º Centigrade (C)) of the San Diego Province and temperate species (i.e., species with temperature preferences below 59º F (15º C)) of the Oregon Province (Horn et al. 2006, Suntsov 2012).

The California Current system is rich in microscopic organisms (i.e., diatoms, tintinnids, and dinoflagellates) which form the base of the food chain in the area (Hardy 1993). Small coastal pelagic fish and squid depend on this planktonic food supply and in turn are fed upon by larger species. Groundfish (e.g., flatfish, roundfish, skates/sharks/chimeras, rockfish, etc.) are important recreational and commercial species (Love 2006). The shelf and slope demersal rockfish are the most specious genus of fish off the western coast of North America (Love et al. 2002). These fish are typically the dominant species in many ichthyological surveys, in terms of abundance and diversity, especially between the 20 to 200 m isobaths. Highly migratory species (e.g., tuna, billfish, sharks, dolphinfish, and swordfish) and coastal pelagic species (e.g., anchovies, mackerels, sardines, and squids) support extensive fisheries in the area (Hackett et al. 2009).

The diverse habitats of the Southern California Bight greatly influence the distribution of marine fauna and flora in the area (Horn et al. 2006, Miller and Schiff 2012, McClatchie 2014). Cross and Allen (1993) defined fish habitats in three broad categories: the pelagic zone, soft substrate habitats (i.e., bays, estuaries, open coast), and hard substrate and kelp bed habitats (i.e., rocky habitats, reefs). The pelagic zone, relating to open water, is the largest habitat in the area with 40% of the fish species inhabiting this area. This zone is subdivided into three distinct regions: epipelagic (up to 50 m deep), mesopelagic (50 to 500 m deep), and bathypelagic regions (greater than 500 m deep). The epipelagic region is inhabited by small, planktivorous schooling fish (e.g., northern anchovy), predatory schooling fish (e.g., Pacific mackerel), and large solitary predators (e.g., blue shark). Abundance of all epipelagic species changes seasonally with fish moving offshore to spawn. The mesopelagic region is characterized by steep environmental gradients and fish that are small, slow growing, long-lived, and reproduce early and repeatedly (e.g., bigeye lightfish). The bathypelagic zone is a rather uniform region containing large, sluggish, fast growing, short-lived fish, that reproduce late and typically only once (e.g., bigscale and hatchetfish) (Cross and Allen 1993, Love et al. 2009).

Typical fish utilizing soft substrates (sand, silt, and mud) include sharks, skates, rays, smelts, flatfish (flounders), gobies and northern anchovies. Regions with hard substrates and kelp beds (*Macrocystis*) are not as abundant as other benthic habitats in the Southern California Bight, but provide productive habitats for many species.

Shallow reefs (i.e., <30 m depth) are the most common type of hard substrate (i.e., coarse sand, calcareous organic debris, rocks) found in the area. These reefs also support kelp beds, which serve as nursery areas for various fish species. Rocky intertidal regions are often turbulent, dynamic environments, where organisms must cope with stresses associated with tides (e.g., changes in temperature, salinity, oxygen, and pH) and wave impact. Deep reef fish, found along deep banks and seamounts, are typically large, mobile species (e.g., rockfish and spiny dogfish).

Kelp beds promote a high diversity of associated marine organisms (Foster and Schiel 1985, Reed et al. 2011, Foster et al. 2013). Smaller fish feed on high plankton densities in the area, while larger fish congregate to feed on smaller species. Kelp beds are especially important habitats for young-of-the-year rockfish species, such as the kelp rockfish, whose densities positively correlate to the size of the kelp bed.

Inshore areas (bays and estuaries) provide nursery habitats and feeding grounds to a variety of species, some of commercial importance (e.g., California halibut) (Allen et al. 2006). San Diego Bay's seagrass beds are used by schooling species, such as anchovies and topsmelt (Allen et al. 2002) with the highest abundance and biomass of fish occurring in the spring (i.e., April) and summer (i.e., July). Juvenile northern anchovy, topsmelt, and slough anchovy comprise up to 79% of the fish in the Bay.

The influence of the California Current on the physical and biological environment of the Southern California Bight fluctuates significantly on a year-to-year basis (Noble 2009, Bjorkstedt et al. 2013, Koslow et al. 2013, Miller and McGowan 2013). It is also affected by larger-scale climate variations, such as ENSO, PDO, and NPGO (Dayton and Tegner 1984, 1990, Tegner and Dayton 1987, 1991, Dayton et al. 1992, Hickey 1993, Tegner et al. 1996, 1997, Horn and Stephens 2006, Parnell et al. 2010, Miller and Schiff 2012, Miller et al. 2013, NOAA 2013). The El Niño-La Niña n Oscillation is the result of interannual changes in sea level pressures between the eastern and western hemispheres of the tropical Pacific; these events can initiate large shifts in the global climate, atmospheric circulation, and oceanographic processes (Doney et al. 2012, Chenillat et al. 2013, NMFS 2013a, NOAA 2013, Sydeman et al. 2013).

El Niño conditions typically last 6 to 18 months although they can persist for longer periods of time. Under normal conditions, rainfall is low in the eastern Pacific and is high over the warm waters of the western Pacific. El Niño conditions occur when unusually high atmospheric pressure develops over the western tropical Pacific and Indian Oceans and low sea level pressure develops in the southeastern Pacific. During El Niño conditions, the trade winds weaken in the central and west Pacific; thus, the normal east to west surface water transport and upwelling along South America decreases. This results in increased (sometimes extreme) rainfall across the southern U.S. and Peru and drought conditions in the western Pacific (Field et al. 2003). La Niña is the opposite phase of El Niño in the Southern Oscillation cycle. La Niña is characterized by strong trade winds that push the warm surface waters back across to the western Pacific increasing upwelling along the eastern Pacific coastline, causing unusually cold sea surface temperatures.

The Pacific Decadal Oscillation (PDO) is a longer-term climatic pattern than El Niño with similar warm and cool phases that may persist for 20 to 30 years (Miller 1996, Benjamin and Carton 1999). PDO warm regimes increases water temperature, giving temporary advantage to warm-water species, allowing them to become more abundant and widespread (CMLPA 2009). PDO cold regimes have the opposite effect, causing cold-water species to grow more abundant and widespread, while warm-water species become less so.

During years experiencing an El Niño event, tropical species (i.e., species with temperature preferences above 68º F (20º C)) begin to migrate into the project area, while temperate species, which normally inhabit the area, move north and out of the region (Allen et al. 2005). For example, two tropical species, the Mexican barracuda and scalloped hammerhead shark, were recorded off southern California for the first time during the 1997/1998 El Niño event. Rockfish are particularly sensitive to El Niño, with these events resulting in recruitment failure and adults exhibiting reduced growth. Ultimately, a decline in biomass results and a poor overall condition in the region becomes evident, such as landings of market squid being dramatically decreased during the 1997/1998 El Niño event (Hayward 2000).

During El Niño years, San Diego Bay often becomes a refuge for subtropical/tropical species that have a normal distribution further south than the study area (Allen et al. 2002). For example, from April 1997 through July 1998, three new fish (bonefish, yellowfin goby, and longtail goby) and three new invertebrate species (arched swimming crab, Mexican brown shrimp, and a bivalve species (*Petricola hertzana*)) were recorded in the southern California estuaries of the San Diego coastal region (i.e., Tijuana Estuary and Los Peñasquitos Lagoon), while northern anchovy, the dominant species in San Diego Bay, was virtually absent during the El Niño event. Southern species moving into these areas are typically incapable of reproducing or establishing permanent populations due to the short-term nature of these events.

Past La Niña events have not had such a dramatic impact on ichthyofauna and marine invertebrate populations as El Niño events. Nevertheless, La Niña years can result in below normal recruitment for many invertebrate species (e.g., rock crabs), and larval rockfish abundance has been reportedly low during years experiencing La Niña events (Lundquist et al. 2000). Cooling trend years have increased abundance and commercial landings of herring, anchovies, and squid populations (Hayward 2000; Lluch-Belda et al. 2003, Zeidberg et al. 2006).

COMMERCIAL AND RECREATIONAL FISHERIES

Introduction

The marine environment in the vicinity of Point Loma supports a wide variety of commercial and recreational fisheries. This section begins with a discussion of Essential Fish Habitat, followed by a description of commercial and recreational fishing in the Point Loma area with fisheries catch tallied for the period 2009-2013.

This assessment uses the term “fish” to include both cartilaginous species - sharks, skates, and rays - and bony species. Cartilaginous fish, as the name implies, have a skeleton of cartilage, which is partially calcified, but is not true bone. Bony fish also have cartilage, but their skeletons consist of calcified bone. Fish are generally categorized as pelagic (living in the water column), benthic (living on or near the ocean bottom), or demersal (associated with the ocean bottom, but also feeding in the water column).

Essential Fish Habitat

The Sustainable Fisheries Act of 1996 provided a new habitat conservation tool: the Essential Fish Habitat (EFH) mandate (NOAA 2014b). Regional Fishery Management Councils (FMCs) are required to identify EFH for federally managed species (i.e., species covered under Fishery Management Plans (FMPs)). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 United States Code [U.S.C.] 1802[10]). The term "fish" is defined as "finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds". The U.S. National Marine Fisheries Service (NMFS) in 2002 further clarified EFH with the following definitions (50 Code of Federal Regulations (CFR) 600.05–600.930): "Waters" include all aquatic areas and their associated biological, chemical, and physical properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "Necessary" means the habitat required to support a sustainable fishery and the 'Managed Species' contribution to a healthy ecosystem; and "Spawning, breeding, feeding, or growth to maturity" covers a species' "full life cycle" (NMFS 2002a).

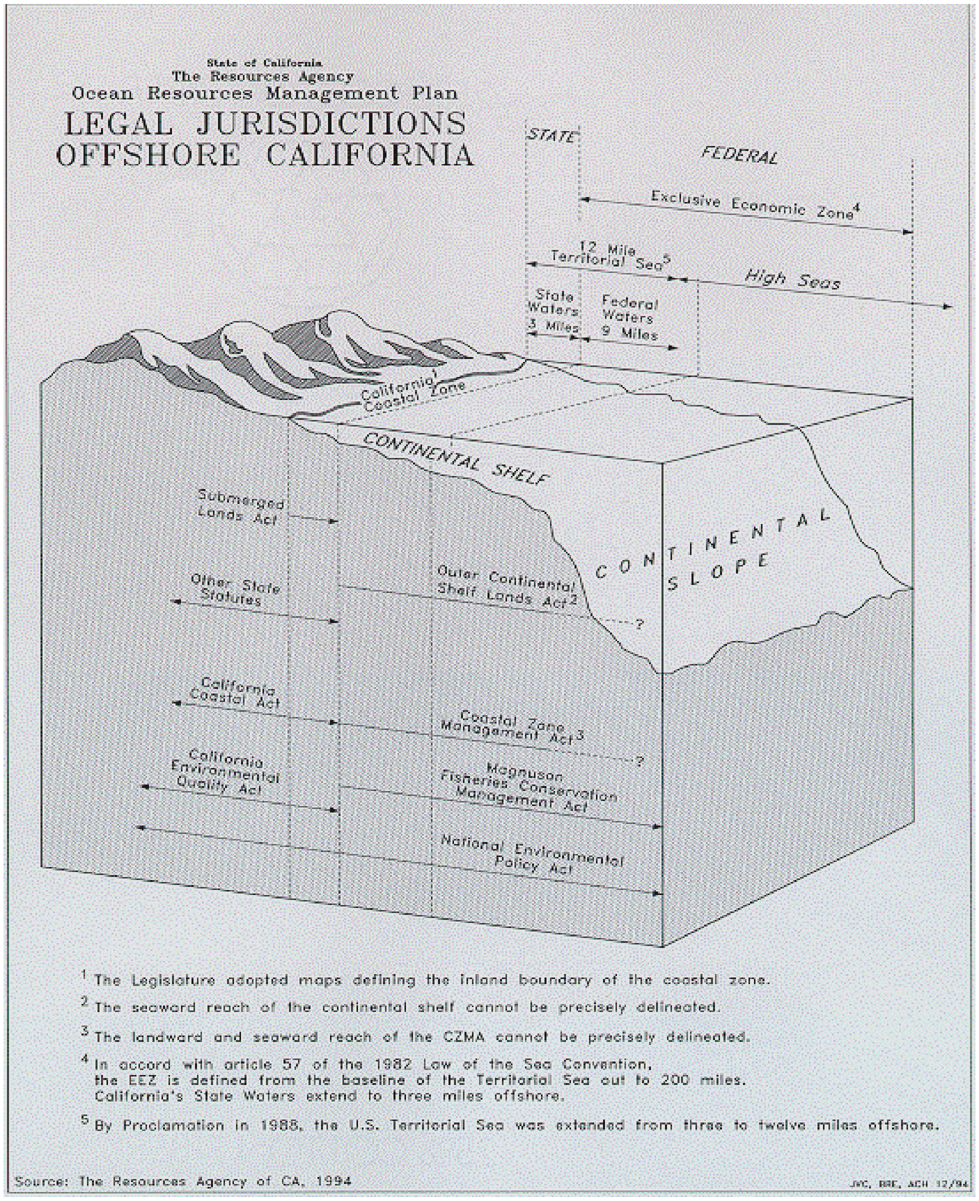
The Sustainable Fisheries Act requires that EFH be identified and mapped for each federally managed species. The NMFS and regional FMCs determine the species' distributions by life stage and characterize associated habitats, including Habitat Areas of Particular Concern (HAPC). HAPC are discrete areas within EFH that either play especially important ecological roles in the life cycles of managed species or are especially vulnerable to degradation from human-induced activities (50 CFR 600.815[a][8]). The Sustainable Fisheries Act requires federal agencies to consult with the NMFS on activities that may adversely affect EFH. For actions that affect a threatened or endangered species, or its critical habitat, and its EFH, federal agencies must integrate Endangered Species Act (ESA) and EFH consultations.

An Essential Fish Habitat Assessment (EFHA) is a critical review of a proposed project and its' potential impacts to EFH. As set forth in the rules (50 CFR 600.920[e][3]), EFHAs must include (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species and associated species; (3) the effects of the action on EFH; and (4) proposed mitigation, if applicable. Once the NMFS learns of a federal or state activity that may have adverse effects on designated EFH, the NMFS is required to develop EFH consultation recommendations for the activity. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH (NOAA 2007).

Regulatory Background

Commercial fisheries are protected and managed by the Magnuson-Stevens Fishery Conservation and Management Act (NOAA 2007), by State and Inter-State Fisheries Management Plans (e.g., Pacific Fisheries Management Council (PFMC) 2014a), and by the California Department of Fish and Wildlife (CDFW) 2014a), prior to 2103 called the California Department of Fish and Game (CDFG). The Magnuson-Stevens Fishery Conservation and Management Act of 1976 established jurisdiction over marine fishery resources in the 200-nm (370-km) U. S. Exclusive Economic Zone (Figure 6). The Magnuson-Stevens Fishery Conservation and Management Act was reauthorized and amended by the Sustainable Fisheries Act of 1996 (NOAA 2014b). The Sustainable Fisheries Act requires that regional Fishery Management Councils (FMCs) develop and implement Fishery Management Plans (FMPs) to protect managed species included in the plans. FMPs are developed to achieve the goal of no net loss of the productive capacity of habitats that sustain commercial, recreational, and native fisheries. Magnuson-Stevens Fishery Conservation and Management Act was reauthorized in 2006 (NOAA 2007) and is periodically updated and amended (U. S. House of Representatives (USHR) 2013).

Figure 6. Legal Jurisdictions Offshore California.



[1] The Legislature adopted maps defining the inland boundary of the coastal zone.

[2] The seaward reach of the continental shelf cannot be precisely delineated.

[3] The landward and seaward reach of the CZMA cannot be precisely delineated.

[4] In accord with article 57 of the 1982 Law of the Sea Convention, the EEZ is defined from the baseline of the Territorial Sea out to 200 miles. California's State Waters extend to three miles offshore.

[5] By Proclamation in 1988, the U.S. Territorial Sea was extended from three to twelve miles offshore.

Source: The Resources Agency of CA, 1994

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Fishery Management Plans

The U. S. Exclusive Economic Zone extends from the outer boundary of state waters (3 nm (5.6 km) from shore) to a distance of 200 nm (370 km) from shore. Offshore fisheries in the Southern California Bight are managed by the National Marine Fisheries Service (NMFS) (NOAA 2014c) with assistance from the Pacific Fisheries Management Council (PFMC) (PFMC 2014a), and the Southwest Fisheries Science Center (NOAA 2014d). Inshore fisheries (less than 3 nm (5.6 km)) from shore are managed by the California Department of Fish and Wildlife (CDFW 2014a). In practice, state and federal fisheries agencies manage fisheries cooperatively with FMPs generally covering the area from coastal estuaries out to 200 nm (370 km) offshore.

Fishery Management Plans are extensive documents that are constantly revised and updated. The Pacific Coast Groundfish Fishery Management Plan, for example, originally produced in 1977, has been amended 23 times (PFMC 2014b). FMPs describe the nature, status, and history of the fishery, and, specify management recommendations, yields, quotas, regulations, and harvest guidelines. Associated Environmental Impact Statements (EISs) address the biological and socioeconomic consequences of management policies. Fishery Management Councils have web sites that present the various elements of their FMPs, current standards and regulations, committee hearings and decisions, research reports, source documents, and links to related sites (e.g., PFMC 2014a). Coverage of the ecology of marine fish, fisheries, and environmental issues in California is presented in reviews by Horn and Allen 1978, Allen et al. 2006, Horn and Stephens 2006, Horn et al. 2006, Love 2006, 2011, Butler et al. 2012, Miller and Schiff 2012, Suntsov et al. 2012, Koslow et al. 2013, Miller and McGowan 2013, and NAVFAC 2013.

Fisheries Management Plans with managed species that could occur in the vicinity of Point Loma are the Pacific Groundfish FMP (NMFS 2013b, PFMC 2011a), the Coastal Pelagic Species (CPS) FMP (PFMC 2011b), and the U. S. West Coast Fisheries for Highly Migratory Species (HMS) (PFMC 2011c) (Table 2).

Table 2. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Groundfish Management Plan Species

http://www.pcouncil.org/groundfish/fishery-management-plan/

COMMON NAME	SCIENTIFIC NAME
Sharks	
Big skate	*Raja binoculata*
California skate	*Raja inornata*
Leopard shark	*Triakis semifasciata*
Longnose skate	*Raja rhina*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling (Pacific flatnose)	*Antimora microlepis*
Grenadiers	
Pacific rattail (Pacific grenadier)	*Coryphaenoides acrolepis*
Roundfish	

Table 2. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Lingcod	*Ophiodon elongatus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*
Harlequin rockfish	*S. variegatus*
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*

Table 2. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
	S. serriceps
Treefish	
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberrimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

Table 2. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Coastal Pelagic Management Plan Species	
http://www.pcouncil.org/coastal-pelagic-species/fishery-management-plan-and-amendments/	
Jack mackerel	*Traxchurus symmetricus*
Krill	*euphausiids*
Pacific mackerel	*Scomber japonicus*
Pacific sardine	*Sardinops sagax*
Market squid	*Loligo opalescens*
Northern anchovy	*Engraulis mordax*
Highly Migratory Management Plan Species	
http://www.pcouncil.org/highly-migratory-species/fishery-management-plan-and-amendments/	
Sharks	
Bigeye thresher shark	*Alopias superciliosus*
Blue shark	*Prionace glauca*
Common thresher shark	*Alopias vulpinus*
Pelagic thresher shark	*Alopias pelagicus*
Shortfin mako shark	*Isurus oxyrinchus*
Tunas	
Albacore tuna	*Thunnus alalunga*
Bigeye tuna	*Thunnus obesus*
Northern bluefin tuna	*Thunnus orientalis*
Skipjack tuna	*Katsuwonus pelamis*
Yellowfin tuna	*Thunnus albacares*
Billfish	
Striped marlin	*Tetrapturus audax*
Broadbill swordfish	
Swordfish	*Xiphias gladius*
Dolphin-fish	
Dorado (mahi mahi)	*Coryphaena hippurus*

The Pacific coast groundfish fishery is the largest, most important fishery managed by the Pacific Fishery Management Council in terms of landings and value (PFMC 2014b). Groundfish managed species are found throughout the Southern California Bight. More than 90 species of bottom-dwelling marine finfish are included in the federally-managed groundfish fishery. Groundfish species include all rockfishes in the Scorpaenidae family, flatfishes such as Dover sole (*Microstomus pacificus*) and petrale sole (*Eopsetta jordani*), roundfishes such as sablefish (*Anoplopoma fimbria*) and lingcod (*Ophiodon elongatus*), and various sharks and skates. The species managed under the Pacific Groundfish Management Plan are usually found on or near the bottom; rockfish - including widow, yellowtail, canary, shortbelly, and vermilion rockfish; bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch; roundfish - lingcod, cabezon, kelp greenling, Pacific cod, Pacific whiting (hake), and sablefish; flatfish - including various soles, starry flounder, and sanddab; sharks and skates - leopard shark, soupfin shark, spiny dogfish, big skate, California skate, and longnose skate; and three other species: ratfish, finescale codling, and Pacific rattail grenadier (Table 2) (PFMC 2011a).

The groundfish species managed by the Pacific Groundfish FMP range throughout the Exclusive Economic Zone and occupy diverse habitats at all stages in their life histories. Some species are broadly dispersed during specific life stages, especially those with pelagic eggs and larvae. The distribution of other species and/or life stages may be relatively limited, as with adults of many nearshore rockfish that show strong affinities to a particular location or substrate type.

Rockfish are found from the intertidal zone out to the deepest waters of the Exclusive Economic Zone (Love et al. 2002, 2009, Butler et al. 2012,). For management purposes, these species are often placed in three groups defined by depth range and distance offshore: nearshore rockfish, shelf rockfish, and slope rockfish (Table 3, from CDFG 2007).

Table 3. Rockfish Distribution in the Southern California Bight.

Shallow Nearshore Rockfish	
Black and yellow (*Sebastes chrysomelas*)	grass (*S. rastrelliger*)
China (*S. nebulosus*)	kelp (*S. atrovirens*)
gopher (*S. carnatus*)	
Deeper Nearshore Rockfish	
black (*Sebastes melanops*)	copper (*S. caurinus*)
blue (*S. mystinus*)	olive (*S. serranoides*)
brown (*S. auriculatus*)	quillback (*S. maliger*)
calico (*S. dalli*)	treefish (*S. serriceps*)

Table 3. Rockfish Distribution in the Southern California Bight.

Shelf Rockfish

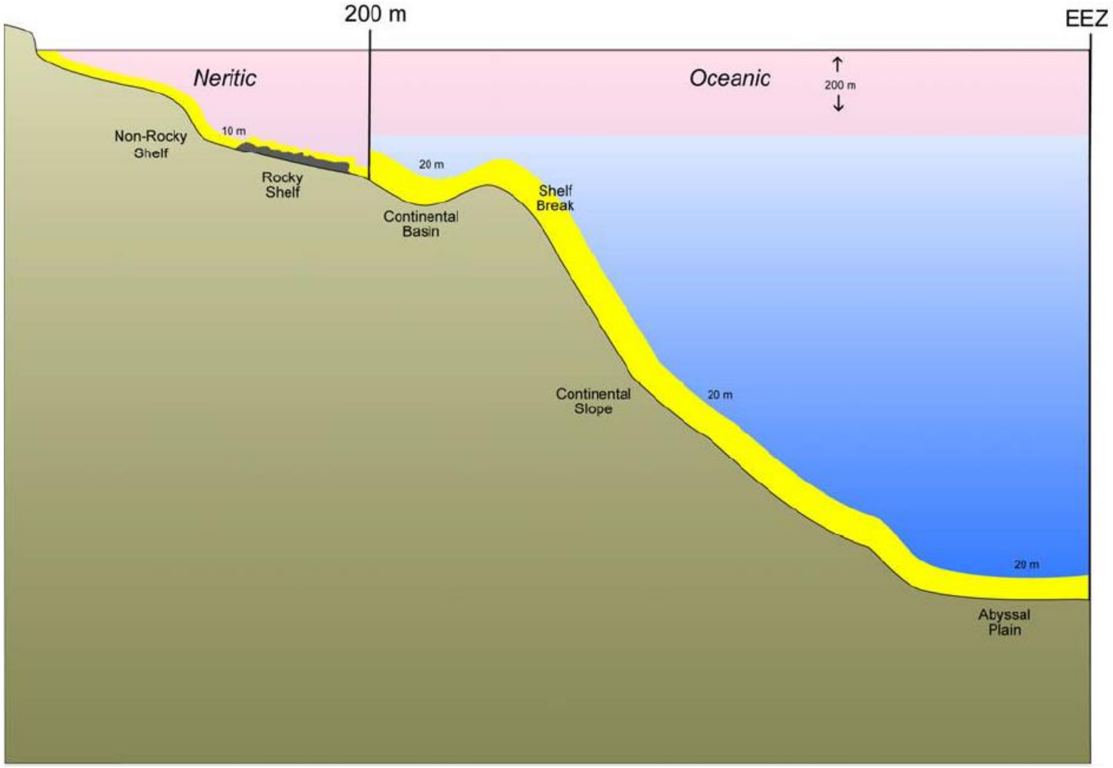
bocaccio (*Sebastes paucispinis*)
bronzespotted (*S. gilli*)
canary (*S. pinniger*)
chameleon (*S. phillipsi*)
chilipepper (*S. goodei*)
cowcod (*S. levis*)
dwarf-red (*S. rufinanus*)
flag (*S. rubrivinctus*)
freckled (*S. lentiginosus*)
greenblotched (*S. rosenblatti*)
greenspotted (*S. chlorostictus*)
greenstriped (*S. elongatus*)
halfbanded (*S. semicinctus*)
honeycomb (*S. umbrosus*)
Mexican (*S. macdonaldi*)
pink (*S. eos*)
pinkrose (*S. simulator*)
pygmy (*S. wilsoni*)
redstriped (*S. proriger*)
rosethorn (*S. helvomaculatus*)
rosy (*S. rosaceus*)
silvergrey (*S. brevispinis*)
speckled (*S. ovalis*)
squarespot (*S. hopkinsi*)
starry (*S. constellatus*)
stripetail (*S. saxicola*)
swordspine (*S. ensifer*)
tiger (*S. nigrocinctus*)
vermilion (*S. miniatus*)
widow (*S. entolemas*)
yelloweye (*S. ruberrimus*)
yellowtail (*S. flavidus*)

Slope Rockfish

aurora (*Sebastes aurora*)
bank (*S. rufus*)
blackgill (*S. melanostomus*)
darkblotched (*S. crameri*)
Pacific ocean perch (*S. alutus*)
redbanded (*S. babcocki*)
rougheye (*S. aleutianus*)
sharpchin (*S. zacentrus*)
shortraker (*S. borealis*)
splitnose (*S. diploproa*)
yellowmouth (*S. reedi*)

The nearshore rockfish spend most of their lives in relatively shallow water. This group is often subdivided into a shallow component and a deeper component. Shelf rockfish are found along the continental shelf (Figure 7, from USDO 2013). Slope rockfish occur in the deeper waters of the shelf and down the continental slope. The roundfish, flatfish, sharks, and skates covered under the Groundfish FMP are generally concentrated in shallow water while the ratfish, finescale codling, and Pacific rattail are deepsea fish (Eschmeyer et al. 1985, Leet et. al. 2001, Butler et al. 2012, CDFW 2013a).

Figure 7. Pacific Coast Groundfish Ranges.



The Pacific halibut (*Hippoglossus stenolepis*), a flat groundfish, is regulated by the United States and Canada through a bilateral commission, the International Pacific Halibut Commission (IPHC) (IPHC 2014) and is therefore not in a federal FMP. The normal range of Pacific halibut is from Santa Barbara, California to Nome, Alaska. It would not usually be found in the Point Loma area.

A variety of different fishing gear is used to target groundfish including troll, longline, hook and line, pots, gillnets, and other types of gear (bottom trawls were banned in March 2006 out to a depth of 3,500 m) (Table 4 (from NMFS 2005b)). The West Coast groundfish fishery has four access components: limited entry - which limits the number of vessels allowed to participate; open access - which allocates a portion of the harvest to fishers without limited entry permits; recreational; and tribal - fishers who have federally recognized treaty rights (PFMC 2011a).

Table 4. Gear Types Used in the West Coast Groundfish Fishery.

	Trawl and Other Net	Longline, Pot, Hook and Line	Other
Limited Entry Fishery (commercial)	Mid-water Trawl, Whiting trawl, Scottish Seine	Pot, Longline	
Open Access Fishery Directed Fishery (commercial)	Set Gillnet Sculpin Trawl	Pot, Longline, Vertical hook/line, Rod/Reel, Troll/dinglebar, Jig, Drifted (fly gear), Stick	
Open Access Fishery Incidental Fishery (commercial)	Exempted Trawl (pink shrimp, spot and ridgeback prawn, CA halibut, sea cucumber), Setnet, Driftnet, Purse Seine (Round Haul Net)	Pot (Dungeness crab, CA sheephead, spot prawn) Longline, Rod/Reel Troll	Dive (spear) Dive (with hook and line) Poke Pole
Tribal	as above	as above	as above
Recreational	Dip Net, Throw net (within 3 miles)	Hook and Line methods Pots (within 3 miles) from shore, private boat, commercial passenger vessel	Dive (spear)

Managed jointly by the Pacific Fishery Management Council (PFMC) and the National Marine Fisheries Service (NMFS) under the Coastal Pelagic Species Fisheries Management Plan (CPS FMP), Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), and northern anchovy (*Engraulis mordax*) are included in complex known as the Coastal Pelagic Species (CPS). The Coastal Pelagics FMP also includes two invertebrates, market squid and krill (PFMC 2014c). The CPS inhabit the pelagic realm, i.e., live in the water column, not near the sea floor. They are usually found from the surface to 3,281 ft (1,000 m) deep.

Northern anchovy (*Engraulis mordax*) are small, short-lived fish that typically school near the surface (PFMC 2014c). They occur from British Columbia to Baja California. Northern anchovies are divided into northern, central, and southern sub-populations. The central sub-population has been the focus of large commercial fisheries in the U.S. and Mexico. Most of this sub-population is located in the Southern California Bight between Point Conception, California and Point Descanso, Mexico. Northern anchovy are an important part of the food chain for other species, including other fish, birds, and marine mammals.

Pacific sardine (*Sardinops sagax*), also a small schooling fish, have been the most abundant fish species managed under the Pacific Groundfish FMP. They range from the tip of Baja California to southeastern Alaska. Sardines live up to 13 years, but are usually captured by their 5th year.

Pacific (chub) mackerel (*Scomber japonicus*) are found from southeastern Alaska to Mexico, and are most abundant south of Point Conception, California within 20 mi (32 km) from shore. The "northeastern Pacific" stock of Pacific mackerel is harvested by fishers in the U. S. and Mexico. Like sardines and anchovies, mackerel are schooling fish, often co-occurring with other pelagic species like jack mackerel and sardines. As with other CPS, they are preyed upon by a variety of fish, mammals, and sea birds.

Jack mackerel (*Trachurus symmetricus*) grow to about 2 ft and can live up to 35 years. They are found throughout the northeastern Pacific, often well outside the Exclusive Economic Zone. Small jack mackerel are most abundant in the Southern California Bight, near the mainland coast, around islands, and over shallow rocky banks. Older, larger fish range from Cabo San Lucas, Baja California, to the Gulf of Alaska, offshore into deep water and along the coast to the north of Point Conception. Jack mackerel in southern California usually school over rocky banks, artificial reefs, and shallow rocky reefs.

Market squid (*Loligo opalescens)* range from the southern tip of Baja California to southeastern Alaska (Leet et al. 2001). They are most abundant between Punta Eugenio, Baja California, and Monterey Bay, California. Usually found near the surface, market squid can occur to depths of 2,625 ft (800 m) or more. Squid live less than a year and prefer full-salinity ocean waters. They are important forage foods for fish, birds and marine mammals.

In 2006, the PFMC included krill in the CPS and adopted a complete ban on commercial fishing for all species of krill in West Coast federal waters (PFMC 2006). Krill are small shrimp-like crustaceans that are an important basis of the marine food chain. They are eaten by many managed species, as well as by whales and seabirds.

Coastal pelagic species are harvested directly and incidentally (as bycatch) in other fisheries. Usually targeted with "round-haul" gear including purse seines, drum seines, lampara nets, and dip nets, they are also taken as bycatch in midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs. Market squid are fished nocturnally using bright lights to attract the squid to the surface. They are pumped directly from the sea into the hold of the boat, or taken with an encircling net (PFMC 2005). Market squid are harvested for human consumption and as bait in recreational fisheries.

Most of the CPS commercial fleet is located in California, mainly in Los Angeles, Santa Barbara-Ventura, and Monterey. About 75 percent of the market squid and Pacific sardine catch are exported, mainly to China, Australia (where they are used to feed farmed tuna), and Japan (where they are used as bait for longline fisheries).

The U.S. West Coast Fisheries for HMS covers 13 free-ranging species; 5 tuna - Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin; 5 sharks - common thresher, pelagic thresher, bigeye thresher, shortfin mako, and blue shark; 2 billfish - striped marlin and Pacific swordfish; and dorado (also known as dolphinfish or mahi-mahi) (Table 2) (PFMC 2011c). HMS have a wide geographic distribution, both inside and outside the Exclusive Economic Zone. They are open-ocean, pelagic species, that may spend part of their life cycle in nearshore waters. HMS are harvested by U. S. commercial fishers and by foreign fishing fleets, with only a fraction of the total harvest taken within U.S. waters (PFMC 2014d).

The Fishery Management Plan for Highly Migratory Species (HMS) includes tunas, billfish and pelagic sharks as managed species. The albacore surface hook-and-line fishery is by far the most economically important commercial HMS fishery, followed by the drift gillnet fishery for swordfish and thresher shark (NMFS 2014). HMS are also an important component of the catch for the Pacific Regions recreational commercial passenger fishing vessel fleet, and the private recreational boat fleet.

Under the HMS FMP, the PFMC monitors other species for informational purposes. In addition, some species-including great white sharks, megamouth sharks, basking sharks, Pacific halibut, and Pacific salmon - are designated as prohibited catch. If fishers targeting highly migratory species catch these species, they are required to immediately release them.

The federal Shark Conservation Act of 2010 was signed into law January 4, 2011, specifying that no shark is to be landed without fins being naturally attached (CalCOFI 2013). In addition, the State of California passed AB 376 - a bill banning the possession and sale of shark fins, beginning January 1, 2012. While shark fisheries in California are still legal, and those possessing the proper license or permit are allowed to retain shark fins under California law, sales and distribution are prohibited. Restaurants and retailers were allowed to sell stock on hand as of the implementation until July 1, 2013. There is also an exception for taxidermy.

The HMS fishery, with the exception of the swordfish drift gillnet fishery off California, is one of the only remaining open access fisheries on the West Coast. However, the PFMC is currently considering a limited entry program to control excess capacity. The use of entangling nets (set and drift gill nets, and trammel nets) in California state waters (<3 nm (5.6 km) from shore) was banned in 1994 by Proposition 132, the Marine Resources Protection Act of 1990 (FGC §8610 et seq.).

Many different gear types are used to catch HMS in California (PFMC 2011c). These include; 1) trolling lines - fishing lines with jigs or live bait deployed from a moving boat, 2) drift gillnets - panels of netting weighted along the bottom and suspended vertically in the water by floats that are attached to a vessel drifting along with the current, 3) harpoon - a small and diminishing fishery mainly targeting swordfish, 4) pelagic longlines - baited hooks on short lines attached to a horizontal line (the HMS FMP now prohibits West Coast longliners from fishing in the Exclusive Economic Zone due to concerns about the take of endangered sea turtles), 5) coastal purse seines - encircling nets closed by synching line threaded through rings on the bottom of the net (usually targeting sardines, anchovies, and, mackerel but also target tuna where available), 6) large purse seines - used in major fisheries in the eastern tropical Pacific and the central and western Pacific (this fishery is monitored by the Inter-American Tropical Tuna Commission, and, in the Exclusive Economic Zone by NMFS); and, 7) recreational fisheries - HMS recreational fishers in California include private vessels and charter vessels using hook-and-line to target tunas, sharks, billfish, and dorado.

As mentioned previously, Pacific halibut (*Hippoglossus stenolepis*) is managed by the International Pacific Halibut Commission (IPHC 2014). This large species of halibut is mainly encountered well north of the Point Loma area, and, its harvest is prohibited in the area. A smaller relative, the California halibut (*Paralichthys californicus*), is found along the coast of southern California, but is not included in a FMP.

Although FMPs are mandated for federal waters, managed species also occur in state waters. These areas in California (i.e., inshore of 3 nm) are managed under the California Marine Life Management Act (CMLMA) (CDFW 2014b). California FMPs have been produced for nearshore finfish (CDFW 2014c), white seabass (CDFWd), market squid (CDFWe), and, a spiny lobster FMP is being developed (CDFWf).

The California Nearshore Fishery Management Plan (CNFMP) (CDFW 2014c) covers both commercial nearshore fisheries and recreational fishers. The five goals of the CNFMP are to 1) ensure long-term resource conservation and sustainability 2) employ science-based decision-making 3) increase constituent involvement in management 4) balance and enhance socio-economic benefits 5) identify implementation costs and sources of funding. Five management approaches form the basis for integrated management strategies to meet the goals and objectives of the CNFMP and CMLMA. They are: the Fishery Control Rule, Management Measures, Restricted Access, Regional Management, Marine Protected Areas (MPAs), and Allocation (Table 5, from CDFW 2014c).

Table 5. Key CNFMP Management Goals and Objectives.

NFMP Goal or Objective	Fishery Control Rule	Management Measures	Restricted Access	Regional Management	MPAs	Allocation
Conserve ecosystems	**Stock assessments completed**					
Allow only sustainable uses	**Setting TACs based on NFMP fishery control rule; inseason monitoring**	**Size limits on species that survive release; trip limits match capacity; limit gear**				
Adjust catch allowance to reflect uncertainty	**TACs based on stock assessments (black & gopher rockfish, cabezon, CA scorpionfish)**	**Trip limits**				
Match fish harvest capacity to sustainable catch levels			**RA program for NFP species; DNSFP program**			

Table 5. Key CNFMP Management Goals and Objectives.

NFMP Goal or Objective	Fishery Control Rule	Management Measures	Restricted Access	Regional Management	MPAs	Allocation
Allocate restrictions and benefits fairly and equitably		**FGC guidance to Council for regulation development**		**Regional discussions with constituents on proposed regulation changes**		**Revised as updated information is available**
Minimize/limit bycatch and mortality		**Match seasons and depths for cooccurring species**	**Bycatch permit with trip quota; bimonthly trip limits**			
Maintain, restore and preserve habitat			**Allowable gear limited to hook & line, traps and dip nets**	**Identify appropriate habitat for 19 species; NFMP MPA criteria in MLPA Master plan design criteria**		
Identify, assess, and enhance habitats					**Identify appropriate habitat for 19 species**	
Identify and minimize fishing that destroys habitat		**CA input into Council EFH designations**	**NFP program gear endorsements**			
Employ Science based Decision making	**OYs/TACs based on stock assessments**					
Conduct collaborative research	**CRANE**					
Collect data on spatial distribution of habitats and organisms	**CRANE EFI collection**			**Initial focus on southern California and south central regions**		**CRANE & Channel Islands MPA monitoring**

The CNFMP covers 19 species that frequent kelp beds and reefs generally less than 120 ft (36 m) deep off the coast of California and the near offshore islands (Table 6, from CDFW 2014c).

Table 6. Managed Species - California Nearshore Fisheries Management Plan.

Black rockfish - *Sebastes melanops*
Gopher rockfish - *Sebastes carnatus*
Black & yellow rockfish - *Sebastes chrysomelas*
Grass rockfish - *Sebastes rastrelliger*
Blue rockfish - *Sebastes mystinus*
Kelp greenling – *Hexagrammos decagrammus*
Brown rockfish - *Sebastes auriculatus*
Kelp rockfish – *Sebastes atrovirens*
Cabezon - *Scorpaenichthys marmoratus*
Monkeyface prickleback – *Cebidichthys violaceus*
Calico rockfish - *Sebastes dallii*
Olive rockfish - *Sebastes serranoides*
California scorpionfish - *Scorpena guttata*
Quillback rockfish - *Sebastes maliger*
California sheephead – *Semicossyphus pulcher*
Rock greenling - *Hexagrammos lagocephalus*
China rockfish - *Sebastes nebulosus*
Treefish - *Sebastes serriceps*
Copper rockfish - *Sebastes caurinus*

Thirteen of these species are rockfish - all of which are included in the federal Pacific Groundfish FMP. Three of the remaining six species are also covered under the Pacific Groundfish FMP. The three species not covered by the Pacific Groundfish FMP are the California sheephead (*Semicossyphus pulcher*), the rock greenling (*Hexagrammos lagocephalus*), and the monkeyface prickleback (*Cebidichthys violaceus*). These species are actively managed by the CDFW (CDFW 2014c) through catch limits, gear restrictions and monitoring.

The California sheephead is a large, colorful member of the wrasse family (Leet et al. 2001, CDFW 2013a). Male sheephead reach a length of 3 ft, a weight of 36 lbs, and have a white chin, black head, and, a pink to red body. Females are smaller, with a brown-colored body (Eschmeyer et al. 1985). Sheephead populations off southern California have declined because of fishing pressure. Large males are now rare because they are sought by recreational spear fishermen. Sheephead are taken commercially by traps and kept alive for display in restaurant aquaria where patrons select a specific fish for preparation. The rock greenling is a smaller member of the lingcod family. The monkeyface prickleback, also called the monkeyface eel, is more closely related to rockfish than eels. Its elongate shape is an adaptation to living in cracks, crevices, and under boulders.

White seabass (*Atractoscion nobilis*), large members of the croaker family, occur in ocean waters off the west coasts of California and Mexico. This highly-prized species is recovering from reduced population levels in the late 1900s. The current California management strategy of the White Seabass Fishery Management Plan (WSFMP) provides for moderate commercial harvests while protecting young white seabass and spawning adults through seasonal closures, gear provisions, and size and bag limits (CDFW 2014d). The WSFMP also has a recreational fishery component with size and bag limits, and season closures. There is an ongoing white seabass hatchery program at Carlsbad, California operated by the Hubbs-Sea World Research Institute. The hatchery provides juvenile white seabass to other field-rearing systems operated by volunteer fishermen throughout southern California.

Market squid (*Loligo opalescens*), discussed previously under the Coastal Pelagics FMP, is the state's largest fishery by tonnage and economic value (CDFW 2014g). Market squid are also important to the recreational fishery as bait and as forage for fish, marine mammals, birds, and other marine life. Squid belong to the class Cephalopoda of the phylum Mollusca. They have large eyes and strong parrot-like beaks. Using their fins for swimming and jets of water from their funnel they are capable of rapid propulsion forward or backward. The squid's capacity for sustained swimming allows it to migrate long distances.

The Abalone Recovery and Management Plan (CDFW 2014h) establishes a cohesive framework for the recovery of depleted abalone populations in southern California. All of California’s abalone species are included in the plan: red abalone, *Haliotis rufescens*; green abalone, *H. fulgens*; pink abalone, *H. corrugata*; white abalone, *H. sorenseni*; pinto abalone, *H. kamtschatkana* (including *H. assimilis*); black abalone, *H. cracherodii*; and flat abalone, *H. walallensis*. The recovery and management plan for these species implements measures to prevent further population declines throughout California, and to ensure that current and future populations will be sustainable.

The decline of abalone is due to a variety of factors, primarily commercial and recreational fishing, disease, and natural predation. The recovery of a near-extinct abalone predator, the sea otter, has further reduced the possibility for an abalone fishery in most of central California. Withering syndrome, a lethal bacterial infection, has caused widespread decline among black abalone in the Channel Islands and along the central California coast. As nearshore abalone populations became depleted, fishermen traveled to more distant locations, until stocks in most areas collapsed. Advances in diving technology also played a part in stock depletion. The advent of self-contained underwater breathing apparatus (SCUBA) in the mid-1900s gave birth to the recreational fishery in southern California, which placed even more pressure on a limited number of fishing areas.

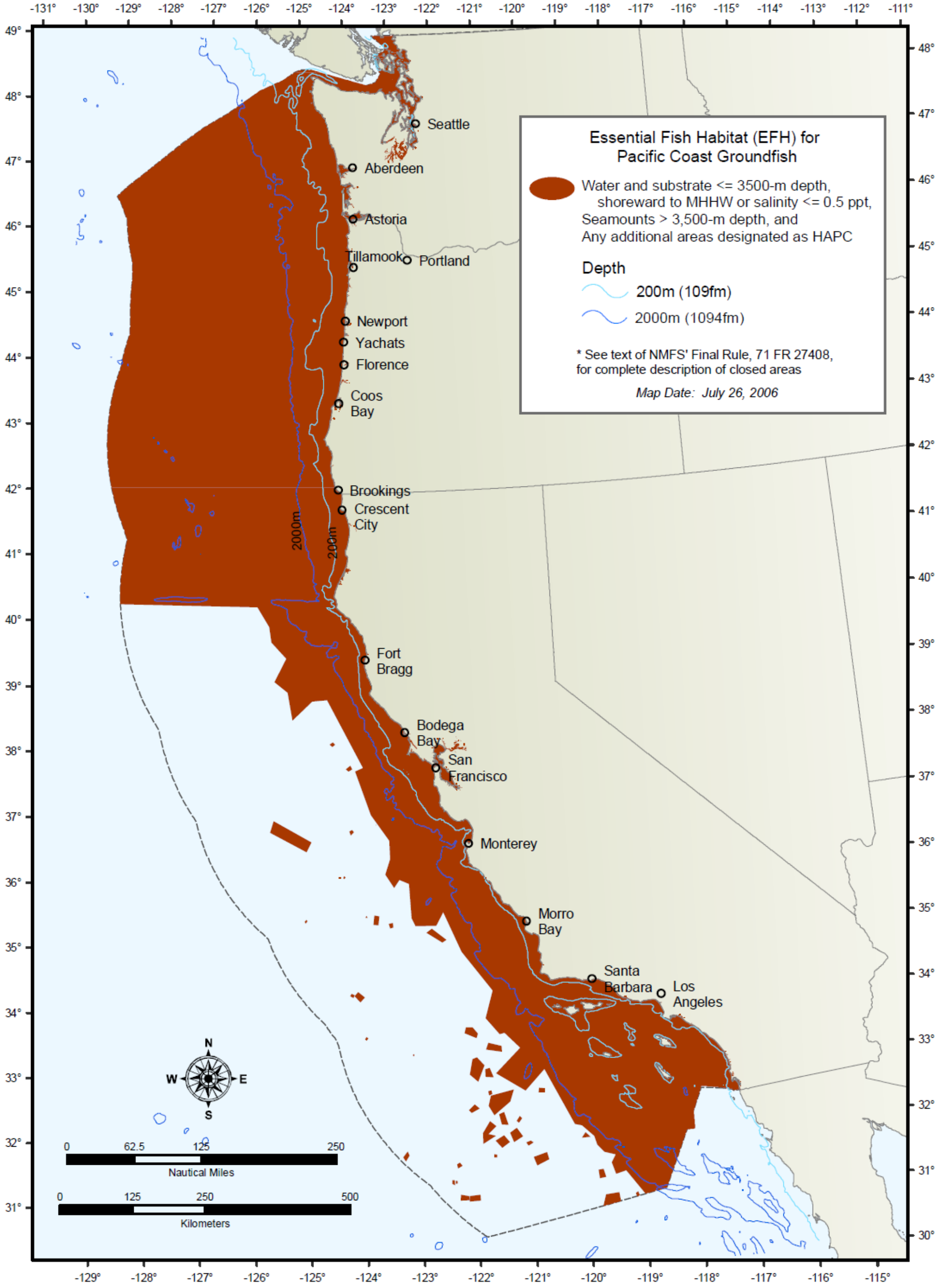
Following stock collapse, the California Fish and Game Commission closed the southern California pink, green, and white abalone fisheries in 1996 and all abalone fishing south of San Francisco in early 1997. The southern abalone fishery was closed indefinitely with the passage of the Thompson bill (AB 663) in 1997. This bill created a moratorium on taking, possessing, or landing abalone for commercial or recreational purposes in ocean waters south of San Francisco, including all offshore islands.

Designated Essential Fish Habitat

The National Marine Fisheries Service and the Pacific Fishery Management Council designate Essential Fish Habitat and develop Fishery Management Plans for all fisheries occurring within the Southern California Bight from Point Conception to the U.S./Mexico border. The Sustainable Fisheries Act contains provisions for identifying and protecting habitat essential to federally Managed Species (NOAA 2014e). The FMPs identify EFH, describe EFH impacts (fishing and non-fishing), and suggest measures to conserve and enhance EFH (NMFS 2010). The FMPs also designate Habitat Areas of Particular Concern (HAPC) where one or more of the following criteria are demonstrated: (a) important ecological function; (b) sensitivity to human-induced environmental degradation; (c) development activities stressing the habitat type; or (d) rarity of habitat.

Essential fish habitat for groundfish managed species includes all waters and substrate from the high tide line or the upriver extent of saltwater intrusion to: 1) depths of 11,483 ft (3,500 m), 2) seamounts in depths greater than 11,483 ft (3,500 m), and 3) areas designated as HAPC not already identified by the above criteria (PFMC 2011a, NMFS 2013b, Figure 8, from PFMC 2012). With respect to EFH, nearshore areas are considered to be shallower than 120 ft (36 m) with offshore areas beyond that depth. The continental shelf is considered to begin at the 656 ft (200 m) contour.

Figure 8. Groundfish Essential Fish Habitat.



The Pacific Groundfish FMP divides EFH into seven composite habitats including their waters, substrates, and biological communities: 1) estuaries - coastal bays and lagoons, 2) rocky shelf - on or within 33 ft (10 m) of rocky bottom (excluding canyons) from the high tide line to the continental shelf break, 3) nonrocky shelf - on or within 33 ft (10 m) of unconsolidated bottom (excluding the rocky shelf and canyons) from the high tide line to the continental shelf break, 4) <u>canyon</u> - submarine canyons, 5) <u>continental slope/basin</u> **-** on or within 66 ft (20 m) of the bottom of the continental slope and basin below the shelf break extending to the westward boundary of the Exclusive Economic Zone, 6) <u>neritic zone</u> **-** the water column more than 33 ft (10 m) (narrow yellow band above) above the continental shelf, and 7) <u>oceanic zone</u> - the water column more than 66 ft (20 m) (wide yellow band above) above the continental slope and abyssal plain, extending to the westward boundary of the Exclusive Economic Zone (Table 7, from PFMC 2011a and PFMC 2014b).

Table 7. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
<u>Flatfish</u>							
Curlfin Sole			A, SA	E		A, SA	E
Dover Sole			A, SA, J	L, E		A, SA, J	L, E
English Sole	A*, SA, J*, L*, E	A*, SA, J*	A*, SA, J*	L*, E		A*	
Petrale Sole			A, J	L, E		A, SA	L, E
Rex Sole	A		A, SA	E		A, SA	L, E
Rock Sole		A*, SA*, J*, E*	A*, SA*, J*, E*	L		A*, SA*, J*, E*	
Sand Sole			A, SA, J	L, E			
Pacific Sanddab	J, L, E		A*, SA, J	L, E			L, E
<u>Rockfish</u>							
Aurora Rockfish			A, MA, LJ			A, MA, LJ	L
Bank Rockfish		A, J	A, J		A, J	A, J	
Black Rockfish	A*, SJ*	LJ*	LJ*	A*, SJ*			A*
Black-and-yellow Rockfish		A*, MA, LJ*, SJ*,		L*			

Table 7. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
		P					
Blackgill Rockfish		LJ		SJ, L		A, LJ	S, LJ
Blue Rockfish		A*, MA, LJ*	LJ*	SJ*,L			
Bocaccio	SJ*, L	A*, LJ*	A*, LJ*	SJ*, L	LJ*	A*, LJ*	
Bronzespotted Rockfish						A	
Brown Rockfish	A*, MA, J*, P	A*, MA, J*, P					
Calico Rockfish	A, J	A, J	A, J				
Canary Rockfish		A, P		SJ*, L		A, P	SJ*, L
Chilipepper		A, LJ, P	A, LJ, P	SJ*, L		A, LJ, P	
China Rockfish		A, J, P		L			
Copper Rockfish	A*, LJ*, SJ*, P	A*, LJ*		SJ*, P			
Cowcod		A, J	J	L			
Darkblotched Rockfish		A, MA, LJ, P	A, MA, LJ, P			A, MA, P	SJ, L
Flag Rockfish		A, P					
Gopher Rockfish		A*, MA, J*, P	A*, A, J*, P				
Grass Rockfish		A*, J*, P					
Greenblotched Rockfish		A, J, P	A, J, P		A, J, P	A, P	
Greenspotted Rockfish		A, J, P	A, J, P				

Table 7. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Greenstriped Rockfish		A, P	A, P				
Honeycomb Rockfish		A, J, P			J		
Kelp Rockfish	SJ*	A*, LJ*, P		SJ*			
Mexican Rockfish		A	A	L			L
Olive Rockfish		A*, J*, P			A*, P		
Pacific Ocean Perch		A, LJ	A, LJ	SJ	A	A, P	SJ, L
Pink Rockfish		A	A			A	
Redbanded Rockfish			A			A	
Redstripe Rockfish		A, P				A, P	
Rosethorn Rockfish		A, P	A, P			A, P	
Rosy Rockfish		A, J, P					
Rougheye Rockfish		A	A			A	
Sharpchin Rockfish		A, P	A, P			A, P	L
Shortbelly Rockfish		A*, P	A*, P		A*, P	A*, P	
Silverygray Rockfish		A*	A*			A*	
Speckled Rockfish		A, J, P			A, P	A, P	
Splitnose Rockfish			A, J*, P			A, P	
Squarespot Rockfish		A, P			A, P		
Starry Rockfish		A, P				A, P	
Stripetail Rockfish			A, P			A, P	
Tiger Rockfish		A				A	
Treefish		A					
Vermilion Rockfish		A, J*	J*		A	A	
Widow Rockfish		A, MA, LJ,P	A, MA, LJ, P	SJ*, L	A, MA, LJ, P	A, MA, P	SJ*, L
Yelloweye Rockfish		A, P				A, P	

Table 7. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Yellowtail Rockfish		A, MA, LJ, P	A, MA, LJ, P	SJ*		A, MA, P	SJ*
Scorpionfish							
California Scorpionfish	E	A, SA, J	A, SA, J	E			
Thornyhead							
Longspine Thornyhead						A, SA, J	L, E
Shortspine Thornyhead			A			A, SA	L, E
Roundfish							
Cabezon	A, SA, LJ, SJ*, L, E	A, SA, LJ, E		SJ*, L			SJ*, L
Kelp Greenling	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E		SJ*, L			SJ*, L
Lingcod	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E	A*, LJ*	SJ*, L		A*	
Pacific Cod	A, SA, J, L, E		A, SA, J, E	A, SA, J, L		A, SA, E	A, SA, J, L
Pacific Hake (Whiting)	A, SA, J, L, E			A, SA, J, L, E			A, SA, L, E
Pacific Flatnose					A	A	
Pacific Grenadier			A, SA, J			A, SA, J	L
Sablefish	SJ	A	A, LJ	SJ, L	A, LJ	A, SA	SJ, L,

Table 7. Groundfish Species Essential Fish Habitat.							
Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).							
Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
							E
<u>Skates/Sharks/ Chimeras</u>							
Big Skate			A, MA, J, E			A, MA	
California Skate	A, MA, J, E		A, MA, J, E			A, MA, J, E	
Longnose Skate			A, MA, J, E			A, MA, J, E	
Leopard Shark	A, MA, J, P	A, MA, J, P	A, MA, J, P	A, MA, J, P			
Soupfin Shark	A, MA, J, P	A, MA, J	A, MA, J, P	A, MA, J, P	A, MA, J		A, MA, J
Spiny Dogfish	A, LJ, SJ, P	A, MA, LJ	A, LJ, P	A, LJ, SJ	A	A, MA	A
Spotted Ratfish	A, MA, J	A, MA, J E	A, MA, J E			A, MA, J, E	

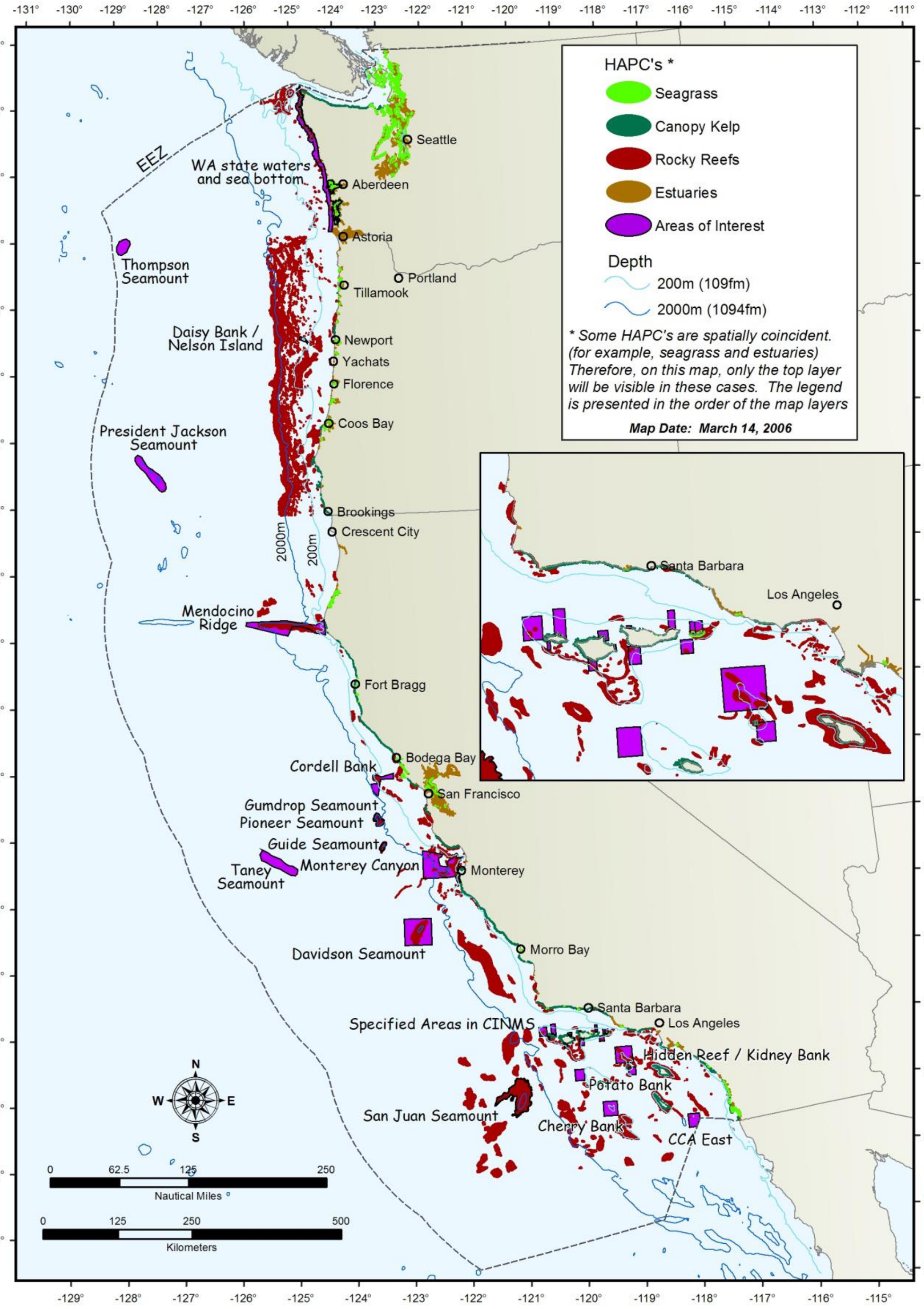
The Pacific Fisheries Management Council has identified six HAPC types. One of these types, certain oil rigs in Southern California waters, was disapproved by NMFS. The current five HAPC types are: estuaries, canopy kelp, seagrass, rocky reefs, and “areas of interest” (e.g., submarine features, such as banks, seamounts, and canyons) (Table 8, Figure 9, from PFMC 2014f).

Table 8. EFH and HAPC in the Southern California Bight.

Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) (PFMC 2014e,f).

	EFH	HAPC
Pacific Groundfish	Marine and estuarine waters less than or equal to 11,483 ft (3,500 m) to mean higher high water level or the upwater extent of seawater intrusion, seamounts in depths greater than 3,500 m, and areas designated as HAPC not identified by the above criteria.	Estuaries, canopy kelp, sea grass, rocky reefs, and other areas of interest.
Coastal Pelagic Species	All marine and estuarine waters above the thermocline from the shoreline offshore to 200 nm offshore.	No HAPC designated.
Highly Migratory Species	All marine waters from the shoreline offshore to 200 nm offshore.	No HAPC designated.
Pacific Coast Salmon	North of project area.	North of project area.

Figure 9. Groundfish Habitat Areas of Particular Concern.



EFH identified for managed Coastal Pelagic Species is wide-ranging. It includes the geographical range where they are currently found, have been found in the past, and may be in the future (PFMC 2011b). In the Southern California Bight, the CPS EFH constitutes all marine and estuarine waters above the thermocline from the shoreline offshore to the limits of the Exclusive Economic Zone with no HAPC designated (PFMC 2011b). The thermocline is an area in the water column where water temperature changes rapidly, usually from colder at the bottom to warmer on top. The CPS live near the surface primarily above the thermocline, and within a few hundred miles of the coast, so their designated EFH (Table 9) is less complex than for Groundfish Managed Species. The PFMC is presently considering identifying EFH and possibly Habitat Areas of Particular Concern (HAPC) for two individual krill species, *Euphausia pacifica* and *Thysanoessa spinifera*, and for other species of krill (PFMC 2008).

Table 9. Coastal Pelagic Species Essential Fish Habitat.

Coastal Pelagic Species and Lifestages Associated with EFH designations. A = Adults, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2014c).

Group/Species	Coastal epipelagic	Coastal mesopelagic	Coastal benthic
Krill	E, L, J, A		
Northern anchovy	E, L, J, A		
Mackerels	E, L, J, A		
Sardine	E, L, J, A		
Market Squid	L, J, A		E

Only market squid are significantly associated with benthic environments; the females lay their eggs in sheaths on sandy bottom in 33-165 ft (10-50 m) depths (PFMC 2011b). The CPS are found in shallow waters and within bays and even brackish waters, but are not considered dependent upon these habitats. They prefer temperatures in the 50-82.4 °F (10-28 °C) range with successful spawning and reproduction occurring from 57-61 °F (14-16 °C). Larger, older individuals are generally found farther offshore and farther north than younger, smaller individuals. All lifestages of CPS species are found in the Southern California Bight.

EFH for Highly Migratory Species (Table 10) such as tuna, sharks and billfish is even more extensive than for CPS (PFMC 2011c). HMS range widely in the ocean, in area and depth. They are usually not associated with the features typically considered fish habitat (estuaries, seagrass beds, rocky bottoms). Their habitat selection appears to be less related to physical features and more to temperature ranges, salinity levels, oxygen levels, and currents. For the U.S. West Coast Fisheries for Highly Migratory Species, EFH occurs throughout the Southern California Bight (PFMC 2011c). The PFMC has currently identified no HAPC for HMS.

Table 10. Highly Migratory Species Essential Fish Habitat.

Highly Migratory Species and Lifestages Associated with EFH Designations. A = Adults, SA = Sub-Adults, LJ = Late Juveniles, N= Neonate, EJ = Early Juveniles, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2014d**)**.

Group/Species	Coastal epi-pelagic	Coastal meso-pelagic	Oceanic epi-pelagic	Oceanic meso-pelagic
<u>Sharks</u>				
Blue Shark			N, EJ, LJ, SA, A	
Shortfin Mako			N, EJ, LJ, SJ, A	
Thresher Sharks	LJ, SA, A	LJ, SA, A	LJ, SA, A	LJ, SA, A
<u>Tunas</u>				
Albacore			J, A	
Bigeye Tuna			J, A	J, A
Northern Bluefin			J	
Skipjack			A	
Yellowfin			J	
<u>Billfish</u>				
Striped Marlin			A	
<u>Swordfish</u>				
Broadbill Swordfish			J, A	J, A
<u>Dolphinfish</u>				
Dorado			J, SA, A	

Rockfish Conservation Areas, closed to fishing, have been established to protect sensitive Pacific coast groundfish habitat (Figure 10, from PMFC 2011a). Bottom trawling was prohibited in March 2006 in these areas out to depths of 11,482 ft (3,500 m). In Cowcod Conservation Areas (Figure 11, from PMFC 2012), bottom trawling and other bottom fishing activities are prohibited in waters greater than 120 ft (36 m). Within these conservation areas, cowcod and other “overfished” federal groundfish species, are protected with very low incidental catch limits (CMLPA 2009). The conservation areas are expected to remain closed until “overfished” stocks are rebuilt or a new management approach is adopted.

Figure 10. Essential Fish Habitat Conservation Areas.

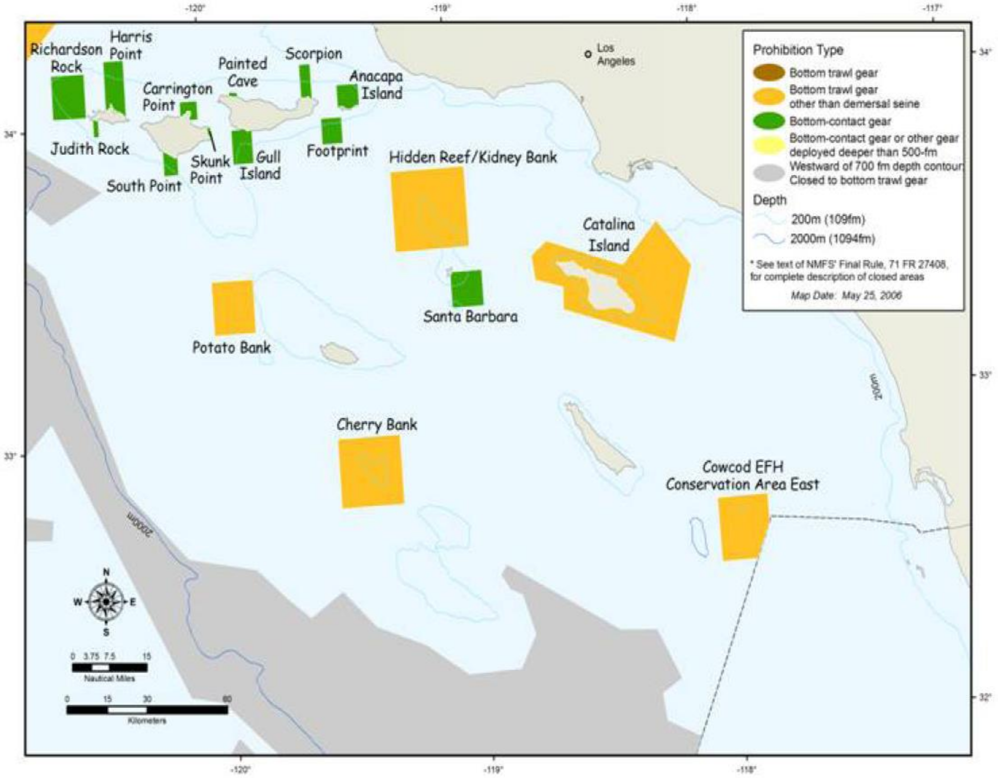
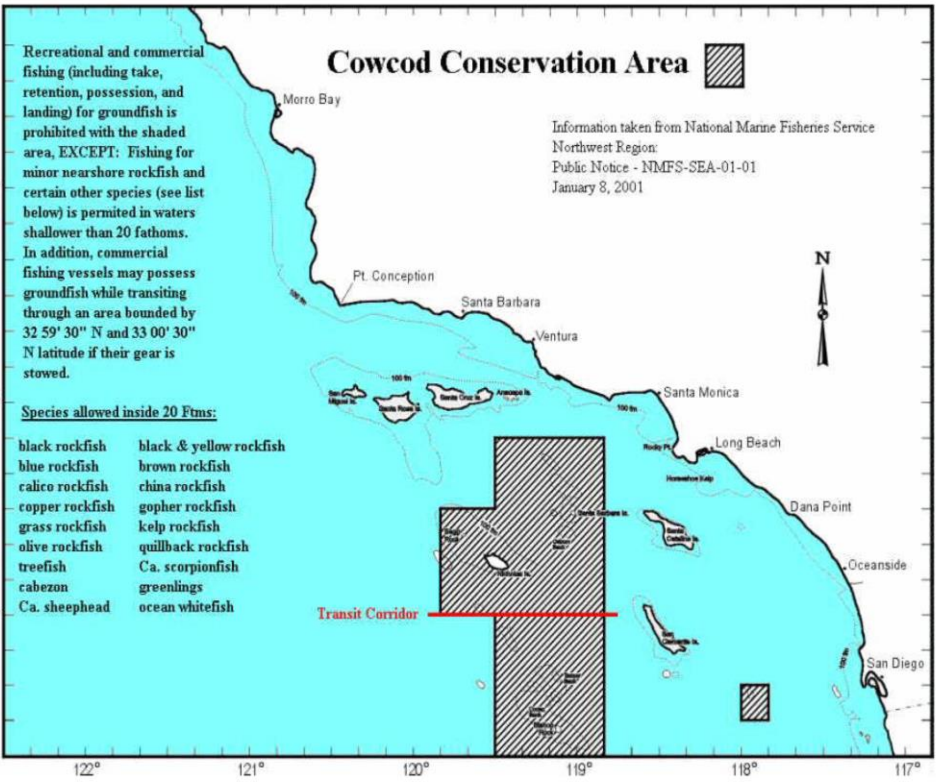


Figure 11. Cowcod Conservation Area.



Recreational and commercial fishing (including take, retention, possession, and landing) for groundfish is prohibited with the shaded area, EXCEPT: Fishing for minor nearshore rockfish and certain other species (see list below) is permited in waters shallower than 20 fathoms. In addition, commercial fishing vessels may possess groundfish while transiting through an area bounded by 32 59' 30" N and 33 00' 30" N latitude if their gear is stowed.

Species allowed inside 20 Ftms:

black rockfish
blue rockfish
calico rockfish
copper rockfish
grass rockfish
olive rockfish
treefish
cabezon
Ca. sheephead
black & yellow rockfish
brown rockfish
china rockfish
gopher rockfish
kelp rockfish
quillback rockfish
Ca. scorpionfish
greenlings
ocean whitefish

Information taken from National Marine Fisheries Service
Northwest Region:
Public Notice - NMFS-SEA-01-01
January 8, 2001

Essential Fish Habitat Impacts

EFH regulations require analysis of potential impacts that could have an adverse effect on EFH and managed species (NMFS 2002a,b). Adverse effect is defined as an impact that reduces the quality and/or quantity of essential fish habitat (NMFS 2004a,b). Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

The Point Loma ocean outfall could have physical impacts associated with the presence of the pipeline and diffusers on the ocean bottom, and chemical and biological impacts associated with the discharge of treated wastewater.

Physical Impacts

The Point Loma outfall pipeline is buried in a trench through the surf zone out to a distance of about 2,600 ft (792 m) offshore. Over the next 400 ft (123 m) it gradually emerges from the trench and beyond 3,000 ft (914 m) offshore it lies in a bed of ballast rock on the ocean floor. At its terminus, the pipeline connects to the diffuser section with two legs, each 2,500 ft (762 m) long. The outfall pipe and diffusers with their supporting bed of ballast rock form an artificial reef. The pipe and rock, covered with encrusting organisms (tube worms, anemones, barnacles), provide food and shelter to a variety of fish and invertebrates (Wolfson and Glinski 1986). This artificial habitat covers an area of about 22 acres (9 hectares) off Point Loma (assuming a 36-ft (11-m) width of pipe and ballast rock). Catches of rockfish could be enhanced over this area, but would probably be too small to be discernible in recreational or commercial landings.

The pipeline and diffusers represent a potential hazard to commercial fishermen using traps that can snag on the pipe and ballast rock. Lobster, crab, and fish traps are used throughout the area (Parnell et al. 2010). Since the location of the pipeline and diffusers is well-marked on navigation charts and commercial vessels are equipped with accurate positioning systems it is possible to place fishing gear a safe distance away. Nevertheless, commercial trap fishermen target the pipe area, apparently choosing to risk higher gear-loss for a better yield per trap next to the high-relief rocky habitat created by the pipe and ballast rock.

Chemical and Biological Impacts

The Point Loma Ocean Outfall monitoring program provides an extensive database on marine water quality and marine biology beginning with pre-design studies in the late 1950s' (COSD 2008-2014). The monitoring program at Point Loma was not designed as a research program, but, instead, was established to determine compliance with local, state, and federal environmental regulations. Even so, the monitoring program has generated data with considerable utility for scientific inquiry. For example, Conversi and McGowan (1992) analyzed 15 years of water transparency data at 7 monitoring stations to evaluate the influence of anthropogenic influences (sewage discharge) and natural oceanographic events. They concluded that anthropogenic activities had not affected transparency, while natural factors such as seasonality and distance from the coast had.

Underwater research has been conducted in the Point Loma kelp bed, 3.5 mi (5.6 km) inshore of the outfall, since the mid 1950's when Wheeler North of the California Institute of Technology and his associates at the Scripps Institution of Oceanography (SIO) began long-term investigations of kelp bed ecology (Neushul 1959, North 1964, North and Hubbs 1968). Professors Paul Dayton and associates at SIO have done ecological surveys at fixed locations in the Point Loma kelp bed since 1971 (e.g., Dayton and Tegner 1984, 1990, Dayton et al. 1992, 2003, Tegner et al. 1995, 1996, 1997, Tegner and Dayton 1987, 1991, Steneck et al. 2002, Graham 2000, 2004, Hewitt et al. 2007, Parnell and Riser 2012, Parnell et al. 2005, 2008, 2010). Their research has demonstrated that large-scale, low-frequency episodic changes in oceanographic climate control kelp forest community structure. The Point Loma kelp bed also serves as a site for SIO and San Diego State University graduate student research (e.g., Neushul 1959, Gerodette 1971, Deysher 1984, Graham 2000, Mai and Hovel 2007), and for ongoing unpublished research on CA spiny lobster movements in the Point Loma kelp bed by Hovel, Lowe, Loflen, and Palaoro. With the single exception of a temporary break in the pipeline conveying wastewater to the offshore outfall whose impact was limited in magnitude and extent (Tegner et al. 1995), there has been no indication in the extensive research on the Point Loma kelp bed ecosystem of any impact of discharged wastewater (see Appendix G – Kelp Forest Ecosystem Monitoring Report).

As a result of regulations promulgated by the San Diego Regional Water Quality Control Board, *Macrocyctis* kelp beds have been mapped quarterly in by the Region Nine Kelp Survey Consortium since 1983 (e.g., MBC 2013, 2014). The kelp survey consortium also tracks the ecological impact of anthropogenic and natural influences on local kelp beds including the effects of ocean wastewater discharges. Results of the most recent kelp survey (MBC 2014) show the Point Loma kelp bed decreased slightly (by 4%) in 2013 though it still exceeded 2 mi^2 (5 km^2) in area. The most recent report of the Kelp Survey Consortium (MBC 2014) concludes: “There was no apparent correlation between kelp bed growth, or lack thereof, with the various discharges in the region, and there was no evidence to suggest any perceptible influence of the various dischargers on the persistence of the region’s giant kelp beds.”

These studies and investigations were not devised to specifically elucidate outfall effects. The Point Loma monitoring program was, however, aimed to do precisely that. The following section briefly reviews monitoring program results related to the impact on EFH and fisheries species.

The discharge of treated wastewater at Point Loma could affect EFH and fisheries species by altering water or sediment quality. Water quality parameters are monitored at stations around the outfall, in the kelp bed, along the shoreline, and at reference stations to the north and south (City of San Diego (COSD) 2008-2014). Strong local currents and high initial dilution (>200:1) facilitate rapid mixing and dispersion of the discharged effluent. Except in the immediate vicinity of the outfall, where minor alterations in dissolved oxygen, pH, and light transmittance may occur, changes in physical and chemical parameters in surrounding ocean waters have reflected only natural alterations in oceanographic processes (e.g., upwelling, plankton blooms) and long-term regime changes like El Niño.

Unlike dissolved components of the wastewater that are swept away by the currents, particles discharged from the outfall may settle to the ocean floor. This can change the grain size and organic content of the sediments which in turn affects the abundance and diversity of marine organisms living there. Contaminants can also be introduced since many of the potentially harmful chemicals in wastewater are bound to particles.

Alterations in sediment quality in the vicinity of the Point Loma Ocean Outfall are only apparent in areas closer than 1,000 ft (300 m) from the diffusers, where coarser sediments and higher sulfide and BOD levels have been periodically detected (COSD 2008-2014). The change in grain size is likely due to turbulence created as the current flows past the pipe on the bottom, wafting away the finer particles (Diener et al. 1997). The physical presence of large ocean outfalls and associated ballast materials can alter the hydrodynamic regime in surrounding areas, thus affecting sediment movement and transport, and the resident biological communities. Although periodic small increases in sulfides and BOD near the discharge site are consistent with the deposition of organic material, concentrations of other indicators of organic loading (e.g. total organic carbon, total nitrogen, total volatile solids) organic enrichment) remain low relative to reference areas (see Appendix C – Ocean Benthic Conditions).

Concentrations of chlorinated pesticides (e.g., DDT), polychlorinated biphenyl congeners (PCBs), and polycyclic aromatic hydrocarbons (PAHs) in sediments at Point Loma are generally low, the notable exception being DDE, a breakdown product of the pesticide DDT. DDE, a legacy of historical discharge, is found in sediments throughout southern California (Mearns et al. 1991, Schiff et al. 2011). Levels of DDE at Point Loma are within the range of concentrations elsewhere in the Southern California Bight (COSD 2008-2014, Schiff et al. 2011).

There is no consistent pattern of metal concentrations in the sediments as a function of distance from the outfall - cadmium, arsenic, antimony, barium, chromium, and iron are consistently higher at the northern reference stations, while mercury, aluminum and copper are consistently higher at the southern sampling stations. Concentrations of sediment metals were highly variable, with most levels within ranges reported elsewhere in the SCB (e.g., Schiff et al. 2011). While high values of various metals have been occasionally recorded at nearfield stations, there are no discernible long-term patterns that could be associated with proximity to the outfall or the onset of wastewater discharge.

Changes in sediment quality should also be reflected in the types of species living on and in the sediment. Two elements of the monitoring program provide this type of information: 1) benthic infauna, and 2) demersal (bottom-dwelling) fish and megabenthic invertebrates. Benthic infauna are collected by taking grab samples of the bottom. Demersal fish and invertebrates are gathered by trawling across the bottom. Living in close association with the sediments, these groups are classic indicators of altered conditions. Also, many important fisheries species live on the bottom and/or feed there.

The infaunal community around the outfall is dominated by an ophiuroid-polychaete assemblage typical of this depth and sediment type in southern California (Ranasinghe et al. 2012). There is, however, some indication of discharge effect at the monitoring station closest to the outfall. Abundance of the ophiuroid *Amphiodia* which is sensitive to organic enrichment has decreased, though this has not been the case for other pollution sensitive species. There has been a concomitant decrease in *Amphiodia* region-wide. Other changes in community structure may be related to the presence of the outfall structure itself, rather than the influence of discharged wastewater, and to large-scale oceanographic events like El Niño (Posey and Ambrose 1994, Zmarzly et al. 1994, Diener et al. 1997, Linden et al. 2007, COSD 2008-2014). Whatever the reason, infaunal communities near the Point Loma outfall remain similar to those observed prior to discharge and are comparable to natural indigenous communities (see Appendix C – Ocean Benthic Conditions).

Trawl samples at Point Loma are dominated by small flatfish and sea urchins. Though inherently more variable than infaunal data, the trawl data also indicate that normal oceanographic processes control the abundance and diversity of demersal fish and megabenthic invertebrates living around the outfall (COSD 2008-2014). Patterns in abundance, biomass, and species composition have remained stable since monitoring began (see Appendix C – Ocean Benthic Conditions). The fish collected by trawling are healthy, with few parasites and a low level or absence of fin rot, tumors, and other physical abnormalities.

One of the most important elements of the Point Loma monitoring program from the EFH and fisheries perspective is the measurement of chemical contaminants in fish tissues. Fish can accumulate pollutants from: 1) absorption of dissolved chemicals in the water, 2) ingestion of contaminated suspended particles or sediment particles, and 3) ingestion of contaminated food (Allen 2006, Newman 2009, Allen et al. 2011, Laws 2013). Incorporation of contaminants into an organism's tissue is called bioaccumulation (Weis 2014, Whitacre 2014). Contaminants can also be concentrated as they are passed through the food web when higher trophic level organisms feed on contaminated prey (Bienfang et al 2013, Daley et al. 2014). Bioaccumulation has potential ecological and human health implications (Klasing and Brodberg 2008, 2011, Walsh et al. 2008, California Office of Environmental Health Hazard Assessment (OEHHA) 2014a,b).

The Point Loma Ocean Outfall monitoring program targets two types of fish for assessment of contaminant levels: flatfish and rockfish (see Bioaccumulation Assessment - Appendix D). Samples are taken at various distances from the outfall and at reference stations to the north and south. Flatfish and rockfish at Point Loma have concentrations of metals in liver and muscle tissue characteristic of values detected throughout the Southern California Bight (Mearns et al. 1991, Allen et al. 2011). There is no apparent relationship between higher metal levels and proximity to the outfall. Elevated levels of arsenic were found in fish species at both outfall and reference stations. The source of this arsenic appears to be vents from natural hot springs off the coast of northern Baja California. A variety of man-made compounds including DDT (and its derivatives) and PCBs are routinely found in fish tissue throughout the area. These chlorinated hydrocarbons are ubiquitous in southern California, but their concentration in sediments and organisms is steadily decreasing in most areas (Mearns et al. 1991, Allen et al. 2011, Setty et al. 2012, SCCWRP 2014). Samples taken near the outfall do not have higher levels of DDT and PCBs than at reference sites.

The EPA and the United States Food and Drug Administration (FDA) establish limits for the concentration of contaminants like arsenic, DDT and PCBs in seafood sold for human consumption (EPA 2014b, FDA 2014). There have been no warnings, advisories, harvest closures, or, restrictions on seafood taken from the Point Loma ocean area (personal communication with the staff of the San Diego County Department of Environmental Health; California State Department of Public Health; California State EPA Office of Environmental Health Hazard Assessment; and the U.S. Food and Drug Administration, San Diego Branch).

In summary, monitoring data show effects of the Point Loma discharge only in deep water near the outfall where minor water and sediment quality alterations have been observed. Marine communities in the Point Loma region remain characteristic of natural conditions with no suggestion of environmentally-significant changes.

Cumulative Impacts

Cumulative impacts are defined in the National Environmental Protection Act (NEPA) (42 USC § 4321 *et seq*. and 32 CFR 775 respectively) as: the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).

In general, the effects of a particular action or group of actions must meet all of the following criteria to be considered cumulative impacts:

- Effects of several actions occur in a common locale or region,
- Effects on a particular resource are similar in nature, such that the same specific element of a resource is affected in the same specific way, and
- Effects are long-term as short-term impacts dissipate over time and cease to contribute to cumulative impacts.

The discharge of wastewater from commercial activities, including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., desalination plants), and storm water from drains into open ocean waters, bays, or estuaries can introduce chemical and biological constituents potentially detrimental to estuarine and marine habitats (Perry 2009, Hutchison et al. 2013). These constituents include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, and toxic chemical compounds (Stein and Cadien 2009, Setty et al. 2012). Historically, wastewater discharges have been one of the largest inputs of these constituents into coastal waters. However, wastewater discharges have been regulated under increasingly stringent requirements over the last 40 years and mass emissions of most constituents have been significantly reduced (Lyon and Sutula 2011, SCCWRP 2012, 2014). Nonpoint source/storm water runoff, on the other hand, has not been managed as effectively and continues to be a substantial remaining source of contamination of coastal areas and the ocean (Setty et al. 2012, Howard et al. 2014).

Potential cumulative threats to EFH and fisheries species include degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, disease, natural events, and global climate change (Field et al. 2003, Horn and Stevens 2006, O'Shea and Odell 2008, Pinnegar and Engelhard 2008, Crain et al. 2009, Halpern et al. 2009, Hoegh-Guldberg and Bruno 2010, Thrush and Dayton 2010, Doney et al. 2012, Hazen et al. 2012, Howell et al. 2012, SCCWRP 2012, NMFS 2013a, Howard et al. 2014, Maruya et al. 2014). Cumulative impacts could alter the physiology, behavior, growth, and reproduction of individual species, shift patterns of larval dispersal and recruitment, modify the composition of ecological communities, and, change the structure, function, productivity, and resilience of marine ecosystems.

In addition, fishing and non-fishing activities, individually or in combination, can adversely affect EFH and fisheries species (Jackson et al. 2001, 2011, Dayton et al. 2003, Hanson et al. 2003, Chuenpagdee et al. 2003, Jackson 2008, Baum and Worm 2009, Worm et al. 2009, Norse 2010, Hilborn and Hilborn 2012, NMFS 2013b, Laugen et al. 2014). Potential impacts of commercial fishing include over-fishing of targeted species, and bycatch, both of which negatively affect fish stocks (Barnette 2001, NRC 2002, Dieter et al. 2003, PFMC 2004, Hseih et al. 2006, Carretta and Enriquez 2012, PFMC and NMFS 2012). Mobile fishing gears such as bottom trawls (now prohibited to deeper than 3,500 ft) disturb the seafloor and reduce structural complexity (Auster and

Langton 1998, Johnson 2002, Lindholm et al. 2011). Indirect effects of trawls include increased turbidity; alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (continued catch by lost or discarded gear), and generation of marine debris (Hamilton 2000, Reeves et al. 2013). Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats (NMFS 2013b). Recreational fishing also poses a threat because of the large number of participants and the intense, concentrated use of specific habitats (Coleman et al. 2004, Ihde et al. 2011, United Nations Food and Agricultural Organization (UNFAO) 2012, Arlinghaus et al. 2013).

Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Davidson et al. 2011, Hutchinson et al. 2013, Moore et al. 2013). Natural stresses include storms and climate-based environmental shifts, such as algal blooms and hypoxia (Kim et al. 2009, SCCWRP 2013).

Allen et al. (2005) analyzed fish population trends from 20- to 30-year fish databases (e.g., power generating station fish impingement and trawl monitoring, recreational fishing, and publicly owned treatment work (POTW) trawl monitoring). Combined, these databases provided information on 298 species of fish. A number of long-term environmental databases (e.g., CalCOFI oceanographic data, shoreline temperature, coastal runoff, and POTW effluent contaminant mass emissions) were used to identify influential, independent environmental variables (e.g., Pacific Decadal Oscillation (PDO); El Niño-Southern Oscillation (ENSO); offshore temperature; upwelling in the north, Southern California Bight, and south; coastal runoff; and contaminant mass emissions). Most southern California fish had population trends that followed changes in natural oceanic variables not anthropogenic inputs. The most important environmental variables were PDO (positive and negative responses), upwelling in the Southern California Bight, offshore temperature, and ENSO. The PDO was the dominant influence for most species in these databases, with the presence or absence of upwelling during the warm regime having an important effect on others (Mills and Walsh 2013). Recent analyses of long-term fish population dynamics in the Southern California Bight also indicate that the primary driver of shifting trends in local fish populations is natural climatological change rather than anthropogenic influence (Miller and Schiff 2012, Koslow et al. 2013, Miller and McGowan 2013).

Removal of fish by fishing can profoundly influence individual populations, their survival, and the composition of the community in which they live (Jackson 2008, Jackson et al. 2011, Hilborn and Hilborn 2012). In a seminal study of retrospective data, Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records spanning 10,000 years, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer term data and information, they concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance to coastal ecosystems including pollution, degradation of water quality, and anthropogenic climatic change.

Underwater research has been conducted in the Point Loma kelp bed, 3.5 mi (5.6 km) inshore of the outfall, since the mid 1950's when Wheeler North of the California Institute of Technology and his associates at the Scripps Institution of Oceanography (SIO) began long-term investigations of kelp bed ecology (Neushul 1959, North 1964, North and Hubbs 1968). Professors Paul Dayton and associates at SIO have done ecological surveys at fixed locations in the Point Loma kelp bed since 1971 (e.g., Dayton and Tegner 1984, 1990, Dayton et al. 1992, 2003, Tegner et al. 1995, 1996, 1997, Tegner and Dayton 1987, 1991, Steneck et al. 2002, Graham 2000, 2004, Hewitt et al. 2007, Parnell and Riser 2012, Parnell et al. 2005, 2008, 2010). Their research has established a long-term database unique in the world, demonstrating that large-scale, low-frequency episodic changes in oceanographic climate control kelp forest community structure. With the single exception of a temporary break in the pipeline conveying wastewater to the offshore outfall whose impact was limited in magnitude and extent (Tegner et al. 1995), there has been no indication in the scientific studies of any impact of the discharged wastewater at Point Loma on the kelp bed ecosystem.

A number of factors influence water quality and biological conditions in the Point Loma area. Key potential influences on water quality include the Point Loma treated wastewater discharge, regional non-point source discharges, local river outflows, and other local non-point sources such as harbors, marinas, storm drains, and urban runoff (Bartlett et al. 2004, Parnell et al. 2008, Parnell and Riser 2012).

The effects of the Point Loma discharge on water quality and biological conditions are evident only in deep waters (below the euphotic zone) within or near the Zone of Initial Dilution (ZID) (COSD 2008-2014). Organic enrichment of the sediments due to the outfall discharge is not occurring beyond the ZID. Contaminant loading of sediments is not evident in the discharge vicinity. Sediment chemistry is comparable to reference areas along southern California's outer continental shelf. Biological conditions do not indicate any environmentally-significant changes associated with the discharge. A balanced indigenous population of shellfish, fish and wildlife exist immediately beyond the ZID.

While significant natural variations in fish populations are observed (in response to factors such as water temperature), the Point Loma wastewater discharge is not having any significant effect on demersal fish assemblages off Point Loma. Fish populations are healthy and lack physical abnormalities such as fin erosion or tumors. Levels of trace metals, chlorinated hydrocarbons, pesticides, and polyaromatic hydrocarbons are relatively low, with concentrations within the range found in fish throughout the Southern California Bight. Overall, no outfall-related effects are evident from bioaccumulation data. Contaminants in fish tissues in the Point Loma area are similar to those at reference sites beyond the influence of the discharge.

Based on scientific research and oceanographic monitoring at Point Loma, the impact on Essential Fish Habitat from the discharge of treated wastewater is expected to be minimal. There will be no significant cumulative, incremental, or synergistic effects on present or reasonably foreseeable future uses of the Point Loma marine environment.

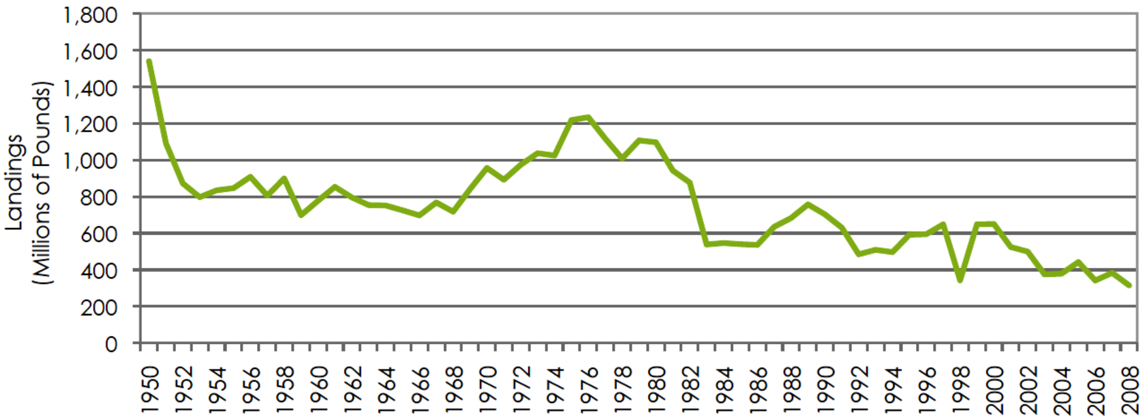
Conclusions

The proposed operation of the Point Loma ocean outfall will not reduce the quality or quantity of Essential Fish Habitat. Extensive monitoring and scientific studies indicate little or no alteration of physical, chemical, or biological conditions of the waters or substrates. Impacts on marine organisms, prey species, their habitat, and other ecosystem components are minimal. Wastewater discharged from the outfall makes an insignificant contribution to regional cumulative impacts on EFH or fisheries species. Thus, the discharge of treated wastewater from the Point Loma Ocean Outfall will not have an adverse effect on Essential Fish Habitat.

Commercial Fishing

Fisheries along the California coast have historically targeted over 285 species in four main groups: groundfish, coastal pelagic fish, highly migratory fish, and invertebrates (California Fisheries Fund 2014). Changing economic conditions and management restrictions have significantly reduced commercial fishing and fishery landings over the last half century (Figure 12, from Port of San Diego (POSD) 2009).

Figure 12. California Commercial Landings: 1958-2008.



Commercial fishing has been affected by seasonal closures, quota reductions, and restrictive long-term stock-building plans (CMLPA 2009). Salmon fishing quotas diminished following the listing of five California salmon population types under the federal Endangered Species Act (ESA). Tuna landings have fallen with the relocation of the fishery to less costly venues in Samoa and Puerto Rico. And, decreasing abalone stocks led to the total commercial fishing ban of abalone south of San Francisco in 1997.

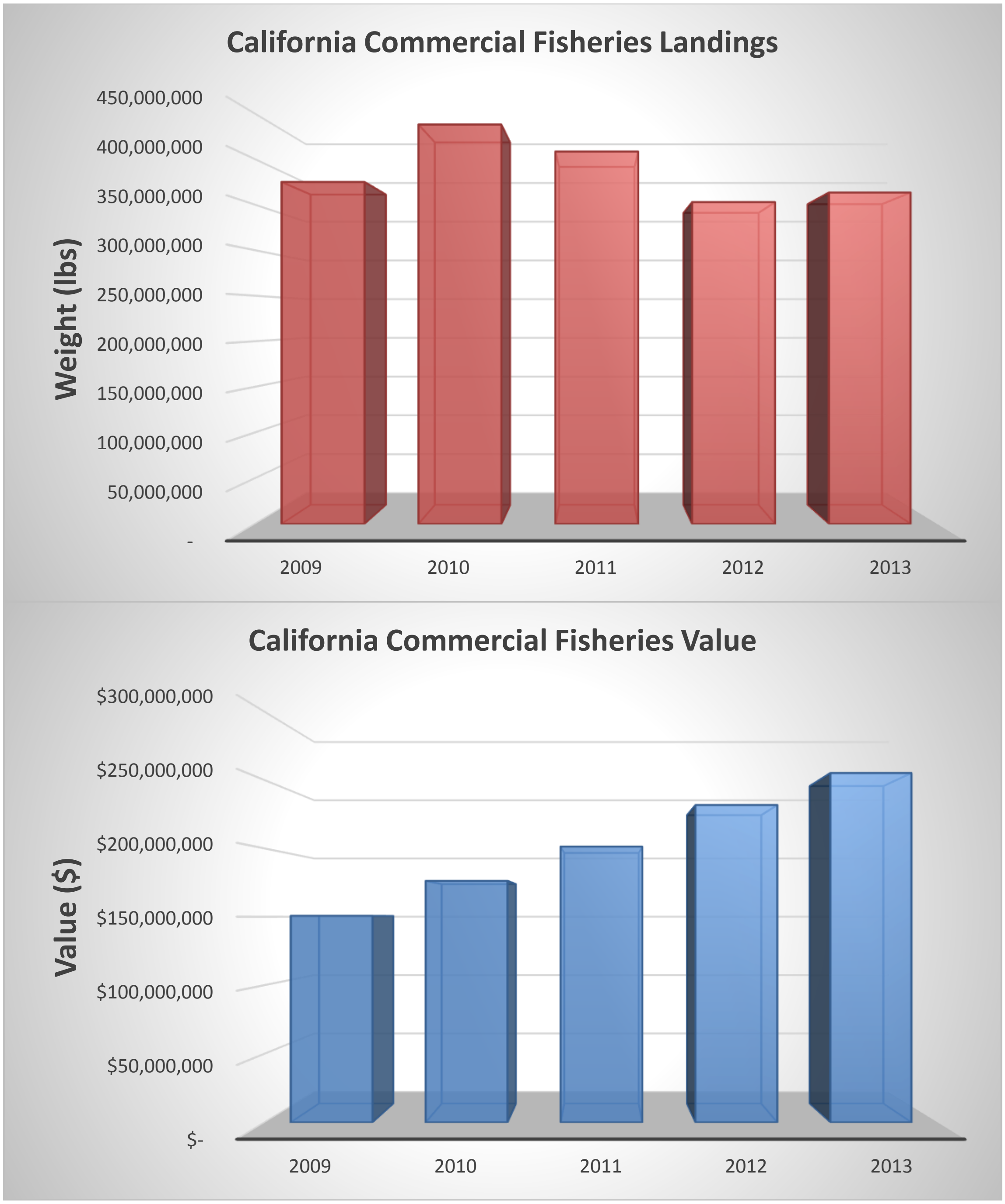
Increasing regulation will likely reduce fisheries catch and landings in the future. The California Marine Life Management Act (MLMA) resulted in permit suspensions in the nearshore fishery and further access restrictions were imposed by the squid management plan (CDFW 2014e). The California Marine Life Protection Act (CMLPA) authorized new protections for ocean habitats and wildlife. It created a network of marine protected (fishing-restricted) areas along the coast to help revive depleted fish stocks (National Ocean Economics Program (NOEP) 2005, 2009). The increasing use of waterfront property for recreational boating, tourism, and housing limits the availability of shore-side space for commercial fishing support facilities.

Despite the general decline of landings in California, some fisheries have been relatively resilient. For example, increased international demand for squid has enhanced landings during non-El Niño years, attracting participation from former salmon fishermen. Specialized fisheries for sea urchin, sea cucumber, Pacific herring, and live rockfish have grown in recent years as well (NOEP 2009, Hackett et al. 2009, NMFS 2014).

Even though the commercial fishing industry in San Diego has contracted, local landings continue to be important to the regional economy. There are more than 130 commercial fishermen in San Diego whose catch includes lobster, sea urchin, swordfish, spot prawn, white sea bass, rockfish, rock crab, shark, and tuna. In 2009, the Port of San Diego developed and began implementing a Commercial Fisheries Revitalization Plan to address the economic opportunities and potential constraints facing the local commercial fishing industry (POSD 2009).

From 2009 through 2013, California commercial fisheries landings stabilized at around 400 million pounds annually (Figure 13, data from CDFW 2014). The value of the California commercial fisheries catch increased steadily during the period from 150 million dollars to over 250 million dollars (Figure 13). The value is ex-vessel, that is, whole fish at wholesale price. The overall economic contribution of the product may be as much as three to four times higher as it passes through the economy (NOEP 2005, 2009, Hackett et al. 2009).

Figure 13. California Commercial Fisheries Landings and Value 2009-2013.



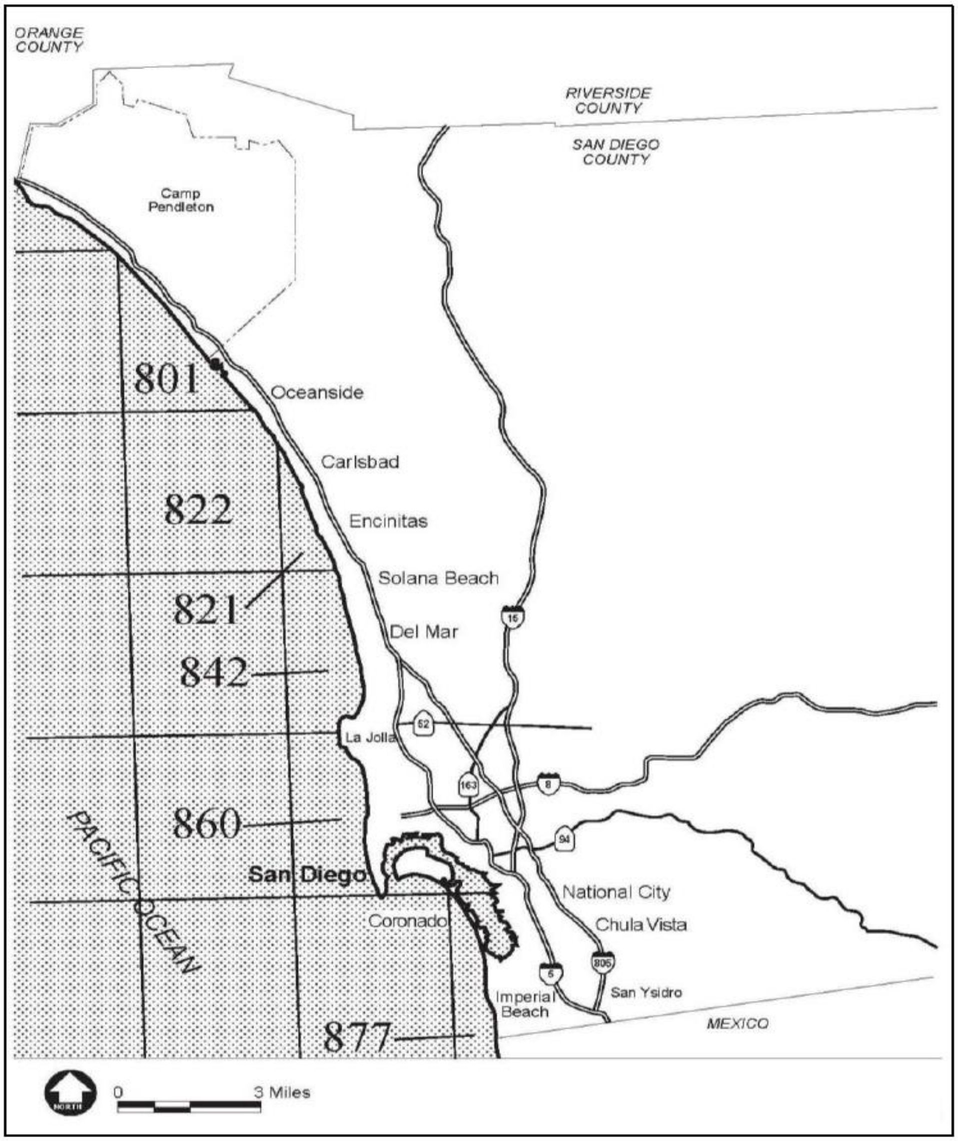
The major commercial fisheries of the Southern California Bight, their seasons, and harvest gear are listed in Table 11.

Table 11. Commercial Fisheries Groups, Seasons, and Harvest Methods.

Fishery	**Season**	**Harvest Methods**
Coastal Pelagic Species		
Anchovy, mackerels, sardine, squid	Year round, seasonal by species, some with harvest guidelines	Purse seine, drum seine, gillnet, dip net, some line gear (mackerel)
Highly Migratory Species		
Tunas, sharks, billfish, swordfish, dolphin	Year round, seasonal by species and region	Gillnet, purse seine, set net, drift net, troll, hook and line, harpoon (swordfish)
Groundfish Species		
Flatfish, rockfish, thorneyheads, roundfish, scorpionfish, skates, sharks, chimeras	Year round, seasonal by species and region	Trap, troll, gillnet, set net, hook and line
Other Finfish		
CA halibut, CA sheephead, white seabass	Year round, seasonal by species	Set gillnet, drift nets, trap, hook and line
Invertebrates		
Lobster, urchin, prawn, crab, shrimp	Year round, seasonal by species	Trap and diver

Fishery catch statistics are reported for large fishery blocks, providing sufficient ambiguity to protect commercial fishers' "secret spots". Fish blocks are 9- by 11-mile rectangles. Figure 14 depicts CDFW nearshore fish blocks in the San Diego area.

Figure 14. San Diego Nearshore Fish Blocks.



From catch data supplied by commercial fishermen, CDFW reports the weight and dollar value of commercial fish landed by species in California. The fish block off Point Loma is block 860. Fish catch and value for block 860 is presented in Table 12 and Figure 15.

Table 12. Yearly Fisheries Catch Reported from Fish Block 860 (lbs).

SPECIES	2009	2010	2011	2012	2013
Barracuda, CA	2,054	397	862		158

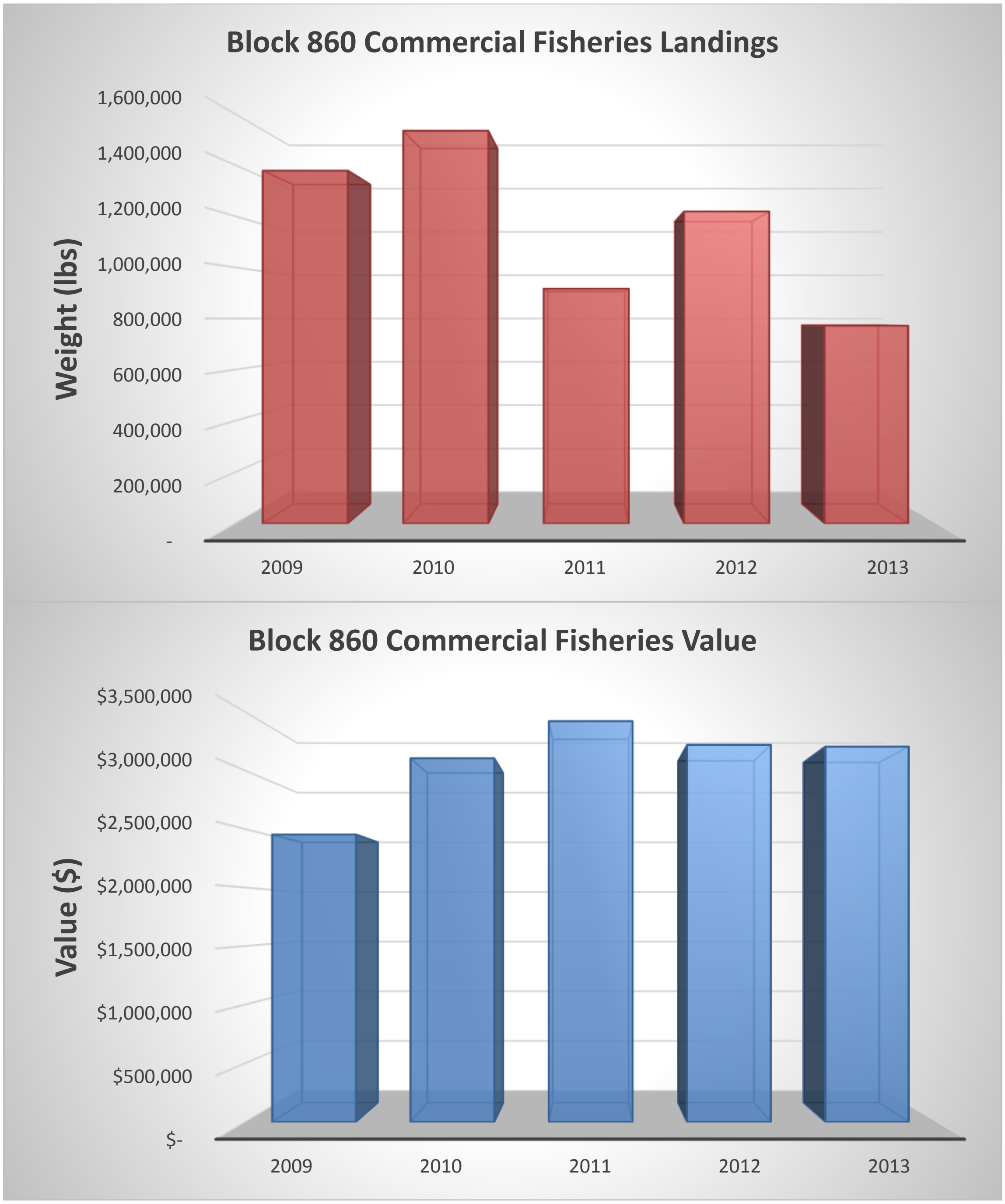
Table 12. Yearly Fisheries Catch Reported from Fish Block 860 (lbs).					
SPECIES	2009	2010	2011	2012	2013
Bass, giant sea	116	83	13		
Bonito, Pacific	138,238				
Cabezon	139	390		329	117
Crab, rock	25,250	32,177	34,869	29,047	25,004
Crab, spider	16,659	9,069	1,722	557	622
Dolphinfish				108	31
Eel, moray	2,215	3,185	38	162	57
Escolar		117			
Guitarfish	27	788	94	81	
Hagfish	59,504	4,661			
Halibut, CA	2,753	2,830	5,177	7,319	6,788
Jacksmelt	228				
Lingcod	113	130	85	20	
Lobster, CA	126,849	127,411	140,341	143,871	144,622
Louvar	119	117		22	8
Mackerel, Pacific	1,890	1		37	
Octopus	50	33	654	76	41
Opah	2,439	1,256		106	1,187
Prawn, spot	2,676	2,151	6,510	4,881	4,686
Ray, bat		4,308	611	434	15
Rockfish, all	5,079	959	2,003	12,591	1,286
Sablefish	10		473	1,399	11
Sanddab	5		47		69
Scorpionfish,CA	57	62	9	29	6
Sea cucumber	1,082	31,730	36,493	11,081	10,690
Sea star	79	158	106	146	135
Seabass, white	1,116	5,605	14,548	11,777	8,604

Table 12. Yearly Fisheries Catch Reported from Fish Block 860 (lbs).

SPECIES	2009	2010	2011	2012	2013
Shark, leopard		424	148	384	17
Shark, shortfin mako	1,244	719	740	722	793
Shark, soupfin		39	245	42	
Shark, thresher	4,885	3,888	1,036	2,548	12,711
Sheephead	11,729	12,333	12,408	9,215	9,134
Shrimp, ghost	6	13			
Snail, sea	101		9		
Snail, top	155	48	303	346	670
Squid, market	171,406	586,439	3,144	366,022	158,753
Surfperch	11	2	7	47	41
Swordfish	6,472	2,043	191	1,230	8,792
Tuna, albacore	376	5,600	65		
Tuna, bluefin	16,403		113	1,431	470
Tuna, skipjack	749				
Tuna, yellowfin	409				246
Urchin, purple	1,556	1,169	1,375	1,009	
Urchin, red	702,362	643,341	643,364	604,297	
Whelk, Kellet	49,033	15,628	7,739	3,507	1,610
Whitefish, ocean	99	99	15	91	22
Yellowtail	566	1,188	655	3,139	4,868

Source data: California Department of Fish and Wildlife.

Figure 15. Block 860 Commercial Fisheries Landings and Value 2009-2013.



Many commercially important fisheries species are taken in block 860, with lobster and sea urchin predominating. Not all fish caught from block 860 are brought to port (landed) in San Diego. For example, the large catch of market squid from block 860 is mostly taken by Los Angeles area fishing vessels that return to ports in that area to offload their catch. Landing data specific to Point Loma is not available, so, the proportion of the catch from block 860 that contributes to San Diego's economy is not known. However, landing data are collected at the two harbors adjacent to Point Loma: Mission Bay and San Diego Bay. These data provide a better estimate of the economic contribution of Point Loma's fisheries to the local economy.

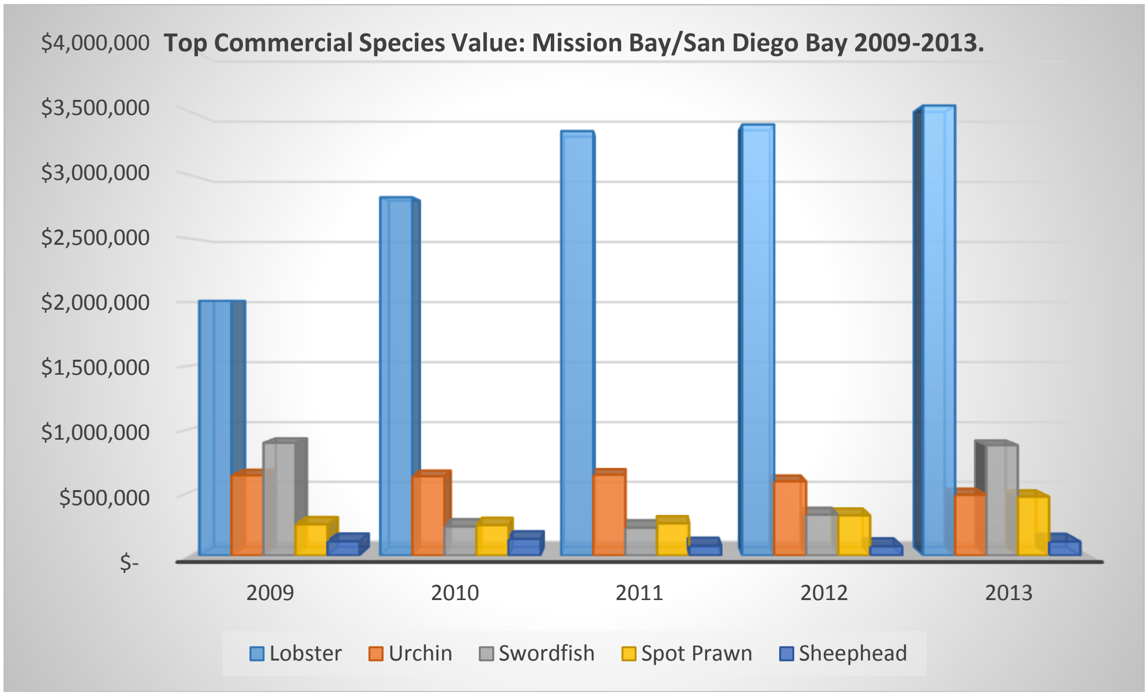
The annual dollar value for the top five commercial fisheries species landed at Mission Bay and San Diego Bay from 2009 to 2013 is presented in Table 13 and Figure 16.

Table 13. Top 5 Fisheries Species Value at Mission Bay/San Diego Bay 2009-2013.

	2009	2010	2011	2012	2013
Lobster	$ 2,010,382	$2,823,889	$ 3,343,231	$ 3,394,925	$ 3,544,437
Urchin	$ 634,020	$626,789	$ 638,895	$ 586,968	$ 479,322
Swordfish	$ 891,628	$229,385	$ 220,283	$ 322,440	$ 873,529
Spot Prawn	$ 247,025	$241,139	$ 254,588	$ 317,250	$ 465,417
Sheephead	$ 112,258	$130,656	$ 77,169	$ 72,622	$ 109,983

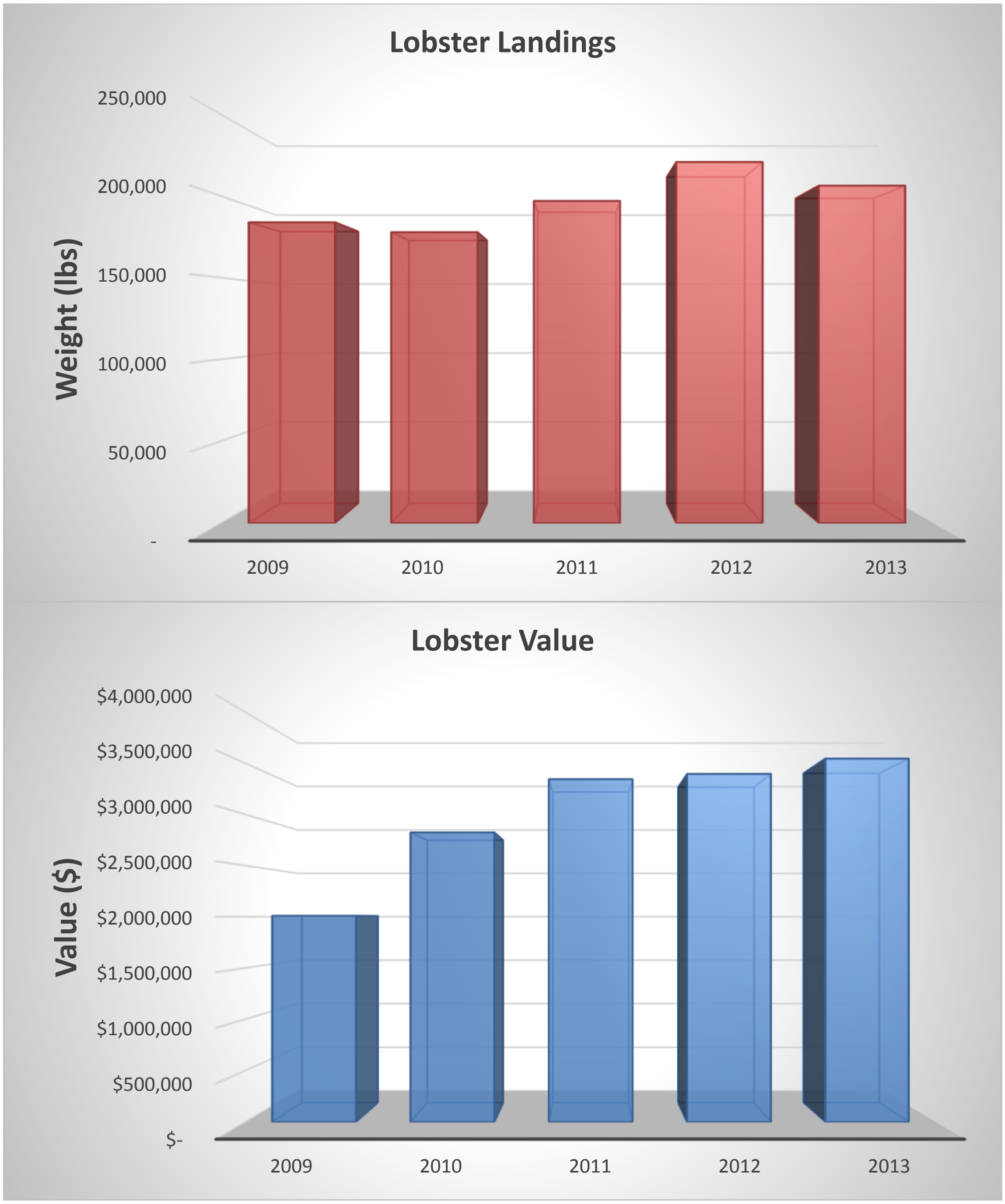
Source data: California Department of Fish and Wildlife.

Figure 16. Top Commercial Species Value: Mission Bay/San Diego Bay 2009-2013.



California spiny lobster are the premier commercial catch in San Diego. Figure 17 shows the weight and value of lobster landed at Mission Bay and San Diego Bay from 2009-2013.

Figure 17. Mission Bay/San Diego Bay Lobster Landings and Value.



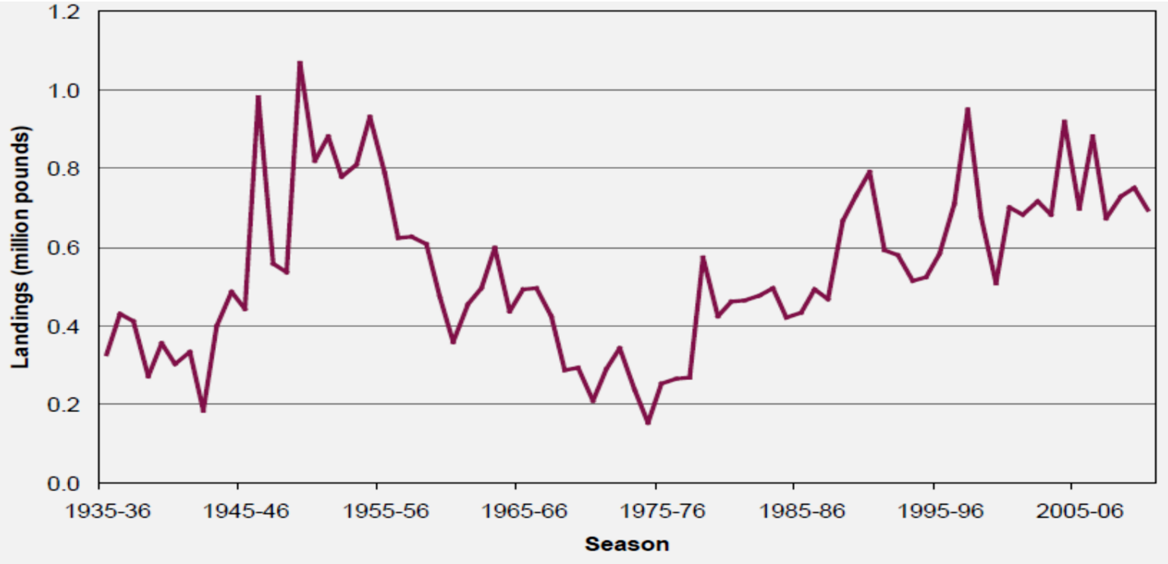
The wholesale value of lobster landed at Mission Bay and San Diego Bay averaged about three million dollars per year during the period 2009-2013. This represented more than a third of the total value of all commercial species landed in San Diego County.

The California spiny lobster (*Panulirus interruptus*) ranges from Monterey, California south to Magdelena Bay, Baja California (Mai and Hovel 2007, CDFW 2013a). They occur from the intertidal zone to a depth of about 200 ft (60 m) and are usually associated with eel grass and kelp beds in rocky areas (Leet et al. 2001). Spiny lobster are a major predator of benthic invertebrates including mussels and sea urchins and act as a keystone species along rocky shores and in kelp forests. Primary predators of lobster include sheephead and black sea bass (Neilson 2011). Lobster are nocturnally-active, sheltering under rocks and in crevices during the day and foraging at night. The females migrate to shallow water during spring and summer to spawn; in fall they move to deeper water to mate.

Lobster have been fished commercially in California since the late 1800s. They are caught in traps set along the inner, middle, and outer edges of kelp beds, and over hard-bottom, mostly in depths of 30-120 ft (9-36 m) (CDFW 2014f). Open season runs from the 1st Wednesday in October to the 1st Wednesday after March 15. Early in the season traps are set from just outside the surf line to the inner edge of kelp beds. As winter storms approach, traps are moved farther offshore into the kelp bed and along their outer edge.

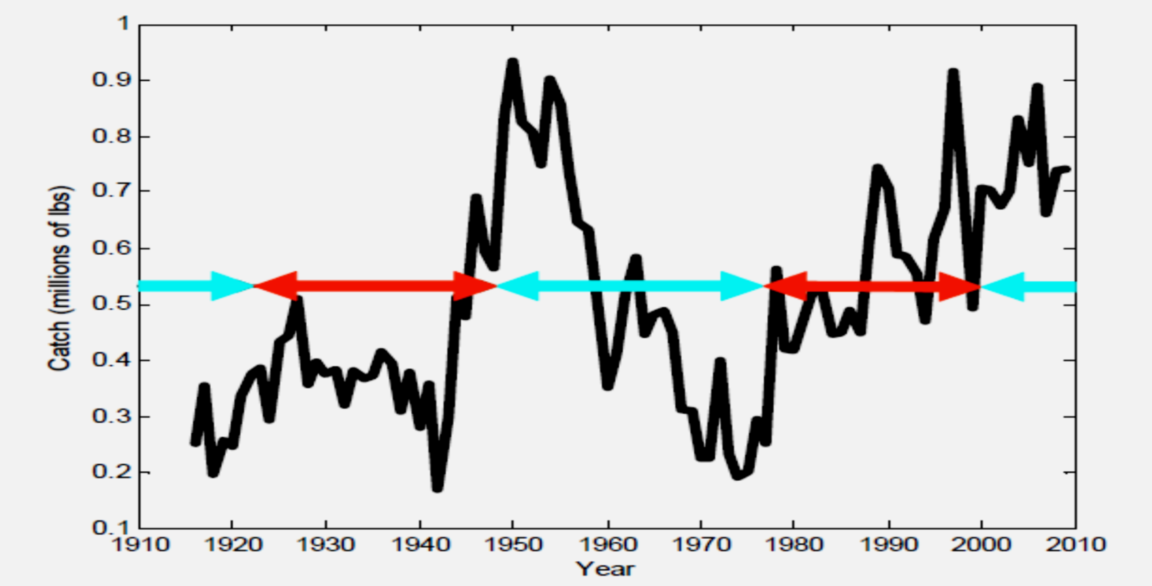
Figure 18, from CDFW 2013a, shows California spiny lobster commercial landings from 1936-2011.

Figure 18. California Historical Lobster Catch.



The lobster catch in California is influenced by the prevailing oceanographic regime. Figure 19, from Neilson 2011, contrasts periods of warm and cold water associated with the Pacific Decadal Oscillation (PDO) with lobster landings from 1916 to the present.

Figure 19. Warm and Cold Water Regimes and Historical Lobster Catch.



The second most valuable seafood landed at Mission Bay and San Diego Bay from 2009-2013 was sea urchin, averaging about six hundred thousand dollars per year (Table 13, Figure 20). Although substantial, sea urchin landed value was less than a quarter of that from lobster.

Sea urchin are harvested for their roe, which is known as “uni”. Harvesting is done by divers, usually in or around kelp bed, at depths of 30-70 ft (9-21 m) using a hookah breathing system connected to a surface vessel or platform.

The overall California catch of sea urchin has varied considerably during the past 40 years (Figure 20, from CalCOFI 2013). Variations are due to a number of factors including limited development of the fishery prior to the mid-1980s, a strong 1982-1983 El Niño, a rush into the unrestricted fishery precipitated by a rapidly developing Japanese market for “uni” during the late 1980s and early 1990s, subsequent limited access permitting in response to resource depletion combined with weak El Niños in 1987 and 1992, and additional catch restrictions. The continued diminished urchin harvests in 1997-1998 were a result of the loss of kelp, their primary food source, during the prevailing strong El Niño (Wolfson and Glinski 2000). Figure 21 shows Mission Bay/San Diego Bay Urchin Landings from 2009-2013.

Figure 20. California State Urchin Catch 1970-2012.

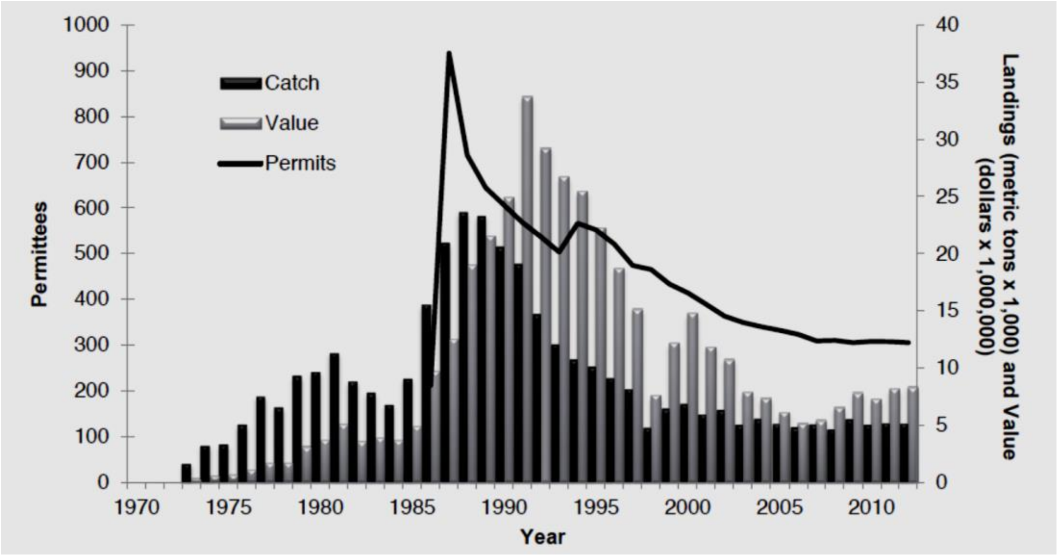
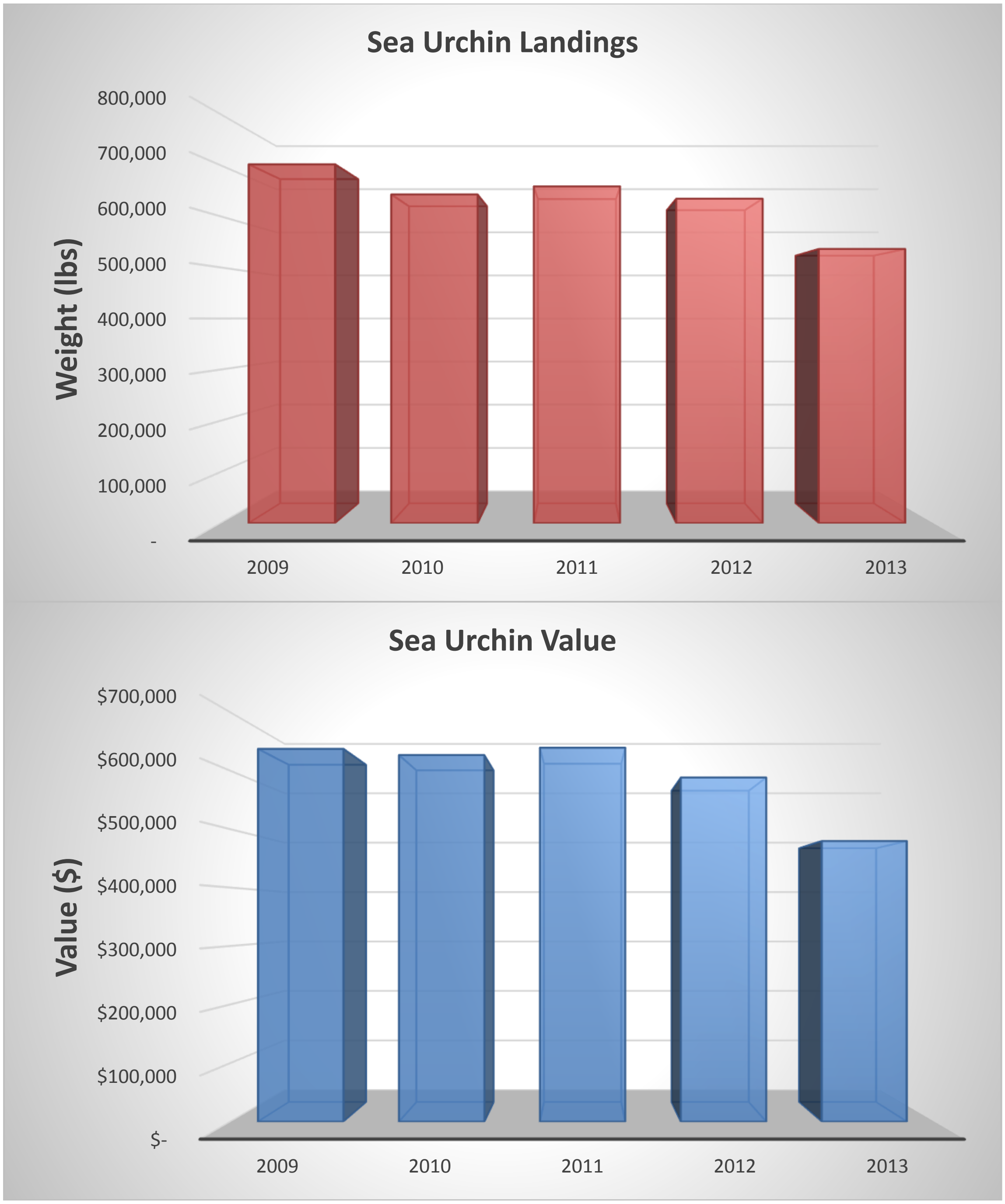


Figure 21. Mission Bay/San Diego Bay Sea Urchin Landings.



Both the lobster and urchin fisheries occur near or in the kelp beds, which are limited to maximum depths of about 90 ft (18 m) over consolidated bottom (out to about 1 mi (1.6 km) from shore). Thus, these fisheries take place at a distance of 3.5 mi (5.6 km) or greater from the Point Loma Ocean Outfall.

Swordfish was the third most valuable seafood commodity landed at Mission Bay and San Diego Bay during the five-year period from 2009-2013. Swordfish (*Xiphias* *gladius*) are found in tropical and temperate ocean waters (Leet et al. 2001). They migrate north from Baja California into California coastal waters in springtime then move south in the fall to spawn and over-winter. Swordfish grow to 1,200 lbs (544 kg) and 14 ft (4.3 m) in length. Adult swordfish eat squid and pelagic fish. They are caught near the surface, mostly at night.

Swordfish are taken well off Point Loma every year. Prior to the early 1980s harpooning swordfish at the surface was the primary harvest method. Only a few boats still use harpoons. West coast longliners are prohibited from fishing in the Exclusive Economic Zone, or anywhere for swordfish using this method.

Spot prawn were ranked the fourth most valuable seafood landed at ports adjacent to Point Loma from 2009-2013. Spot prawn (*Pandalus platyceros*) are shrimp. They have four bright white spots, hence the name. As of 1 April 2003 the use of trawl nets to take spot prawn has been prohibited. The season for spot prawn south of Point Arguello, Santa Barbara is closed November 1 through January 31. Today, most spot prawn are caught in traps set on the sea floor at depths of 600-1,200 ft (183-366 m). Much of the spot prawn catch off Point Loma goes to supply restaurants featuring live display.

Over the past twenty five years there has been a steady increase in demand for “live” finfish. This began primarily to serve members of the Asian community and has since grown to include many markets and Asian restaurants. The “live” finfish industry has grown as an alternate, off-season opportunity for many in the lobster fishery and increased in 1994 with the gillnet closure within 3 nm (5.6 km) of shore. Traps will catch practically any species willing to enter a small space for food. The primary target species generally weigh 1-3 lb (0.5-1.4 kg) and include sheephead, halibut, scorpionfish, cabezon, lingcod, and several members of the genus *Sebastes* (rockfish). These live fish, presented in salt water aquaria for individual selection, bring several times the value of their filleted colleagues. A “Nearshore Finfish Trap Endorsement” is required to catch finfish in baited traps for the “live” market.

Sheephead were the fifth most valuable commercial catch landed at Mission Bay and San Diego Bay from 2009-2013. The California sheephead, *Semicossyphus pulcher*, is a large, colorful wrasse. Male sheephead reach a length of 3 ft (.9 m), a weight of 36 lb (16 kg), and have a white chin, black head, and pinkish to red body. Females are smaller, with a brownish red to rose-colored body. California sheephead begin life as a female with older, larger females developing into secondary males. Female sexual maturity may occur in three to six years and fish may remain female for up to fifteen years. Timing of the transformation to males involves population sex ratio as well as size of available males and sometimes does not occur at all (Leet et al. 2001). California sheephead show high site fidelity and a small home range, but increase their movement range with warmer seasonal waters (Topping et al. 2006).

Populations of California sheephead off southern California have declined because of fishing pressure. Large males are now rare because they are sought by recreational spear fishermen. Sheephead are taken commercially by traps and kept alive for display in restaurant aquaria where patrons select a specific fish for preparation. Although most commercially landed sheephead are caught by trap some are taken by hook-and-line, and also as bycatch in the gill net fishery. The red color and soft, delicate flesh are especially prized in Asian cuisine.

Other notable commercial fisheries in San Diego marine waters include rock crabs, sea cucumbers, Kellet's Whelk, rockfish, thornyheads, white seabass, California halibut, albacore, thresher shark, sablefish, hagfish, market squid, sardines, anchovies, mackerel, giant kelp, and mariculture.

Rock crabs off Point Loma are mostly caught in traps at depths out to 300 ft (90m). The predominant species taken is the yellow rock crab, *Cancer anthonyi*. They range from Magdalena Bay, Baja California to Humbolt Bay, California, but are abundant only as far north as Point Conception. In southern California, rock crab are most common on rocky bottoms at depths of 30-145 ft (9-44 m), but are also found on open sandy bottoms where they partially bury themselves when inactive. Over sand, adults feed on live benthic prey and scavenge dead organisms that fall to the bottom.

Two species of sea cucumbers are taken in the commercial fishery: the California sea cucumber (*Parastichopus californicus*), also known as the giant red sea cucumber, and the warty sea cucumber (*P. parvimensis*). They inhabit the low intertidal to 300 ft (90 m) deep. Sea cucumbers feed on organic detritus, sea stars and other small invertebrates. The warty sea cucumber is fished almost exclusively by divers, and populations at fished sites have declined due to fishing mortality (Schroeter et al. 2011). The California sea cucumber is caught principally by trawling in southern California. A special permit to commercially fish for sea cucumbers was required beginning with the 1992-1993 fishing season. There is no significant sport fishery for sea cucumbers in California and sport fishing regulations forbid their take in nearshore areas in depths less than 20 ft (6 m) (Leet et al. 2001).

Kellet's Whelk (*Kelletia kelletii*) is a large subtidal snail that occurs intertidally to 230 ft (70 m) on rocky reefs, gravel bottoms, kelp beds, and sand from Baja California, Mexico to Monterey Bay (Leet et al. 2001). The Kellet's whelk fishery is growing rapidly. They cannot be taken within 1,000 ft (305 m) from the shore, except incidentally by lobster and/or rock crab traps.

Rockfish are non-migratory, and many species of rockfish are caught in the offshore area of Point Loma. Numerous rockfish stocks in both northern and southern California are considered depleted, and in an effort to better regulate the stocks, rockfish were divided into nearshore, shelf and slope groups in 2001. The shelf group is comprised of 32 fish of the genus *Sebastes*. They are most commonly caught by trap and hook and line over the continental shelf from depths of 120-900 ft (36-274 m). Live catches bring top prices and are often sold live to Asian restaurants.

Shortspine thornyheads (*Sebastolobus alascanus)* are found off California in waters ranging from 100-5,000 ft (30-1524 m) deep. They migrate to deeper water as they grow and are closely associated with the bottom. They are usually fished from bottom waters 1,200-4,200 ft (366-1,280 m) deep with peak abundance generally in the 1,800-3,000 ft (547-914 m) range. Like rockfish, they are members of the family Scorpaenidae and are primarily exported to Japan for sushi.

White seabass (*Atractoscion nobilis*) are the largest members of the croaker family (Sciaenidae) in California. They can grow to 90 lb (41 kg), although fish over 60 lb (27 kg) are rare. Adults school over rocky areas or near and within kelp beds. They can be caught at the surface and to depths of nearly 400 ft (122 m). Other common names for white seabass are king croaker, weakfish and sea trout (juveniles).

California halibut (*Paralichthys californicus*), a regular component of the fisheries catch off Point Loma, are a prized, non-schooling flatfish. Known as the left-eyed-flounders, about 40% are actually right-eyed. They range from Baja California to British Columbia. Halibut feed almost exclusively on anchovies and other small fish. They spawn in shallow waters from April-July. In the San Diego area they are caught in depths to about 300 ft (91 m), by hook and line, directed longline, and set gill nets in federal waters (>3 nm (5.6 km)). The best catches are usually in springtime over sandy bottom. The fishing season is mid-June to mid-March. California halibut range in size up to a maximum of about 70 lb (32 kg), although most are much smaller.

Albacore (*Thunnus alalunga*) are found worldwide in temperate waters; in the eastern Pacific they range from south of Guadalupe Island, Baja California to southeast Alaska (Eschmeyer et al. 1985). Their food varies but consists mostly of small fish, and sometimes squid and crustaceans. In southern California albacore are usually found 20-100 mi (32-160 km) offshore. Normal catch size is 20-40 lb (9-18 kg). Albacore is the most abundant tuna caught in commercial fisheries and recreational fisheries in California and along the West Coast. In the commercial fishery albacore are caught primarily using hook and line gear (jigs, bait, or trolling), but they are also taken in drift gill nets or round haul gear.

Thresher shark (*Alopias vulpinus*) is the most common and valuable shark taken in California commercial fisheries. Commercially-caught thresher shark are principally taken in offshore gill net fisheries.

Sablefish (*Anoplopoma fimbria*) are caught by trawls, nets, trap, and hook and line. Different regulations apply for each method. Sablefish are found in depths of 900-4,200 ft (274-1,280 m), with greatest densities in the 1,200-1,800 ft (366-549 m) range. Sablefish can live 50 years and can weigh up to 126 lb (57 kg). They enter the fishery as early as 1 year of age and most are taken by the trawl fishery by years 4 - 6, at a weight of less than 25 lb (11 kg). Traps and long-line hook fisheries generally catch the older, larger fish. Most of the catch is exported to Japan where it is served as sushi. In the U.S., sablefish are often marketed as black cod, the smaller ones are often filleted and sold as butterfish.

The Pacific hagfish (*Eptatretus stoutii*) is the target of an emerging commercial fishery in California (Bell 2009). Hagfish are unlike any other saltwater finfish. They have four hearts and up to 16 pairs of gill pores along their body. Hagfish feed on dead and dying fish and marine mammals, burrowing into their prey by making a hole with their rasping teeth, or entering through an existing opening (e.g., mouth or gills). They consume prey from the inside, leaving only skin and bones when finished. Moving with a snakelike motion, using their paddle-shaped tails, hagfish resembles an eel, but are not related. The hagfish produces large quantities of slime when agitated, giving it the common name "slime eel." Hagfish occur at depths ranging from 30-5,600 ft (9-1,707 m), but are more common at depths exceeding 300 ft (90 m). The California fishery began in 1982, when Koreans were looking for outside sources of hagfish due to local depletions. Prior to this, California fishermen had only considered hagfish a nuisance because they would eat and destroy their bait and catch. Commercial fishermen usually fish for hagfish at depths of 300-1,800 ft (90-589 m) using strings of baited traps.

The California market squid (*Loligo opalescens*) has been harvested since the 1860s and has become the largest fishery in California in terms of tonnage and dollars since 1993 (Zeidberg et al. 2006). Squid landings decreased substantially following the large El Niño events in 1982-1983 and 1997-1998, but not the smaller El Niño events of 1987 and 1992. Market squid are small (6 inch mantle length). They occupy the middle trophic level in California waters, and may be the state's most important marine forage species. They are short-lived (about 10 months). Market squid are primary prey for at least 19 species of fish, 13 species of birds, and six species of mammals (Morejohn et al. 1978).

Since the decline of the anchovy fishery, market squid is possibly the largest biomass of any single marketable species in the coastal environment of California. The majority of squid landings occur around the California Channel Islands, from Point Dume to the Santa Monica Bay, and in the southern portion of the Monterey Bay (Zeidberg et al. 2006). The fishery has varied through the years due to El Niño events and rapid fluctuations in market value. El Niño events have traditionally depleted the market squid fishery and driven up the value due to poor landings (Leet et al. 2001). They are generally caught near the surface, but can be found to depths of 800 ft (244 m). During the 1990s, purse seines became the dominant gear used to harvest market squid. Currently, market squid are fished year-round with increased catch rates from September through February in southern California.

Sardines (*Sardinops sagax*) are small, pelagic, schooling fish that are members of the herring family. The California fishery peaked in 1936-1937 and vanished from southern California during the 1950s. Fishing pressure was first suspected as the cause, but it was subsequently determined that cooling ocean temperatures contributed to the decline. The late 1990s warm water cycle has brought the sardine back to southern California, where the purse seine fishing season for sardines now runs year-round.

Northern anchovy (*Engraulis mordax*) are small, short-lived pelagic fish found throughout the eastern Pacific Ocean. They are active filter feeders, and consume various types of plankton. Anchovies are ecologically important as prey for many species of birds, mammals, and fish. Historically in California, anchovy supplied a large reduction fishery, which produced fish meal, oil, and soluble protein. They are currently utilized for human consumption, bait, and pet food. Large-scale anchovy landings were first seen in the early 1900s during times of low sardine availability. Commercial landings have been low since the 1980s due to market constraints rather than biological factors.

Pacific mackerel (*Scomber japonicus*) are a schooling seasonal species in the San Diego area. In the eastern Pacific they range from Chile to the Gulf of Alaska. They feed on larval, juvenile and small fish, and, occasionally on squid and crustaceans. Dense schools of Pacific mackerel are caught in surface waters by the purse seine fleet. Most

Pacific mackerel caught off California weigh less than 3 lb (1.4 kg). This fish is known as a "wet fish" because it requires minimal processing prior to canning. The catch is mainly targeted for human consumption and for use as pet food. A small amount is sold at fresh seafood markets.

Giant kelp (*Macrocystis pyrifera*) has been harvested from the Point Loma kelp bed since 1929 by cutter barges that harvest the upper kelp canopy down to a depth of about 4 ft (1.2 m) below the water surface. During the 1980s and 1990s it was the single most valuable fishery in the vicinity of Point Loma because of the high value of products created from it. Algin, extracted from kelp, is used as a binder, stabilizer, and, emulsifier in pharmaceutical products, in cosmetics and soaps, and in a wide variety of food, drink, and industrial products (McPeak and Glantz 1984). Some of the statewide kelp harvest is also used to feed abalone in mariculture operations (MBC 2013, 2014, CalCOFI 2014).

The Point Loma kelp bed, the largest kelp bed in San Diego County, was particularly important because of its proximity to the kelp processing plant in San Diego Bay. Although the poundage and landed value was proprietary, Wolfson and Glinski (2000) estimated a commercial value of $5-$10 million/year for the Point Loma kelp bed. In 2005, after 76 years of operation, the San Diego kelp harvesting and processing operation was shut down and moved to Scotland.

Kelp harvesting in California is regulated by the California Department of Fish and Wildlife. As a result of restrictions on harvesting activities, commercial kelp harvest decreased by 96 percent from 2002 to 2007 (U.S. Army Corps of Engineers (USACOE) 2013). Two kelp beds, one located from the California/Mexico International Boundary to southern tip of San Diego Bay, and one located from the southern tip of San Diego Bay to the southern tip of Point Loma, are considered open, which means they may be harvested by anyone with a kelp harvesting license. Kelp beds at Point Loma and Mission Bay are currently available for lease from the state (USACOE 2013). A proposal to lease the Point Loma kelp bed was approved by the Fish and Game Commission in April 2012, but it is unknown if it is being presently harvested (MBC 2014).

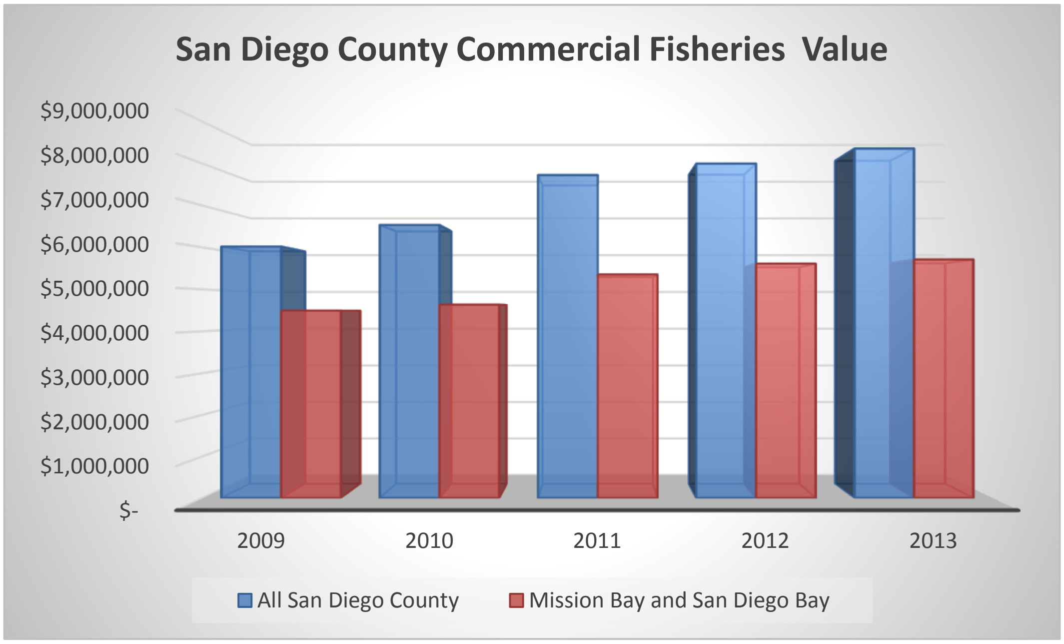
The California Department of Fish and Wildlife is the principal authority issuing permits for marine aquaculture (mariculture) in California. The California State Lands Commission and various municipal entities may grant tideland leases, but if aquaculture is involved, the operation must be registered with the CDFW.

Most mariculture in San Diego is located in lagoons and bays. The Hubbs-SeaWorld Research Institute operates a white seabass hatchery at the Agua Hedionda Lagoon in Carlsbad (27 mi (43.5 km) north of the outfall). Two additional mariculture projects are also located there: the Kent Seafarms Research Facility and Carlsbad Aquafarms, which grows mussel, oyster, clam, abalone, scallop and culinary seaweed (Carlsbad Aquafarms 2014). Sea World sponsors mariculture research at its Mission Bay facility and conducts aquaculture studies at sites in Mission Bay (Hubbs-SeaWorld Research Institute 2014).

Operation White Seabass, a partnership of the Hubbs-SeaWorld Research Institute, Southern California Edison and the San Diego Oceans Foundation, is working to enhance stocks of white seabass in San Diego coastal waters. The program begins at the hatchery in Carlsbad where the young bass are raised to a length of three inches. From there they are transferred to growout pens for a three to four month stay. Then, having reached a length of eight to ten inches, they are released. Growout pens are located in Mission Bay and San Diego Bay with the capacity for nurturing over 50,000 juvenile white seabass annually (Hubbs-SeaWorld Research Institute 2014).

The total annual value of all San Diego County commercial landings from 2009-2013 is shown in Figure 22. As with the total California commercial fisheries value, the San Diego component increased steadily over the period. Also shown in Figure 22 is the proportion of San Diego County commercial landings from Mission Bay and San Diego Bay, which made up over seventy percent of all landed value of commercial fishery species in San Diego County.

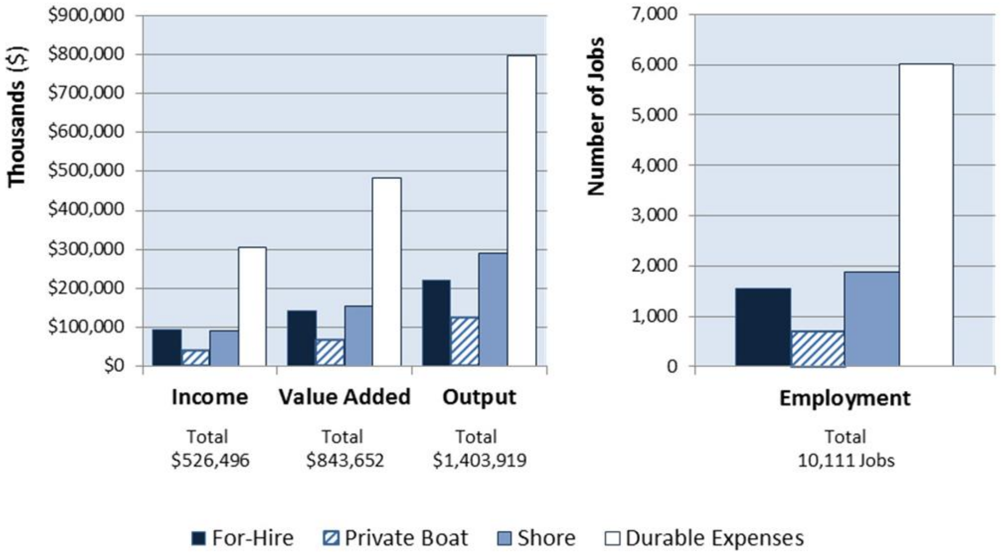
Figure 22. San Diego County Commercial Fisheries Value 2009-2013.



Recreational Fishing

Marine recreational fishing and diving activities along the San Diego coast include surf and shoreline fishing, pier fishing, party boat fishing, private boat fishing, snorkeling, and SCUBA diving. The direct economic impact of recreational fishing expenditures in California for the year 2011 totaled more than $1.4 billion and supported more than 10 thousand jobs (Figure 23, from Lovell et al. 2013) (NMFS 2014).

Figure 23. Economic Value of California Recreational Fishing in 2011.



In 2012, the most recent annual data available, recreational fishing in California sustained over 12,000 jobs (NOAA 2014f). The economic value of California recreational fishing in 2012 exceeded $1.7 billion (NMFS 2014)

The most common target species for beach fishing are barred surfperch, yellowfin croaker, opaleye, and jacksmelt (CMLPA 2009). Fishers from man-made structures catch Pacific mackerel, Pacific sardine, northern anchovy, queenfish, jacksmelt and other nearshore fish. Rented and chartered boat fishing seek offshore species, especially mackerel, croaker, bass, and rockfish (NOAA 2014f). There is a small contingent of operators specializing in half-day and 1-day charters that typically fish nearshore areas and kelp beds. These operators target sand and kelp bass and California halibut. Oceanside harbor has a few boats in this fishery while Mission Bay and San Diego Bay have larger charter fleets. Fishing occurs year-round, although effort markedly increases in the summer months, peaking in July.

Sport diving and spearfishing activities mostly occur in the nearshore waters, and the number of diving trips in San Diego in the early 1990s was about 30,000 per year (USACOE 2013). This rate has likely increased in recent years. Most diving occurs where marine life flourishes; especially in kelp beds and rocky areas. Some of the premier diving in San Diego includes trips to locations only accessible by boat, including the outer reaches of kelp beds, vessels intentionally sunk as artificial reefs in “Wreck Alley” off of Mission Beach, and offshore islands and banks. Shoreline diving is also popular.

Much of Point Loma is a military reservation with restricted shoreline access - thus shore fishing is limited and the vast majority of sport fishing is from boats. Typical species targeted by recreational anglers include rockfish, Pacific mackerel, kelp bass, sand bass, California barracuda, Pacific bonito, California sheephead, white seabass, California halibut, yellowtail, rockfish, and seasonal, migratory species like tunas.

Of all the California fisheries, the most profound changes in catch composition has occurred in the southern California private vessel and Commercial Passenger Fishing Vessel (CPFV) fisheries (Love 2006, Hackett et al. 2009). There has been a sharp decline in the numbers of rockfish caught, particularly bocaccio, olive rockfish, and blue rockfish. Once mainstays of the fishery, bocaccio, olive rockfish, and blue rockfish have practically disappeared from the recreational catch. This was likely caused by overfishing (recreational and commercial) coupled with 25 years of juvenile recruitment failure from suboptimal oceanographic conditions (Love et al. 1998a,b, Schroeder and Love 2002). During the same period, a number of warm-water species, such as yellowtail, Pacific barracuda, California scorpionfish, ocean whitefish, vermilion rockfish, and honeycomb rockfish became much more abundant. The most fundamental, recent change in the California fishing industry is the emergence of the private recreational vessel fleet, which is now the single largest component of the recreational fishery.

At Point Loma, the extensive kelp bed remains the primary focus of sport fishing. A flourishing commercial passenger and private fishing vessel fleet, based in San Diego Bay and Mission Bay, operates in the vicinity of Point Loma. CPFVs (commonly called party boats) provide bait, gear rental, food service, fish cleaning, and transportation to fishing grounds for paying passengers on half-day and full day trips. CPFVs mainly fish the outside edge of the kelp bed, as do the majority of private sport fishing boats (Wolfson and Glinski 1986, 2000).

Catch data (the number of fish caught) for the Commercial Passenger Fishing Vessel fleet in Mission Bay and San Diego Bay during 2009-2013 appears below in Table 14.

Table 14. Mission Bay and San Diego Bay CPFV Fleet Catch 2009-2013.

Common Name	**2009**	**2010**	**2011**	**2012**	**2013**
Barracuda, CA	21,759	11,719	11,336	9,844	6,240
Bass, kelp	64,856	24,080	38,597	36,494	11,573
Bass, sand	30,680	26,090	33,345	14,492	23,811
Bonito, Pacific	15,748	743	389	155	606
Cabezon	46	72	113	173	113
Croaker, white	396	246	424	875	671
Fishes, unspecific	3,809	4,377	4,593	6,398	7,530
Flatfishes, unspecific	34	56	27	4	5
Halibut, CA	459	462	289	613	448
Inverts, unspecific	699	4,913	1,037	8,465	4,919
Lingcod	1,689	2,793	3,177	2,954	4,033

Table 14. Mission Bay and San Diego Bay CPFV Fleet Catch 2009-2013.

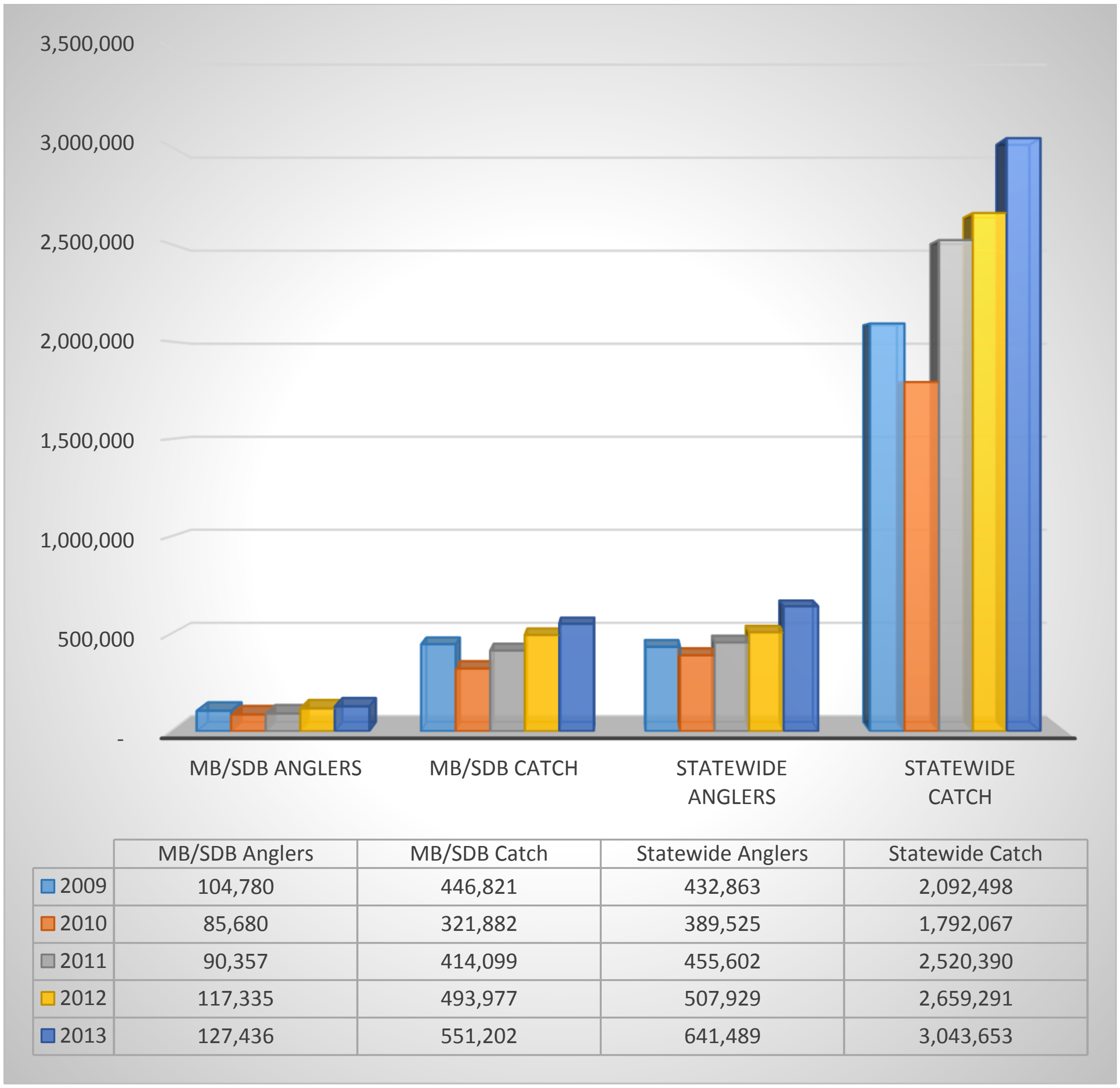
Common Name	**2009**	**2010**	**2011**	**2012**	**2013**
Mackerel, jack	0	299	90	20	227
Mackerel, Pacific	7,100	3,518	6,644	4,612	7,253
Other HMS	106,373	38,976	75,557	158,501	133,004
Rockfish, all	62,049	93,205	135,414	109,800	163,380
Sanddab	920	1,009	1,226	889	702
Scorpionfish, CA	20,788	13,765	15,015	8,386	11,915
Seabass, white	177	477	293	235	303
Shark, all	19	29	74	126	42
Sheephead, CA	2,206	1,740	4,164	3,332	2,765
Tuna, albacore	31,403	19,045	284	1,074	23
Whitefish, ocean	9,441	9,161	10,947	5,313	11,094
Yellowtail	66,447	65,105	71,063	120,583	160,468
TOTAL CATCH	**446,821**	**321,882**	**414,099**	**493,977**	**551,202**
Number of Anglers	104,780	85,680	90,357	117,335	127,436
Number of CPFVs	83	83	81	102	105
Catch/Angler	4.26	3.76	4.58	4.21	4.32

Source data: California Department of Fish and Wildlife.

The annual catch for the CPFV fleet reached a high of over half a million fish in 2013 while serving over 127 thousand anglers. The number of CPFVs in the Mission Bay/San Diego Bay area over the five-year period 2009-2013 increased from 83 to 105 with the catch per angler remarkably steady at about about four fish per trip.

Figure 24 shows a comparison of Mission Bay/San Diego CPFV fleet activity to the statewide CPFV fleet activity from 2009-2013. All catagories of activity increased over the period.

Figure 24. Mission Bay/San Diego Bay and Statewide CPFV Activity.



	MB/SDB Anglers	MB/SDB Catch	Statewide Anglers	Statewide Catch
🟦 2009	104,780	446,821	432,863	2,092,498
🟧 2010	85,680	321,882	389,525	1,792,067
⬜ 2011	90,357	414,099	455,602	2,520,390
🟨 2012	117,335	493,977	507,929	2,659,291
🟦 2013	127,436	551,202	641,489	3,043,653

The top 5 sport fish caught by the CPFV fleet at Mission Bay/San Diego Bay during 2009-2013 were rockfish, yellowtail, other highly migratory species, kelp bass, and sand bass (Table 15).

Table 15. Top 5 Mission Bay/San Diego Bay CPFV Fleet Species 2009-2013.

Common Name	**2009**	**2010**	**2011**	**2012**	**2013**
Rockfish, all	62,049	93,205	135,414	109,800	163,380
Other HMS	106,373	38,976	75,557	158,501	133,004
Yellowtail	66,447	65,105	71,063	120,583	160,468
Bass, kelp	64,856	24,080	38,597	36,494	11,573

Table 15. Top 5 Mission Bay/San Diego Bay CPFV Fleet Species 2009-2013.

Common Name	**2009**	**2010**	**2011**	**2012**	**2013**
Bass, sand	30,680	26,090	33,345	14,492	23,881

Source data: California Department of Fish and Wildlife.

The Recreational Fisheries Information Network (RecFIN) Program includes recreational fishing data from California, Oregon, and Washington. The Recreational Fisheries Information Network is a project of the Pacific States Marine Fisheries Commission (PSMFC) (PSMFC 2014). California data, available from 1980 to the present, represent the best available information regarding recreational catch off California. RecFIN incorporates data from two recreational fishery sampling programs—the Marine Recreational Fisheries Statistical Survey (MRFSS), which operated from 1980 to 2003, and the California Recreational Fishery Survey (CRFS) initiated by the Department of Fish and Wildlife in 2004.

The California Recreational Fisheries Survey (CRFS) is a statewide sampling program designed to collect catch/effort data on all modes of marine recreational finfish fishing. A collaborative effort of the California Department of Fish and Game and the Pacific States Marine Fisheries Commission, this survey provides information dating back to 1999. It includes data collected from CPFVs, harbors, marinas, piers, landings and from shore and other shore structures (PSMFC 2014). Table 16 shows the estimated marine recreational catch for all species of fish for the southern district (Los Angeles, Orange and San Diego counties) in 2013.

Table 16. Marine Recreational Fish Catch for Southern District in 2013.

Fishing Mode				
Man-made Structures	Beaches and Banks	CPFVs	Private and Rental Boats	District Total
489,440	256,505	1,327,829	205,031	2,278,805

Data source: Pacific States Marine Fisheries Commission

Because much of Point Loma is a restricted military installation, the proportion of recreational fishing from beaches and man-made structures is substantially reduced compared to the estimates for southern district shown above.

In recreational boat observations off Point Loma, Wolfson and Glinski (1986) found that fishing from private boats concentrated on the kelp bed (often mirroring CPFVs positions). This results in similar species being caught, with the exception of shellfish species (lobster, crab, rock scallops, and sea urchin) which are taken by sport divers in the nearshore zone.

Sport fishing by divers, both free-divers and SCUBA, at Point Loma also takes place in and around the Point Loma kelp bed. Abalone can no longer be collected, but lobster and scallops continue to be harvested (by hand) and a variety of fish are taken by spear. The rip rap boulders covering the outfall pipeline form an artificial reef providing good nearshore recreational fishery catch.

Recreational fishermen are allowed to catch lobster by hand when skin or scuba diving, or by using hoop nets. Historically, diving was the dominant recreational method for catching lobster in southern California, but hoop nets now account for more of the recreational lobster catch than divers (CDFW 2013a). Hoop nets can be deployed by divers and from boats. Kayaks are increasingly being used to fish for lobster using hoop nets.

Table 17 categorizes typical catch zones for recreational fisheries species caught in the vicinity of Point Loma.

Table 17. Typical Catch Zones for Recreational Species.

	SURFACE	MID WATER	BOTTOM
FISH			
Barracuda	X		
Bass, sand			X
Bass, kelp	X	X	X
Bonito	X	X	
Flatfish			X
Lingcod		X	X
Mackerels	X		
Rockfish			X
Scorpionfish			X
Sheephead			X
Tunas, all	X	X	
Whitefish			X
Yellowtail	X		
SHELLFISH			
Crab			X
Lobster			X
Sea snail			X
Sea urchin			X

Recreational fishing varies seasonally and is weather related, especially when fishing from boats, as is the case off Point Loma. Summer months have greatest fishing activity. Recreational fishing gradual increases throughout the calendar year beginning in March and ending in February.

RECREATIONAL ACTIVITIES

The embracing climate, beaches, bays, and temperate ocean waters of San Diego provide exceptional opportunities for marine recreation (Lew and Larson 2005). San Diego County in 2010 was home to more than three million residents primarily concentrated in the coastal regions (San Diego Association of Governments 2010). San Diego County, like the rest of southern California, had slower population growth in the 2000s due to the recession in the early part of the decade, but growth still occurred. The County experienced a net population increase of 10 percent between 2000 and 2010, and is expected to grow 42 percent by 2050 (San Diego Association of Governments 2010).

California is the number one travel destination in the United States. In 2012 there were over 32 million visitors to San Diego who spent nearly $8 billion dollars (San Diego Convention Center and Visitors Bureau 2014). The economic impact of the visitor industry on the San Diego regional economy was more than $18 billion dollars. Tourism accounted for 160,000 jobs in 2012, 1 out of every 8 jobs in San Diego County (San Diego Tourism Authority 2012). This put tourism in second place behind the research and technology sector which was the largest employer in San Diego County. The U. S. Military was the third largest employer.

All economic activities associated with coastal recreation are linked to good water quality. Protecting coastal uses such as swimming, surfing, boating, and fishing has a direct economic payoff. Burgeoning coastal recreation increases revenue flows to hotels, restaurants, and service industries.

California has some of the most popular beaches in the country. Over 150 million day visits are generated by tourists and residents, who use them annually to sunbathe, swim, wade, and surf (Hanemann et al. 2004, SWRCB 2014a). Beach visitors spend over $10 billion each year in California.

Ocean recreation at Point Loma includes aesthetic enjoyment, sightseeing, sunbathing, hiking, picnicking, tide-pooling, whale watching, boating, sailing, and sport fishing. These types of activities are designated as non-contact water recreation by the San Diego Regional Water Quality Control Board and are defined as “involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible” (SDRWQCB 2012).

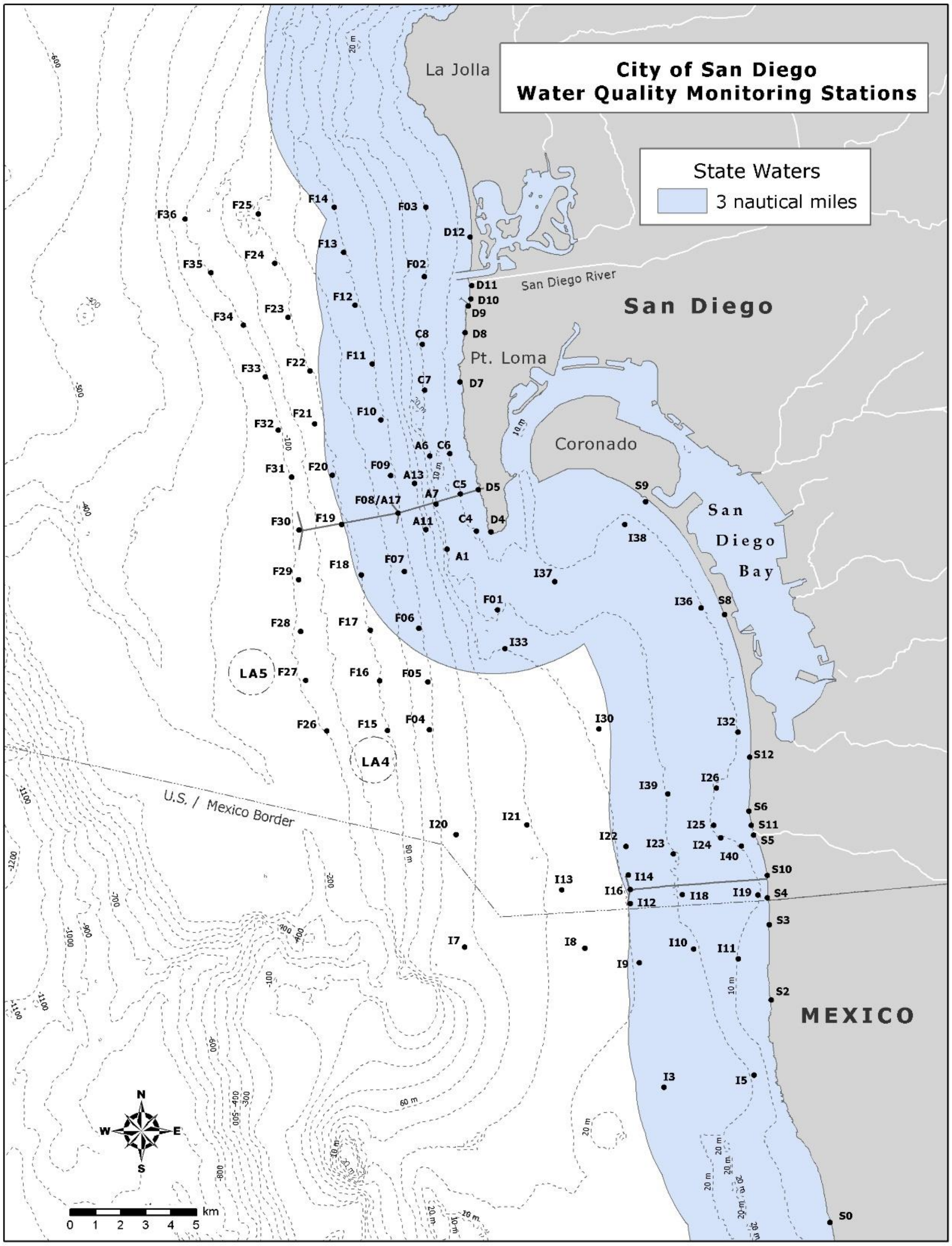
Ocean recreation off Point Loma also includes swimming and wading, skim boarding, water skiing and wake boarding, snorkeling, surfing, sail boarding, kite-sailing, kayaking, outrigger canoeing, paddle boarding, free diving, SCUBA diving, and personal watercraft (PWC) (jet ski) operation. These activities are designated by the San Diego Regional Water Quality Control Board as water contact recreation and are defined as “involving body contact with water, where ingestion of water is reasonably possible” (SDRWQCB 2012).

The only data on specific locations of recreational activity off Point Loma comes from field observations made in the mid 1980’s by Wolfson and Glinski (1986). They identified and plotted the position of individual boats and water craft during the summer of 1986. Most ocean recreation in the vicinity of Point Loma occurred in the nearshore area, with fishing and diving concentrated in the kelp bed and along its’ margins. Power boating and sailing were the only recreational activities observed with any regularity beyond the outer edge of the kelp bed (1 mi (1.6 km) from shore). The intensity of these recreational activities rapidly diminished with increasing distance offshore.

The territorial waters of the State of California extend to 3 nautical miles offshore (Figure 6). The United States Federal Government has exclusive jurisdiction from 3-12 nm offshore (DOALOS 2014). Although no studies have been conducted of recreational use in federal waters off Point Loma, information is available from observations of the crews of the San Diego Public Utilities Department's monitoring vessels. The monitoring vessels currently average about 200 or more days per year in the coastal waters of San Diego and have been active in the area for decades.

The Point Loma Wastewater Treatment Plant (PLWTP) ocean monitoring program conducts water quality sampling along 7.5 mi (12 km) of shoreline and at a grid of offshore stations extending from 5.4 mi (8.7 km) south of the outfall to 8.1 mi (13.1 km) north of the outfall (Figure 25). The offshore sampling stations range in depth from 30 ft (9 m) to 321 ft (98 m) and extend from .3 mi (.5 km) to 6.8 mi (11 km) from shore (Figure 25). Figure 25 shows the extent of California state waters (within 3 nm from shore) in blue.

Figure 25. City of San Diego Water Quality Monitoring Stations.



Large vessels, principally Navy and Coast Guard ships, commercial carriers (cargo transports, oil tankers, barges), and cruise ships generally transit the Point Loma area beyond 5 miles offshore. Most ship traffic funnels into and out of San Diego Bay well to the south of the outfall area. Recreational vessels (fishing and pleasure boats) in federal waters off Point Loma are usually heading to or returning from offshore fishing banks and islands. Power and sail boats traversing the Point Loma area generally cruise along the outer edge of the kelp bed and are rarely seen more than a mile and a half offshore.

Recreational fishing in Point Loma ocean waters takes place primarily in the nearshore zone and in the kelp bed area. The monitoring crews report occasionally seeing commercial passenger fishing vessels (Party Boats) and sport fishing craft as far out as the decommissioned outfall (2 mi offshore) but practically never further offshore.

Swimming, surfing, and snorkeling occur in shallow water, inside the kelp bed. The vast majority of PWC operators, water skiers, wake boarders, board sailors, kite boarders, kayakers, canoers, and paddle boarders are seen inshore of the kelp bed.

Recreational SCUBA diving off Point Loma is focused on the kelp bed, with dive boats rarely sighted beyond a mile and a quarter offshore. State waters transitions to federal waters at a bottom depth of about 260 ft (80 m) off Point Loma well beyond recreational SCUBA diving limits.

Table 18 shows where water contact recreation takes place off Point Loma, based on monitoring crew observations and information from this recreational use assessment. Virtually all swimming, surfing, diving, paddling, fishing from paddle craft, board sailing, water skiing, and PWC operation is confined to waters less than 2 nm from shore. The monitoring crews do not recall seeing a single incident of water contact recreational use occurring in federal waters.

Table 18. Water Contact Recreation in the Vicinity of Point Loma.

ACTIVITY	Inshore	Nearshore	Kelp Bed	Offshore State Waters		Federal Waters
	(depth 0 to 10 ft)	(depth 10 to 30 ft)	(to 100ft/1 mi offshore)	(1-2 nm)	(2-3 nm)	(3-12 nm)
Swimming and wading	X					
Skim boarding	X					
Water skiing and wake boarding	X	X				
Snorkeling	X	X				
Surfing	X	X				
Sail/Kite board	X	X	X			
Kayak/canoeing	X	X	X			
Paddle boarding	X	X	X	X		

Table 18. Water Contact Recreation in the Vicinity of Point Loma.

ACTIVITY	Inshore (depth 0 to 10 ft)	Nearshore (depth 10 to 30 ft)	Kelp Bed (to 100ft/1 mi offshore)	Offshore State Waters		Federal Waters
				(1-2 nm)	(2-3 nm)	(3-12 nm)
Free diving		X	X	X		
SCUBA diving			X	X		
PWC			X	X		

Overall, a number of factors combine to prevent water contact recreation from occurring in federal waters off the coast of Point Lorna, including:

- lack of diving or sporting attractions in the deeper offshore waters compared to nearshore waters,
- offshore water depths that extend well beyond the range of recreational divers,
- adverse wind and current conditions in open offshore waters that create dangers for personal watercraft and self-propelled craft,
- shipping lane traffic that creates dangers for small watercraft,
- haze and fog may limit visibility of the shoreline, and
- range restrictions (fuel-related or otherwise) associated with personal watercraft and self-propelled craft.

Swimming and Wading

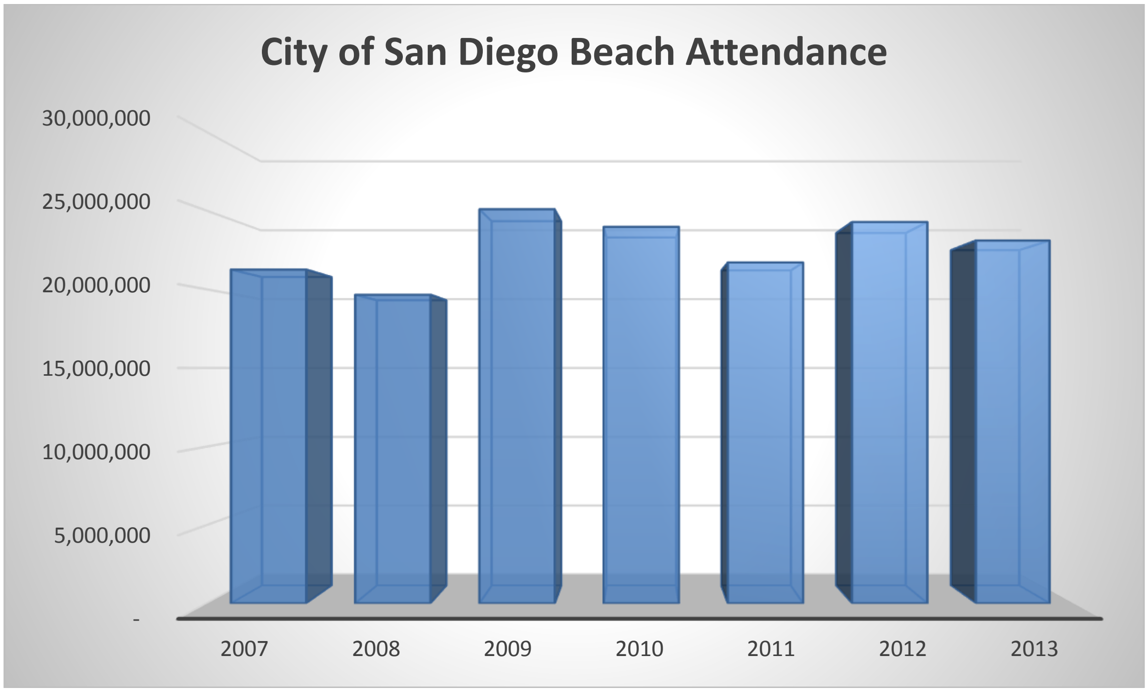
The majority of swimming and wading (walking through the water) in the vicinity of Point Loma takes place at Ocean Beach, about 6 mi (9.6 km) north of the Point Loma Ocean Outfall. Ocean Beach is a mile long, with several rock jetties and a public pier for strolling and fishing. Although some people swim at remote “pocket beaches” along Point Loma, Ocean Beach has virtually all the amenities sought by beach-goers - proximity to major highways, an expansive, gently sloping sandy beach with easy access, a large parking lot, showers, restrooms, a pavilion, and lifeguards.

Dog Beach, a sandy area at the north end of Ocean Beach, is one of only two San Diego 24 hour beaches where dogs are permitted without a leash. Dog owners are responsible for control and clean-up of their dogs. Standard dog laws apply on other portions of Ocean Beach and are strictly enforced. There is a restaurant and bait shop on the pier. Fishing from the pier does not require a fishing license, but catch regulations are enforced.

North of Ocean Beach, San Diego City Lifeguards also service Pacific Beach, Mission Beach, Windansea, La Jolla Cove, La Jolla Shores, and Black’s Beach (City of San

Diego 2014). Figure 26 plots annual beach attendance statistics for City of San Diego Beaches (United States Lifesaving Association 2014).

Figure 26. San Diego City Beaches - Attendance 2007-2013.



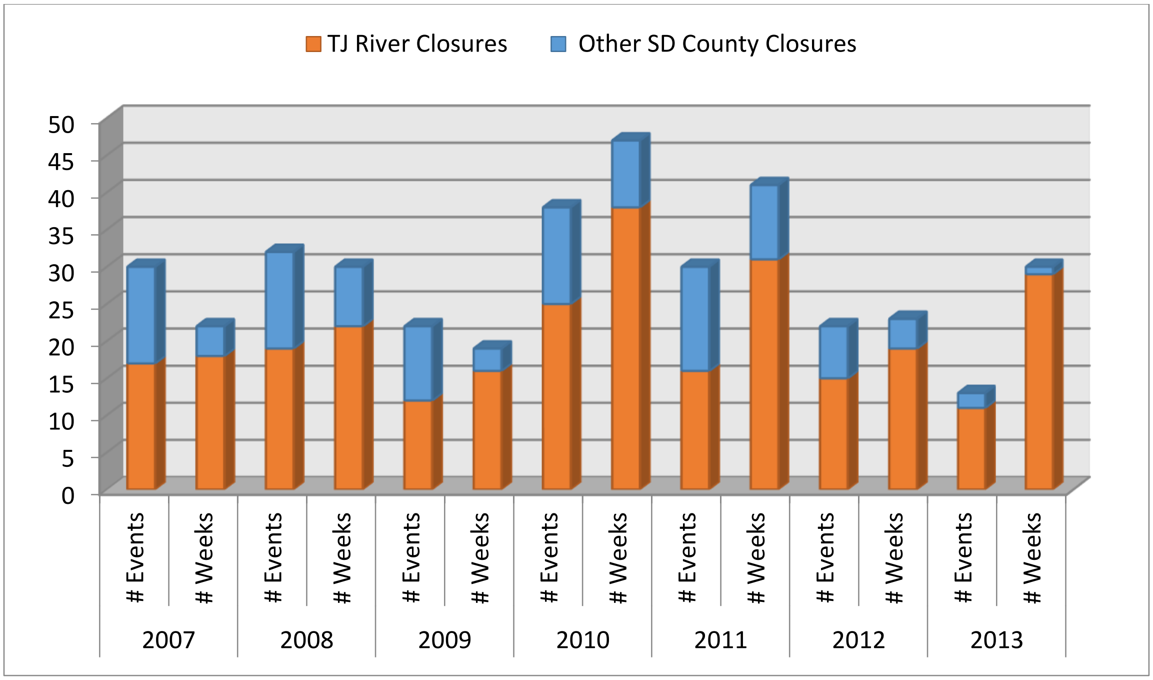
California has the most extensive and comprehensive monitoring and regulatory program for beaches in the nation (SWRCB 2014a). Monitoring is performed by county health agencies, publicly owned sewage treatment plants, other dischargers along the coastal zone, environmental groups, and numerous citizen-monitoring groups.

In San Diego County, the Department of Environmental Health monitors recreational beaches and informs the public when water quality standards are exceeded (County of San Diego 2014). This information, along with data from four other San Diego County agencies (the City of Oceanside, the City of San Diego, the Encina Wastewater Authority, and the San Elijo Joint Powers Authority) is used by Heal the Bay, a non-profit environmental group, to prepare an annual Beach Report Card™ (Heal the Bay 2014). Heal the Bay's Beach Report Cards summarize beach water quality information by grading monitoring locations from Humboldt County to San Diego County.

In the most recent Heal the Bay's Beach Report Card, beach water quality during summer dry weather in San Diego County was generally excellent. The Tijuana Slough at the Tijuana River Mouth (C grade) was the only location to earn a grade lower than an A or B. The County's water quality grades during winter dry weather were also excellent with 98% of monitoring locations receiving A or B grades.

The San Diego County Department of Environmental Health posts notices and closes beaches in San Diego County when monitoring indicates bacteria levels exceed state standards. During the past seven years, the vast majority of closure events and extended durations of closure were in the vicinity of the Tijuana River (Figure 27, from County of San Diego, Department of Environmental Health 2014 records). None of the beach closures were related to the operation of the Point Loma Ocean Outfall.

Figure 27. San Diego County Beach Closures 2007-2013.



The City of Imperial Beach is conducting a Bacterial Source Identification Study in the Tijuana River Watershed. The study will provide a detailed account of the sources, loads, and transport mechanisms of bacteria during both wet weather and dry weather conditions in the watershed.

Water quality standards to protect human health in recreational waters have traditionally been assessed by measuring the concentration of “indicator bacteria” to infer the presence of fecal matter and associated fecal pathogens. Fecal matter originates from the intestines of warm-blooded animals, and the presence of fecal bacteria in surface waters is used as an indicator of human pathogens that can cause illness in recreational water users (Boehm and Soller 2013, Harwood et al. 2013, EPA 2014c). Indicator bacteria may not cause illness themselves, but have been linked to the presence of harmful pathogens (Arnold et al. 2013, EPA 2014d). Indicator bacteria are used as a surrogate for human pathogens because they are easier and less costly to measure than the pathogens themselves.

With the exception of short-term sewage spills and the chronic contamination emanating from the Tijuana River, elevated bacteriological levels at beaches in San Diego County appear to come from sources unrelated to the offshore discharge of treated sewage. Beaches in San Diego with “compromised” water quality are located downstream of watersheds. Bacteria entering estuaries, bays, and the ocean originate from a wide variety of sources including natural sources such as feces from aquatic and terrestrial wildlife, and anthropogenic sources such as sewer line breaks, leaking septic systems, pets, trash, and homeless encampments. Once in the environment, bacteria also re-grow and multiply (City of San Diego and Weston Solutions 2004, Martin and Gruber 2005, City of San Diego and Weston Solutions 2006, McQuaig et al. 2012, Griffith et al. 2013).

During wet weather, wash-off of bacteria from land is the primary mechanism for transport of bacteria from land into the ocean (Griffith et al. 2010, Imamura et al. 2012). During dry conditions, streams in urban areas may sustain a flow even if no rainfall has occurred. These flows result from land use practices that generate urban runoff, which enters storm drains and creeks and carries bacteria into the receiving water.

The San Diego Regional Water Quality Control Board in conjunction with other regulatory agencies and local research organizations investigated bacteriological water quality at “reference beaches” with upstream watershed consisting of at least 95 percent undeveloped lands. Because the reference beach drainage area consists almost entirely of undeveloped land, bacteria washed down to the beach come from natural, non-anthropogenic sources. Measurements during the 2004-2005 winter season showed that at four reference beaches (two in Los Angeles County, one in Orange County, and one in San Diego County) 27 percent of all samples collected within 24 hours of rainfall exceeded water quality standards for at least one indicator bacteria (i.e., a single sample bacteriological threshold was exceeded 27 percent of the time) (Schiff et al. 2005). Thus, lack of compliance with bacteriological standards at beaches downstream of watersheds is likely related to natural sources as well as anthropogenic ones.

The only shoreline sampling stations along Point Loma that have continuing episodes of non-compliance with water contact bacteriological standards (D 8-D 11 - Figure 25) are located over seven miles from the Point Loma Ocean Outfall in the vicinity of the San Diego River (COSD 2008-2014). Results of the long-term, comprehensive City of San Diego bacteriological monitoring program indicate that the Point Loma Ocean Outfall wastewater plume rarely, if ever, contacts the shoreline. Indicator bacteria detected at Ocean Beach adjacent to the San Diego River are derived from natural and urban sources washed off the land and transported to the area by freshwater flows. Thus, any public health risk along the Ocean Beach shoreline would be associated with exposure to pathogens transported from land, not from the ocean discharge of wastewater over seven miles away.

Skim-boarding

A popular activity among the young, skim boarding involves running along the water’s edge and jumping onto a short flat board to skim atop a thin layer of wave-washed water over the sand. Newer boards and the growing popularity of “tricks” have more enthusiasts skimming toward breaking waves, launching into the air, and landing in water (up to a few feet deep) just beyond the beach. This activity is limited to gradually sloping sandy beaches, occurring, in the Point Loma area, mainly at Ocean Beach.

Surfing

About a third of all U. S. surfing occurs in California (NOEP 2005). With its warm climate and waters, San Diego is an especially popular California surfing venue.

Surfing employs a surf board of some type to ride waves - boogie board, surfboard, belly board, knee board, or standup paddle board. Sandy bottom beach breaks in the vicinity of Point Loma, Ocean Beach pier, and the San Diego River channel jetty attract surfers year-round. Farther south along Point Loma, the Sunset Cliffs reefs provide good surfing for experienced surfers. Because waves break in water depths approximately equal to their height, the majority of surfing at Point Loma takes place over depths considerably less that 15-20 ft, and well inside of the shoreward boundary of the kelp bed (½ mile offshore). When low spring tides coincide with large swells, surfers may wait for waves as far out as the inner edge of the Point Loma kelp bed.

A relatively new type of surfing, tow-in surfing, employs a PWC to pull surfers into larger waves peaking offshore well before they become steep enough to break. Once the surfer feels the push of the wave, the tow line is released, the PWC veers off, and the surfer rides the wave like a paddle-in surfer. This type of surfing is rarely observed in the vicinity of Point Loma.

Standup paddle board surfing brings yet another variation to surfing in California (Guisado and Klaas 2013). Participants use longer boards, usually in the 9-12 ft range, and a specialized, extended paddle. Unlike regular surfing in which a surfer lies prone while paddling and jumps up to ride, standup boarders paddle out to the break standing on their board. Waves are also caught standing and the paddle is used for balance and to assist in turning the board. This type of surfing is relatively uncommon off Point Loma.

Sailboarding and Kiteboarding

Sailboarding, sometimes called windsurfing, is a surface water sport that combines elements of surfing and sailing. It uses a board usually 7-10 foot-long powered by wind on a sail. Kiteboarding use a shute or kite on a long set of control lines rather than a sail to harness the wind. Like sailboarders, kite boarders use a board, more like a ski-board or snowboard rather than a surf or sailboard, to carve and skim along the water's surface and get airborne launching off the face of waves. Sailboarders and kite surfers prefer many of the same beaches popular with surfers, although they tend to be on the water when the weather is less ideal for surfers (i.e. windy). The sport was founded over three decades ago in France. Interest in the sport in the U. S. accelerated about 15 years ago with improvements in equipment and the advent of articles and magazines dedicated to the sport. Classes are offered at various San Diego locations including the Mission Bay Aquatic center. Both sports can be pursued in bays and large enclosed bodies of water, but the ultimate thrill comes with ocean boarding involving wave riding and jumping. Like sail boarding, kite boarding requires easy access to the shore. The steep stairs and cliffs along Point Loma are not conducive to the sports and participants generally prefer long sandy beaches and relatively kelp-free waters so high speeds can be attained. Sail and kite boards can be deployed from boats, but this is infrequent. Therefore, sailboarding and kiteboarding are not well represented in the immediate vicinity of Point Loma.

Kayaking, Surf Ski and Outrigger Canoeing

Ocean kayaking is rarely observed in the vicinity of the Point Loma. The steep bluffs eliminate the possibility of beach launching, so kayakers must reach the area by larger pleasure boats or by paddling from Ocean Beach, San Diego Bay or Mission Bay harbor. Though uncommon, some sport fishing from kayaks does take place at the northern and southern ends of the Point Loma kelp bed, and the occasional surf kayaker is observed riding waves in the surf zone.

Kayakers participate in the Bay to Bay ocean race mentioned in the outrigger canoe section below. The route taken varies depending upon ocean swell conditions and race strategy; some participants remain shoreward of the kelp bed while others take a route beyond the kelp bed.

Surf skis are similar to kayaks, however, the vehicle used is a cross between a surfboard and a kayak. The rider sits in an indentation on the board rather than within its confines. Most surf skiers ride waves like surfers, but many simply paddle for enjoyment and in competition. Competitions usually involve other classes of craft, such as canoes and kayaks. They may take place in offshore ocean waters over routes covering many miles.

With approximately 24 clubs in southern California, outrigger canoeing is a popular aquatic team sport in California. There are four outrigger canoe clubs in Mission Bay with several hundred male and female active members. One to 6 person Polynesian-style canoes are used with an “ama” or outrigger on the left side. Clubs have divisions for ages 12 and under all the way up through men and women’s Senior Masters (45 and older). They practice several times a week and participate in local, regional and, international races. Most practice sessions and local races are within the confines of the bay, but some practices and races venture into the ocean from Mission Bay harbor, and may go out as much as 3 mi offshore.

In San Diego, the longest local ocean race is the annual Bay to Bay Race. Running from Mission Bay to San Diego Bay and held in mid-to-late summer, the Bay to Bay Race draws between 100 to 200 participants and every kind of paddling class including kayaks. The actual race routes depend on prevailing weather and swell conditions. When ocean swells are large, paddlers opt for the outside the kelp bed route, when calm conditions prevail most competitors take a more direct, inshore of the kelp bed, route. Other events exit Mission Bay, head to sea in the direction of Crystal pier in Pacific Beach, and then return to finish inside Mission Bay.

Outside of organized competitions, kayaking and canoeing are only infrequently observed off Point Loma. However, some fishing from kayaks, surf skis and canoes is seen at times in and around the kelp bed during summer.

Paddleboarding

Paddleboards are specialized large surfboards (usually about 14 ft) used for paddle races. Some organized races are open water ocean courses of 16 mi or more. Most popular in the waters off Hawaii, paddle races do occur in California waters, notably, the Catalina Island and the San Onofre races and some long distance races between various San Diego piers, and between San Diego and Mission Bays. Some practice paddling takes place in the vicinity of the Point Loma kelp bed. During summer, paddle boarders may fish near shore or in and around the kelp bed; but, this activity is infrequent.

Water Skiing and Wake Boarding

Although water skiing and wake boarding are popular activities in San Diego as a whole, they are not often seen in the vicinity of Point Loma. Both activities usually remain within the confines of either Mission Bay or San Diego Bay. The ocean waters only rarely offer the smooth surface preferred by skiers, and as the name implies, wake boarders perform their maneuvers on the wake of the towing vessel, or the wake caused by another vessel. In the past the tow vessel was always a boat. Today, with larger more powerful PWC (discussed below) wake boarders can venture into the ocean and make use of ocean swells in the surf zone in a manner similar to tow-in surfers.

SCUBA, Snorkeling, and Free-diving

The abundant and diverse marine life, an array of dive charter boats, and year-round temperate weather make southern California one of the world's great diving destinations. Recreational divers of all types frequent both natural habitats such as reefs, seamounts and kelp beds such as those off Point Loma, and artificial habitats.

Readily accessible by boat from San Diego Bay and Mission Bay, the Point Loma kelp bed and reef is one of the premier dive spots in southern California (Wolfson and Glinski 1986, Krival 2001, Sheckler and Sheckler 2008). Underwater photography is increasingly popular, and has far surpassed hunting for game species. Some divers spearfish for sheephead, rockfish, bass, flatfish, wrasses, bonitos, amberjacks, barracudas, and sculpins. Harvesting of lobsters, sea urchins, rock scallops and other invertebrates is permitted in some areas, such as the Point Loma kelp forest, and prohibited in others, such as the La Jolla Cove Marine Preserve.

Artificial marine habitats off southern California are also popular, particularly among SCUBA and free divers (Reed et al. 2006). These habitats include shipwrecks, artificial reefs composed of concrete rubble, Navy towers, oil and gas platforms, and even airplane wrecks. Underwater substrates quickly become encrusted with marine life and attract a wide assortment of marine species including predatory migratory species (Broughton 2012, McKinney 2013).

Wreck Alley (described in the artificial reef section) is one of the most popular diving destinations off San Diego. Located just offshore of Mission Bay, Wreck Alley showcases the remains of several vessels that were scuttled in order to benefit divers and serve as artificial reefs, including the *Ruby E*, ex-HMCS *Yukon*, *Shooter's Fantasy*, and *El Rey*.

Also located offshore of Mission Bay is the Naval Ocean Systems Center Tower, a Naval research station that collapsed in a storm in 1988. At an average depth of 30 ft (9 m), this site is suitable for divers of all skill levels including snorkelers. Off San Diego Bay are two additional shipwrecks, the ex-USS *Hogan* (a destroyer) and *S-37* (a submarine), which were used as Naval bombing targets during WWII.

The popularity of SCUBA diving in San Diego is affected by economic and meteorological conditions. During good economic times and mild weather, the number of people learning to dive and the frequency of diving by certified divers increases. When rough, low light or cold conditions prevail, SCUBA activity subsides. The usual maximum range of recreational SCUBA divers is about 100 ft, but most dives are made in 40-70 ft depths.

Snorkeling generally takes place much closer to shore in shallow waters, usually 8-15 ft deep, and perhaps out to 20-30 ft depths in the vicinity of Point Loma. Some limited snorkeling does occur within the Point Loma kelp bed, however, this activity has declined greatly since the ban on abalone harvesting from all waters south of San Francisco went into effect.

Pendleton and Rooke (2006) estimate that SCUBA diving in California generates on the order of $138 million to $276 million in annual gross revenues, and the potential magnitude of expenditures associated with snorkeling is similar. They estimate the non-market use value for California divers at between $21 million and $69 million annually and a range of $19 million to $115 million for snorkeling.

Freediving, breath hold deep-diving, is similar to snorkeling but involves greater depths and frequently, hunting for game. Just after WWII, a close knit group of skin divers in San Diego known as the "Bottom Scratchers" began skin diving in the La Jolla-Point Loma area. They made their own gear and, initially, their primary goal was seeking game. Freediving has since evolved into a unique sport with specialized but minimal gear. Freedivers hunt game, particularly large fish, in deep and sometimes open blue water. It is a hardy pursuit for a small group of well-conditioned individuals. There are numerous freedive clubs around the nation, with one in San Diego. They have meets and competitions for their members and with other freedive clubs from outside the area. Experienced freedivers dive in excess of 40 ft to spear game. Some freediving takes place in and around the Point Loma kelp bed. Freediving also includes the extreme sport of competitive apnea diving where divers attain great depths without use of an underwater breathing apparatus. The "no limits" (wear any weight & weight drop permitted, sled use OK, balloons OK for ascent) free-diving world record currently stands at 702 ft.

Wolfson and Glinski (1986) estimated about 5,000 SCUBA dives occurred annually in and around the Point Loma kelp bed. Other types of diving in the area are limited.

Jet Skiing/Personal Watercraft

Jet skiing, or personal water craft boats (PWC), developed over the past two decades. Jet skiing is a generic term for all forms of personal, motorized watercraft including the traditional Jet Ski with a single rider, now replaced by larger more powerful PWC capable of carrying more than one rider. PWCs have gasoline-powered engines and use water jets for propulsion.

PWC are infrequently seen off Point Loma. Access limitations and use restrictions tend to confine personal watercraft activity to areas of San Diego and Mission Bay and their harbor entrances. PWC are prohibited in the nearshore zone off Cabrillo National Monument and anywhere near bathers, swimmers, or surfers. Since beach access is not feasible, personal watercraft must come from San Diego or Mission Bay. Rarely, PWC are launched from large pleasure boats anchored offshore. PWC use is not common off Point Loma.

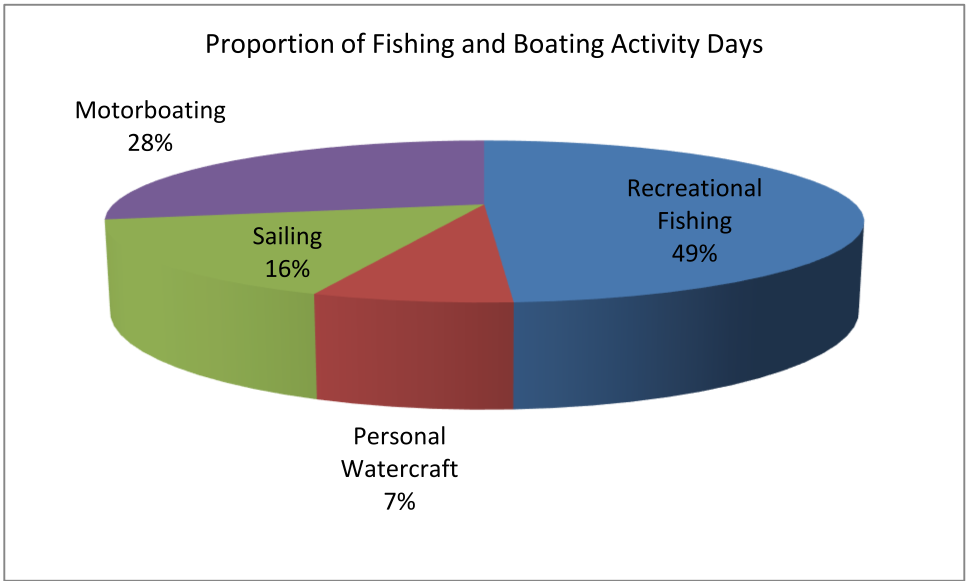
Tidepooling

Tidepooling is a popular recreational activity at Point Loma. The Mia J. Tegner State Marine Conservation Area, at the southern tip of Point Loma at Cabrillo National Monument, is the focal point of tidepooling in the area. It is estimated that about one hundred thousand people per year visit the Cabrillo National Monuments' tide pools (Engle and Largier 2006). Another "easy access" point to the rocky shoreline is the stairs at the foot of Ladera Street and Sunset Cliffs Boulevard. From there, the level of tidepooling activity diminishes rapidly both north and south with increasing distance from the stairs.

Boating and Sailing

Boating and sailing are popular throughout coastal California. In 2000, more than 2.7 million fishers participated in more than 20.3 million recreational fishing activity days along the California coast, while more than 4 million people participated in marine boating related activities. California had the largest number of marine fishers and sailors, while it was ranked second, behind Florida, in motor boating in the U. S. The proportions of different boating and fishing related activities are depicted in Figure 28 (NOEP 2005).

Figure 28. Boating Related Activity in California.



The waters in and around San Diego Bay are an internationally recognized venue for competitive yachting. In 1995, the America's Cup regatta was held in waters offshore of San Diego Bay. Competitive sailors from a number of different countries frequently practice along the offshore racing course. Inside the bay, a regatta course is located in open waters to the west of Naval Station San Diego. Within San Diego Bay there are 23 public marinas, seven private yacht clubs, four free boat launch ramps, six boatyards, and thousands of docks and anchorages (Recreational Research 2014, San Diego Waterfront 2014). Recreational boat berthing areas are found mainly at Shelter Island, Harbor Island, The Embarcadero, Glorietta Bay, Coronado Cays, and Chula Vista. In addition, Mission Bay has 4 public launch ramps, nine public marinas, a yacht club and over a thousand boat slips.

Most ocean boating near San Diego and Mission Bays takes place in and around the Point Loma kelp bed (fishing and diving), and sail and power boats traverse the area 1-1.5 mi offshore just beyond the outer edges of the kelp bed while traveling between San Diego and Mission Bays.

Whale Watching

Gray whales (*Eschrichtius robustus*) migrate through San Diego’s coastal waters twice yearly on their way between summer feeding grounds off Alaska and calving areas in the coastal lagoons of Baja California. The major migration route through southern California is between the mainland and the offshore islands. The whales tend to swim closer to the shore during February and March on their northward migration when calves are present, than on the southward migration during December and January. At Point Loma they traverse the offshore waters from the outer edge of the kelp bed, about 1 nm offshore, out to the horizon.

Private boats and commercial passenger vessels venture out from San Diego Bay and Mission Bay to watch the whales. As of 2014, 12 charter companies ran whale watching tours (using a wide variety of sail, paddle, and powerboats) (San Diego Convention Center and Visitors Bureau 2014). Kayakers also venture out from shores to observe whales.

During warm, calm, winter and spring weekends, dozens of boats may be seen off Point Loma observing whales. The National Marine Fisheries Service, the agency responsible for protecting gray whales under the Marine Mammal Protection Act, has issued guidelines for safe, non-disruptive whale watching (NMFS 2011a). Vessels are to go no faster than a whale or group of whales while paralleling them within 100 yards and do nothing to cause a whale to change direction. The guidelines also state that a whale’s normal behavior should not be interrupted and that doing so constitutes illegal harassment. In season, whale watching vessels regularly ply the waters off Point Loma.

Cruising

Another increasingly popular form of ocean adventure is a voyage on a cruise ship. As of 2014, over 190 cruise ships dock annually at San Diego's two Cruise Ship Terminals (POSD 2014a). The Holland America Line, Royal Caribbean International, and Celebrity Cruises homeport in San Diego. San Diego is visited by cruise ships with itineraries that include Mexico, Hawaii, the Caribbean, and even distant locales such as Tahiti. Cruises are designed to please people of all ages and have varying lengths of cruises.

OTHER BENEFICIAL USES

Marine Protected Areas

Marine Protected Areas (MPAs) are discrete geographic marine or estuarine areas seaward of the mean high tide line or the mouth of a coastal river, including any area of intertidal or subtidal terrain, together with its overlying water and associated flora and fauna, that have been designated by law or administrative action to protect or conserve marine life and habitat (California Fish and Game Commission (CFGC) 2010, CDFW 2013b). There are two types of state MPAs in southern California: State Marine Reserves (SMRs) and State Marine Conservation Areas (SMCAs) (CDFW 2014i).

California also has dedicated Areas of Special Biological Significance (ASBSs) that the California State Legislature has defined as having biological communities of such extraordinary value that no risk of change in their environment can be entertained (SWRCB 2014b). The California Ocean Plan prohibits discharge of waste into an ASBS and requires that outfalls be located at a sufficient distance away from an ASBS to assure the maintenance of natural water quality conditions (Raimondi et al. 2012, SWRCB 2012b).

In addition, California State Water Quality Protection Areas (SWQPAs) are designated to protect marine species or biological communities from an undesirable alteration in natural water quality (SWRCB 2012b). All Areas of Special Biological Significance (ASBS) that were previously designated by the State Water Board are now also classified as a subset of State Water Quality Protection Areas and require special protections afforded by the California Ocean Plan.

Six ocean MPAs are within 15 mi (13 nm) of Point Loma:

The Tijuana River Mouth State Marine Conservation Area extends along the shoreline from Imperial Beach 2.3 mi (3.7 km) south to the Mexican Border and offshore to a depth of 55 ft (17 m). It is geographically connected with Tijuana River National Estuarine Research Reserve and the Tijuana Slough National Wildlife Refuge creating the most intact contiguous estuarine/marine complex in southern California. The Tijuana River Mouth SMCA includes a river mouth delta, soft sediment sea floor, a large cobble reef, and a flourishing kelp bed. Taking all living marine resources is prohibited, except recreational take of coastal pelagic species (except market squid, by hand-held dip net only) and commercial take of coastal pelagic species (except market squid, by round haul net only).

The Cabrillo State Marine Reserve extends 1.3 mi (2 km) along the southern Point Loma shore and out to a depth of 30 ft (6 m). It incorporates the previously established Mia J. Tegner Point Loma State Marine Conservation Area. The Cabrillo SMR includes a nearshore portion of the Point Loma kelp bed, along with rocky, sandy beach and intertidal habitat, surf grass, and shallow rock reef habitat. It is adjacent to and contiguous with the Cabrillo National Monument. Take of all living marine resources is prohibited. The seaward boundary of the Cabrillo SMR is approximately 4.2 mi (6.8 km) inshore from the Point Loma outfall.

South La Jolla State Marine Conservation Area lies adjacent to and west of the South La Jolla SMR and extends to the limit of state jurisdiction (3 nm (5.6 km) offshore) in depths from 176 to 274 ft (54 to 84 m). The South La Jolla SMCA has a shared northern and southern boundary with the South La Jolla SMR Reserve: from Palomar Avenue in La Jolla to Diamond Street in Pacific Beach, encompassing 2 mi (3.2 km) of shoreline. The recreational take of pelagic finfish, including Pacific bonito, by hook and line is allowed within the SMCA.

South La Jolla State Marine Reserve is adjacent to and east of the South La Jolla SMCA with a shared northern and southern boundary: from Palomar Avenue in La Jolla to Diamond Street in Pacific Beach. It ranges in depth from 0 to 176 ft (0 to 54 m). The recreational take of pelagic finfish, including Pacific bonito, by hook and line is allowed within the SMR.

Matlahuayl State Marine Reserve is just north of Point La Jolla. It has an alongshore span of 1.2 mi (1.9 km) with depths ranging from 0 to 331 ft (101 m). Approximately 13.8 mi (12 nm) north of the Point Loma Ocean Outfall, the Matlahuayl SMR protects near-shore habitat that supports research activities of the Scripps Institution of Oceanography. It encompasses the San Diego-La Jolla Ecological Reserve Area of Special Biological Significance. This is the closest ASBS/SWQPA to the Point Loma Ocean Outfall. The other ASBS/SWQPA in San Diego County is part of the San Diego-Scripps Coastal State Marine Conservation Area to the north. The Matlahuayl SMR is part of the 5,977 acre (9.3 mi2) San Diego-La Jolla Underwater Park which was dedicated by the San Diego City Council in 1970 to protect the natural ecology and environment. The Park extends from Alligator Point in La Jolla north to Del Mar and out to a distance of 8,000 ft (2,438 m) from shore. All take of living marine resources is prohibited.

San Diego-Scripps Coastal State Marine Conservation Area is adjacent to and north of the Matlahuayl SMR. It spans 1.1 mi (1.8 km) of shoreline and extends across depths of 10-366 ft (3-112 m). It incorporates the San Diego Marine Life Refuge adjacent to Scripps Institution of Oceanography. In 1929, the California State Legislature granted the University of California “sole possession, occupation, and use” of the intertidal zone and subtidal zone to 1,000 ft offshore along the 2,600-ft oceanfront of the Scripps Institution of Oceanography (SIO). This area was designated as the San Diego Marine Life Refuge in 1957 and was included in the University of California’s Natural Reserve System in 1965. It is also part of the San Diego-La Jolla Underwater Park and incorporates the San Diego-Scripps ASBS/SWQPA. Take of all living marine resources in the San Diego-Scripps Coastal SMCA is prohibited except for the recreational take of coastal pelagic species and market squid, by hook-and-line. Officers, employees, and students of the University of California and may take, for scientific purposes, invertebrates, fish, or specimens of marine plant or algae under the conditions prescribed in a scientific collecting permit issued by the CDFW.

Research and Education

Underwater research has been conducted in the Point Loma kelp bed since the mid 1950’s when Wheeler North of the California Institute of Technology and his associates at SIO began long-term investigations of kelp bed ecology (Neushul 1959, North 1964, North and Hubbs 1968). Professors Paul Dayton and associates at SIO have done ecological surveys at fixed locations in the Point Loma kelp bed since 1971 (e.g., Dayton and Tegner 1984, 1990, Dayton et al. 1992, 2003, Tegner et al. 1995, 1996, 1997, Tegner and Dayton 1987, 1991, Steneck et al. 2002, Graham 2000, 2004, Hewitt et al. 2007, Parnell and Riser 2012, Parnell et al. 2005, 2008, 2010). Their descriptive and experimental studies have established a database unique in the world. They have demonstrated that large-scale, low-frequency episodic changes in oceanographic climate ultimately control kelp forest community structure. Local biological processes, like recruitment, growth, survivorship, and, reproduction, may be driven by small-scale ecological patterns. But, decade-long shifts in climate (between cold water, nutrient-rich La Niñas and warm water, nutrient-stressed El Niños) and rare but catastrophic storms have been the principal forces governing the diversity and productivity of the kelp forest community at Point Loma.

The Point Loma kelp bed also serves as a site for SIO and San Diego State University graduate student research (e.g., Neushul 1959, Gerodette 1971, Deysher 1984, Graham 2000, Mai and Hovel 2007), and for ongoing unpublished research on CA spiny lobster movements in the Point Loma kelp bed by Hovel, Lowe, Loflen, and Palaoro.

Cabrillo National Monument’s intertidal community has been studied since the 1970s and investigations continue today (Becker 2006, Engle and Largier 2006, Fenberg and Roy 2012). Diver surveys and fish collections have also been conducted in the Monument’s 128 acre administrative waters which extend out to 900 ft from shore and encompass the Mia J. Tegner SMCA (Craig and Pondella 2005). Within the Monument’s administrative waters 100 species of macroalgae (Miller 2005), 247 species of marine invertebrates (National Park Service (NPS) 2006), and 48 species of fish have been recorded (Craig and Pondella 2005). The fish assemblage is typical of the southern California rocky mainland coast, and the overall richness is comparable to similar habitats in the San Diego region (NPS 2006). The Cabrillo National Monument Intertidal Monitoring Program began in 1990 and continues twice/year coinciding with extreme low tides during spring and fall. Thirteen key taxa are monitored near shore and in the kelp, and, birds and visitors are also counted. Students from schools throughout San Diego County make field trips to the Cabrillo National Monuments’ tide pool areas. An estimated one hundred thousand people visit the Cabrillo National Monuments’ tide pools annually (NPS 2014).

The Point Loma Ocean Outfall Monitoring Program provides an extensive database on marine water quality and marine biology beginning with pre-design studies in 1958-59. The monitoring program at Point Loma was not intended to be a research program, but, instead, was established to determine compliance with local, state, and federal environmental regulations. Even so, the monitoring program has generated data with considerable utility for scientific inquiry. For example, Conversi and McGowan (1992) analyzed 15 years of water transparency data at 7 monitoring stations to evaluate the influence of anthropogenic influences (sewage discharge) and natural oceanographic events. They concluded that anthropogenic activities had not affected transparency, while natural factors such as seasonality and distance from the coast had.

The La Jolla ocean area to the north of Point Loma is a major focus of research and education in San Diego. The Scripps Institution of Oceanography, one of the nation’s premier oceanographic training institutions, studies physical, chemical, and biological aspects of the marine environment; research aimed at understanding how two-thirds of the planet functions (SIO 2014). The longest continuous measurements of oceanographic parameters (salinity, temperature, biomass, nutrients, etc.) anywhere in the world have been taken in this area. La Jolla waters are used to calibrate and test ocean instruments developed for deployment throughout the world.

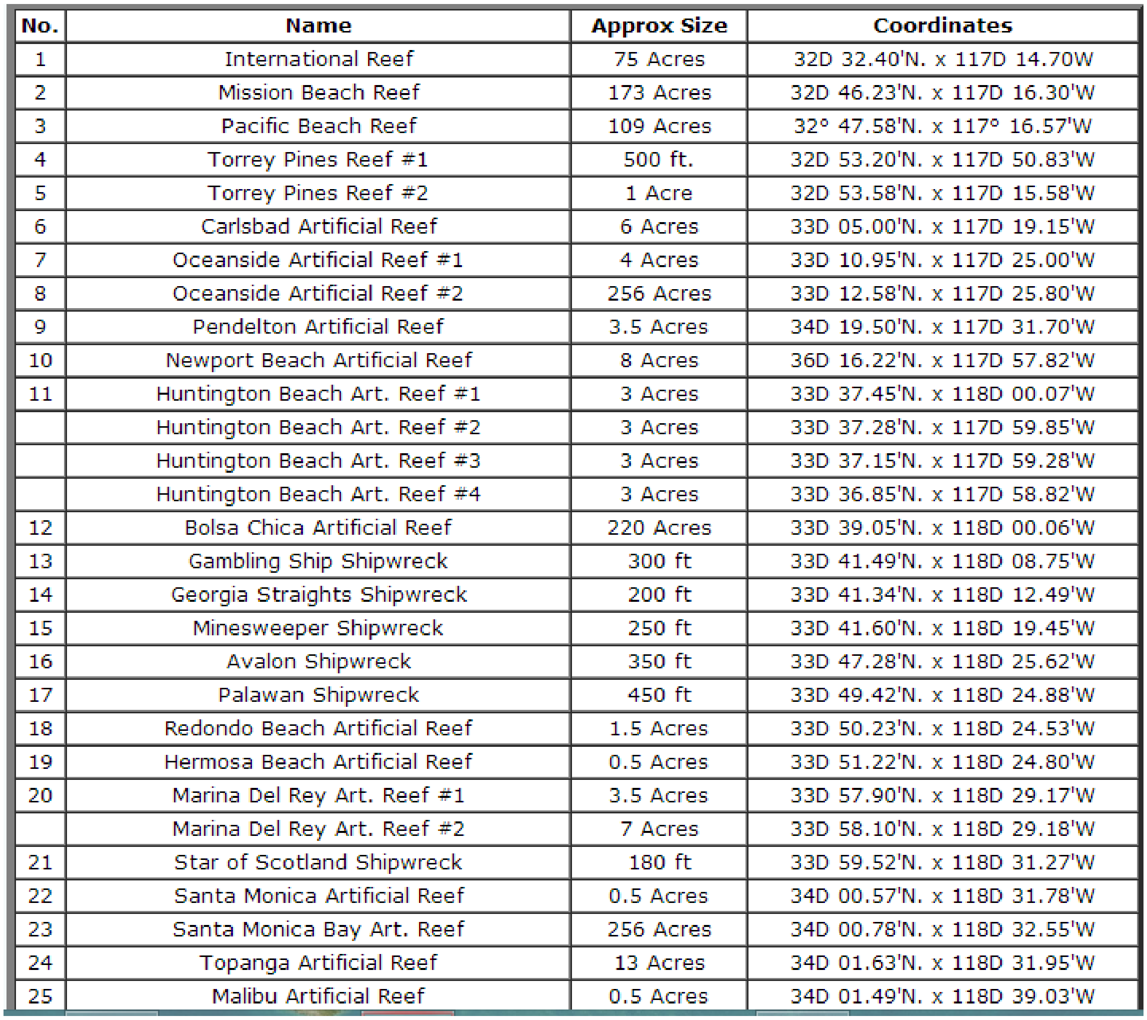
The United States National Marine Fisheries Service has a major marine center in La Jolla. San Diego State University, the University of San Diego, and the Hubbs/Sea World Research Institute all have ocean studies programs in the San Diego area. The Environmental Science Division of the Naval Command, Control and Ocean Surveillance Center, San Diego, conducts ecological research in San Diego Bay and occasionally off Point Loma.

The Marine Mammal Systems Division of the U.S. Navy Space and Naval Warfare System Center on Point Loma conducts a wide variety of research on marine mammal biology, some involving training and field trials in San Diego ocean waters. Navy research has focused on dolphins because of their exceptional sonar capability for detecting objects in the water and on the bottom (superior to any sonar developed by man) and on sea lions because of their acute underwater hearing and low light level vision. Both are also capable, unlike human divers, of making repeated deep dives without experiencing “the bends” (decompression sickness). Working with dolphins and sea lions, Navy scientists have developed Marine Mammal Systems (MMS) for operational fleet deployment. Each “System” has 4 to 8 marine mammals, an Officer-in-Charge, and, several enlisted personnel. All MMSs can be deployed by aircraft, helicopter, and, land vehicles with the equipment necessary to sustain an operational deployment. Four types of MMSs are based at Navy facilities in San Diego Bay: Mk 4 – using dolphins to detect and mark mines moored off the bottom, Mk 5 – using sea lions to detect and recover mines (at depths up to 1,000 ft), Mk 6 - using dolphins to detect and intercept swimmers and divers, and, Mk 7 - using dolphins to detect and mark mines on the bottom. Training exercises for these systems and others currently under development are conducted in the open ocean off Point Loma.

Artificial Reefs

Designed to enhance sportfishing, 25 artificial reefs have been built along the southern California coast since 1958 (CDFG 2001, CDFW 2014j). Nine of these are in San Diego County. Five artificial reefs are within 20 mi (32 km) of Point Loma (Table 19, from Spira 2014).

Table 19. Artificial Reefs in Southern California.



No.	Name	Approx Size	Coordinates
1	International Reef	75 Acres	32D 32.40'N. x 117D 14.70W
2	Mission Beach Reef	173 Acres	32D 46.23'N. x 117D 16.30'W
3	Pacific Beach Reef	109 Acres	32° 47.58'N. x 117° 16.57'W
4	Torrey Pines Reef #1	500 ft.	32D 53.20'N. x 117D 50.83'W
5	Torrey Pines Reef #2	1 Acre	32D 53.58'N. x 117D 15.58'W
6	Carlsbad Artificial Reef	6 Acres	33D 05.00'N. x 117D 19.15'W
7	Oceanside Artificial Reef #1	4 Acres	33D 10.95'N. x 117D 25.00'W
8	Oceanside Artificial Reef #2	256 Acres	33D 12.58'N. x 117D 25.80'W
9	Pendelton Artificial Reef	3.5 Acres	34D 19.50'N. x 117D 31.70'W
10	Newport Beach Artificial Reef	8 Acres	36D 16.22'N. x 117D 57.82'W
11	Huntington Beach Art. Reef #1	3 Acres	33D 37.45'N. x 118D 00.07'W
	Huntington Beach Art. Reef #2	3 Acres	33D 37.28'N. x 117D 59.85'W
	Huntington Beach Art. Reef #3	3 Acres	33D 37.15'N. x 117D 59.28'W
	Huntington Beach Art. Reef #4	3 Acres	33D 36.85'N. x 117D 58.82'W
12	Bolsa Chica Artificial Reef	220 Acres	33D 39.05'N. x 118D 00.06'W
13	Gambling Ship Shipwreck	300 ft	33D 41.49'N. x 118D 08.75'W
14	Georgia Straights Shipwreck	200 ft	33D 41.34'N. x 118D 12.49'W
15	Minesweeper Shipwreck	250 ft	33D 41.60'N. x 118D 19.45'W
16	Avalon Shipwreck	350 ft	33D 47.28'N. x 118D 25.62'W
17	Palawan Shipwreck	450 ft	33D 49.42'N. x 118D 24.88'W
18	Redondo Beach Artificial Reef	1.5 Acres	33D 50.23'N. x 118D 24.53'W
19	Hermosa Beach Artificial Reef	0.5 Acres	33D 51.22'N. x 118D 24.80'W
20	Marina Del Rey Art. Reef #1	3.5 Acres	33D 57.90'N. x 118D 29.17'W
	Marina Del Rey Art. Reef #2	7 Acres	33D 58.10'N. x 118D 29.18'W
21	Star of Scotland Shipwreck	180 ft	33D 59.52'N. x 118D 31.27'W
22	Santa Monica Artificial Reef	0.5 Acres	34D 00.57'N. x 118D 31.78'W
23	Santa Monica Bay Art. Reef	256 Acres	34D 00.78'N. x 118D 32.55'W
24	Topanga Artificial Reef	13 Acres	34D 01.63'N. x 118D 31.95'W
25	Malibu Artificial Reef	0.5 Acres	34D 01.49'N. x 118D 39.03'W

Torrey Pines Artificial Reefs (Number 4 and 5 above) are 16 mi (26 km) to the north and the International Artificial Reef (Number 1) is 18 mi (29 km) south of the Point Loma Treatment Facility. Mission Beach Artificial Reef and Pacific Beach Artificial Reef (Number 2 and 3) are about 9 mi (14 km) north of the tip of Point Loma are the closest artificial reefs to the Point Loma Ocean Outfall.

The Mission Beach Artificial Reef, located at 32 ° 46.23’ N X 117° 16.30’ W at depths of 80-90 ft (24-27 m) is closest to the Point Loma Ocean Outfall. It was established in 1987 as a 173 acre site. The original reef consisted of three sunken vessels. Concrete rubble has been added periodically. Most notable was the 1991-1993 addition of 9,000 tons of concrete roadway rubble which was scattered over 11 acres at 60 ft (18 m) depths. Shortly after the material was placed kelp began growing, and this artificial reef has supported the kelp since then. It became a focus of research prior to the construction of the Southern California Edison mitigation kelp reef off San Clemente, since the Mission Beach Kelp Reef represents the first time kelp has been sustained for more than a couple of years on an artificial reef in the United States. This artificial reef also includes a “Wreck Alley” of ships deliberately placed on the bottom to provide high-relief habitat for fish and invertebrates. “Wreck alley” is a popular dive spot only 1 nm from the entrance to Mission Bay (about 7 mi (6 nm) from the Point Loma Ocean Outfall) at a magnetic heading of 324 °. The site includes the decommissioned 366-ft Canadian destroyer, HMCS *Yukon*, which was deliberately sink on 14 July 2000 and is a popular dive destination for experienced divers.

The Pacific Beach Artificial Reef is located 3 mi (2.5 nm) from the Mission Bay entrance channel, also on a heading of 324° magnetic. It encompasses about 109 seafloor acres with depths ranging from 42-72 ft (13-22 m). Composed of 10,000 tons of quarry rock, it quickly became a kelp habitat complete with kelp bass and sand bass, and is a seasonal destination for divers seeking lobster. Artificial reefs are increasingly popular destinations for fishing and sport diving (Reed et al. 2006, Love and Nishimoto 2012, McKinney 2013).

Navigation and Shipping

Coastal shipping lanes are over ten miles from shore, but commercial vessels come closer off Point Loma where they funnel into San Diego Bay. Arriving ships make landfall at Buoy-1, three miles due west of the harbor entrance, where they pick up a pilot to guide them in to their berth.

The Port of San Diego is located in San Diego Bay and extends across five adjacent cities including Imperial Beach, National City, Chula Vista, San Diego and Coronado. It is the fourth largest of California’s 11 public ports and has jurisdiction over approximately 5,500 acres of land and water in and around San Diego Bay. Within this area, the Port operates two deep-water cargo terminals and two cruise ship terminals. The two cargo terminals, the Tenth Avenue Marine Terminal and the National City Marine Terminal, are located in the region’s working waterfront area, at the center of industrial activity occurring in San Diego Bay. Port maritime industrial businesses are located between the two terminals including shipbuilding and repair, auto processing, transportation of goods, and manufacturing. These businesses, which are linked to the Port’s maritime operations, are port tenants that provide goods and services supporting the region’s maritime activity. The cruise ship terminals are located in the North Embarcadero area of downtown San Diego. The port also has a large volume of military vessel traffic, as it contains various naval air stations, a naval amphibious base, and training centers.

In May and June of 2012, the San Diego-based ERISS Corporation conducted a study of the Maritime Economy of San Diego involving quantitative economic analysis, in-person and telephone interviews, and an online survey (ERISS Corporation 2012). In total, the analysis indicated that an estimated 46,000 employees work in San Diego's Maritime Industry. The Port of San Diego was the largest sector in San Diego's maritime economy, with other sectors also providing significant numbers of jobs and revenue, including aquaculture and fishing, marine recreation, ocean energy and minerals, biomedicine, and ocean science.

Military and Industrial Use

San Diego has 18 different Naval and Marine bases. The Naval Base San Diego is the largest on the west coast and the principal homeport of the Pacific Fleet with 54 ships and 13 piers that stretch over 977 acres of land and 326 acres of water (San Diego Chamber of Commerce 2014). The total on-base population is 20,000 military personnel and 6,000 civilians. As many as 100 Navy ships may be in port at one time including aircraft carriers, destroyers, cruisers, frigates, submarines, amphibious ships, and service (auxiliary) vessels.

The active duty military account for more than 114,000 jobs in San Diego with an additional 25,000 full-time civilian workers also employed by the U. S. Department of Defense (San Diego Economic Development Corporation 2014). In 2012, defense spending generated $32 billion in economic activity for San Diego.

Navy ships enter and exit San Diego Bay virtually every day. The offshore area is used extensively for military operations including surface and submarine fleet maneuvers, and for antisubmarine warfare training. Most of this activity takes place well seaward of the Point Loma Ocean Outfall discharge area.

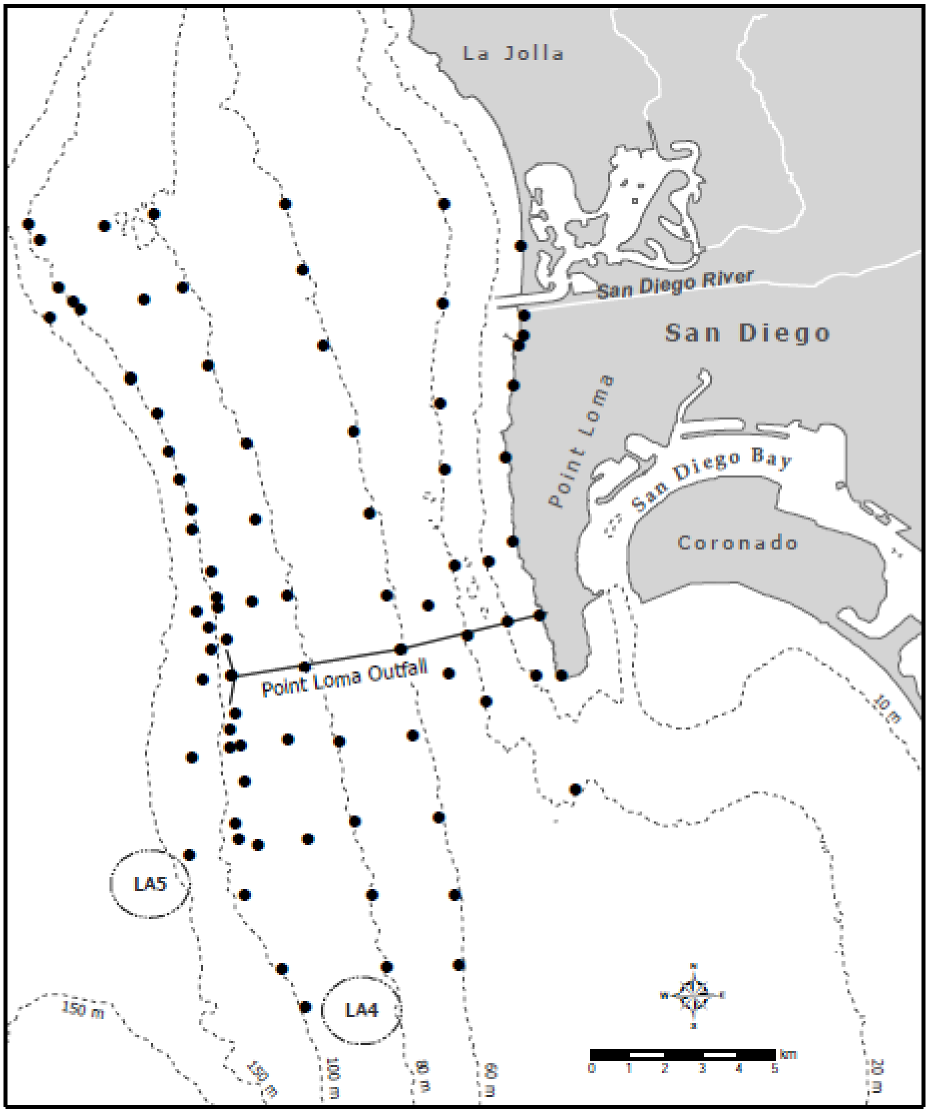
Three facilities in the City of San Diego utilize significant volumes of sea water: Sea World in Mission Bay, the Scripps Institution of Oceanography, and the Western Salt Company at the southern end of San Diego Bay, which has been in operation for more than 100 years producing solar evaporated salt from ponds. All operate under permits from the EPA and the San Diego Regional Water Quality Control Board.

Located in San Diego Bay, General Dynamics NASSCO has been designing and building ships since 1960 and is the only full service shipyard on the west coast of the United States. NASSCO specializes in auxiliary and support ships for the U.S. Navy and oil tankers and dry cargo carriers for commercial markets. The largest heavy industrial manufacturer in San Diego, NASSCO employs 3,600 people. Because of its location, expertise and full-service capabilities, the Navy relies on NASSCO as a repair facility for its Pacific Fleet ships (General Dynamics NASSCO 2014). General Dynamics NASSCO also performs maintenance and repairs for commercial operators.

Environmental Monitoring

The Environmental Monitoring and Technical Services Division of the City of San Diego’s Public Utilities Department monitors the ocean in the vicinity of the Point Loma Ocean Outfall. The primary objectives of ocean monitoring for the Point Loma outfall region are to measure compliance with NPDES permit requirements and California Ocean Plan water-contact standards, elucidate changes in ocean conditions over space and time, and assess any impacts of wastewater discharge or other man-made or natural influences on the local marine environment, including effects on water quality, sediment conditions, and marine life (COSD 2008-2014). The monitoring area centers on the discharge site 4.5 mi (7.2 km) off Point Loma at a depth of 320 ft (98 m) (Figure 29).

Figure 29. Point Loma Monitoring Stations.



Shoreline monitoring extends from Mission Beach southward to the tip of Point Loma while offshore monitoring occurs seaward to a depth of about 380 ft (116 m), encompassing an area of approximately 70 mi^2 (182 km^2).

There are six components to the core monitoring program: coastal oceanographic conditions, water quality compliance and plume dispersion, sediment conditions, macrobenthic communities, demersal fishes and megabenthic invertebrates, and bioaccumulation of contaminants in fish tissues. In addition to core monitoring, a broader geographic survey of benthic conditions is conducted each year at randomly selected sites that range from the USA/Mexico border region to northern San Diego County and that extend further offshore to waters as deep as 1,640 ft (500 m).

Region-wide surveys off the coast of San Diego are conducted as part of larger, multi-agency surveys of the entire Southern California Bight (e.g., Allen et al. 2011, Schiff et al. 2011, Ranasinghe et al. 2012). Such large-scale surveys are useful for characterizing the ecological health of diverse coastal areas and in distinguishing reference sites from those impacted by wastewater or stormwater discharges, urban runoff, or other sources of contamination (SCCWRP 2014).

The Point Loma Monitoring and Reporting Program also includes provisions for adaptive or special strategic process studies. The first of these studies was a comprehensive review of the Point Loma ocean monitoring program by a team of scientists from the Scripps Institution of Oceanography and several other institutions (SIO 2004). This was followed by a 2-phase sediment mapping study of the San Diego outfall areas (see Appendix C4; Stebbins et al. 2004, 2012) as well as a deep benthic pilot study (Stebbins & Parnell 2005, COSD 2006) and subsequent ongoing assessment of deeper continental slope benthic habitats of the region (see Appendix C5). Another special study designed to determine the characteristic fates of the PLOO wastewater plume in the coastal waters off Pt Loma was completed in 2012 (see Appendix F; Rogowski 2012, 2013).

In addition, the City of San Diego provides staffing or funding support for several other projects assessing ocean quality in the region. One such project involves remote sensing (satellite imaging) of the San Diego/Tijuana coastal region (see Appendix H and Svejkovsky 2014). The City also helps fund a long-term study of the Point Loma and La Jolla kelp forests being conducted by scientists at the Scripps Institution of Oceanography (see Appendix G and Parnell and Riser 2012, 2014), and participates as a member of the Region Nine Kelp Survey Consortium to support aerial surveys of all the major kelp beds in San Diego and Orange Counties (e.g., MBC 2013, 2014).

PUBLIC HEALTH

Introduction

This section covers aspects of the Point Loma Ocean Outfall monitoring program that relate to public health: water quality compliance and bioaccumulation of contaminants in fish tissues. The City of San Diego analyzes seawater samples collected along the shoreline and in offshore coastal waters to characterize water quality conditions in the region and to identify possible impacts of wastewater discharge on the marine environment. To provide information about the dilution and dispersion of discharged wastewater, densities of fecal indicator bacteria (e.g., total and fecal coliforms, Enterococcus) are measured and evaluated in context with oceanographic data. This also helps identify other sources of bacterial contamination. Water quality monitoring also establishes compliance with the water contact standards specified in the California Ocean Plan, which defines bacterial, physical, and chemical water quality objectives and standards to protect beneficial uses of state ocean waters (SWRCB 2012a).

Water quality standards to protect human health in recreational waters are customarily assessed by measuring the concentration of FIB to infer the presence of fecal matter and associated fecal pathogens. Fecal matter originates from the intestines of warm-blooded animals, and the presence of fecal bacteria is used as an indicator of human pathogens that can cause illness in recreational water users (Boehm and Soller 2013, Harwood et al. 2013, EPA 2014c). Indicator bacteria may not cause illness themselves, but have been linked to the presence of harmful pathogens (Arnold et al. 2013, EPA 2014d). FIB are used as a surrogate for human pathogens because they are easier and less costly to measure than the pathogens themselves.

Multiple sources of potential bacterial contamination exist in the Point Loma monitoring region in addition to the wastewater outfall. Local, nonoutfall sources of bacterial contamination include San Diego Bay and the Tijuana and San Diego Rivers (Svejkovsky 2014). Storm drain discharges and wet-weather runoff from local watersheds can also flush contaminants seaward (Colford et al. 2007, Sercu et al. 2009, Griffith et al. 2010). And, beach wrack (e.g., kelp, seagrass), storm drains impacted by tidal flushing, and beach sediments can act as reservoirs, cultivating bacteria until release into nearshore waters by returning tides, rainfall, and/or other disturbances (Martin and Gruber 2005, Yamahara et al. 2007, Phillips et al. 2011, Griffith et al. 2013). The presence of dogs and birds and their droppings has also been associated with bacterial exceedances that may impact nearshore water quality (Wright et al. 2009, Griffith et al. 2010, Araújo et al. 2014).

Water Quality Compliance

The Point Loma Ocean Outfall monitoring program is designed to assess general water quality and determine the level of compliance with regulatory standards in the current NPDES discharge permit (SDRWQCB and EPA 2009) (Table 20). Seawater samples are collected from shoreline and offshores sampling stations to establish fecal indicator bacteria (FIB) concentrations (Figure 30). The collection, handling, and laboratory analysis of the seawater samples are described in the Annual Monitoring Reports (e.g., see COSD 2014).

Water quality monitoring results for the most recent full year of data available - 2013 - are discussed in the following section. A four-year analysis (2010-2013) of bacteriological monitoring to determine compliance with body-contact recreational standards in the vicinity of the PLOO (Appendix I.2) is summarized in the subsequent section.

Table 20. PLOO NPDES Permit Bacteriological Standards.

Bacteriological compliance standards (CFU = Colony Forming Units).

30-day Geometric Mean:

The following standards are based on the geometric mean of the five most recent samples from each site:

1) Total coliform density shall not exceed 1,000 per 100 ml;

2) Fecal coliform density shall not exceed 200 per 100 ml; and

3) Enterococcus density shall not exceed 35 per 100 mi.

Single Sample Maximum:

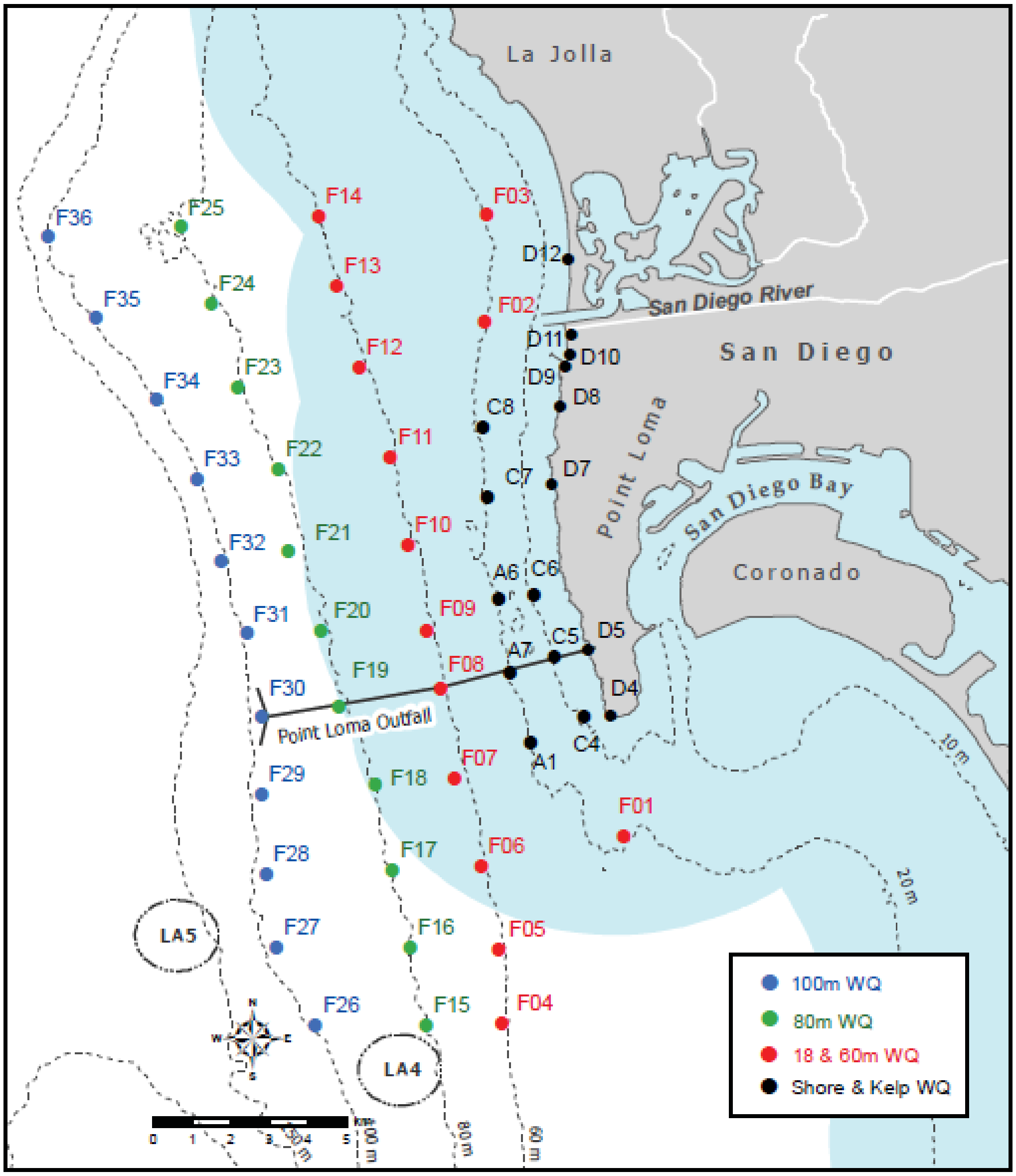
1) Total coliform density shall not exceed 10,000 per 100 ml;

2) Fecal coliform density shall not exceed 400 per 100 ml;

3) Enterococcus density shall not exceed 104 per 100 ml; and

4) Total coliform density shall not exceed 1,000 per 100 ml when the fecal coliform/total coliform ratio exceeds 0.1.

Figure 30. Water Quality Monitoring Stations.
(Light blue shading represents California state jurisdictional waters.)



Seawater samples are collected five times per month at eight shore stations (i.e., D4, D5, and D7-D12) (Figure 30). Eight stations located in nearshore waters in the Point Loma kelp bed are monitored five times a month to determine water quality conditions and Ocean Plan compliance in areas used for recreational activities such as SCUBA diving, surfing, fishing, and kayaking. These include stations C4, C5, and C6 located near the inner edge of the kelp bed along the 9-m depth contour and stations A1, A6, A7, C7, and C8 located near the outer edge of the kelp bed along the 18-m depth contour (Figure 30).

An additional 36 stations located offshore of the kelp bed stations are sampled to monitor FIB levels in deeper waters and to estimate dispersion of the wastewater plume. These offshore "F" stations are arranged in a grid surrounding the discharge site along or adjacent to the 18, 60, 80, and 98-m depth contours (Figure 30). In contrast to shore and kelp bed stations, offshore stations are monitored on a quarterly basis during February, May, August and November with each of these quarterly surveys conducted over a 3-day period. Bacterial analyses for these offshore stations are limited to Enterococcus.

Seawater samples are collected at three discrete depths at the kelp stations and 18- and 60-m offshore stations, four depths at the 80-m offshore stations, and five depths at the 98-m offshore stations (Table 21).

Table 21. Seawater Sampling Depths at Water Quality Stations.

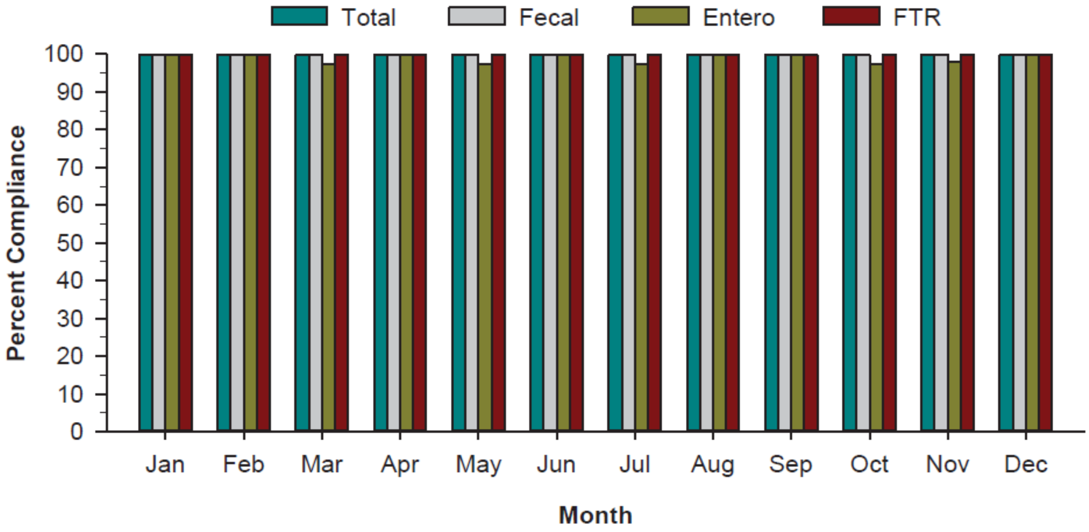
Depths at which seawater samples are collected for bacteriological analysis at the PLOO kelp bed and offshore stations.

Station Contour	**Sample Depth (m)**								
	1	**3**	**9**	**12**	**18**	**25**	**60**	**80**	**98**
Kelp Bed									
9-m	X	X	X						
18-m	X			X	X				
Offshore									
18-m	X			X	X				
60-m	X					X	X		
80-m	X					X	X	X	
98-m	X					X	X	X	X

Shore Stations

During 2013, compliance at the eight shore stations in the PLOO region was 100% for the 30-day total coliforms, fecal coliforms, and Enterococcus geometric mean standards. Compliance with the single sample maximum (SSM) standards was 100% for total coliforms, fecal coliforms, and the fecal:total coliform (FTR) criterion, while Enterococcus ranged from 98 to 100% (Figure 31).

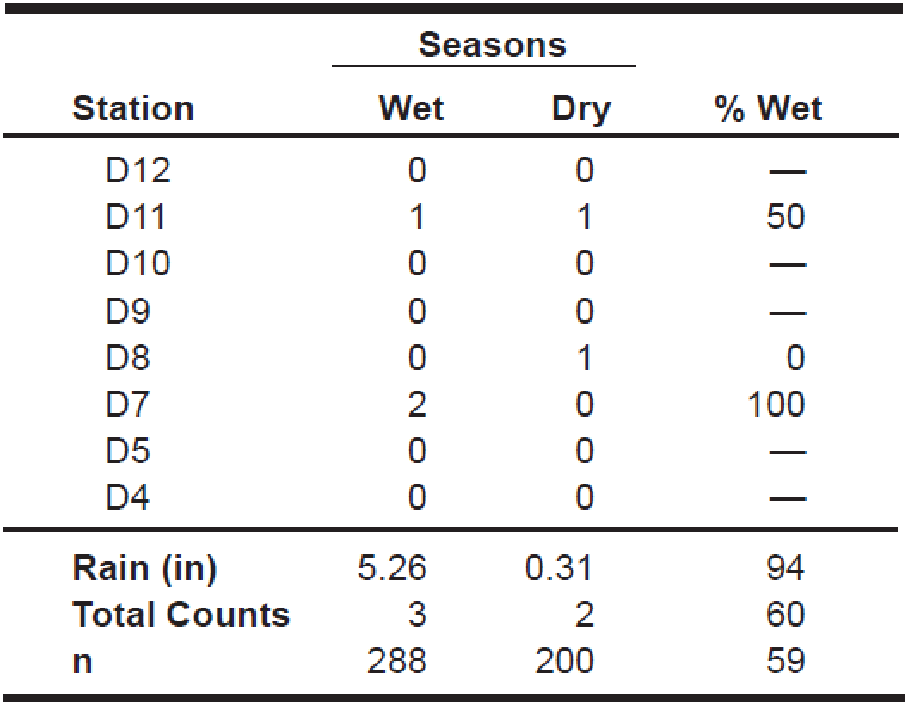
Figure 31. Single Sample Bacteriological Compliance - 2013.



Monthly mean FIB densities ranged from 2 to 556 CFU/100 ml for total coliforms, 2 to 43 CFU/100 ml for fecal coliforms, and 2 to 1442 CFU/100 ml for Enterococcus (see Appendix B.2 – COSD 2014). Of the 488 seawater samples collected from shore stations during the year, only five (1.0%) had elevated FIB, occurring at stations D7, D8, and D11 (Table 22).

Table 22. Shore Stations with Elevated FIB Densities in 2013.

(The number of samples with elevated FIB densities at PLOO shore stations during the wet (October-April) and dry (May-September) seasons in 2013. Rain data are from Lindbergh Field, San Diego, CA. Stations are listed north to south from top to bottom.)

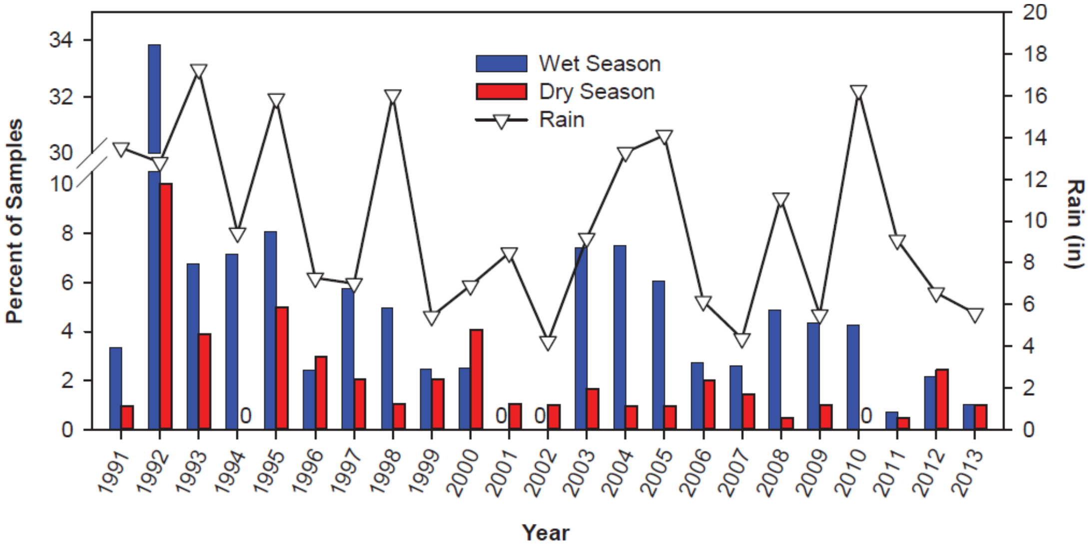


	Seasons		
Station	**Wet**	**Dry**	**% Wet**
D12	0	0	—
D11	1	1	50
D10	0	0	—
D9	0	0	—
D8	0	1	0
D7	2	0	100
D5	0	0	—
D4	0	0	—
Rain (in)	5.26	0.31	94
Total Counts	3	2	60
n	288	200	59

A general relationship between rainfall and elevated bacterial levels at shore stations has been evident since water quality monitoring began in the Point Loma region (Figure 32). Historical data indicate that occurrence of a sample with elevated FIB was significantly more likely during the wet season than during the dry (7% versus 2%, respectively; $n = 7678$, $\chi^2 = 102.171$, $p < 0.0001$). Contrary to the historical trend, no seasonal effect was observed for FIB exceedances in 2013.

Figure 32. Rainfall/Elevated FIB Densities at Shore Stations 1991-2013.

(Comparison of annual rainfall to the percent of samples with elevated FIB densities in wet versus dry seasons at PLOO shore stations from 1991 through 2013. Rain data are from Lindbergh Field, San Diego, CA.)

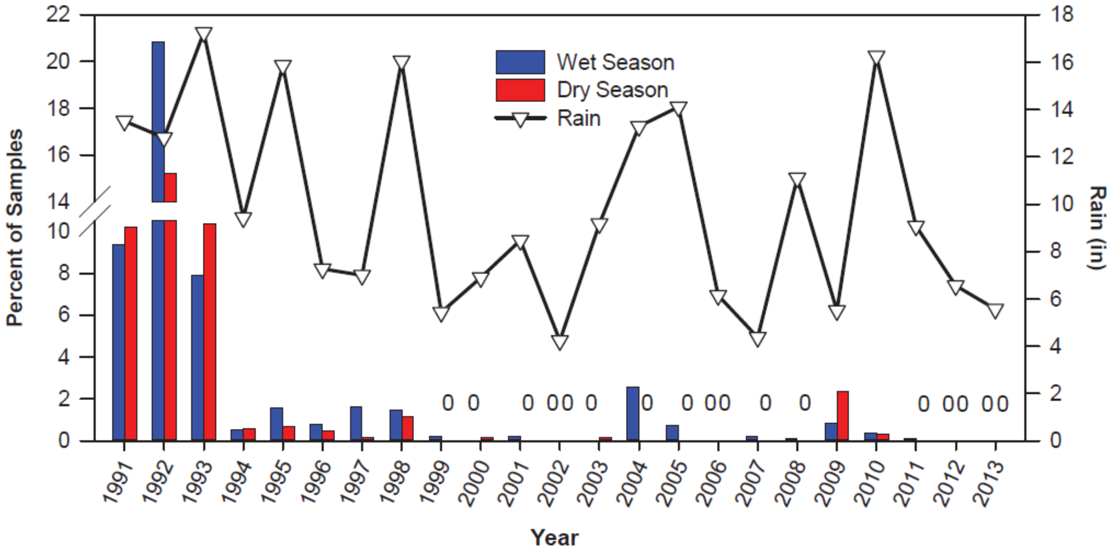


Kelp Bed Stations

Compliance at the eight kelp bed stations in the PLOO region was in 100% with all all 30-day geometric mean and SSM standards during 2013. These results are consistent with those from 2012, when the water contact standard compliance rates were also at 100% (COSD 2013). Further, no signs of wastewater (e.g., foam, sewage-like odor) were observed at any of the kelp stations during the year. Satellite imagery showed that runoff from the San Diego River was typically restricted to the area between the shore and inside of the kelp forest during 2013 (Svejkovsky 2014). Monthly mean FIB densities at the PLOO kelp bed stations were lower than those at the shore stations, ranging from 2 to 31 CFU/100 ml for total coliforms, and 2 to 3 CFU/100 ml for fecal coliforms, while Enterococcus remained at only 2 CFU/100 ml throughout the year. This low incidence of elevated FIBs is consistent with water quality results dating back to 1994 after the outfall was extended to its present deepwater discharge site (Figure 33). In contrast, FIB levels were much higher at the kelp bed stations prior to the outfall extension. No relationship between rainfall and elevated FIB levels was evident at these stations over the years, as the proportion of samples with high FIBs was similar between wet and dry seasons (~4% for both).

Figure 33. Rainfall/Elevated FIB Densities at Kelp Bed Stations 1991-2013.

(Comparison of annual rainfall to the percent of samples with elevated FIB densities in wet versus dry seasons at PLOO kelp bed stations from 1991 through 2013. Rain data are from Lindbergh Field, San Diego, CA.)

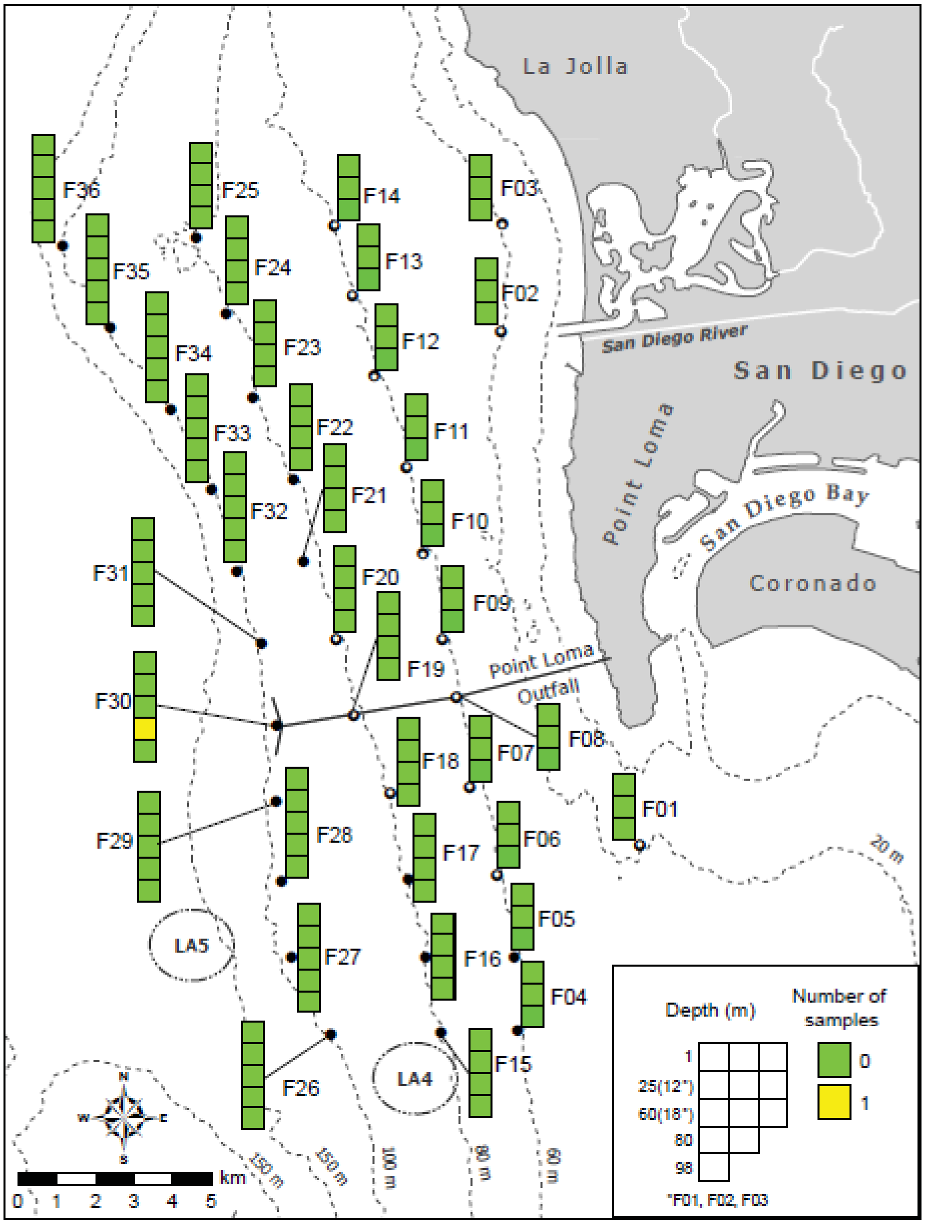


Offshore Stations

The maximum concentration of Enterococcus bacteria at the 36 offshore stations was 400 CFU/100 ml in 2013. There were no signs of wastewater at any of the offshore stations based on visual observations. Only one of 564 offshore samples (0.2%) had elevated Enterococcus levels > 104 CFU/100 ml; it was collected at station F30 located nearest the discharge site at a sample depth of 80 m (Figure 34).

Figure 34. Elevated Offshore Enterococcus Densities - 2013.

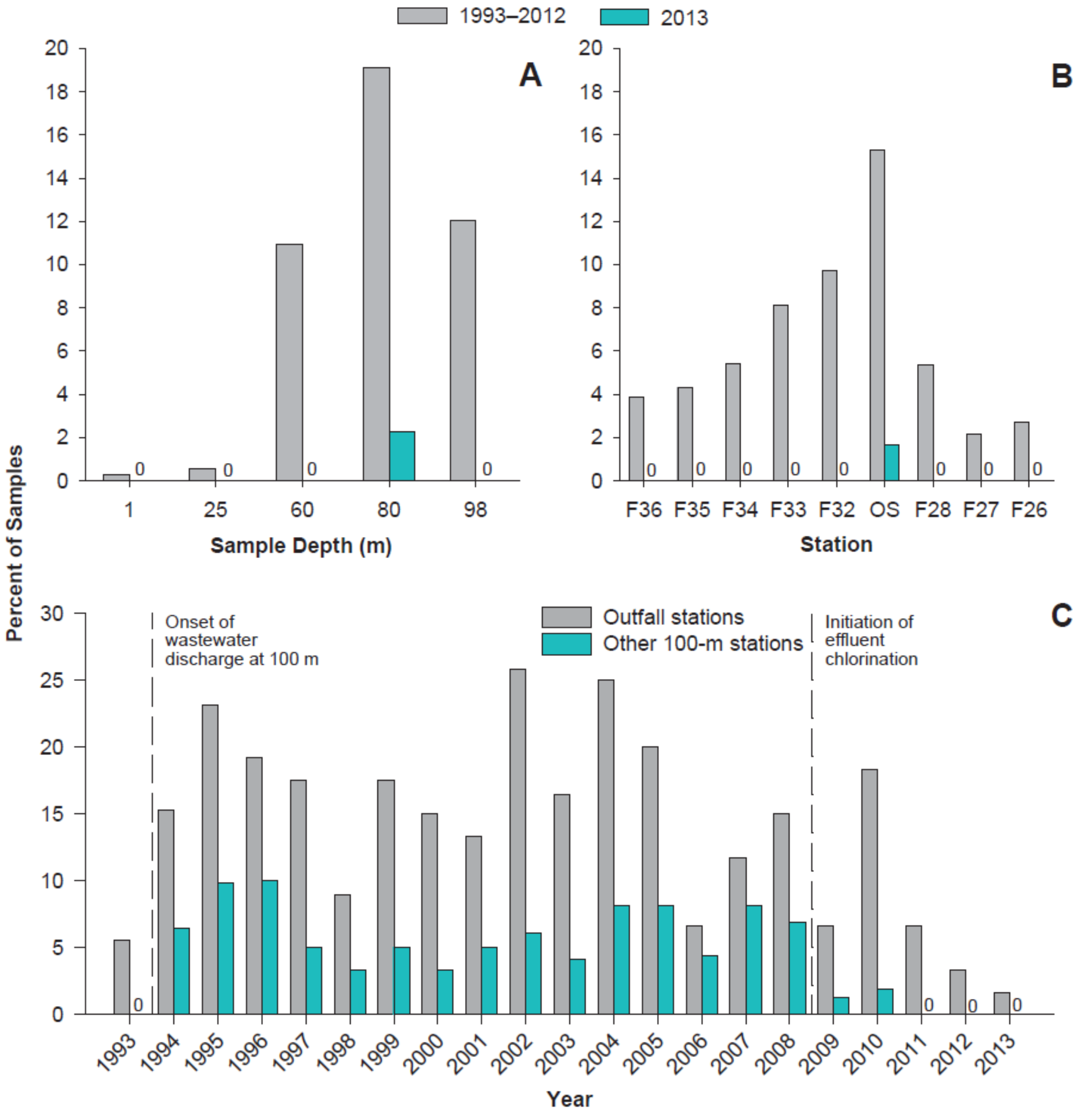
(Distribution of elevated Enterococcus samples collected at offshore stations during 2013. Data are number of samples that exceeded concentrations greater than 104CFU/100 ml. Open circles indicate stations sampled within state jurisdictional waters.)



No exceedances occurred within State jurisdictional waters (i.e., within 3 nautical miles of shore). These results suggest that the wastewater plume was restricted to relatively deep, offshore waters throughout the year. This conclusion is consistent with remote sensing observations that provided no evidence of the plume reaching surface waters in 2013 (Svejkovsky 2014). These findings are also consistent with historical analyses, which revealed that < 1% of the samples collected at the eleven stations located along the 100-m discharge depth contour from 1991 through 2013 at depths ≤ 25 m contained elevated levels of Enterococcus (Figure 35A). Over this time period, detection of elevated FIB was significantly more likely at the three stations located near the discharge zone (i.e., F29, F30, F31) than at any other 100-m site (15% versus 5%, respectively; n = 5020, $\chi2$ = 154.97, p < 0.0001) (Figure 35B). Following the initiation of chlorination in August 2008, the number of samples with elevated Enterococcus also dropped significantly at these three stations (17% before versus 7% after, n = 1721, $\chi2$ = 18.85, p < 0.0001), as well as at the other 100-m stations (6% before versus 0.6% after; n = 3299, $\chi2$ = 42.25, p < 0.0001) (Figure 35C).

Figure 35. Elevated Offshore Enterococcus Densities 1993 - 2013.

(Percent of samples collected from PLOO 100-m offshore stations with elevated bacteria densities. Samples from 2013 are compared to those collected between 1993 and 2012 by (A) sampling depth, (B) station listed from north to south from left to right, and (C) year. OS = outfall stations (F29, F30, F31)).



In summary, water quality conditions in the Point Loma outfall region were excellent during 2013. Overall compliance with Ocean Plan water-contact standards was >99.9%, which was similar to the >99.9% compliance observed during the previous year (COSD 2013). In addition, there was no evidence during the year to suggest that wastewater discharged into the ocean via the PLOO reached the 18-m stations or the shoreline. Elevated FIB were detected in samples from five shoreline stations and no kelp bed stations during 2013. Historically, elevated FIB at shore and kelp bed stations have been mostly associated with rainfall events, heavy recreational use, or the presence of seabirds or decaying kelp and surfgrass (COSD 2008-2013). The main exception to this pattern occurred during a short period in 1992 following a catastrophic break of the outfall within the Point Loma kelp bed (Tegner et al. 1995).

Previous reports have indicated that the PLOO wastefield typically remains offshore and submerged in deep waters ever since the extension of the outfall was completed in late 1993 (COSD 2008-2013, Rogowski et al. 2012, 2013). This pattern remained true for 2013 with evidence indicating that the wastewater plume was restricted to depths of 40 m or below in offshore waters. The deepwater (100-m) location of the discharge site may be the dominant factor that inhibits the plume from reaching surface waters. For example, wastewater released into these deep, cold and dense waters does not appear to mix with the upper 25 m of the water column (Rogowski et al. 2012, 2013). It appears that not only is the plume being trapped below the pycnocline, but now that effluent is undergoing partial chlorination prior to discharge, densities of indicator bacteria have dropped significantly at all offshore stations along the 100-m depth contour, including those nearest the outfall.

Appendix I.2 evaluates compliance of the Point Loma Ocean Outfall discharge with body-contact recreational standards for ocean waters from 2010-2013. The discharge of treated wastewater from the Point Loma Wastewater Treatment Plant (Point Loma WWTP) through the PLOO is regulated by Order No. R9-2009-0001 (NPDES Permit No. CA0107409) (SDRWQCB and EPA 2009). The Order and NPDES permit implement receiving water recreational body-contact (REC-1) standards established within the California Ocean Plan, which apply to state-regulated waters within three nautical miles (3.4 statute miles) of the coast (Table 20). The PLOO discharge occurs 4.5 statute miles offshore, but the City of San Diego implements sodium hypochlorite disinfection at the Point Loma WWTP to ensure compliance with the REC-1 receiving water standards in the event that discharged wastewater is transported toward state-regulated waters.

In Appendix I.2, offshore receiving water data from 2010-2013 collected as part of the City of San Diego's ocean monitoring program are evaluated and compared to the California Ocean Plan REC-1 standards (SWRCB 2012a). The analysis indicates virtually 100 percent compliance with the California Ocean Plan REC-1 standards at all offshore receiving water stations and all monitoring depths within state-regulated waters.

For waters outside the state-regulated three nautical mile limit, Order No. R9-2009-0001 implements receiving water bacteriological standards promulgated by EPA pursuant to Section 304(a)(1) of the Clean Water Act. The 304(a)(1) standards apply to "primary contact recreation" activities defined by EPA. As indicated in the Recreational Activities section of this Appendix, (and as acknowledged in the Fact Sheet to Order No. R9-2009-0001), no federally-defined primary contact recreation activities have been documented off the Point Loma coast beyond the limit of state-regulated waters. While the 304(a)(1) standards are thus not applicable, PLOO receiving water bacteriological monitoring data during 2010-2013 demonstrate virtual 100 percent compliance with the 304(a)(1) single sample maximum enterococcus standard for "infrequent use" and the 301(a)(1) enterococcus 30-day geometric mean standard. Additionally, PLOO receiving water data from 2010-2013 demonstrate virtual 100 compliance with enterococcus criteria for marine waters that were established in 2012 by the EPA in Recreational Water Quality Criteria (EPA 820-F-12-058) (EPA 2012a).

Fish Tissue Compliance

Introduction

Potentially toxic chemicals enter the ocean environment through various sources including rivers and streams, storm drains, industrial discharges, municipal wastewater discharges, dredge and disposal activities, aerial fallout, vessel activities and spills, mineral mining, oil exploration and extraction, and through natural sources such as hydrothermal vents, hydrocarbon and elemental seeps (Setty et al. 2012, Hutchinson 2013). All these sources may impact fish populations and possibly public health, if fish accumulate these constituents and are consumed (Klasing and Brodberg 2008, 2011, Walsh et al. 2008, California Office of Environmental Health Hazard Assessment (OEHHA) 2014a, b). Some of the chemicals entering the ocean remain dissolved and are distributed by ocean currents and eddies. Many are physically or chemically bound to particulate matter and settle to the bottom. Chemical constituents may bioaccumulate - that is, be retained in the tissues of marine organisms and concentrated through food-webs (Newman 2009, Daley et al. 2014). The degree to which bioaccumulation occurs depends on the solubility, particle affinity, oxidation state, volatility, and degradability of the specific chemical (Laws 2013). These differences determine how contaminants are distributed within biological communities and throughout the environment (Bienfang et al. 2013).

Fish exposure may include absorption of dissolved chemicals from seawater (by the gills or epidermis), contact with sediment contaminants, ingestion of sediment particles or suspended particulate matter, and ingestion and assimilation of contaminants from food organisms ((Newman 2009, Allen et al. 2011, Laws 2013). Demersal (bottom dwelling) fish are useful in biomonitoring programs because of their proximity to bottom sediments, and because most contaminants found in marine organisms are hydrophobic, and accumulate in lipid (fatty) reservoirs of the organism (Schiff and Allen 1997, Allen 2006). The potential impacts of bioaccumulation by marine organisms include compromised immune response and disease resistance, altered behavior, diminished breeding success, developmental abnormalities, population declines via direct mortality, and shifts the composition of communities by affecting top predators and keystone species (Newman 2009, NAVFAC 2013).

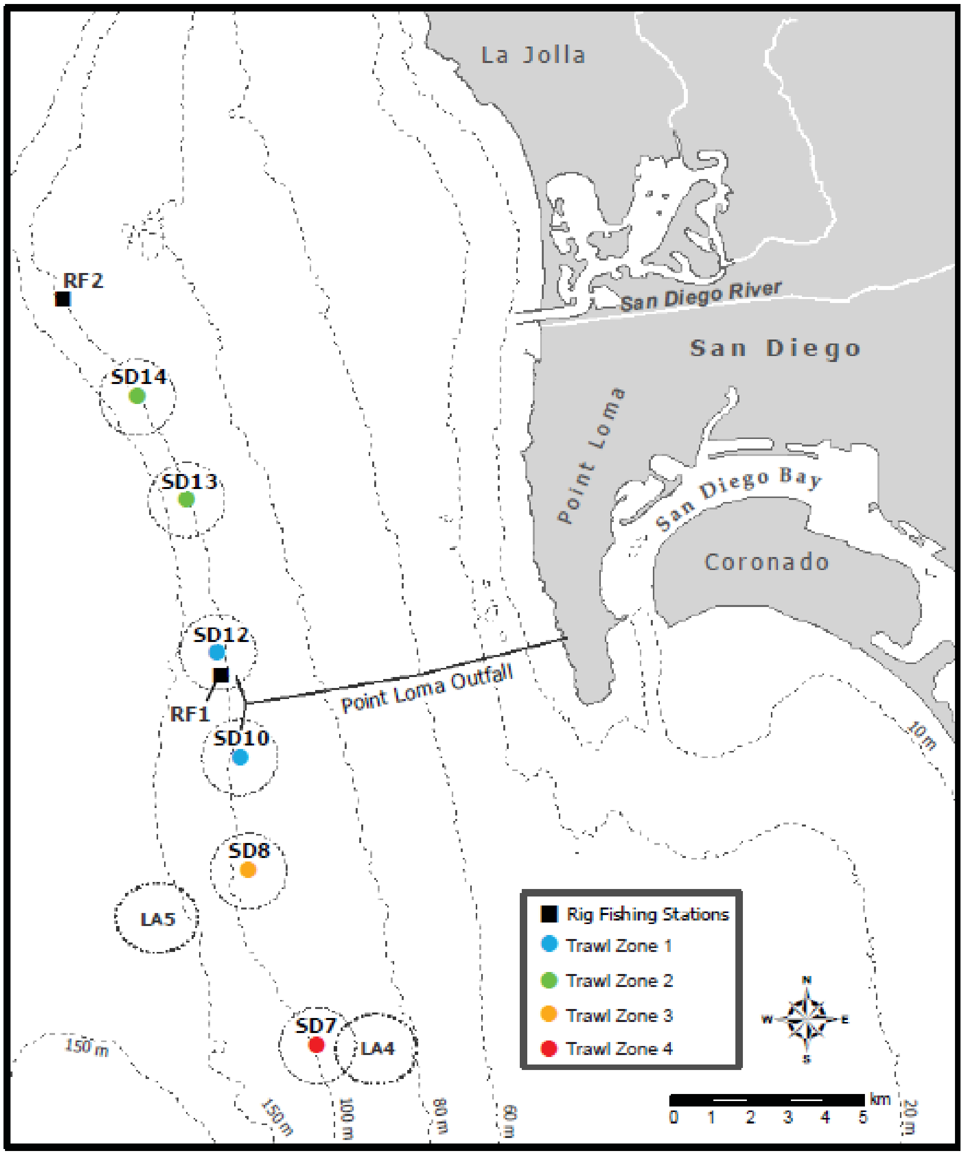
The primary goals of the bioaccumulation portion of the City’s ocean monitoring program are to: (1) document levels of contaminant loading in local demersal fish, (2) identify whether any contaminant bioaccumulation in fish collected around the PLOO may be due to the outfall discharge, and (3) identify other potential natural and anthropogenic sources of pollutants to the local marine ecosystem. Two types of samples are taken: liver tissues from trawl-caught fish and muscle tissues from fish caught by hook and line (rig fishing). Species collected by trawling are considered representative of the general demersal fish community off San Diego, and specific species are targeted based on their prevalence and ecological significance. The chemical analysis of liver tissues in these trawl-caught fish is important for assessing population effects because this is the organ where contaminants typically bioaccumulate. Species targeted for capture by rig fishing represent fish that are typical of a sport fisher’s catch, and are more directly relevant to human health concerns. Muscle samples are analyzed from these fish because this is the tissue most often consumed by humans.

The following section reviews the results of bioaccumulation sampling and analysis during 2013. Appendix D presents an assessment of fish tissue bioaccumulation data from 1995-2013.

Contaminants in Trawl-Caught Fish

During October 2013, fish were collected from four trawl zones and two rig fishing stations (Figure 36). Each trawl zone represents an area centered on one or two specific trawl stations. Trawl Zone 1 includes the “nearfield” area within a 1-km radius of stations SD10 and SD12 located just south and north of the PLOO, respectively. Trawl Zone 2 includes the area within a 1-km radius surrounding northern “farfield” stations SD13 and SD14. Trawl Zone 3 represents the area within a 1-km radius surrounding “farfield” station SD8, which is located south of the outfall near the LA-5 dredged material disposal site. Trawl Zone 4 is the area within a 1-km radius surrounding “farfield” station SD7 located several kilometers south of the outfall near the non-active LA-4 disposal site. Fish collected at the two rig fishing stations were caught within 1 km of the station coordinates using standard rod and reel procedures. Station RF1 is located within 1 km of the outfall and is considered the “nearfield” rig fishing site. In contrast, station RF2 is located about 11 km northwest of the outfall and is considered the “farfield” rig fishing site. The species and sizes collected and details of handling, transport, and laboratory and data analysis are contained in Chapter 7 of the City’s Annual Monitoring Report (COSD 2014).

Figure 36. Otter Trawl and Rig Fishing Stations and Zones.



Contaminant levels in muscle tissue samples collected in 2013 were compared to the following state, national, and international limits and standards to address seafood safety and public health issues: (1) California Office of Environmental Health Hazard Assessment (OEHHA), which has developed fish contaminant goals for chlordane, DDT, methylmercury, selenium, and PCBs (Klasing and Brodberg 2008); (2) United States Food and Drug Administration (USFDA), which has set limits on the amount of mercury, total DDT, and chlordane in seafood to be sold for human consumption (Mearns et al. 1991); (3) international standards for acceptable concentrations of various metals and DDT (Mearns et al. 1991).

Nine trace metals occurred in 100% of the liver tissue samples from trawl-caught Pacific sanddabs collected in the Point Loma outfall region during 2013 (Table 23). These included arsenic, cadmium, copper, iron, manganese, mercury, selenium, tin and zinc.

Antimony, barium, chromium, lead, silver and thallium were also detected, but at rates between 8–92%. Aluminum, beryllium and nickel were not detected in any liver samples collected during the year. Most metals occurred at concentrations ≤14.3 parts per million (ppm), though higher concentrations up to 31 ppm for zinc and 152 ppm for iron were recorded. Comparisons between nearfield and farfield zones suggest that there was no clear relationship between metal concentrations in Pacific sanddab liver tissues and proximity to the outfall (Figure 37). Most metals were present in samples from all stations at variable concentrations. Trawl Zone 1 fishes had the highest values of arsenic, cadmium, iron, mercury, and silver, Trawl Zone 2 fishes had the highest values of antimony, manganese and lead, Trawl Zone 3 fishes had the highest values of selenium, tin, and zinc, and Trawl Zone 4 fishes had the highest values of barium, copper, and thallium.

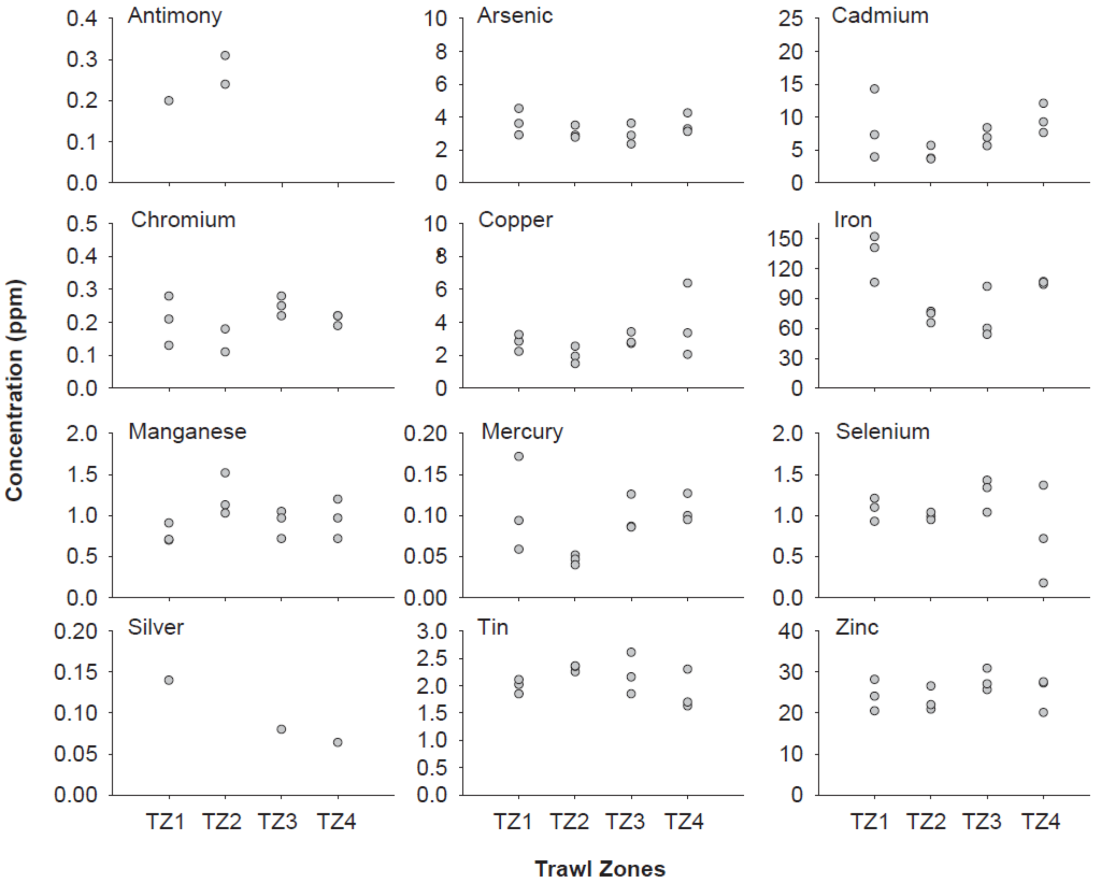
Table 23. Liver Tissue Analysis for Trawl Caught Fish in 2013.

(Summary of metals, pesticides, total PCBs, and lipids from PLOO trawl zones during 2013. Data include detection rate (DR), minimum, maximum, and mean detected concentrations (n = 12) (nd = non-detect)).

Parameter	DR (%)	Min	Max	Mean
Metals (ppm)				
Aluminum	0	—	—	—
Antimony	25	nd	0.31	0.25
Arsenic	100	2.4	4.5	3.3
Barium	17	nd	0.075	0.061
Beryllium	0	—	—	—
Cadmium	100	3.63	14.30	7.38
Chromium	92	nd	0.28	0.21
Copper	100	1.5	6.4	2.9
Iron	100	53.9	152.0	95.8
Lead	17	nd	0.33	0.27
Manganese	100	0.7	1.5	1.0
Mercury	100	0.04	0.172	0.090
Nickel	0	—	—	—
Selenium	100	0.18	1.43	1.02
Silver	25	nd	0.140	0.095
Thallium	8	nd	0.75	0.75
Tin	100	1.63	2.61	2.01
Zinc	100	20.1	30.9	25.1
Pesticides (ppb)				
HCB	100	2.7	15.0	5.0
Total chlordane	92	nd	12.0	6.7
Total DDT	100	163.1	460.9	299.7
Total PCB (ppb)	100	116.1	520.3	280.7
Lipids (% weight)	100	32.0	50.7	39.2

Figure 37. Metals in Fish Liver Tissues in 2013.

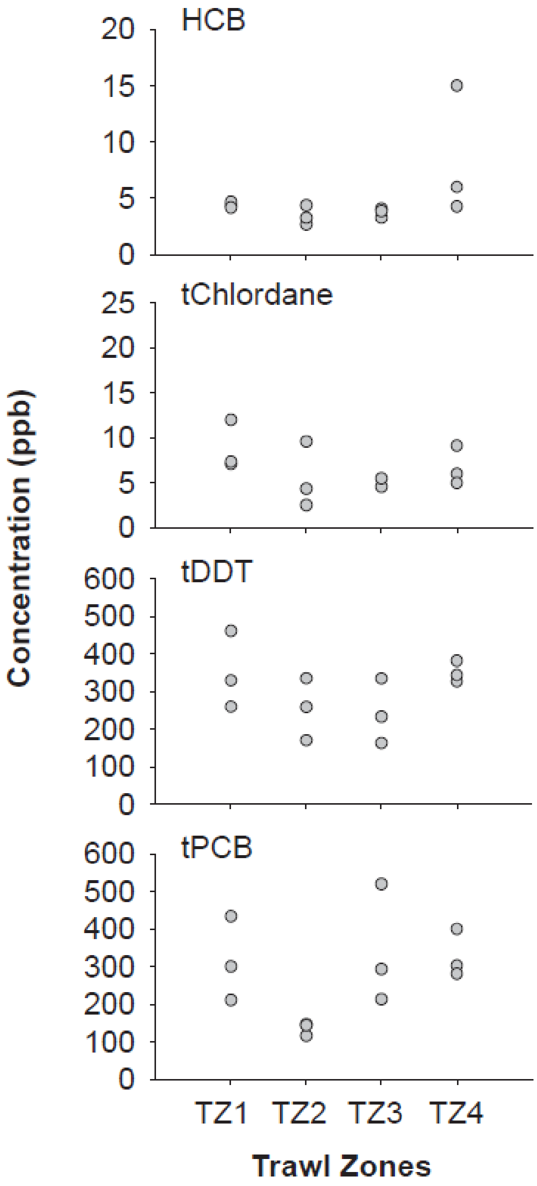
(Concentrations of metals with detection rates ≥ 20% in liver tissues of Pacific sanddabs collected from each PLOO trawl zone (TZ) during 2013. Trawl Zone 1 is considered nearfield.)



Only three chlorinated pesticides were detected in Pacific sanddab liver tissues during 2013 (Table 22). DDT was found in every tissue sample collected in the PLOO region, with total DDT (tDDT) concentrations ranging from 163 to 461 parts per billion (ppb). The DDT metabolites p,p-DDD, p,p-DDE, and p,p-DDMU were found in 100% of the samples, whereas o,p-DDE and p,p-DDT were detected in 92% of the samples. Hexachlorobenzene (HCB) and chlordane also occurred frequently at rates of 100% and 92%, respectively, but at much lower concentrations than tDDT (≤15 ppb). Total chlordane consisted of alpha (cis) chlordane (detection rate = 17%) and trans nonachlor (detection rate = 83%). Total DDT, HCB and chlordane were present in samples from all stations at variable concentrations, with the highest values occurring in tissues from Trawl Zone 1 or Trawl Zone 4 (Figure 38).

Figure 38. Pesticides in Fish Liver Tissues in 2013.

(Concentrations of HCB, total chlordane, total DDT, and total PCBs in liver tissues of Pacific sanddabs collected from each PLOO trawl zone (TZ) during 2013. Trawl Zone 1 is considered nearfield.)



PCBs were detected in every Pacific sanddab liver tissue sample collected from the Point Loma outfall region during 2013. Total PCB concentrations were somewhat variable, ranging from 116 to 520 ppb. Twenty of the 29 detected congeners occurred in all samples, including PCB 49, PCB 52, PCB 66, PCB 70, PCB 74, PCB 99, PCB 101, PCB 105, PCB 110, PCB 118, PCB 128, PCB 138, PCB 149, PCB 153/168, PCB 158, PCB 170, PCB 170, PCB 180, PCB 183, and PCB 187. The remaining congeners were found in 17–92% of the samples. Overall, there was no clear relationship between total

PCB and proximity to the outfall with the highest value occurring in a sample from Trawl Zone 3 (Figure 38).

Contaminants in Fish Collected by Rig Fishing in 2013

Only four trace metals occurred in all rockfish muscle tissue samples collected at the PLOO rig fishing stations during 2013: arsenic, mercury, selenium and tin (Table 24). Chromium, copper, iron, and zinc were also detected, but at rates ≤83%. In contrast, aluminum, antimony, barium, beryllium, cadmium, lead, manganese, nickel, silver, and thallium were not detected in any muscle tissue samples. The metals present in the highest concentrations were arsenic (≤2.1 ppm), iron (≤2.6 ppm), and zinc (≤4.8 ppm). Concentrations of all remaining metals were ≤1.1 ppm. Overall, the six frequently detected metals had variable concentrations and occurred at both rig fishing stations (Figure 39). The highest concentrations of arsenic, mercury, selenium and zinc were found in one or two samples from station RF1; however the fishes that comprised these samples were different species, and larger on average, than those collected at station RF2 (see following discussion).

Table 24. Metals in Fish Muscle Tissue in 2013.

Summary of metals in muscle tissues of fishes collected from PLOO rig fishing stations during 2013. Data include the number of detected values (n), minimum, maximum, and mean[a] detected concentrations per species, and the detection rate and maximum value for all species. Concentrations are expressed as parts per million (ppm). The number of samples per species is indicated in parentheses. Bold values meet or exceed OEHHA fish contaminant goals, USFDA action limits (AL), or median international standards (IS). See Appendix F.2 for names of each metal represented by periodic table symbol.

	Al	Sb	As	Ba	Be	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Se	Ag	Tl	Sn	Zn
Speckled rockfish																		
n (out of 3)	0	0	3	0	0	0	2	0	0	0	0	3	0	3	0	0	3	2
Min	—	—	0.4	—	—	—	nd	—	—	—	—	0.066	—	**0.34**	—	—	0.880	nd
Max	—	—	0.5	—	—	—	0.25	—	—	—	—	0.091	—	**0.40**	—	—	1.080	3.4
Mean	—	—	0.5	—	—	—	0.20	—	—	—	—	0.080	—	**0.38**	—	—	0.993	3.3
Starry rockfish																		
n (out of 1)	0	0	1	0	0	0	1	0	1	0	0	1	0	1	0	0	1	1
Min	—	—	0.5	—	—	—	0.16	—	2.6	—	—	0.16	—	**0.69**	—	—	0.975	4.0
Max	—	—	0.5	—	—	—	0.16	—	2.6	—	—	0.16	—	**0.69**	—	—	0.975	4.0
Mean	—	—	0.5	—	—	—	0.16	—	2.6	—	—	0.16	—	**0.69**	—	—	0.975	4.0
Mixed rockfish																		
n (out of 2)	0	0	2	0	0	0	2	1	0	0	0	2	0	2	0	0	2	2
Min	—	—	0.4	—	—	—	0.15	nd	—	—	—	**0.249**	—	**0.46**	—	—	0.600	3.0
Max	—	—	**2.1**	—	—	—	0.19	0.1	—	—	—	**0.447**	—	**0.47**	—	—	0.610	4.8
Mean	—	—	1.2	—	—	—	0.17	0.1	—	—	—	**0.348**	—	**0.46**	—	—	0.605	3.9
All Species:																		
Detection Rate (%)	0	0	100	0	0	0	83	17	17	0	0	100	0	100	0	0	100	83
Max	—	—	**2.1**	—	—	—	0.25	0.1	2.6	—	—	**0.447**	—	**0.69**	—	—	1.080	4.8
OEHHA[b]	na	na	na	na	na	na	na	na	na	na	na	0.22	na	7.4	na	na	na	na
AL[c]	na	na	na	na	na	na	na	na	na	na	na	1	na	na	na	na	na	na
IS[c]	na	na	1.4	na	na	1.0	1.0	20	na	2.0	na	0.5	na	0.3	na	na	175	70

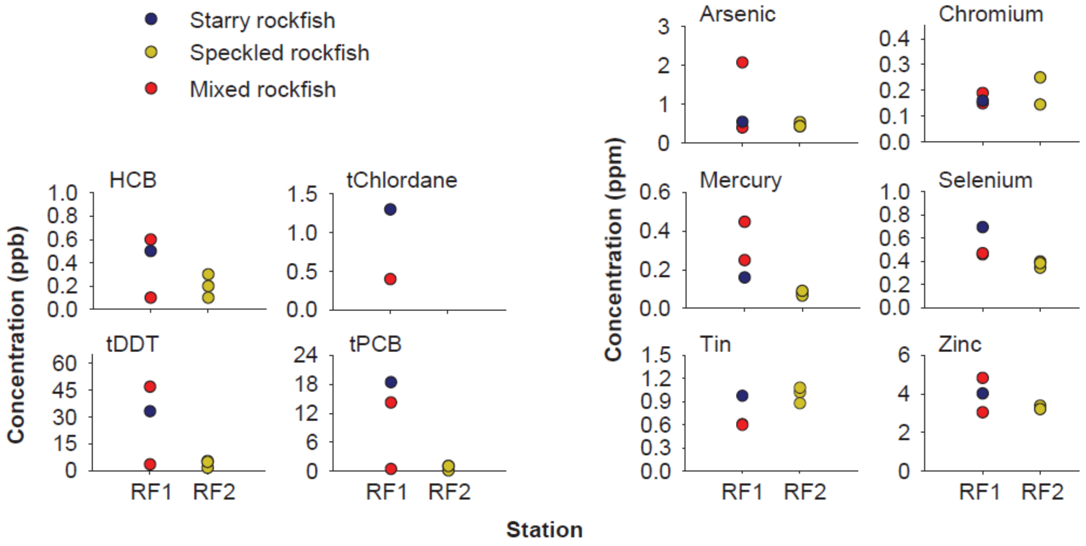
na = not available; nd=not detected

[a] Minimum and maximum values were calculated based on all samples, whereas means were calculated from detected values only

[b] From the California OEHHA (Klasing and Brodberg 2008)

[c] From Mearns et al. 1991. USFDA action limits for mercury and all international standards are for shellfish, but are often applied to fish

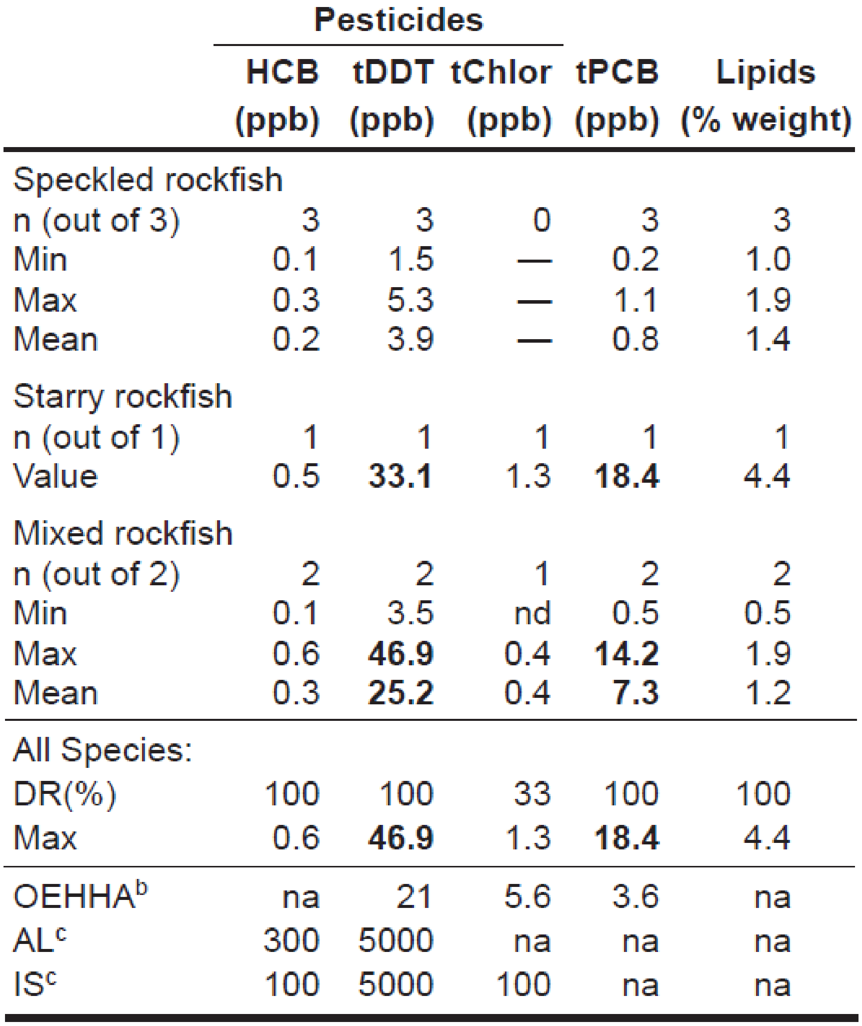
Figure 39. Chemicals with ≥ 20% Detection Rates in Fish Muscle Tissue in 2013.



Every rockfish muscle tissue sample collected during 2013 contained detectable levels of tDDT, HCB, and tPCB (Table 25), while chlordane was found in 33% of the samples. All four of these contaminants had concentrations ≤46.9 ppb, with the highest values reported from one or two samples from station RF1 (Figure 39). As noted above for metals, the fishes that comprised these samples differed in terms of weight, length, and species than those collected at station RF2 (see following discussion). The DDT metabolite p,p-DDE and the PCB congeners PCB 138 and PCB 153/168 were found in all samples. Another 23 PCB congeners were detected ≤83% of the time.

Table 25. Pesticides, Total PCBs, and Lipids in Fish Muscle Tissues in 2013.

(Data include number of detected values (n), minimum, maximum, and mean detected concentrations per species, and the detection rate (DR) and maximum value for all species. The number of samples per species is indicated in parentheses. Bold values meet or exceed OEHHA fish contaminant goals, USFDA action limits (AL), or median international standards (IS). na = not available; nd = non-detect. a = minimum and maximum values were calculated based on all samples, whereas means were calculated from detected values only. b = from the California OEHHA (Klasing and Brodberg 2008). c = from Mearns et al. 1991. USFDA action limits for mercury and all international standards are for shellfish, but are often applied to fish.)



	Pesticides				
	HCB (ppb)	tDDT (ppb)	tChlor (ppb)	tPCB (ppb)	Lipids (% weight)
Speckled rockfish					
n (out of 3)	3	3	0	3	3
Min	0.1	1.5	—	0.2	1.0
Max	0.3	5.3	—	1.1	1.9
Mean	0.2	3.9	—	0.8	1.4
Starry rockfish					
n (out of 1)	1	1	1	1	1
Value	0.5	**33.1**	1.3	**18.4**	4.4
Mixed rockfish					
n (out of 2)	2	2	1	2	2
Min	0.1	3.5	nd	0.5	0.5
Max	0.6	**46.9**	0.4	**14.2**	1.9
Mean	0.3	**25.2**	0.4	**7.3**	1.2
All Species:					
DR(%)	100	100	33	100	100
Max	0.6	**46.9**	1.3	**18.4**	4.4
OEHHA[b]	na	21	5.6	3.6	na
AL[c]	300	5000	na	na	na
IS[c]	100	5000	100	na	na

Most contaminants detected in rockfish muscle tissues during 2013 occurred at concentrations below state, national, and international limits or standards (Tables 24 and 25). Exceptions included: (1) arsenic, which occurred at levels higher than median international standards in a single sample of mixed rockfish from station RF1; (2) selenium, which exceeded international standards in all samples; (3) mercury, which exceeded OEHHA fish contaminant goals in two samples of mixed rockfish from station RF1; (4) total DDT and total PCB, both of which exceeded OEHHA goals in a single sample of mixed rockfish and a single sample of starry rockfish from station RF1.

Discussion

Several trace metals, PCB congeners, and the chlorinated pesticides DDT, HCB, and chlordane were detected in liver tissues from Pacific sanddabs collected in the Point Loma outfall region during 2013. Many of the same metals, PCBs, chlordane, DDT, and HCB were also detected in rockfish muscle tissues during the year, although often less frequently and/or in lower concentrations. Although tissue contaminant concentrations varied among different species of fish and between stations, all values were within ranges reported previously for Southern California Bight (SCB) fish (see Mearns et al. 1991, Allen et al. 1998, COSD 2000, 2008-2013). Additionally, all muscle tissue samples from sport fish collected in the region had concentrations of mercury and total DDT below USFDA action limits and international standards. However, some tissue samples composed of speckled rockfish, starry rockfish and/or mixed species of rockfish had arsenic and selenium concentrations above median international standards for human consumption, and concentrations of mercury, total DDT and total PCB above OEHHA limits. Elevated levels of these contaminants are not uncommon in sport fish from the PLOO survey area (COSD 2008–2013) or from the rest of the San Diego region (COSD 2014). For example, muscle tissue samples from fishes collected since 1995 in the South Bay outfall survey area, including the Coronado Islands, have occasionally had concentrations of arsenic, mercury, selenium and total PCB that exceeded different consumption limits (COSD 2000).

The frequent occurrence of metals and chlorinated hydrocarbons in the tissues of fish captured off Point Loma may be due to multiple factors. Many metals occur naturally in the environment, although little information is available on background levels in fish tissues. Brown et al. (1986) determined that there may be no area in the SCB sufficiently free of chemical contaminants to be considered a reference site, while Mearns et al. (1991) described the distribution of several contaminants such as arsenic, mercury, DDT and PCBs as being ubiquitous. The wide-spread distribution of contaminants in SCB fish has been supported by more recent work regarding PCBs and DDT (e.g., Allen et al. 1998, 2011).

Other factors that affect contaminant loading in fish tissues include the physiology and life history of different species (Groce 2002). Exposure to contaminants can also vary greatly between different species of fish and among individuals of the same species depending on migration habits (Otway 1991). Fish may be exposed to contaminants in a highly polluted area and then move into an area that is not. For example, California scorpionfish tagged in Santa Monica Bay have been recaptured as far south as the Coronado Islands (Hartmann 1987, Love et al. 1987). This is of particular concern for fish collected in the vicinity of the PLOO, as there are many point and non-point sources that may contribute to local contamination in the region, including the San Diego River, San Diego Bay, and offshore dredged material disposal sites (Parnell et al. 2008). In contrast, assessments of contaminant loading in sediments surrounding the outfall have revealed no evidence to indicate that the PLOO is a major source of pollutants to the area (Parnell et al. 2008).

Summary

Overall, there was no evidence of contaminant bioaccumulation in PLOO fishes during 2013 that could be associated with wastewater discharge from the outfall. Concentrations of most contaminants were generally similar across zones or stations, and no relationship associated with the PLOO was evident. These results are consistent with findings of other assessments of bioaccumulation in fish off San Diego (Parnell et al. 2008, Appendix D – Bioaccumulation Assessment). Finally, there were no other indications of poor fish health in the region, such as the presence of fin rot or other indicators of disease.

The state of California Office of Environmental Health Hazard Assessment, Fish and Water Quality Evaluation Unit (OEHHA 2014 a,b) and the California Department of

Public Health (CDPH 2014) provide information on fish contaminants, publish tissue limits for contaminants, and issue fish consumption advisories. OEHHA is the responsible agency for evaluating chemical contaminant human health risk of California marine fish consumed by anglers. Neither OEHHA nor the California Department of Public Health have issued any restrictions on fish consumption or advisories for ocean waters in San Diego County.

RESTRICTIONS

There are no federal, state, or, local restrictions on recreational activities or other Beneficial Uses in the vicinity of the Point Loma discharge.

ENDANGERED SPECIES

Introduction

This section responds to the following questions in the Application for Modification of Secondary Treatment Requirements:

- Are endangered species present in the vicinity of the discharge?
- Have endangered species been effected by the discharge?

Regulatory Framework

Endangered Species Act

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§ 1531 et seq.) establishes protection over and conservation of endangered species and the ecosystems on which they depend (USFWS 2014a,b). An endangered species is a species that is in danger of extinction throughout all or a significant portion of its range. The ESA establishes procedures for nominating species for protection and prohibits actions that would jeopardize their continued existence. All federal agencies are required to implement protection programs for endangered species and to use their authority to further the purposes of the ESA.

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. §§ 1361 et seq.) creates the authority to protect marine mammals in waters or on lands under U. S. jurisdiction (NMFS 2014a). It defines federal responsibility for conserving marine mammals (whales, dolphins, porpoises, seals, sea lions, and sea otters). The MMPA prohibits harassing, capturing, disturbing, or, killing marine mammals except under special permit. It creates a Marine Mammal Commission, Regional offices, and Fisheries Science Centers to implement research and protection.

California Endangered Species Act

The California Endangered Species Act (CESA) of 1970, re-amended in 1984, is part of the California Fish and Game Code and is administered by the California Department of Fish and Wildlife (CDFW 2014k). It establishes measures to conserve, protect, restore, and enhance endangered species and their habitats. Certain species that are not recognized as endangered under the federal Endangered Species Act may be listed as endangered under the California Endangered Species Act. The provisions included in the CESA generally parallel those in the federal ESA, but also apply to species petitioned for listing (i.e., state candidates).

Endangered Species

Twenty-four endangered species covered under the federal Endangered Species Act, the federal Marine Mammal Protection Act, and/or the California Endangered Species Act may occur in the vicinity of Point Loma (Table 26): eight marine mammals, seven birds, five sea turtles, two fish, and two invertebrates. Their population biology, status, distribution, and potential environmental effects of the Point Loma ocean outfall on endangered species are discussed in the following paragraphs.

Table 26. Endangered Species That May Occur in the Vicinity of Point Loma.

California Department of Fish and Wildlife 2014k.
National Marine Fisheries Service 2014a.
U.S. Fish and Wildlife Service 2014a.

Marine Mammals		
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Meaptera novaeangliae*	Endangered
Right Whale	*Eubalaena japonica*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Guadalupe Fur Seal	*Arctocephalus townsendi*	Threatened
Steller Sea Lion	*Eumetopias jubatus*	Threatened
Birds		
California Least Tern	*Sterna antillarum browni*	Endangered
Light-footed Clapper Rail	*Rallus longirostris levipes*	Endangered
Western Snowy Plover	*Charadrius alexandrinus nivosus*	Threatened
Guadalupe Murrelet	*Synthliboramphus hypoleucus*	Threatened
Marbled Murrelet	*Brachyramphus marmaoratus*	Threatened
Scripps's Murrelet	*Synthliboramphus scrippsi*	Threatened

Table 26. Endangered Species That May Occur in the Vicinity of Point Loma.

Short-tailed Albatross	*Phoebastria albatrus*	Endangered
Sea Turtles		
Green Sea Turtle	*Celonia mydas*	Endangered
Loggerhead Sea Turtle	*Caretta caretta*	Endangered
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Endangered
Hawkbill Sea Turtle	*Eretmochelys imbricata*	Endangered
Fish		
Chinook Salmon	*Oncorhynchus tshawytscha*	Endangered
Steelhead	*Oncorhynchus mykiss*	Endangered
Mollusk		
White Abalone	*Haliotis sorenseni*	Endangered
Black Abalone	*Haliotis cracherodii*	Endangered

Whales

Marine mammals are warm-blooded, have fur or hair, breathe air through lungs, bear live young, and nurse them with milk. They have streamlined bodies and most have an insulating layer of blubber. Two types of marine mammals pass through or inhabit San Diego coastal waters; cetaceans and pinnipeds. Whales are members of the first group that also includes dolphins and porpoises (NMFS 2014b, Perrin et al. 2008). Cetaceans are entirely aquatic, have two front flippers, and tails with horizontal extensions that provide swimming power. The great whales, like blue, gray, and humpback whales, have rows of closely spaced baleen plates that filter out and trap plankton and small fish. Sperm whales, dolphins, and porpoises have teeth for grasping prey.

The second group of marine mammals, pinnipeds (sea lions and seals), regularly haul out on land to rest, breed, and give birth (NMFS 2014c). Sea lions have visible external ears and can walk on all four flippers by rotating their rear flippers forward under their body. Their swimming power comes from large front flippers. Seals have no external ears and can only crawl on land because their front flippers are small and their hind flippers cannot rotate forward. Seals swimming power comes from their large, fan-like rear flippers.

Of the eight species of great whales that may pass by Point Loma, six are endangered: the blue whale, the fin whale, the humpback whale, the right whale, the sei whale, and the sperm whale (Table 26). The other two great whales, the gray whale and the minke whale, were previously endangered but have now recovered. There are no endangered dolphins or porpoises in the San Diego area.

The gray whale, *Eschrichtius robustus*, is the most common whale observed along the San Diego coast and the most easily seen from shore (Jefferson et al. 2011). These large whales can grow to about 50 ft (15 m) long and weigh approximately 80,000 lb (35,000 kg). Gray whales are found only in the north Pacific Ocean – an Atlantic form is extinct (Jones and Swartz 2009). Gray whales occur in two genetically and spatially distinct populations on the eastern and western sides of the North Pacific Ocean (NMFS 2013a). The eastern north Pacific gray whales are the subject of the following discussion.

Each year, the gray whale undertakes the longest migration of any mammal, travelling 9,000-12,000 mi (14,500-19,300 km) from its summer feeding grounds in the Bering and Chukchi Seas to breeding and calving lagoons of Baja California and back again to the Arctic Ocean. The journey south, led by pregnant females, begins in late autumn with most whales passing Point Loma during January and February. The northern migration occurs during springtime with whales (especially mother-calf pairs) passing closer to shore than on the way south.

Gray whales usually feed in shallow waters less than 200 ft (60 m) deep (Perrin et al. 2008). They are primarily bottom feeders whose prey includes a wide range of invertebrates living on or near the seafloor. The whales filter amphipods and other crustaceans with their baleen plates. Although generally fasting during the migration and calving season, opportunistic feeding occurs in the shallow coastal waters along the migration path and in the calving lagoons. The gray whale is preyed on by killer whales. Many exhibit attack scars indicating not all attacks are fatal, however fatalities are known (Jones and Swartz 2009).

Gray whales are susceptible to entanglement in fishing gear and ship strikes. No gray whales were observed entangled in California gillnet fisheries between 2007 and 2011 (Carretta and Enriquez 2012), but previous mortality in the swordfish drift gillnet fishery has been observed and there have been recent sightings of free-swimming gray whales entangled in gillnets (Carretta et al. 2014). Although acoustic pingers are known to reduce the entanglement of cetaceans in the California drift gillnet swordfish fishery (Carretta and Barlow 2011), it is unknown whether pingers have any effect on gray whale entanglement. Most data on human-caused mortality and serious injury of gray whales is from strandings. There are few at-sea reports of entangled animals alive or dead. Strandings represent only a fraction of actual gray whale deaths (natural or human-caused), as reported by Punt and Wade (2012), who estimated that only 3.9% to 13.0% of gray whales that die in a given year end up stranding and being reported.

For 2007-2011, the most recent five-year period reported by NMFS (Carretta et al. 2013), the total mortality of eastern north Pacific gray whales attributed to ship strikes was six deaths. Additional mortality from ship strikes probably goes unreported because the whales either do not strand or have no evident signs of trauma when observed at sea.

Hunted practically to extinction, the gray whale has staged a remarkable comeback since it was listed as endangered throughout its range under the Endangered Species Act (ESA) in 1973. The species appears to have fully recovered and is thought to be close to or at its initial unexploited stock size. The gray whale species was delisted in 1994, as it was no longer considered endangered under the ESA. Its current population estimate is approximately 20,000 individuals (Carretta et al. 2014).

As with other great whales that may occur in the Point Loma region, the National Marine Fisheries Service has not designated any critical habitat for gray whales (NMFS 2013a).

Minke whales, *Balaenoptera acutorostrata*, the smallest of the baleen whales, can occur year-round off California (Carretta et al. 2014). These sleek, baleen whales feed on krill and schooling fish such as herring, pollock, and cod (Jefferson et al. 2011). Minke whales are lunge feeders, often plunging through patches of krill or shoaling fish. They frequent shallower water more often than any other whales except gray whales. Minke whales are prey for killer whales. Increasing levels of anthropogenic sound in the world's oceans is considered a habitat concern for whales, particularly for baleen whales that communicate using low-frequency sound (McDonald et al. 2008, Hildebrand 2009, Rolland et al. 2012).

As with other whales, entanglement in commercial gillnets and ship strikes pose a threat to minke whales. Minke whales may occasionally be caught in coastal set gillnets off California and in offshore drift gillnets off California and Oregon (Carretta et al. 2014).

Ship strikes were implicated in the death of one minke whale in 1977, but the reported minke whale mortality due to ship strikes was zero for the period 2004-2008 (Carretta et al. 2014).

Although rare in California (estimated population in the low to mid hundreds (Carretta et al. 2014)), minke whales are relatively abundant elsewhere and are not listed as endangered under the Endangered Species Act. Like the gray whale, minke whales are protected under the Marine Mammal Protection Act but are not considered depleted.

The other whales that periodically traverse the area off Point Loma are deeper water species. The most spectacular of these is the blue whale, *Balaenoptera musculus*. Blue whales, the largest animal that has ever lived, can reach over 100 ft (30 m) in length and weigh as much as 330,000 pounds (lb) (150,000 kilograms (kg)) (Perrin et al. 2008). Preying almost exclusively on zooplankton, especially krill, they lunge feed and consume approximately 12,000 lb (5,500 kg) of krill per day.

The blue whale inhabits all oceans and typically occurs near the coast over the continental shelf, though it is also found in oceanic waters (Sears and Perrin 2008). The U. S. west coast is a feeding area for blue whales during summer and fall (Carretta et al. 2014). They are regularly observed in the Southern California Bight most often along the 200-m (656 ft) isobath.

Blue whales have been documented to be preyed on by killer whales (Jefferson et al. 2011). While there is little evidence that killer whales attack this species in the north Atlantic or southern hemisphere, 25 percent of photo-identified whales in the Gulf of California show rake scars from killer whale attacks (Sears and Perrin 2008).

Blue whales are susceptible to ship strikes and entanglement in fishing gear (Redfern et al. 2013). Between 1988 and 2007, 21 blue whale deaths were reported along the California coast and eight of these whales were confirmed to have died as a result of ship strikes (Berman-Kowalewski et al. 2010). The offshore drift gillnet fishery is the only fishery that is likely to entangle blue whales off southern California, although no fishery mortality or serious injuries have been observed (Carretta et al. 2013). The drift gillnet fisheries for swordfish and sharks along the Pacific coast of Baja California, Mexico may take animals from this population as well. Some gillnet mortality of large whales goes unobserved because whales swim away with a portion of the net; however, fishermen report blue and fin whales usually swim through nets without entangling and with little damage to the nets (Carretta et al. 2014).

Tagged blue whales exposed to simulated mid-frequency military sonar sounds showed significant behavioral responses, including cessation of feeding, increased swimming speeds, and movement away from the simulated sound sources, even though the simulated source levels were orders of magnitude lower than some operational military sonar systems (Goldbogen et al. 2013). This study suggests that sonar sources could disrupt feeding and displace whales from high-quality feeding areas, with negative implications for individual fitness and population health.

The current best available abundance estimate for the Eastern North Pacific stock of blue whales that occur off California, Oregon, and Washington is 1,647 (Carretta et al. 2014.)

As a result of commercial whaling, blue whales were listed as endangered under the Endangered Species Conservation Act of 1969. This protection was transferred to the Endangered Species Act in 1973. They are still listed as endangered and consequently the Eastern North Pacific stock is automatically considered as depleted under the MMPA.

Fin whales, *Balaenoptera physalus*, like blue whales, occur mainly in offshore waters (Jefferson et al. 2011). They do, however, venture closer to shore after periodic upwelling that leads to increased krill density. Recent observations show aggregations of this, second largest of the baleen whales, year-round off southern California (Carretta et al. 2014). Fin whales feed on krill, small schooling fishes, squid, and copepods. They are not known to have a significant number of predators, but in areas where killer whales are abundant, some fin whales exhibit attack scars on their flippers, flukes, and flanks.

The organochlorines DDE, DDT, and PCBs have been identified in fin whale blubber, but at lower concentrations than in toothed whales that feed at higher levels in the food chain (Marsili and Focardi 1996). Female fin whales contain lower burdens than males, likely due to mobilization and export of contaminants during pregnancy and lactation (Gauthier et al. 1997).

Fin whales are susceptible to ship strikes and entanglement in fishing gear (Carretta et al. 2014). Ship strikes were implicated in the deaths of seven fin whales during 2007-2011 (Carretta et al. 2013). During 2007-2011, there were an additional four injuries of unidentified large whales attributed to ship strikes. Documented ship strike deaths and serious injuries are derived from actual counts of whale carcasses and are considered minimum values (Carretta et al. 2013).

As with blue whales, the offshore drift gillnet fishery is the only fishery that is likely to pose a threat of entanglement for fin whales. One fin whale death has been observed in over 8,000 sets since 1990 when NMFS began observing the fishery (Carretta et al. 2014).

Moore and Barlow (2011) present evidence of increasing fin whale abundance in the California Current region. They predict continued increases in fin whale numbers over the next decade that may result in fin whale densities reaching "current ecosystem limits." The best available abundance estimate of fin whales in California, Oregon, and Washington waters is 3,051 (Carretta et al. 2014).

Historical whaling drastically reduced fin whale and other whale stocks. Populations began to recover with implementation of the International Whaling Commission, Endangered Species Act, and the Marine Mammal Protection Act. Fin whales are listed as endangered under the ESA, and as depleted under the MMPA.

Humpback whales, *Meaptera novaeangliae*, are distinguished by their long pectoral fins (flippers) and complex, repetitive vocalizations (Jefferson et al. 2011). The migratory population of humbacks present in California offshore waters during summer and fall ranges from Costa Rica to southern British Columbia (Carretta et al. 2014). Humpback whales feed on schools of fish and krill and reach a length of 60 ft (18 m). In the southern California feeding grounds, humpback whales feed on a wide variety of invertebrates and small schooling fish. Feeding occurs both at the surface and in deeper waters, wherever prey is abundant. Humpback whales are the only species of baleen whale that cooperate when feeding in large groups (Perrin et al. 2008).

This species is known to be attacked by both killer whales and false killer whales as evidenced by toothrake scars on their bodies and fins (Jefferson et al. 2011). Humpback whales observed on the feeding grounds off Washington and California have the highest rate of rake marks of any of their observed feeding grounds.

Entanglement in fishing gear poses a threat to humpback whales throughout the Pacific Ocean. Pot and trap fisheries are the most commonly documented source of mortality and serious injury of humpback whales in U. S. west coast waters (Carretta et al. 2013). Between 2007 and 2011, there were 16 documented humpback whale interactions with pot/trap fisheries. Gillnet and unidentified fisheries accounted for 1 death and 9 serious injuries of humpback whales between 2007 and 2011 (Carretta et al. 2014). An additional number of whales are likely entangled in fishing gear from Mexican fisheries, though quantitative data are not presently available for most of these fisheries.

Humpback whales, especially calves and juveniles, are highly vulnerable to ship strikes. Younger whales spend more time at the surface, are less visible, and are found closer to shore, making them more susceptible to collisions (USDON 2013). Eight humpback whales were reported struck by vessels with four resulting deaths between 2007 and 2011 (Carretta et al. 2013). The recorded number of serious injuries and mortality from ship strikes is a fraction of the total because additional mortality from ship strikes goes unreported.

Organochlorines, including PCBs and DDE, have been identified from humpback whale blubber (Gauthier et al. 1997). As with blue whales, these contaminants are transferred to young through the placenta, leaving newborns with contaminant loads equal to that of their mothers (Elfes et al. 2010). Humpback whales feed higher on the food chain, consuming prey carrying higher contaminant loads than the krill that blue whales feed on.

The Central North Pacific stock of humpback whales is the focus of whale-watching activities in both its feeding grounds (Alaska) and breeding grounds (Hawaii) (NMFS

2013a). Regulations addressing minimum approach distances and vessel operating procedures are in place to help protect the whales; however, there is still concern that whales may abandon preferred habitats if the disturbance is too high (USDON 2013).

The estimated abundance of humpback whales in the entire Pacific Basin is about 22,000 with approximately 2,000 in California and Oregon waters (Barlow et al. 2011).

As a result of commercial whaling, humpback whales were listed as endangered under the Endangered Species Conservation Act of 1969, and again under the Endangered Species Act (ESA) in 1973. The species is still listed as endangered under the ESA and is considered as depleted under the MMPA. Based on evidence of population recovery in many areas, the species is being considered by NMFS for removal or downlisting from the ESA (NMFS 2014d).

Prior to being hunted by man, the right whale, *Eubalena japonica*, occurred from the Bering Sea to central Baja California (NMFS 2014b). It was targeted early for exploitation because it was slow moving, easy to approach, provided large quantities of meat, oil, and bone, and floated after being killed – thus the common name – the right whale to kill. Right whales are large baleen whales with adults about 50 ft (15 m) length and can weigh up to 14,000 lb (6,350 kg) (Perrin et al. 2008). They consume zooplankton, krill and copepods. Unlike other baleen whales, right whales are skimmers: they feed by removing prey from the water using baleen while moving with their mouth open through a patch of zooplankton. There are no reliable estimates of current abundance or trends for right whales in the North Pacific. They would be rarely sighted in southern California waters and highly unlikely in the Point Loma area.

The North Pacific right whale has been listed as endangered under the ESA since 1973 when it was listed as the "northern right whale." It was listed as a separate, endangered species in April 2008. The species is designated as depleted under the MMPA.

The sei whale, *Balaenoptera borealis*, is the fastest great whale and can reach speeds well over 20 miles per hour. Sei whales occur rarely in offshore waters in southern California (Carretta et al. 2014). They are present as early as May and June, but primarily are encountered during July to September and leave California waters by mid-October. Sei whales feed on a diversity of prey, including copepods, krill, fish, and cephalopods like squid, cuttlefish, and octopus (Jefferson et al. 2011).

The best current estimate of abundance for the eastern north Pacific stock of sei whales that occur off California, Oregon, and Washington waters out to 300 nautical miles (nm) is 126 animals (Carretta et al. 2014). Sei whales, like other large baleen whales, are subject to occasional attacks by killer whales. Based on the statistics for other large whales, it is likely that ship strikes and bycatch also pose a threat to sei whales along the west coast. The sei whale is listed as endangered under the ESA and as depleted under the MMPA.

The only great whale with teeth instead of baleen, the sperm whale, *Physeter macrocephalus*, is by far the most abundant worldwide. During the past 2 centuries, commercial whalers took about 1,000,000 sperm whales (NMFS 2014b). Its current population is estimated at roughly one million – four times the combined total population of the other five endangered large whale species. Sperm whales attain lengths of 60 ft (18 m) and are distinguished by an extremely large head (Perrin et al. 2008). Feeding primarily on squid and fish, sperm whales can make dives of over ten thousand feet deep lasting an hour and a half. Broadly distributed in the north Pacific, sperm whales are found year-round off California, with peak abundance in summer (Carretta et al. 2014).

Contaminants including organochlorines and several heavy metals have been identified in sperm whales, but vary widely in concentration based upon life history and geographic location with northern hemisphere individuals generally carrying higher burdens (Evans et al. 2004). Unlike other marine mammals, females appear to bioaccumulate toxins at greater levels than males, which may be related to possible dietary differences between females who remain at relatively low latitudes compared to more migratory males (Wise et al. 2009).

Bycatch of sperm whales in the California swordfish drift gillnet fishery has rarely been documented since the inception of the observer program in 1990 (Carretta et al. 2013). This fishery has been the subject of field study every year since 1990, and through 2012 a total of 8,365 drift gillnet sets have been observed. Ten sperm whales have been recorded entangled during this time. All of the entanglements occurred from October through December in waters deeper than 4,900 ft (1,500 m), in proximity to steep continental shelf bathymetry. One sperm whale died as the result of a ship strike in Oregon in 2007 (Carretta et al. 2014).

Large populations of sperm whales exist in waters several thousand miles west and south of California, but there is no evidence that sperm whale move from there into U. S. west coast waters (Carretta et al. 2014). The most precise, recent estimate of sperm whale abundance for the California to Washington stock is 971 animals. As a result of previous whaling, sperm whales are listed as endangered under the ESA, and the California to Washington stock is considered depleted under the MMPA.

Seals and Sea Lions

The other endangered marine mammals, the Guadalupe fur seal, *Arctocephalus townsendi*, the Steller sea lion, *Eumetopias jubatus*, are occasional but uncommon visitors to San Diego offshore waters. Severely reduced by hunting in the 1800s, the Guadalupe fur seal was considered extinct by the turn of the century. A small, remnant breeding colony was discovered by Carl Hubbs of the Scripps Institution of Oceanography on Guadalupe Island in 1954 and the population has grown since then (Hubbs 1956). Guadalupe fur seals feed on crustaceans, squid and fish (NMFS 2014e). The Guadalupe fur seal breeds mainly on Guadalupe Island about 100 mi (161 km) off the Baja California coast. Guadalupe fur seals may migrate at least 230 mi (600 km) from their rookery sites, based on observations of individuals in the Southern California Bight (Carretta et al. 2014). The Guadalupe fur seal population is now in the process of recovering (Gallo 1994).

Drift and set gillnet fisheries may cause incidental mortality of Guadalupe fur seals in Mexico and the United States. In the United States there have been no reports of mortality or injuries for Guadalupe fur seals (Carretta et al. 2014). No information is available for human-caused mortality or injuries in Mexico. The Guadalupe seal is listed as threatened under the ESA and depleted under the MMPA.

The Steller sea lion ranges from Baja California to Alaska, but prefers the colder temperate to sub-arctic waters of the North Pacific Ocean (NMFS 2014f). It is seldom seen in southern California except near the Channel Islands. Steller sea lions are opportunistic marine predators, feeding on a variety of fish including mackerel, sculpin, rockfish, salmon, squid, and octopus (Perrin et al. 2008). Among pinnipeds, they are only surpassed in size by the walrus and elephant seal. Although the Steller sea lion may be able to avoid being hit by ships, they could be subject to entanglement in fishing gear (Carretta et al. 2005).

The Steller sea lion was listed under the ESA as threatened throughout its range in 1990. On June 4, 1997, the population west of 144° W longitude was listed as an endangered Distinct Population Segment (DPS) (the Western DPS) under the ESA; the population east of 144° W remained listed as threatened as the Eastern DPS. A Final Rule to Delist the Eastern DPS was issued on November 4, 2013 (NMFS 2013c).

Birds

Of the seven species of endangered birds in Table 26, only the California least tern (*Sternula antillarum browni*) would be regularly encountered in marine waters off Point Loma. Once common along the southern California coast, the least tern population diminished to a low of about 600 pairs in the early 1970s as a result of loss of wetland habitat and increasing human disturbance (USFWS 2009). Implementation of mitigation measures following their classification as an endangered species helped the species slowly recover. The California least tern historically nested on beaches, often near estuaries. Now, active management is required to create and maintain safe nesting sites. Fencing, signs, education, and predator control are all employed to protect the species. Least terns are generally present at nesting areas between mid-April and late September, often with two waves of nesting during this time.

California least terns are distributed along the U. S. Pacific Coast from San Francisco to Baja California (USFWS 2014c). Foraging habitats include nearshore ocean waters, bays, and salt marshes. They plunge-dive to capture prey, usually within 1 mi (1.6 km) from shore in waters less than 60 ft (18 m) deep. Prey species include anchovies, smelt, and gobies. Peak foraging behavior typically occurs from the end of May through mid-July after chicks hatch. California least terns eggs, chicks, and adults are preyed upon by gulls, ravens, hawks, crows, rodents, raccoons, and coyotes. The California least tern was federally listed as endangered in 1970 and was listed as endangered by the state of California in 1971.

The 2013 California least tern breeding survey estimated 4,353-5,561 California least tern breeding pairs established 5,894 nests and produced 1,399-1,634 fledglings at 56 documented locations (Frost 2014). Camp Pendleton, Naval Base Coronado, Batiquitos Lagoon, and Huntington State Beach represented over half of the breeding pairs. Sites with at least 90 fledgling numbers each (Alameda Point, Naval Base Coronado, Camp Pendleton, Hayward Regional Shoreline, Batiquitos Lagoon, and Huntington State Beach), contributed 67% of the state’s production, and the sites with greater than 35 fledglings each (including the six previously mentioned sites plus Seal Beach, Tijuana Estuary, and Oceano Dunes), contributed 82% of the state’s production. The closest California least tern breeding area to the Point Loma outfall is the Naval Base Coronado.

The nesting sites there accounted for an estimated 713.5-912 breeding pairs, 1,034 nests, and 153 fledglings in 2013 (Frost 2014).

The 2013 statewide California least tern non-predation chick mortality rate was 22%, much less than that in 2012 (49%) and a reverse in the upward trend observed in the previous five years. With the exceptions of Batiquitos Lagoon and Camp Pendleton, the larger nesting colonies experienced non-predation chick mortality rates less than the average, similar to that documented in 2012. The predators known to be responsible for the greatest number of depredated least terns in 2013 were common ravens (*Corvus corax*), peregrine falcons (*Falco peregrinus*), unknown gull spp., domestic cats (*Felis catus*), American crows (*Corvus brachyrhynchos*), American kestrels (*Falco sparverius*), coyotes (*Canis latrans*), great horned owls (*Bubo virginianus*), northern harriers (*Circus cyaneus*), unknown avian spp., unknown spp., Cooper's hawks (*Accipiter cooperii*), and red-tailed hawks (*Buteo jamaicensis*).

The light-footed clapper rail, *Rallus longirostris levipes*, is a hen-sized bird with long legs and toes. It has a tawny breast, gray-brown back, and gray and white striped flanks (USFWS 2014d). They feed primarily on invertebrates such as snails, crab, insects and worms and are year-round inhabitants of coastal estuaries. Light-footed clapper rails historically ranged from Santa Barbara County to San Quintin, Baja California, Mexico. Loss and degradation of southern California wetlands resulted in the species being listed as federally endangered in 1970 and California state endangered in 1971. In the vicinity of Point Loma, light-footed clapper rails inhabit the Tijuana River Valley, the Sweetwater Marsh National Wildlife Refuge, and the San Diego River Flood Control Channel.

The light-footed clapper rail population fell to its lowest level in 1989 when only 163 pairs were recorded in eight southern California marshes. The population then slowly increased to 325 and 307 pairs censused in 1996 and 1997, respectively in 15 of 16 California coastal wetlands (Zembel et al. 1997). The thirty-fourth annual census of the light-footed clapper rail in California was conducted from 2 March to 21 June 2013 (Zembel et al. 2013). Thirty coastal wetlands were surveyed by assessing call counts from Mugu Lagoon in Ventura County, south to Tijuana Marsh National Wildlife Refuge on the Mexican border. For the second year in a row the California population of the light-footed clapper rail exceeded 500 breeding pairs. A total of 525 pairs exhibited breeding behavior in 22 marshes in 2013. This was the highest count on record, representing an increase of four pairs over the breeding population detected in 2012, and 18.5% larger than the former high count in 2007. The Tijuana Marsh National Wildlife Refuge was at its third highest recorded level with 105 breeding pairs, an increase of 4% over the 2012 breeding season but 26% lower than the record high of 142 pairs in 2007. The Tijuana Marsh National Wildlife Refuge comprised 20% of the breeding population of this rail in California.

The western snowy plover, Charadrius alexandrinus nivosus, is a small, pale-colored shorebird with dark patches on its upper breast (USFWS 2014e). It feeds by probing the sand at the beach-surf interface for small crustaceans and marine worms. It breeds on coastal beaches from southern Washington to southern Baja California, Mexico. In southern California, snowy plovers typically nest in association with federally endangered California least terns. The western snowy plover is threatened by habitat loss, human disturbance, and nest/egg destruction by native and introduced predators and domesticated pets. Western snowy plovers nest in San Diego Bay along the Silver Strand and at the south San Diego Bay Saltworks. They are occasional visitors to the Point Loma shoreline. A 2006 breeding season census of western snowy plovers by the USFWS observed 95 adults in San Diego Bay and Tijuana Estuary and a total of 1,723 adults state-wide (USFWS 2007). The Pacific coast population of western snowy plovers was listed as threatened under the ESA in 1993. In 2012, a 0.6 mi (0.96 km) stretch of Coronado City Beach to the south of Point Loma was designated as western snowy plover critical habitat (USFWS 2012).

The last four bird species in Table 26 – the Guadalupe murrelet, marbled murrelet, Scripps's murrelet, and short-tailed albatross are strictly sea birds, usually found well offshore in southern California waters (USDON 2013). These endangered birds would rarely be seen in the Point Loma area (UCSD 2013).

Sea Turtles

Five species of sea turtles occasionally visit San Diego ocean waters: green, loggerhead, leatherback, olive Ridley, and hawksbill – all are protected under the Endangered Species Act (Table 26). The U. S. National Marine Fisheries Service (NMFS) and the U. S. Fish and Wildlife Service (USFWS) share Federal jurisdiction for sea turtles, with NMFS having lead responsibility in the marine environment and USFWS having lead responsibility on nesting beaches (NMFS 2014g, USFWS 2014f).

Sea turtles are saltwater reptiles with streamlined bodies built for trans-oceanic navigation (Wyneken et al. 2013). Although they live most of their life in the ocean, females return to land to lay their eggs on nesting beaches. Recovery plans for the U.S. Pacific populations of sea turtles provide a wealth of information on their distribution, diet, growth, reproduction, behavior, and health (NMFS and USFWS 1998a,b,c,d,e). These plans also discuss threats to the continued existence of sea turtles and define procedures and goals for their recovery.

All five species of sea turtles forage along the California coast in the summer and early fall when sea temperatures are warmest (Eckert 1993). There are no known sea turtle nesting sites in the San Diego area or anywhere on the west coast of the United States (USDON 2013).

Most commonly seen in San Diego marine waters, the east Pacific green sea turtle, *Chelonia mydas*, nests on beaches of the Pacific coast of Mexico and ranges throughout the north Pacific Ocean (NMFS 2014h). Adults have three-foot-wide shells with a radiating pattern of brown, black, and cream colored markings and weigh about 200-300 lb (90-136 kg). The biting edge of their lower jaw is serrated. They eat algae and sea grasses. Green sea turtles are often found from July through September off the coast of California. As for the other endangered sea turtles discussed here, there is no designated green turtle critical habitat in the San Diego region.

In the past, Green sea turtles have aggregated at the southern end of San Diego Bay, attracted to the warm water effluent from a power plant (McDonald et al. 1995, McDonald et al. 2012). A 20-year monitoring program of these turtles indicated an annual abundance of between 16 and 61 turtles (Eguchi et al. 2010). Local researchers have used genetics and satellite telemetry to determine that the turtles are part of the Eastern Pacific nesting populations, and migrate thousands of miles to lay their eggs on beaches off the coast of Mexico. Within San Diego Bay, the turtles can most often be seen surfacing within the South San Diego Bay National Wildlife Refuge, which provides a protected foraging and rest area, as well as a prime study site for turtle biologists. The power plant, which had continuously operated since 1960, ceased operation in December 2010. The closure of the power plant may impact these resident turtles and alter movement patterns (Turner-Tomaszewicz and Seminoff 2012). The green turtles' greatest threat in San Diego Bay is being hit by boats traveling over the 5-mile/hour speed limit posted throughout the southern portion of the bay (POSD 2014b).

The loggerhead turtle, *Caretta caretta*, is a reddish-brown sea turtle with a large head. Adult loggerheads average about 200-300 lb (91-136 kg) with shells about three-feet (1 m) wide (NMFS 2014i). They take over two decades to mature and in the northern Pacific are only known to nest in southern Japan. Their diet consists of crabs, shrimp, mollusks and jellyfish. Most recorded sightings in California are juveniles (Battey 2014).

The leatherback sea turtle, *Dermochelys coriacea*, is the largest sea turtle, reaching over six-feet in diameter and weighing as much as 1,400 lb (635 kg) (NMFS 2014j). Unlike other species which have solid shells covered with scales, the leatherbacks' shell is a bony matrix covered with a firm, rubbery skin with seven longitudinal ridges or keels (Wyneken et al. 2013). Most sea turtles are cold-blooded and prefer to live in warm waters. Leatherbacks are the exception, and are more likely to be found in colder waters at higher latitudes because of their unique ability to maintain an internal body temperature higher than that of the environment (Dutton 2006). These large sea turtles feed mostly on jellyfish and nest in the tropics and subtropics. Along the western U. S coast, leatherbacks are mostly seen in waters over the continental slope, with greatest densities off central California (NMFS 2013a). The majority of loggerheads observed in the eastern North Pacific Ocean are juveniles, believed to have come from nesting beaches in Japan (USDON 2013).

The olive Ridley turtle, *Lepodochelys olivacea*, is the smallest sea turtle in Pacific waters. Their shell is heart-shaped to round and may be colored grey-brown, black, or, olive. Olive Ridleys' are primarily carnivores and eat a wide variety of food including crab, shrimp, lobster, jellyfish, and tunicates (NMFS 2014k). In San Diego waters, loggerheads, leatherbacks, and olive Ridleys are most often seen well offshore, unlike green sea turtles which tend to hug the shoreline (USDON 2013).

Like other Pacific sea turtles, the hawksbill turtle, *Eretmochelys imbricata*, makes vast oceanic excursions and could occur off the U. S. west coast (NMFS 2014l). Hawksbills were originally considered to be omnivores, but subsequent research revealed they are primarily specialist sponge carnivores, preferring only a few species of sponge (Vicente 1994). There have been few hawksbill sightings north of Baja California Sur and its appearance in San Diego waters would be extremely unlikely (USDON 2013).

Fish

In 1997, the National Marine Fisheries Service listed the southern California Evolutionary Significant Unit of West Coast steelhead (*Oncorhynchus mykiss*) as endangered (Federal Register: 18 August 1997 [Volume 62, Number 159, Pages 43937-43954]) (NMFS 1997). In March of 1999, NMFS added nine species of salmon and steelhead to the Endangered Species list and designated critical habitat for them in 2005 (NMFS 2005c). Though most of these are Pacific northwest species, the chinook salmon and steelhead range south to California (NMFS 2014m). Chinook salmon are mostly encountered north of Point Conception.

Steelhead trout are usually dark-olive in color, shading to silvery-white on the underside with a heavily speckled body and a pink to red stripe running along their sides (USFWSg). Steelhead are born in freshwater streams and later move into the ocean where most of their growth occurs. After 1 to 4 years in the ocean, they return to their home freshwater stream to spawn. Some steelhead, however, spend their entire life in freshwater: these fish are called rainbow trout. Steelhead tend to move immediately offshore on entering the marine environment although, in general, steelhead tend to remain closer to shore than other Pacific salmon species (Beamish et al. 2005).

Steelhead occurred historically in all San Diego County watersheds that drain into the ocean (NMFS 2012). Currently, steelhead in southern California range only as far south as San Mateo Creek in northern San Diego County (USDON 2013). Both steelhead and chinook salmon are occasionally caught in ocean waters off San Diego but do not enter streams in the San Diego Metropolitan area.

Invertebrates

The white abalone, *Haliotis sorenseni*, was historically found from Punta Abreojos, Baja California, Mexico, to Point Conception, California (NMFS 2014n). Inhabiting deeper water than any other abalone species, white abalone in southern California typically occur from 60 to 195 ft (18 to 59 m), with the highest densities between 130 and 165 ft (40 and 50 m) (Butler et al. 2006). They reproduce by broadcast spawning and reach sexual maturity at age 4 to 6 years at a size of 3 to 5 inches. Newly settled individuals feed on benthic diatoms, bacterial films, and single-celled algae found on coralline algal substrates. As they grow larger, white abalone feed on drift and attached algae. Adult white abalone can reach a shell length of up to 9 inches. Except for some isolated survivors, the species is currently distributed only around the Santa Barbara Channel Islands and along various banks far offshore from Point Loma.

Inhabiting deeper water initially provided white abalone a refuge from divers, but a commercial fishery began in the early 1970s and together with increasing recreational take, over-harvesting lead to the collapse of the fishery in the 1980s. The state of California suspended all forms of harvesting of the white abalone in 1996 and, in 1997, and imposed an indefinite moratorium on the harvesting of all abalone in central and Southern California (NMFS 2008). The white abalone was federally listed as an endangered species on 29 May 2001 (NMFS 2001). Critical habitat is not designated for white abalone.

The black abalone, *Haliotis cracherodii*, inhabits the intertidal and shallow subtidal zones where it has been easily targeted for exploitation (NMFS 2014o). It has experienced dramatic population declines due to recreational and commercial fishing and withering syndrome disease (VanBlaricom et al. 2009). The state of California imposed a moratorium on black abalone harvesting 1993 and adopted an Abalone

Recovery Management Plan 2005 (CDFG 2005). There is concern that the low remaining densities of both black and white abalone may be insufficient for continued reproductive success (VanBlaricom et al. 2009).

The black abalone was proposed as a candidate for listing as an endangered species in 2005 (NMFS 2005d) and listed as endangered under the ESA on 14 January 2009 (NMFS 2009). Critical habitat was designated for black abalone in 2011 (NMFS 2011b). The designated critical habitat extends north of the Palos Verdes Peninsula and in waters surrounding Santa Catalina Island and the Channel Islands.

Environmental Effects

Twenty four endangered species; eight marine mammals, seven birds, five sea turtles, two fish, and two invertebrates, may occur in the Point Loma area (Table 26).

Endangered species in southern California are subject to a variety of natural and human influences (Davidson et al. 2011, Van Der Hoop et al. 2013, NOAA 2014g). Changes in wide-scale oceanographic regimes can alter endangered species foraging success through impacts on prey distributions and locations, which in turn affects reproductive success and survival (O'Shea and Odell 2008, Simmonds and Eliott 2009, Salvadeo et al. 2010, 2013, Fiedler et al. 2013, NMFS 2013a). Climate shifts can transform the type and the intensity of human activities, such as fishing, shipping, oil and gas extraction, and coastal construction, all of which may have an impact on endangered species (Alter et al. 2010, Hoegh-Guldberg and Bruno 2010, Doney et al. 2012, Hazen et al. 2012). Other potential anthropogenic stressors include noise, bioaccumulation of chemicals, overfishing, marine debris, and habitat deterioration or destruction (Crain et al. 2009, Halpern et al. 2009, Jackson et al. 2011, Hilborn and Hilborn 2012, NAVFAC 2013). Incidence of disease, parasitism, and adverse effects from algal blooms may also pose a threat to the health of endangered species (Brodie et al. 2006, Walsh et al. 2008, Bossart et al. 2011). These impacts have the potential to alter the physiology, behavior, growth, and reproduction of individual species, shift patterns of larval dispersal and recruitment, modify the composition of ecological communities, and, change the structure, function, productivity, and resilience of marine ecosystems

For marine mammals and sea turtles, ship strikes and fisheries bycatch (accidental or incidental catch) are the primary cause of human-related mortality in southern California ocean waters (Harvey et al. 2010, Carretta et al. 2013, Geijer and Read 2013). In addition to these direct effects, marine mammals and sea turtles may also be indirectly effected by noise, bioaccumulation, habitat alteration, and depletion of prey species (Redfern et al. 2013, NMFS 2013a, NOAA 2014g). In 1994, the MMPA was amended to formally address these issues (16 U.S.C. 1361-1407: PL103-238:108 Stat. 532).

The Marine Mammal Protection Act requires the National Marine Fisheries Service to document human-caused mortality and injury of marine mammals as part of assessing marine mammal stocks (Roman et al. 2013, Carretta et al. 2014). A recent NMFS report summarizes records of human-caused mortality and injury from 2007 to 2011 for U. S. west coast marine mammal populations (Carretta et al. 2013). Among marine mammals, pinnipeds were most commonly injured or killed by anthropogenic activity followed by small cetaceans and large whales. The primary causes of pinniped injury and mortality were recreational hook and line fishery interactions, shootings, and entrainment into power plant water intakes. Vessel strikes and fishery-related entanglements were the most common form of mortality and injury to whales. Net fisheries accounted for most of the injuries and mortalities for small cetaceans. Sea turtles and sea birds are also at risk of entanglement in fishing gear (Carretta and Enriquez 2012). Impacts of commercial fisheries that utilize nets, pots, and traps are likely to be greater than the number of observed incidents because derelict gear can entangle animals for as long as it remains in the environment (EPA 2012b, Reeves et al. 2013).

Habitat deterioration and loss is an issue for almost all coastal marine mammals (Davidson et al. 2011, Roman et al. 2013). Anthropogenic noise is a potential habitat level stressor especially in areas of industrial activity or commercial ship traffic (McDonald et al. 2008, Hildebrand 2009). Noise is a particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals (USDON 2013). It may induce marine mammals to leave a habitat, impair their ability to communicate, or cause stress (Rolland et al. 2012, Erbe et al. 2012). Noise can create behavioral disturbances and mask other sounds including the marine mammals' own vocalizations (Southall et al. 2012). With ecotourism on the rise, marine life viewing activities like whale watching have the potential to impact the behavior and migration of marine mammal populations (NMFS 2013a, NOAA 2014g).

Endangered species are also subject to bioaccumulation of toxic chemicals. Natural and synthetic chemicals enter the ocean through various sources including rivers and streams, storm drains, industrial discharges, municipal wastewater discharges, dredge and disposal activities, aerial fallout, vessel activities and spills, mineral mining, oil exploration and extraction, and through hydrothermal vents and hydrocarbon seeps (Setty et al. 2012, Hutchinson et al. 2013). Some of the chemical constituents entering the ocean remain dissolved and are distributed by ocean currents and eddies. Many are physically or chemically bound to particulate matter and settle to the bottom.

Marine organisms can absorb dissolved chemicals directly from seawater (by the gills or epidermis), and indirectly through contact with sediment, by ingesting sediment particles or suspended particulate matter, and through assimilation from food organisms (Newman 2009, Allen et al. 2011, Laws 2013). Chemical compounds accumulate in an organism's tissue if they cannot be metabolized and eliminated faster than they are absorbed. Tissue concentration can also increase as these chemicals are passed through the food web from lower to higher trophic levels (Bienfang et al. 2013, Daley et al. 2014, Weis 2014). The degree to which bioaccumulation occurs depends on the solubility, particle affinity, oxidation state, volatility, and degradability of the specific chemical (Laws 2013). These differences determine how chemical compounds are distributed within biological communities and throughout the environment (Whitacre 2014). The potential impacts of bioaccumulation by marine organisms include compromised immune response and disease resistance, altered behavior, diminished breeding success, developmental abnormalities, population declines via direct mortality, and shifts in the composition of communities by affecting top predators and keystone species (Newman 2009, NAVFAC 2013).

The species most at risk from bioaccumulation of toxic compounds are those at the highest trophic levels, especially marine mammals (O'Hara and O'Shea 2005, Tornero et al. 2014). Marine mammals are vulnerable to bioaccumulation because they have long life spans and large blubber stores that can serve as repositories for lipophilic chemicals (Moore et al. 2013). Bioaccumulation of anthropogenic contaminants may also increase susceptibility to other stressors including parasitism and disease (O'Hara and O'Shea 2005, Bossart 2011).

Marine debris is a potential threat to endangered marine mammals (EPA 2012b, Howell et al. 2012). Marine debris flows into the ocean from rivers, harbors, estuaries, and, though prohibited in U. S. waters, occasionally from vessels at sea (NOAA 2008). Ingestion of debris can have fatal consequences for whales. The stomach contents of two sperm whales that stranded in California included extensive amounts of discarded fishing netting (NMFS 2013a). Another Pacific sperm whale contained nylon netting in its stomach when it washed ashore in 2004 (NMFS 2013a). Seals and sea lions are also subject to entanglement in marine debris (Carreta et al. 2013). A recent study by Oregon State University found Steller sea lions entangled with rubber bands used on crab pots, hard plastic packing bands from cardboard boxes, fishing line and hooks, and other fishing gear (OSU 2011).

Sea turtles are exposed to a wide variety of natural and anthropogenic threats (Santidrián Tomillo et al. 2012, NMFS 2013a, Wyneken et al. 2013). Nesting beaches are threatened by hurricanes and tropical storms. Hatchlings are preyed on by herons, gulls, and sharks. Juveniles and adults are eaten by sharks and other large marine predators. Sea turtles are also killed or injured by fisheries and by vessel strikes (Carretta et al. 2005, Hazel et al. 2007, Wallace et al. 2010, Work et al. 2010). Marine debris can be detriment as well. Floating plastic garbage can be mistakenly ingested by sea turtles. Leatherback sea turtles in particular may mistake floating plastic garbage as jellyfish, an important component of the leatherback diet (Lazar and Gračan 2011). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown all life stages (Mrosovsky et al. 2009).

All the nearshore birds in Table 26 became endangered because of habitat loss and disturbance. These bay and estuarine species - California least tern, light-footed clapper rail, and western snowy plover - occasionally forage over San Diego coastal water. The primary threat to their well-being in ocean waters would be exposure to bioaccumulated toxic compounds from prey captured in the area (Arnold et al. 2007).

Regional evaluations have shown that virtually all bottom-dwelling fish populations in southern California have detectable levels of DDT and PCBs as a result of past discharge practices, now discontinued (SCCWRP 2012). The highest concentrations are on or near the Palos Verdes shelf off Whites Point in Los Angeles, an area with highly contaminated sediments, the result of historical discharge. Fish tissue burdens of DDT and PCBs decline to the north and south across the Southern California Bight. Concentrations of chlorinated hydrocarbons in fish from reference areas are now less than 5% of levels measured two decades ago (Allen et al. 2011). Contaminant burdens in fish tissues at Point Loma are comparable to those at reference sites beyond the influence of the discharge (COSD 2008-2014). Endangered birds feeding in the Point Loma area would not be exposed to a higher risk of bioaccumulation from the discharge of treated wastewater.

Of the five species of endangered sea turtles that may pass through the San Diego marine environment (Table 26), the green sea turtle would be most common and the one found closest to shore. Green turtles are subject to entrainment in coastal power plants, perhaps attracted to the lush growth of algae on the cooling water intake structures (Seminoff 2007). Green turtles have also been struck by boats and entangled in fishing gear in southern California (Carretta et al. 2005). Although capable of deep dives, most sea turtles passing San Diego would be in surface waters. They should not be exposed to the effluent plume which is normally trapped below the thermocline, especially during the summer when turtles would be most prevalent. The potential impact of discharged debris is minimized by screens in the Point Loma wastewater headworks that remove entrained material greater than an inch in diameter (COSD 2014).

The two other endangered species possibly occurring at Point Loma, the steelhead trout and black abalone, would not be jeopardized by the discharge. Steelhead trout would be transitory, and the black abalone, if present, would be well inshore of the outfall, beyond potential adverse influence.

Operation of the Point Loma ocean outfall could affect endangered species by altering physical, chemical or biological conditions including: water quality, biological integrity (e.g., species abundance and diversity), food web dynamics (e.g., availability of prey), habitat suitability, and the health of organisms (e.g., bioaccumulation of toxic substances, disease, and parasitism).

The City of San Diego monitors changes in ocean conditions over space and time, and assesses any impacts of wastewater discharge or other man-made or natural influences on the local marine environment. Monitoring results are contained in Annual Monitoring Reports (COSD 2008-2014). The monitoring program has six components: coastal oceanographic conditions, water quality and plume dispersion, sediment conditions, macrobenthic communities, demersal fish and megabenthic invertebrates, and contaminants in fish tissues. The overall findings are summarized in the following paragraphs.

There has been no indication of change in any physical or chemical water quality parameter (e.g., dissolved oxygen, pH) attributable to wastewater discharge off Point Loma. Instead, changes in oceanographic parameters have historically been associated with varying climate regimes and with natural events such as storm activity and the presence of plankton blooms.

Benthic conditions off Point Loma show some changes that may be expected near large ocean outfalls, though restricted to a relatively small, localized region near the discharge site. For example, sediment quality data have indicated slight increases over time in sulfide content and biological oxygen demand at sites nearest the discharge, where the physical presence of the outfall structure has caused relatively coarse sediment particles to accumulate. Other measures of environmental impact such as concentrations of sediment contaminants (e.g., trace metals, pesticides) show no patterns related to wastewater discharge.

Some descriptors of benthic community structure (e.g., abundance, species diversity) or indicators of environmental disturbance (e.g., brittle star populations) have shown temporal differences between reference areas and sites nearest the outfall. However, results from environmental disturbance indices such as the Benthic Response Index that are used to evaluate the condition of benthic assemblages indicate that benthic invertebrate communities in the Point Loma region remain characteristic of natural conditions.

Analyses of bottom dwelling fish and trawl-caught invertebrates reveal no spatial or temporal patterns that can be ascribed to effects of wastewater discharge. Instead, historical data (1991-2014) indicates that patterns of change in benthic communities are related to large-scale oceanographic events or specific site conditions (e.g., near dredge material disposal sites) (see Appendix C – Ocean Benthic Conditions). The lack of physical anomalies and other symptoms of disease in local fish, as well as the low level of contaminants in fish tissues, are also indicative of a healthy marine environment.

Cumulative Impacts

Cumulative impacts are defined in the National Environmental Protection Act (NEPA) (42 USC § 4321 *et seq*. and 32 CFR 775 respectively) as: the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).

In general, the effects of a particular action or group of actions must meet all of the following criteria to be considered cumulative impacts:

- Effects of several actions occur in a common locale or region,
- Effects on a particular resource are similar in nature, such that the same specific element of a resource is affected in the same specific way, and
- Effects are long-term as short-term impacts dissipate over time and cease to contribute to cumulative impacts.

The discharge of wastewater from commercial activities, including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., desalination plants), and storm water from drains into open ocean waters, bays, or estuaries can introduce chemical and biological constituents potentially detrimental to estuarine and marine habitats (Perry 2009, Hutchinson et al. 2013). These constituents include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, and toxic chemical compounds (Crain et al. 2009, Stein and Cadien 2009, Setty et al. 2012). Historically, wastewater discharges have been one of the largest inputs of these constituents into coastal waters. However, wastewater discharges have been regulated under increasingly stringent requirements over the last 40 years and mass emissions of most constituents have been significantly reduced (Lyon and Sutula 2011, SCCWRP 2012, 2014). Nonpoint source/storm water runoff, on the other hand, has not been managed as effectively and continues to be a substantial remaining source of contamination of coastal areas and the ocean (Setty et al. 2012, Howard et al. 2014).

Human activities, such as shipping, oil and gas extraction, and coastal construction have the potential to directly or indirectly affect endangered species (Alter et al. 2010, Hoegh-

Guldberg and Bruno 2010, Doney et al. 2012, Hazen et al. 2012). Other possible cumulative threats to endangered species include degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, and disease (Field et al. 2003, Horn and Stevens 2006, O'Shea and Odell 2008, Pinnegar and Engelhard 2008, Crain et al. 2009, Halpern et al. 2009, Hoegh-Guldberg and Bruno 2010, Thrush and Dayton 2010, Doney et al. 2012, Hazen et al. 2012, Howell et al. 2012, SCCWRP 2012, NMFS 2013a, Howard et al. 2014, Maruya et al. 2014). Cumulative impacts could alter the physiology, behavior, growth, and reproduction of individual species, shift patterns of larval dispersal and recruitment, modify the composition of ecological communities, and, change the structure, function, productivity, and resilience of marine ecosystems.

Fishing and non-fishing activities, individually or in combination, can adversely affect endangered species (Jackson et al. 2001, 2011, Dayton et al. 2003, Chuenpagdee et al. 2003, Hanson et al. 2003, Jackson 2008, Baum and Worm 2009, Worm et al. 2009, Norse 2010, Hilborn and Hilborn 2012, NMFS 2013b, Laugen et al. 2014). Potential impacts of commercial fishing include over-fishing of targeted species and bycatch (Dieter et al. 2003, PFMC 2004, Hseih et al. 2006, Carretta and Enriquez 2012, PFMC and NMFS 2012). Indirect effects may include removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (continued catch by lost or discarded gear), and generation of marine debris (Reeves et al. 2013). Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats (NMFS 2013b). Recreational fishing also poses a threat because of the large number of participants and the intense, concentrated use of specific habitats (Coleman et al. 2004, Ihde et al. 2011, United Nations Food and Agricultural Organization (UNFAO) 2012, Arlinghaus et al. 2013).

Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Davidson et al. 2011, Hutchinson et al. 2013, Moore et al. 2013). Natural stresses include storms and climate-based environmental shifts, such as algal blooms and hypoxia (Kim et al. 2009, SCCWRP 2013).

A number of factors influence water quality and biological conditions in the Point Loma area. Key potential influences on water quality include the Point Loma treated wastewater discharge, regional non-point source discharges, local river outflows, and other local non-point sources such as harbors, marinas, storm drains, and urban runoff (Bartlett et al. 2004, Parnell et al. 2008, Parnell and Riser 2012).

The effects of the Point Loma discharge on water quality and biological conditions are evident only in deep waters (below the euphotic zone) within or near the Zone of Initial Dilution (ZID) (COSD 2008-2014). Organic enrichment of the sediments due to the outfall discharge is not occurring beyond the ZID. Contaminant loading of sediments is not evident in the discharge vicinity. Sediment chemistry is comparable to reference areas along southern California's outer continental shelf. Biological conditions do not indicate any environmentally-significant changes associated with the discharge. A balanced indigenous population of shellfish, fish and wildlife exist immediately beyond the ZID.

While significant natural variations in fish populations are observed (in response to factors such as water temperature), the Point Loma wastewater discharge is not having any significant effect on fish assemblages off Point Loma. Fish populations are healthy and lack physical abnormalities such as fin erosion or tumors. Levels of trace metals, chlorinated hydrocarbons, pesticides, and polyaromatic hydrocarbons are relatively low, with concentrations within the range found throughout the Southern California Bight. No outfall-related effects are evident from bioaccumulation data. Contaminants in fish tissues in the Point Loma area are similar to those at reference sites beyond the influence of the discharge.

The discharge of treated wastewater at Point Loma will, therefore, make a minimal, insignificant contribution to regional cumulative impacts on endangered species and their critical habitat.

Summary

Operation of the Point outfall could potentially impact endangered species through changes in environmental conditions that affect the species or their habitat. Monitoring data and research show effects of the Point Loma discharge only in deep water near the outfall where minor water and sediment quality alterations have been observed. Marine communities in the Point Loma area remain characteristic of natural conditions with no suggestion of ecologically-significant changes.

There is no indication of adverse impacts from operation of the Point Loma Ocean Outfall on environmental conditions or biological communities that could affect the health and well-being of endangered species or threaten their critical habitat. Future flows and contaminant concentrations from the Point Loma Ocean Outfall would be at or below currently permitted levels. Thus, the proposed, future discharge of treated wastewater from the Point Loma Ocean Outfall is not likely to affect endangered species or threaten their critical habitat. Consultation with the U. S. National Marine Fisheries Service and the U. S. Fish and Wildlife Service supports these findings (see Correspondence - Appendix V).

BENEFICIAL USE IMPACTS

Beneficial uses in the vicinity of Point Loma include aesthetic enjoyment, tide-pooling, wading and swimming, surfing, snorkeling, diving, sailing and boating, recreational and commercial fishing, whale watching, research and education, navigation and shipping, military and industrial use, endangered species, and, conservation of marine species and habitats. The Point Loma Ocean Outfall Monitoring Program focuses on key water quality influences and biological conditions that protect and maintain these uses (Table 27) using the types of data indicated in Table 28.

Table 27. Water Quality and Biological Conditions Monitored at Point Loma.

Water Quality Conditions:	Biological Conditions:
Acute Toxicity	Abundance, Richness, and Diversity
Chronic Toxicity	Habitat Enhancement
Dissolved Oxygen Depression	Impairment of Reproduction, Growth or Development
Conductivity/Salinity Temperature	Incidence of Disease
Nutrient Levels	Migratory Patterns
pH	Nuisance Species
Presence of Pathogens	Survival of Biota
Water Clarity/Light Penetration	Endangered Species and Habitats

Table 28. Data Used to Assess Water Quality and Biological Conditions.

General Issue	Specific Area of Concern	Available Monitoring Data
Water Quality Conditions	Acute Toxicity	DO, Un-ionized-NH_3, Effluent Toxics, Bioassay
	Chronic Toxicity	Un-ionized-NH_3, Effluent Toxics, Bioassay
	Dissolved Oxygen Depression	Dissolved Oxygen
	Nutrient Levels	Ammonia
	Pathogens	Total coliform, fecal coliform, enterococcus
	Salinity, temperature, pH	Salinity, temperature, pH
	Toxics Accumulation in Organisms	Effluent Toxics, Fish tissue bioaccumulation
	Toxics Accumulation in Sediments	Effluent Toxics, Fish tissue bioaccumulation
	Water Clarity & Light Penetration	Observation, Turbidity, Transmissivity
Biological Conditions	Abundance, Richness, and Diversity	Benthic Infauna, Fish and Megabenthic Invertebrates

Table 28. Data Used to Assess Water Quality and Biological Conditions.

General Issue	Specific Area of Concern	Available Monitoring Data
	Habitat Enhancement	Observation
	Impairment of Reproduction, Growth, or Development	DO, Fish observations
	Incidence of Disease and Parasitism	Observation
	Migratory Patterns	Observation
	Nuisance Species	Observation, Benthic Infauna, Fish
	Endangered Species and Habitats	Observation
	Survival of Biota	Observation

The City of San Diego conducts extensive ocean monitoring to evaluate potential environmental effects from the discharge of treated wastewater to the Pacific Ocean via the Point Loma Ocean Outfall (PLOO). The primary objectives of the ocean monitoring program are to measure compliance with NPDES permit requirements and California Ocean Plan (Ocean Plan) water-contact standards, monitor changes in ocean conditions over space and time, and assess any impacts of wastewater discharge or other man-made or natural influences on the local marine environment. The monitoring program has six components: coastal oceanographic conditions, water quality compliance and plume dispersion, sediment conditions, macrobenthic communities, demersal fish and megabenthic invertebrates, and contaminants in fish tissues. The following bullet points highlight the overall findings in each of these categories.

Coastal Oceanographic Conditions

- Ocean currents flow along a predominantly north-south axis during most of the year.

- The fate of discharged wastewater is determined by outfall diffuser geometry, the rate of effluent flow, and by oceanographic factors that govern water mass movement.

- Ocean conditions off Point Loma are consistent with well documented patterns for southern California and within the range of normal conditions.

- Natural factors such as upwelling and changes due to large-scale climatic events explain most of the temporal and spatial variability in the coastal waters off Point Loma.

Water Quality and Plume Dispersion

- Prevailing water quality conditions in the Point Loma area are excellent. Overall compliance with Ocean Plan water-contact standards is close to 100%.
- There is no indication that discharged wastewater reaches the shore or the Point Loma kelp bed.
- The Point Loma Ocean Outfall plume remains restricted to relatively deep, offshore waters throughout the year.
- With partial chlorination, densities of indicator bacteria in the submerged plume have dropped significantly at all offshore stations including those nearest the outfall.

Sediment Conditions

- After 20 years of wastewater discharge, sediment quality at Point Loma remains comparable to other areas in the San Diego region.
- There is no buildup of fine sediments attributable to wastewater discharge.
- Contaminant loads and organic content in sediments remain typical for San Diego and other coastal areas of southern California.
- The only periodic effects on benthic sediments are restricted to within 1,000 ft (300 m) of the ocean outfall.

Macrobenthic Communities

- Macrofaunal assemblages off Point Loma are comparable to natural, balanced indigenous populations elsewhere in the Southern California Bight.
- Macrobenthic species abundance, richness, and diversity in the vicinity of the outfall are characteristic of natural ranges for the San Diego region.
- Minor changes in macrofaunal populations located within 1,000 ft (300 m) of the outfall remain within the range of normal variations in southern California communities.
- There is no evidence that wastewater discharge has caused degradation of the marine benthos at any of the monitoring sites.

Demersal Fish and Megabenthic Invertebrates

- Demersal fish and megabenthic invertebrate communities in the Point Loma region are unaffected by wastewater discharge.
- Although highly variable, patterns in the abundance and distribution of individual species are similar at stations located near the outfall and farther away.
- Community structure analysis does not indicate any environmentally-significant changes associated with the discharge.
- Local fish populations remain healthy, with < 1% of all fish captured in the monitoring program having external parasites or any evidence of disease.

Contaminants in Fish Tissues

- Several metals, pesticides, and PCBs have been detected liver tissues of flatfish and muscle tissues of rockfish but there are no patterns related to wastewater discharge.
- These contaminants occur in fish distributed throughout the region and all contaminants are within ranges reported previously for southern California fish.
- Several muscle samples exceeded state or international standards for a few contaminants; all samples were within federal (USFDA) action limits.
- There is no indication that contaminant loads in Point Loma fish are affected by operation of the Point Loma Ocean Outfall.

In summary, there are few changes to local receiving waters, benthic sediments, and marine invertebrate and fish communities that can be attributed to Point Loma wastewater discharge. Coastal water quality conditions and compliance with Ocean Plan standards are excellent, and there is no evidence that the wastewater plume from the outfall surfaces or is transported inshore to recreational waters along the shore and in the Point Loma kelp bed. There are no outfall related patterns in sediment contaminant distributions, or in differences between invertebrate and fish assemblages at the different monitoring sites. The lack of physical anomalies or other symptoms of disease in local fish, as well as the low level of contaminants in fish tissues, reflect a healthy marine environment. Benthic habitats in the Point Loma region remain in good condition and are similar to reference areas in the Southern California Bight.

Water quality and biological conditions associated with the existing Point Loma Ocean Outfall discharge and expected for the proposed, future Point Loma Ocean Outfall discharge are summarized in Tables 29 and 30.

Table 29. Water Quality Conditions - Existing and Proposed Outfall Discharge.

Water Quality Conditions	Monitoring Data	Existing Conditions (Current Discharge)	Projected Conditions (Future Discharge)
Acute Toxicity	DO, Un-ionized-NH_3, Effluent Toxics, Bioassay	Discharge complies with *Ocean Plan* standards.	No change.
Chronic Toxicity	Un-ionized-NH_3, Effluent Toxics, Bioassay	Discharge complies with *Ocean Plan* standards.	No change.
Conductivity/Salinity	Salinity	No measurable impact on salinity.	No change.
Dissolved Oxygen Depression	Dissolved Oxygen (DO)	DO levels within range of natural conditions throughout water column.	No change.
Pathogens	Total and fecal coliforms, enterococcus	Discharge complies with applicable receiving water standards.	No change.
pH	pH	pH within range of natural conditions throughout water column.	No change.
Oil and grease	Oil and grease	No visible surface slicks or floating particles.	No change.
Temperature	Temperature	No measurable impact on temperature.	No change.
Toxics accumulation in marine organisms	Trace metals, other toxics, pesticides	Levels of contaminants within the range of natural variability and regional reference stations.	No change.
Toxics accumulation in water and sediments	Trace metals, other toxics, pesticides	No significant increase in toxics in sediments.	No change.
Water Clarity/Light Penetration	Observation, Turbidity, Transmissivity	No measurable impact on light transmittance.	No change.

Table 30. Biological Conditions - Existing and Proposed Ocean Outfall Discharge.

Biological Conditions	Monitoring Data	Existing Conditions (Current Discharge)	Proposed Conditions (Future Discharge)
Abundance, Richness, and Diversity	Benthic Infauna, Fish and Macroinvertebrates	Balanced Indigenous Population (BIP) beyond Zone of Initial Dilution.	No change.
Impairment of Reproduction, Growth or Development	DO, Fish observations	No impact.	No change.
Incidence of Disease or Parasitism	Observation	No impact.	No change.
Nuisance Species	Observation, Benthic Infauna, Fish	No impact.	No change.
Endangered Species	Observation	No impact.	No change.
Survival of Biota	Observation, Abundance	No impact.	No change.

CONCLUSIONS

No significant, outfall-related changes in water quality and biological conditions have been detected in long-term research and monitoring of the existing Point Loma Wastewater Treatment Plant discharge. There is no indication of impacts from operation of the Point Loma Ocean Outfall on environmental conditions that protect and maintain beneficial uses of the ocean. The proposed, future Point Loma Wastewater Treatment Plant discharge will, likewise, protect and maintain beneficial uses.

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Appendix I.2
COMPLIANCE WITH RECREATIONAL BODY CONTACT STANDARDS

Renewal of NPDES CA0107409

APPENDIX I.2

COMPLIANCE WITH BODY CONTACT RECREATIONAL STANDARDS

Evaluation of Compliance with State of California Recreational Body Contact Receiving Water Standards

and

Federal Recreational Body Contact Water Quality Criteria

January 2015

APPENDIX I.2

COMPLIANCE WITH BODY CONTACT RECREATIONAL STANDARDS

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List of Abbreviations

Basin Plan	*Water Quality Control Plan for the San Diego Region*
California Ocean Plan	2012 *Water Quality Control Plan, Ocean Waters of California*
EPA	United States Environmental Protection Agency (also USEPA)
m	meters
mgd	million gallons per day
ml	milliliters
NPDES	National Pollutant Discharge Elimination System
PLOO	Point Loma Ocean Outfall
Point Loma WWTP	Point Loma Wastewater Treatment Plant
PUD	San Diego Public Utilities Department
REC-1	body contact recreation
Regional Board	Regional Water Quality Control Board, San Diego Region
SCUBA	self contained underwater breathing apparatus
STV	statistical threshold value

APPENDIX I.2

COMPLIANCE WITH BODY CONTACT RECREATIONAL STANDARDS

ABSTRACT

This appendix evaluates compliance of the Point Loma Ocean Outfall (PLOO) discharge with body-contact recreational standards for ocean waters. The discharge of treated wastewater from the Point Loma Wastewater Treatment Plant (Point Loma WWTP) to the PLOO is regulated by Order No. R9-2009-0001 (NPDES CA0107409) issued by the California Regional Water Quality Control Board (Regional Board) and U.S. Environmental Protection Agency (EPA). The NPDES permit implements receiving water recreational body-contact (REC-1) standards established within the *California Ocean Plan*, which apply to state-regulated waters within three nautical miles (3.4 statute miles) of the coast. The PLOO discharge occurs 4.5 statute miles offshore, but the City of San Diego implements sodium hypochlorite disinfection at the Point Loma WWTP to ensure compliance with the REC-1 receiving water standards in the event that discharged wastewater is transported toward state-regulated waters. Offshore receiving water data from 2010-2013 collected as part of the City's comprehensive ocean monitoring program are evaluated and compared to the *California Ocean Plan* REC-1 standards. The analysis indicates virtually 100 percent compliance with the *California Ocean Plan* REC-1 standards at all offshore receiving water stations and all monitoring depths within state-regulated waters.

For waters outside the state-regulated three nautical mile limit, Order No. R9-2009-0001 implements receiving water bacteriological standards promulgated by EPA pursuant to Section 304(a)(1) of the Clean Water Act. The 304(a)(1) standards apply to "primary contact recreation" activities defined by EPA. As documented in Appendix I.1 (and as acknowledged in the Fact Sheet to Order No. R9-2009-0001), no federally-defined primary contact recreation activities have been documented off the Point Loma coast beyond the limit of state-regulated waters. While the 304(a)(1) standards are thus not applicable, PLOO receiving water bacteriological monitoring data during 2010-2013 demonstrate virtual 100 percent compliance with the 304(a)(1) single sample maximum enterococcus standard for "infrequent use" and the 301(a)(1) enterococcus 30-day geometric mean standard. Additionally, PLOO receiving water data from 2010-2013 demonstrate virtual 100 compliance with enterococcus criteria for marine waters that were established in 2012 by EPA in *Recreational Water Quality Criteria* (EPA 820-F-12-058).

I.2.1 BODY CONACT RECREATIONAL STANDARDS

California Ocean Plan REC-1 Standards. Receiving water quality standards for state-regulated waters of the Pacific Ocean are established by the California State Water Resources Control Board in the *California Ocean Plan*. Table 1.2-1 summarizes *California Ocean Plan* receiving water bacteriological standards to protect body contact recreational uses (REC-1).

Table 1.2-1
California Ocean Plan Bacteriological Standards
to Protect Body-Contact Recreation (REC-1)

Parameter	Concentration Organisms (Most Probable Number) per 100 ml	
	Single Sample Maximum[1]	30-Day Geometric Mean[1]
Total coliform	10,000[2]	1,000
Fecal coliform	400	200
Enterococcus	104	35

1 *California Ocean Plan* recreational body-contact (REC-1) bacteriological limits apply to State-regulated receiving waters that are within 1,000 feet of the shore, within the 30-foot depth contour, in designated kelp beds, or in other state-regulated ocean waters designated by Regional Boards as being subject to REC-1 (body contact recreation) use. The above receiving water standards do not apply within designated ocean outfall zones of initial dilution. State-regulated ocean waters extend from the coastline three nautical miles offshore.

2 Single sample maximum for total coliform is 1,000 organisms per 100 milliliters when the fecal coliform to total coliform ratio exceeds 10 percent.

Prior to 2005, the *California Ocean Plan* body-contact recreational (REC-1) standards applied to ocean waters with a high potential for recreational use, including waters within:

- 1,000 feet of the shore,
- the 30-foot depth contour, and
- designated kelp beds.

In 2005, the *California Ocean Plan* was revised (per direction from EPA) to also apply body-contact standards to waters designated by the Regional Board as being subject to REC-1 use (body contact recreation). The *Water Quality Control Plan for the San Diego Region* (Basin Plan) generically lists REC-1 as a beneficial use of the Pacific Ocean, and does not distinguish between beneficial uses at recreational beaches or beneficial uses in deep waters far offshore. Because of this lack of specificity, EPA has interpreted the San Diego Basin Plan as designating all state-regulated ocean waters as being subject to REC-1 use within the San Diego Region. Order No. R9-2009-0001 (NPDES CA0107409) implements this EPA interpretation, and the Order applies the *California Ocean Plan* REC-1 bacteriological receiving water standards throughout the entire depth of the water column within the three nautical mile state-regulated limit.

Clean Water Act Section 304(a) Criteria. Receiving Water Limitation V.A.1.e and Table 12 of Order No. R9-2009-0001 implement federal receiving water standards that apply outside the state-regulated three nautical mile limit:

> V.A.1.e *Ocean waters beyond the outer limit of the territorial sea shall not exceed the following 304(a)(1) criteria for enterococcus density beyond the zone of initial dilution in areas where primary contact recreation, as defined in USEPA guidance, occurs. USEPA describes the "primary contact recreation" use as protective when the potential for ingestion of, or immersion in, water is likely. Activities usually include swimming, water-skiing, skin-diving, surfing, and other activities likely to result in immersion. (Water Quality Standards Handbook, EPA823-B-94-005a, 1994, p. 2-2.)*

Table 12. 304(a)(1) ambient water quality criteria for bacteria in federal waters where primary contact recreation occurs.

Indicator	***30-day Geometric Mean (per 100 ml)***	***Single Sample Maximum (per 100 ml)***
Enterococci	*35*	*104 for designated bathing beach* *158 for moderate use* *276 for light use* *501 for infrequent use*

The above Clean Water Act Section 304(a) water quality standards for enterococcus apply in all areas beyond the state-regulated three nautical mile limit where "primary contact recreation" occurs (except within the PLOO zone of initial dilution, which is exempted).[1]

As part of the required monitoring and reporting program, Order No. R9-2009-0001 requires the City to make visual observations at the offshore monitoring stations, which include describing "the nature and extent of primary contact recreation in federal waters." City of San Diego Public Utilities Department (PUD) ocean monitoring vessels are active at Point Loma ocean monitoring stations approximately 200 days each year. As documented within Appendix I.1, visual observations conducted as part of the PLOO monitoring program during 2010-2014 did not identify any federally-defined primary contact recreation activities beyond the three nautical mile state-regulated limit. Offshore visual observations conducted during 2010-2014 are in keeping with historic recreational use studies and observations conducted offshore from Point Loma which have not documented any federally-defined primary contact recreational activities outside the state-regulated three nautical mile limit.[2]

Point Loma WWTP Disinfection. The PLOO discharges treated effluent from the Point Loma WWTP to the ocean at a depth of 320 feet approximately 4.5 statute miles (3.9 nautical miles) offshore. The PLOO discharge occurs outside the state-regulated limit and ocean currents

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[1] See Section V, Page F-46 of the Fact Sheet to Order No. R9-2009-0001 (NPDES CA0107409).

[2] Page F-13 of the Fact Sheet to Order No. R9-2009-0001 states: "The discharger has documented no federally-defined primary contact recreational activities occurring in waters beyond three nautical miles (see Volume V, Appendix G, of the 2007 301 (h) application)."

(see Appendix P) are predominantly downcoast and upcoast. These upcoast/downcoast currents, along with the distance offshore and depth of the PLOO discharge, result in the PLOO discharge plume (see Appendix F) predominantly being maintained offshore outside the three nautical mile state-regulated limit. As documented within Appendix F, however, periodic (albeit short-term) onshore currents can carry the PLOO discharge plume toward and into state-regulated waters.

The City (see Appendix A) employs hypochlorite disinfection at the Point Loma WWTP to reduce effluent concentrations of pathogens and indicator organisms. With such effluent disinfection, the City ensures compliance with *California Ocean Plan* REC-1 body contact standards in the event the PLOO discharge plume is transported within the state-regulated three nautical mile limit. While no federally-defined primary contact use occurs outside the three nautical mile limit, the Point Loma WWTP disinfection is useful for reducing receiving water pathogen concentrations beyond this three nautical mile boundary.

Table I.2-2 summarizes concentrations of total coliform, fecal coliform, and enterococcus in the Point Loma WWTP effluent during 2013. As shown in the table, Point Loma WWTP effluent total coliform concentrations are typically on the order of 10^6 organisms per 100 milliliters, while fecal coliform concentrations are typically on the order of 10^5 organisms per 100 milliliters.

Table I.2-2
Summary of Point Loma WWTP Effluent Bacteriological Monitoring, 2013

Parameter[1]	**Number of Samples**	**Point Loma WWTP Effluent Concentration (organisms per 100 ml)**[2]				
		90th Percentile	**75th Percentile**	**50th Percentile**	**25th Percentile**	**10th Percentile**
Total Coliform	185	1.09E+007	4.35E+006	1.62E+006	1.95E+005	5.62E+004
Fecal Coliform	185	1.92E+006	7.49E+005	1.20E+005	1.45E+004	5.56E+003
Enterococcus	185	2.57E+004	7.98E+003	8.60E+002	1.00E+002	1.00E+002

1 Bacteriological receiving water parameter for which body contact recreational standards are established within the *California Ocean Plan*.

2 Point Loma WWTP effluent bacteriological samples collected by operations staff during calendar year 2013 for purposes of assessing the effectiveness of Point Loma WWTP effluent disinfection. Point Loma WWTP effluent samples were collected at Monitoring Station EFF-001 prior to discharge to the PLOO.

Order No. R9-2009-0001 assigns a minimum month initial dilution of 204:1 to the PLOO discharge. Initial dilution modeling (see Appendix Q) demonstrates that the PLOO achieves a median initial dilution of 338:1 at the full 240 mgd design flow of the Point Loma WWTP. With this initial dilution achieving in excess of a 10^2 reduction, concentrations of total coliform and fecal coliform at the edge of the zone of initial dilution should typically be respectively reduced to less than 10^4 and 10^3 organisms per 100 milliliters. Additional dilution, dispersion, and die-off would be expected to occur as the effluent plume is transported from the discharge point.

I.2.2 COMPLIANCE WITH STATE OF CALIFORNIA STANDARDS

PLOO Monitoring Stations. To assess compliance with *California Ocean Plan* REC-1 receiving water bacteriological standards, Order No. R9-2009-0001 establishes a comprehensive bacteriological receiving water monitoring program that includes monitoring at:

- 11 offshore "F" monitoring stations along the 98 meter (326 foot) depth contour,
- 11 offshore "F" monitoring stations along the 80 meter (266 foot) depth contour,
- 11 offshore "F" monitoring stations along the 60 meter (200 foot) depth contour, and
- eight kelp bed stations, including three "A" stations along the 18 meter (60 foot) depth contour and five "C" monitoring stations along the 18 meter (60 foot) and 9 meter (30 foot) depth contours.

Figure I.2-1 (page I.2-6) presents the location of the monitoring stations. Table I.2-3 (page I.2-7) summarizes PLOO ocean monitoring stations within the state-regulated three nautical mile limit. As shown in Table I.2-3 and Figure I.2-1, nine monitoring stations inside of the 60 meter (200 foot) depth contour are within the state-regulated three nautical mile limit (Stations F5 through F14), along with three monitoring stations along the 80 meter (266 foot) contour (Stations F18, F19, and F20).

It should be noted that Order No. R9-2009-0001 also requires bacteriological monitoring at seven shore stations ("D" stations). While useful for assessing impacts from storm runoff or shore-based contaminant sources, the shore "D" stations are of little benefit in assessing PLOO discharge impacts. Historic outfall receiving water data (see Appendix P) demonstrate that predominant upcoast/downcoast ocean currents maintain the PLOO discharge plume far offshore. Additionally, thermal stratification prevents the PLOO discharge plume from surfacing throughout all but a small portion of the year.

Because of these factors (and the distance and depth offshore of the PLOO discharge), the shore "D" stations are not influenced by the PLOO discharge. Instead, water quality at the "D" stations is reflective of shore-based activities such as storm runoff, urban runoff, recreation, and other shore-based discharges. For these reasons, bacteriological water quality data from the shore "D" stations are not considered in assessing PLOO compliance with *California Ocean Plan* REC-1 receiving water bacteriological standards. To evaluate potential effects related to outfall performance, this analysis focuses on monitoring stations along the 98 meter, 80 meter, 60 meter, 18 meter, and 9 meter contours.

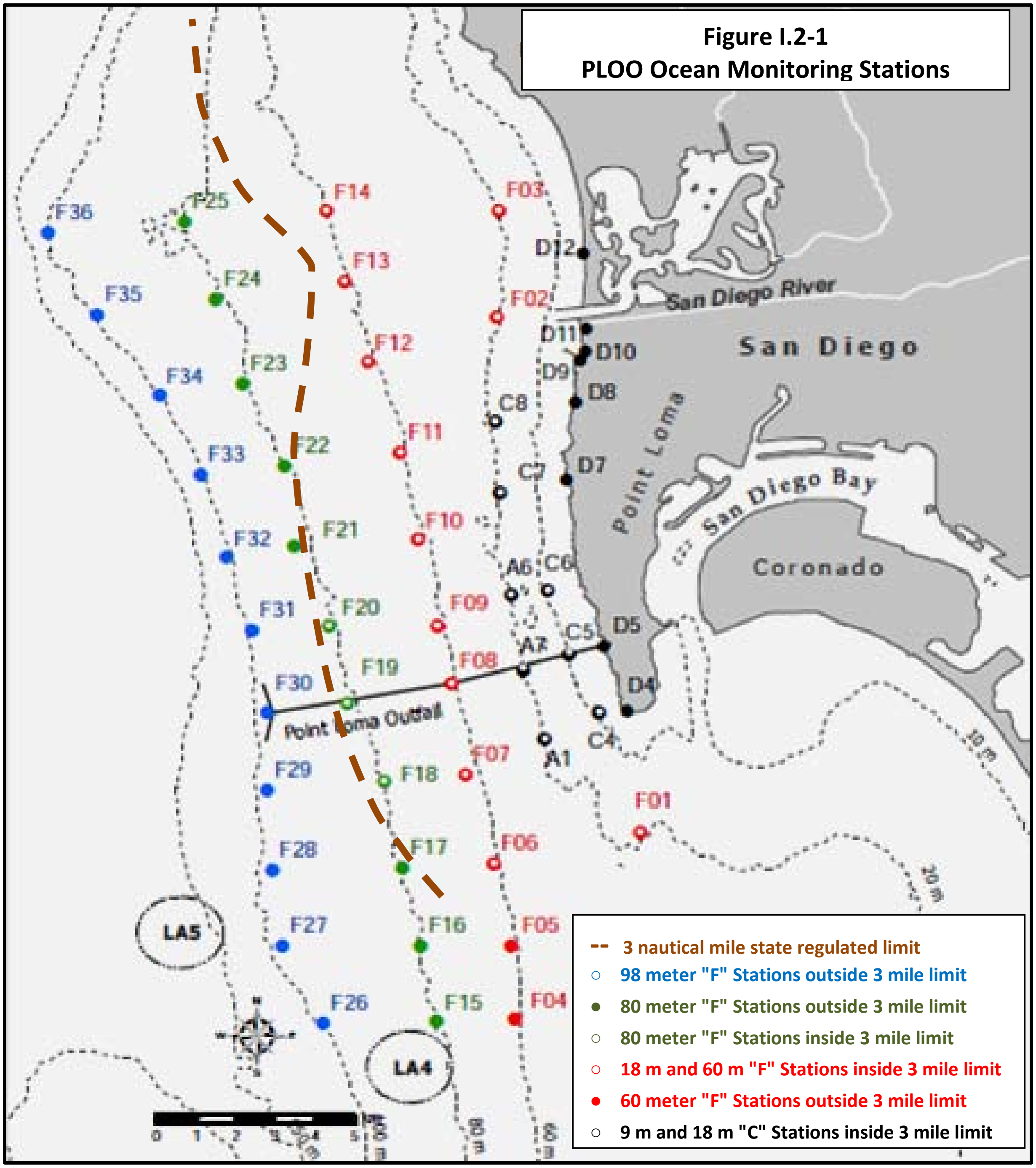

Figure I.2-1
PLOO Ocean Monitoring Stations

Table I.2-3
PLOO Offshore Receiving Water Monitoring Stations Within State-Regulated Waters[1]

Category	Station[1]	Ocean Depth		Approximate Upcoast/Downcoast Distance from PLOO[2]	
		Meters	Feet	Nautical Miles	Kilometers
Kelp Bed Stations[3]	C4	9[4]	30[4]	0.8 s	1.5 s
	C5	9[4]	30[4]	0	0
	C6	9[4]	30[4]	0.9 n	1.6 n
	C7	18[5]	60[5]	2.2 n	4.1 n
	C8	18[5]	60[5]	3.2 n	5.9 n
	A1	18[5]	60[5]	1.0 s	1.8 s
	A6	18[5]	60[5]	0.9 n	1.7 n
	A7	18[5]	60[5]	0	0
Offshore Stations	F1[6]	18[5]	60[5]	2.1 s	3.8 s
	F2[7]	18[5]	60[5]	5.1 n	9.4 s
	F3[8]	18[5]	60[5]	6.6 n	12.1 n
	F6	60[9]	200[9]	2.5 s	4.6 s
	F7	60[9]	200[9]	1.3 s	2.3 s
	F8	60[9]	200[9]	0	0
	F9	60[9]	200[9]	0.8 n	1.5 n
	F10	60[9]	200[9]	2.0 n	3.7 n
	F11	60[9]	200[9]	3.2 n	5.9 n
	F12	60[9]	200[9]	4.4 n	8.2 n
	F13	60[9]	200[9]	5.6 n	10.3 n
	F14	60[9]	200[9]	6.5 n	12.1 n
	F18[5]	80[10]	266[10]	1.1 s	2.0 s
	F19[5]	80[10]	266[10]	0	0
	F20[5]	80[10]	266[10]	1.0 n	1.9 n

1 Monitoring station locations per Monitoring and Reporting Program No. R9-2009-0001. The above stations include all PLOO offshore and kelp bed monitoring stations located within the three nautical mile limit of state regulation. See Figure I.2-1 (page I.2-6) for monitoring station locations.

2 Approximate distance north (n) or south (s) of the PLOO centerline.

3 Includes "C" stations located along the 9 meter and 18 meter contours, and three "A" stations along the 18 meter contour.

4 The 9-meter (30 foot) contour is located approximately 0.4 nautical miles offshore at the outfall centerline. See Figure I.2-1.

5 The 18 meter (60 foot) contour is located approximately 0.8 nautical miles (1.0 statute miles) offshore at the outfall centerline.

6 Station F1 station is located offshore from the mouth of San Diego Bay.

7 Station F2 is located offshore from the San Diego River mouth.

8 Station F3 is located offshore from Pacific Beach.

9 The 60 meter (200 foot) contour is located approximately 1.6 nautical miles (1.9 statute miles) offshore at the outfall centerline. See Figure I.2-1.

10 The 80 meter (266 foot) contour is located approximately 2.7 nautical miles (3.2 statute miles) offshore at the outfall centerline, slightly beyond the beyond the three nautical mile limit of state-regulated waters. See Figure I.2-1.

Total Coliform Single Sample Maximum Limits. Table I.2-4 (page I.2-9) summarizes compliance with *California Ocean Plan* REC-1 single sample maximum standards for total coliform during 2010-2013. As shown in Table I.2-4 the PLOO discharge achieved virtual 100 percent compliance with the REC-1 total coliform sample maximum limits during 2010-2013 within the three nautical mile limit of state-regulated waters.

Four exceptions to this 100 percent compliance occurred during 2010-2013, three of which may be related to the PLOO discharge. Table I.2-5 (page I.2-10) summarizes these exceptions. As shown in Table I.2-5, three of these exceptions occurred in March and May, 2010, prior to the August 1, 2010 effective date of Order No. R9-2009-0001. Since these exceedances occurred at depth and coincided with higher than normal total and fecal coliform concentrations in nearby offshore stations outside the three nautical mile limit, the March and May 2010 exceedances are likely related to the PLOO discharge.

The March 2010 exceedances occurred at a time when Point Loma WWTP flows were approximately 20 percent above normal, and plant inflows may have reduced the contact time within the effluent channel (and hence the effectiveness of disinfection). Additionally, chlorination dosage at this time was manually controlled by Point Loma WWTP operators, who were in the process of gaining experience with and fine tuning onsite chlorination operations.

One exceedance of the total coliform single sample maximum limit occurred after Order No. R9-2009-0001 became effective, and this exceedance does not appear related to the PLOO discharge. A total coliform value of 14,000 occurred at Station A7 at the ocean surface on November 6, 2010, but total coliform concentrations at 12 and 18 meter depths at this station were negligible. This surface water exceedance occurred at a time when thermal stratification typically traps the discharge plume well below the ocean surface. Additionally, fecal coliform and enterococcus values at the surface at Station A7 were within the REC-1 limits. Further, no exceedances of total coliform, fecal coliform, or enterococcus occurred at adjoining stations or at stations outside the 3 nautical mile limit at or near this November 6, 2010 date. Because of the isolated nature of the exceedance, probable thermal stratification effects, and lack of unusual bacteria concentrations at adjoining stations and depths, the cause of the ocean surface total coliform exceedance during November 7, 2010 is unknown, and the result is considered an anomaly.

Fecal Coliform Single Sample Maximum Limits. Table I.2-6 (page I.2-11) summarizes compliance with *California Ocean Plan* REC-1 single sample maximum standards for fecal coliform. As shown in Table I.2-6, PLOO ocean monitoring stations within the three nautical mile limit achieved 100 percent compliance with *California Ocean Plan* REC-1 single sample maximum standards for fecal coliform.

Table I.2-4
Receiving Water Total Coliform, 2010-2013
PLOO Monitoring Stations within State-Regulated Ocean Waters

Month	Number of Total Coliform Receiving Water Samples[1]	Number of Total Coliform Samples Exceeding 10,000 Organisms per 100 ml[2,4]	Number of Total Coliform Samples Exceeding 1,000 Organisms per 100 ml when Fecal to Total Coliform Ratio Exceeds 10%[3,4]	Number of Total Coliform Samples that Exceed Maximum Daily Limit[5]	Percent of Receiving Water Samples that Comply with the REC-1 Total Coliform Single Sample Maximum Limit[3,4]
Jan	477	0	0	0	100%
Feb	471	0	0	0	100%
Mar	527	1[6,7]	1[7,8]	2	99.6%
Apr	479	0	0	0	100%
May	526	0	1[9]	1[9]	99.8%
Jun	480	0	0	0	100%
Jul	480	0	0	0	100%
Aug	480	0	0	0	100%
Sep	480	0	0	0	100%
Oct	480	0	0	0	100%
Nov	480	1[10]	0	1[10]	99.8%
Dec	480	0	0	0	100%
Totals	5,840	2	2	4	> 99.9%

[1] Number of receiving water total coliform samples collected during the period January 2010 through December 2013 at all depths at all kelp bed stations and offshore stations located within three nautical miles of the coast. Includes 2010 samples collected prior to the August 1, 2010 effective date of Order No. R9-2009-0001. Sampled stations include Station Nos. A1, A6, A7, C4, C5, C6, C7, C8, F1, F2, F3, F6, F7, F8, F9, F10, F11, F12, F13, F14, F18, F19 and F20.

[2] Total coliform concentration expressed in units of Most Probable Number (MPN) of organisms per 100 milliliters.

[3] The *California Ocean Plan* recreational body contact (REC-1) receiving water single sample maximum total coliform standard is 10,000 MPN per 100 ml when observed fecal coliform comprise less than 10 percent of the observed total coliform.

[4] The *California Ocean Plan* REC-1 receiving water single sample maximum total coliform standard is 1,000 MPN per 100 ml when the observed fecal coliform comprise more than 10 percent of the observed total coliform.

[5] Total number of samples where either the 10,000 per 100 ml single sample maximum or the 1,000 per 100 ml limit (when the fecal coliform to total coliform ratio exceeds 10 percent) are exceeded.

[6] Total coliform value of 16,000 per 100 ml occurred at a 60 meter depth at Station F19 on March 12, 2010. This exceedance occurred prior to the effective date of Order No. R9-2009-0001. See Table I.2-5 for details.

[7] March 2010 exceedances occurred immediately after a storm period where Point Loma WTP wastewater flows were approximately 20 percent higher than normal due to storm water infiltration and inflow. The higher Point Loma WTP flows may have rendered the Point Loma WTP disinfection less effective during this brief period.

[8] Total coliform concentrations of 1,300 per 100 ml occurred at a 80 meter depth at Station F20 on March 6, 2010 at a time that the fecal coliform concentration was 140 per 100 ml (fecal:total coliform ratio of 10.8 percent). This exceedance occurred prior to the effective date of Order No. R9-2009-0001. See Table I.2-5 for details.

[9] Total coliform value of 2,200 per 100 ml occurred at a 60 meter depth at Station F8 on May 6, 2010, while a fecal coliform concentration of 360 per 100 ml (fecal to coliform ratio of 16 percent) occurred at the 60 meter depth at this time at Station F8. This exceedance occurred prior to the August 1, 2010 effective date of Order No. R9-2009-0001. See Table I.2-5 for details

[10] Total coliform value of 14,000 occurred at Station A7 at the ocean surface on November 6, 2010. Fecal coliform and enterococcus values were within REC-1 limits at the ocean surface at this time. Total coliform, fecal coliform, and enterococcus concentrations at Station A7 at 12 and 18 meter depths were negligible at this time. Further, no exceedances occurred at adjoining stations or at stations outside the 3 mile limit. The cause of the ocean surface total coliform exceedance during November 7, 2010 is unknown, but it is likely not related to the outfall discharge as thermal stratification during early November is typically strong enough to maintain the discharge plume well below the surface.

Table 1.2-5
Summary of Exceedances
California Ocean Plan Single Sample Maximum Standards for Total Coliform[1]

Date	Station	Depth (meters)	Total Coliform Concentration[2] (per 100 ml)	Cause of Exceedance
Exceedances Prior to the August 1, 2010 Effective Date of Order No. R9-2009-0001[3]				
3/6/2010	F20	80	1,300[4]	Exceedance is likely related to the PLOO discharge, as above-normal concentrations of total and fecal coliform were observed both at Stations F19 and F20. Additionally, high concentrations of total coliform, fecal coliform, and enterococcus were observed on 3/6/2010 at 60, 80 and 98 meter depths at Station F30 (within the PLOO ZID, offshore from Stations F19/F20). These exceedances occurred immediately after a storm period where Point Loma WTP wastewater flows were approximately 20 percent higher than normal due to storm water infiltration and inflow. The higher Point Loma WTP flows (hence shorter contact times in the effluent channel) may have rendered the Point Loma WTP disinfection less effective during this brief period, as plant operators were manually dosing disinfectant and were still in the process of fine-tuning disinfection operations.
3/12/2010	F19	60	16,000	
5/6/2010	F8	60	2,200[5]	Exceedance is likely related to the PLOO discharge, as high concentrations of total coliform and fecal coliform were also noted at depth at Station F30 (within the PLOO ZID). Higher than normal total coliform concentrations were also observed at a 80 meter depth at Station F19 (1.1 nautical miles offshore from Station F8).
Exceedances During After Order No. R9-2009-0001 Became Effective[6]				
11/6/2010	A7	Surface	14,000	Anomaly of unknown cause. Not likely related to the PLOO discharge, as the PLOO discharge plume would be maintained below the surface by thermal stratification. Bacteria concentrations were minimal at all other depths and at all surrounding stations. Further, fecal coliform and enterococcus concentrations were negligible at the ocean surface at Station A7 at this time, and bacteria concentrations at depth were within the normal range.

1 Summary of exceedances of *California Ocean Plan* REC-1 total coliform single sample maximum standards at PLOO ocean monitoring stations within the three nautical mile limit during 2010-2013. Sampled stations include Station Nos. A1, A6, A7, C4, C5, C6, C7, C8, F1, F2, F3, F6, F7, F8, F9, F10, F11, F12, F13, F14, F18, F19 and F20.

2 The *California Ocean Plan* establishes a total coliform single sample maximum limit of 10,000 organisms per 100 ml, or 1,000 per 100 ml limit when the fecal coliform to total coliform ratio exceeds 10 percent.

3 Exceedances that occurred prior to Order No. R9-2009-0001 becoming effective on August 1, 2010.

4 Fecal coliform to total coliform ratio was 10.8 percent, hence the 1,000 total coliform per 100 ml standard is in effect.

5 Fecal coliform to total coliform ratio was 16 percent, hence the 1,000 total coliform per 100 ml standard is in effect.

6 Exceedances that occurred after the August 1, 2010 effective date of Order No. R9-2009-0001.

As shown in Table I.2-6, one exceedance of the fecal coliform single sample maximum occurred during 2010-2013; this exceedance (May 12, 2010) occurred before the August 1, 2010 effective date of Order No. R9-2009-0001. The May 12, 2010 fecal coliform exceedance at a 60 meter depth at Station F19 coincided with exceedances of total coliform and enterococcus limits, and is likely the result of a temporary impingement of the PLOO discharge plume into state-regulated waters. As noted, the March 12, 2010 exceedance occurred at a time when Point Loma WWTP flows were approximately 20 percent above normal, and plant inflows may have reduced the contact time within the effluent channel (and hence the effectiveness of disinfection). No exceedances of the *California Ocean Plan* fecal coliform single sample maximum limit have occurred since Order No. R9-2009-0001 became effective.

Table I.2-6
Receiving Water Fecal Coliform, 2010-2013
PLOO Monitoring Stations within State-Regulated Ocean Waters

Month	Number of Fecal Coliform Receiving Water Samples[1]	Number of Fecal Coliform Samples Exceeding 400 Organisms per 100 ml[2,3]	Percent of Receiving Water Samples that Comply with the REC-1 Fecal Coliform Single Sample Maximum Limit[3]
Jan	480	0	100%
Feb	471	0	100%
Mar	527	1[4]	99.8%
Apr	480	0	100%
May	528	0	100%
Jun	480	0	100%
Jul	480	0	100%
Aug	480	0	100%
Sep	480	0	100%
Oct	480	0	100%
Nov	480	0	100%
Dec	480	0	100%
Totals	5,846	1[4]	> 99.9%

[1] Number of receiving water fecal coliform samples collected during the period January 2010 through December 2013 at all depths at all kelp bed stations and offshore stations located within three nautical miles of the coast. Includes 2010 samples collected prior to the August 1, 2010 effective date of Order No. R9-2009-0001. Sampled stations include Station Nos. A1, A6, A7, C4, C5, C6, C7, C8, F1, F2, F3, F6, F7, F8, F9, F10, F11, F12, F13, F14, F18, F19 and F20.

[2] Fecal coliform concentration expressed in units of Most Probable Number (MPN) per 100 milliliters.

[3] The *California Ocean Plan* recreational body contact (REC-1) receiving water single sample maximum fecal coliform standard is 400 MPN per 100 ml.

[4] A fecal coliform value of 1,600 per 100 ml occurred at Station F19 at 60 meter depth on March 12, 2010. Total coliform and enterococcus values also exceeded the single sample maximum limits at Station F19 at a 60 meter depth on this date, and higher total and fecal coliform values were also observed beyond the three nautical mile limit at Station F30 on March 12, 2010 at depths of 60, 80, and 98 meters. On this basis, it is presumed that the Station F19 pathogen indicator exceedances were likely due to a temporary impingement of the outfall plume. It should be noted that this exceedance occurred immediately after a storm period where Point Loma WTP wastewater flows were approximately 20 percent higher than normal due to storm water infiltration and inflow. The higher Point Loma WTP flows may have rendered Point Loma WTP disinfection less effective during this brief period. This exceedance occurred prior to the effective date of Order No. R9-2009-0001.

Enterococcus Single Sample Maximum Limits. Table I.2-7 (page I.2-13) summarizes compliance with *California Ocean Plan* REC-1 single sample maximum standards for enterococcus during 2010-2013. With six exceptions, the PLOO discharge achieved 100 percent compliance with the *California Ocean Plan* single sample enterococcus limits during 2010-2013. Table I.2-8 (page I.2-14) summarizes the six exceedances. As shown in the table, five of the enterococcus exceedances occurred prior to the August 1, 2010 effective date of Order No. R9-2009-0001.

The only enterococcus single sample exceedance that occurred after Order No. R9-2009-0001 became effective is unlikely to be related to the PLOO discharge. An enterococcus concentration of 200 per 100 ml occurred at a 3 meter depth at Station A7 on August 23, 2010. Enterococcus concentrations at Station A7 at 1 and 9 meter depths, however, were not detectable. Additionally, concentrations of total coliform, fecal coliform, or enterococcus were negligible at nearby monitoring stations at this time. Further, ocean thermal stratification is typically strong in August, ensuring that the discharge plume is maintained well below the ocean surface. For these reasons, this isolated August 23, 2010 enterococcus exceedance does not appear to be related to the PLOO discharge.

30-Day Geometric Mean Limits. Order No. R9-2009-0001 requires the monthly collection of five receiving water bacteriological samples at the eight kelp bed stations (Stations A1, A6, A7, C4, C5, C6, C7 and C8). Table I.2-9 (page 1.2-15) summarizes compliance at these stations with *California Ocean Plan* 30-day geometric mean standards for total coliform fecal coliform, and enterococcus.

As shown in Table I.2-9, 100 percent compliance was achieved with the *California Ocean Plan* 30-day geometric mean standards for total coliform, fecal coliform, and enterococcus during 2010-2013 at the outfall monitoring stations that featured multiple monthly bacteriological samples.

Order No. R9-2009-0001 requires only quarterly sampling at the majority of the monitoring stations along the 60-meter and 80-meter contours. As a result, only one sample per quarter at these stations is available for assessing compliance. Table I.2-10 (page (I.2-16) presents a percentile breakdown of all bacteriological samples collected within state-regulated waters during 2010-2013. As shown in the table, the 99th percentile values of all individual total coliform, fecal coliform, and enterococcus samples collected within state-regulated waters during 2010-2013 were within the 30-day geometric mean limits established within the *California Ocean Plan.*

Table I.2-7
Receiving Water Enterococcus, 2010-20131
PLOO Monitoring Stations within State-Regulated Ocean Waters

Month	Number of Enterococcus Receiving Water Samples[1]	Number of Enterococcus Samples Exceeding 104 Organisms per 100 ml[2,3]	Percent of Receiving Water Samples that Comply with the REC-1 Enterococcus Single Sample Maximum Limit[3]
Jan	480	0	100%
Feb	615	0	100%
Mar	527	2[4,5]	100%
Apr	480	1[6]	99.8%
May	672	2[7]	99.7%
Jun	480	0	100%
Jul	480	0	100%
Aug	672	1[8]	99.9%
Sep	480	0	100%
Oct	480	0	100%
Nov	672	0	100%
Dec	480	0	100%
Totals	6,518	6	> 99.9%

1 Number of receiving water enterococcus samples collected during the period January 2010 through December 2013 at all depths at all kelp bed stations and offshore stations located within three nautical miles of the coast. Includes 2010 samples collected prior to the August 1, 2010 effective date of Order No. R9-2009-0001. Sampled stations include Station Nos. A1, A6, A7, C4, C5, C6, C7, C8, F1, F2, F3, F6, F7, F8, F9, F10, F11, F12, F13, F14, F18, F19 and F20.

2 Enterococcus concentration expressed in units of Most Probable Number (MPN) per 100 milliliters.

3 The *California Ocean Plan* recreational body contact (REC-1) receiving water single sample maximum enterococcus standard is 104 MPN per 100 ml.

4 Enterococcus concentrations exceeded the single sample maximum value at two locations during March 2010, including a concentration of 3.000 per 100 ml at Station A1 (18 meter depth) on March 22, 2010 and a concentration of 140 per 100 ml at Station C4 (3 meter depth) on March 22, 2010. These exceedances occurred prior to the effective date of Order No. R9-2009-0001. See Table I.2-8 for details.

5 The March 2010 exceedances occurred after a storm period where Point Loma WTP wastewater flows were approximately 20 percent higher than normal due to storm water infiltration and inflow. The higher and normal Point Loma WTP flows may have rendered the Point Loma WTP disinfection less effective during this brief period, contributing to the March 2010 exceedances.

6 Enterococcus concentration of 880 per 100 ml occurred at 12 meter depth at Station A1 on April 13, 2010, but enterococcus concentrations were negligible at 1 meter or 18 meter depths. Additionally, concentrations of total and fecal coliform were negligible at all depths at Station A1 on April 13, 2010, and pathogen concentrations were negligible at all surrounding stations on this date. Cause of the isolated exceedance is unknown. This exceedance occurred prior to the effective date of Order No. R9-2009-0001.

7 Enterococcus concentrations of 180 and 700 per 100 ml occurred at the ocean surface at Stations A6 and A7 on May 7, 2010. These exceedances occurred prior to the effective date of Order No. R9-2009-0001. See Table I.2-8 for details.

8 An enterococcus concentration of 200 per 100 ml occurred at 12 meter depth at Station A7 on August 23, 2010. The enterococcus concentration was not detectable at 1 and 9 meter depths at Station A7 at this time, and concentrations of total coliform, fecal coliform, or enterococcus were negligible at nearby monitoring stations at this time. Additionally, thermal stratification during August is typically strong, preventing the PLOO discharge plume from rising to near the surface. As a result of these factors, the August 23, 2010 Station A7 enterococcus exceedance appears to be an anomaly not related to the PLOO discharge. See Table I.2-8 for details.

Table 1.2-8
Summary of Exceedances
California Ocean Plan Single Sample Maximum Standard for Enterococcus[1]

Date	Station	Depth (meters)	Total Coliform Concentration[2] (per 100 ml)	Cause of Exceedance
Exceedances Prior to the August 1, 2010 Effective Date of Order No. R9-2009-0001[3]				
3/22/2010	A1	18	3,000	Exceedance may be related to the PLOO discharge, as above-normal concentrations of total and fecal coliform were observed both at offshore Stations F19 and F20 during the prior week. These exceedances occurred immediately after a storm period where Point Loma WTP wastewater flows were approximately 20 percent higher than normal due to storm water infiltration and inflow. The higher Point Loma WTP flows (hence shorter contact times in the effluent channel) may have rendered the Point Loma WTP disinfection less effective during this brief period, as plant operators were manually dosing disinfectant and were still in the process of fine-tuning disinfection operations.
3/22/2010	C4	3	140	
4/13/2010	A1	12	880	Enterococcus concentration of 880 per 100 ml occurred at 12 meter depth at Station A1 on April 13, 2010, but enterococcus concentrations were negligible at 1 meter or 18 meter depths at this station. Additionally, concentrations of total and fecal coliform were negligible at all depths at Station A1 on April 13, 2010, and pathogen concentrations were negligible at all surrounding stations on this date. Cause of the isolated exceedance is unknown.
5/7/2010	A6	Surface	180	Enterococcus concentrations at the surface were elevated, but no detectable concentrations of enterococcus were observed at 12 meter and 18 meter depths. Additionally, concentrations of total coliform and fecal coliform were within the allowable limits at Stations A6 and A7. A total coliform exceedance occurred at a 60 meter depth at Station F8 at this time, and higher than normal coliform concentrations were observed at Stations F9 at this time, suggesting that the enterococcus exceedance, while isolated, may have resulted from a portion of the outfall plume being transported within the state-regulated zone.
5/7/2010	A7	Surface	700	
Exceedances During After Order No. R9-2009-0001 Became Effective[4]				
8/23/2010	A7	12	200	Anomaly of unknown cause. Not likely related to the PLOO discharge, as the PLOO discharge plume would be maintained below the surface by strong thermal stratification. Additionally, enterococcus concentrations at 1 and 18 meter depths were low, and concentrations of total and fecal coliform were not detectable at any depth at Station A7. Additionally, no anomalous total coliform, fecal coliform or enterococcus values occurred at any of the surrounding stations during August 2010.

[1] Summary of exceedances of *California Ocean Plan* REC-1 enterococcus single sample maximum standards at PLOO ocean monitoring stations within the three nautical mile limit during 2010-2013. Sampled stations include Station Nos. A1, A6, A7, C4, C5, C6, C7, C8, F1, F2, F3, F6, F7, F8, F9, F10, F11, F12, F13, F14, F18, F19 and F20.

[2] The *California Ocean Plan* establishes an enterococcus single sample maximum limit of 104 organisms per 100 ml.

[3] Exceedances that occurred prior to Order No. R9-2009-0001 becoming effective on August 1, 2010.

[4] Exceedances that occurred after the August 1, 2010 effective date of Order No. R9-2009-0001.

Table I.2-9
Compliance with California Ocean Plan 30-Day Geometric Mean Standards, 2010-2013
PLOO Monitoring Stations A1, A6, A7, C4, C5, C6, C7, and C8[1]

Station	Depth (meters)	Total Number of Samples Collected			Number of Months during 2010-2013 in which the *California Ocean Plan* 30-Day Geometric Mean Standard is Exceeded[2]		
		Total Coliform	Fecal Coliform	Enterococcus	Total Coliform (1,000 MPN per 100 ml)[3]	Fecal Coliform (200 MPN per 100 ml)[4]	Enterococcus (35 MPN per 100 ml)[5]
A1	1	240	240	240	0	0	0
	12	240	240	240	0	0	0
	18	240	240	240	0	0	0
A6	1	240	240	240	0	0	0
	12	240	240	240	0	0	0
	18	240	240	240	0	0	0
A7	1	238	240	240	0	0	0
	12	240	240	240	0	0	0
	18	240	240	240	0	0	0
C4	1	240	240	240	0	0	0
	3	240	240	240	0	0	0
	9	240	240	240	0	0	0
C5	1	240	240	240	0	0	0
	3	240	240	240	0	0	0
	9	240	240	240	0	0	0
C6	1	240	240	240	0	0	0
	3	240	240	240	0	0	0
	9	240	240	240	0	0	0
C7	1	239	240	240	0	0	0
	12	240	240	240	0	0	0
	18	240	240	240	0	0	0
C8	1	239	240	240	0	0	0
	12	239	240	240	0	0	0
	18	239	240	240	0	0	0
Totals		5,754	5,760	5,760	0	0	0

1 Bacteriological sampling is typically conducted five times per month at Stations A1, A6, A7, C4, C5, C6, C7, and C8, allowing for assessment of compliance with the 30-day geometric mean standard. Only four monthly samples were collected during February 2012.

2 Geometric mean of all monthly samples collected at a given station at a given depth, computed on a calendar month basis.

3 The *California Ocean Plan* 30-day geometric mean standard for total coliform is 1,000 MPN per 100 ml. Collectively at all stations, one sample exceeded a total coliform concentration of 1,000 per 100 ml, but the 30-day geometric mean was less than 1,000 per 100 ml at all of the above stations at all depths during all calendar months during 2010-2013.

4 The *California Ocean Plan* 30-day geometric mean standard for fecal coliform is 200 MPN per 100 ml. None of the fecal coliform samples for the above stations exceeded a concentration of 200 per 100 ml during 2010-2013.

5 The *California Ocean Plan* 30-day geometric mean standard for enterococcus is 35 MPN per 100 ml. Collectively at all stations, a total of 21 samples exceeded an enterococcus concentration of 35 per 100 ml, but the 30-day geometric mean was less than 35 per 100 ml at all of the above stations at all depths during all calendar months during 2010-2013.

Table I.2-10
Percentile Breakdown of Total Coliform, Fecal Coliform and Enterococcus, 2010-2013
PLOO Monitoring Stations within State-Regulated Ocean Waters[1]

Percentile	Concentration (organisms per 100 ml)		
	Total Coliform[1,2]	Fecal Coliform[1,3]	Enterococcus[1,4]
10	2	2	2
20	2	2	2
30	2	2	2
40	2	2	2
50	2	2	2
60	2	2	2
70	2	2	2
80	6	2	2
90	20	2	2
95	20	2	2
96	22	2	4
97	40	4	4
98	100	4	8
99	200	8	22
99.363[5]	--	--	35
99.829[6]	1,000	--	--
99.948[7]	--	200	--

1 Bacteriological receiving water samples collected during the period January 2010 through December 2013 at all depths at all kelp bed stations and offshore stations located within three nautical miles of the coast. Includes 2010 samples collected prior to the August 1, 2010 effective date of Order No. R9-2009-0001. Sampled stations include Station Nos. A1, A6, A7, C4, C5, C6, C7, C8, F1, F2, F3, F6, F7, F8, F9, F10, F11, F12, F13, F14, F18, F19 and F20.
2 Percentile statistics for 5,840 offshore receiving water total coliform samples collected within the state-regulated waters during 2010-2013.
3 Percentile statistics for 5,846 offshore receiving water fecal coliform samples collected within state-regulated waters during 2010-2013.
4 Percentile statistics for 6,518 offshore receiving water enterococcus samples collected within state-regulated waters during 2010-2013
5 A total of 0.637 percent of 6,518 enterococcus samples during 2010-2013 exceeded a concentration of 35 per 100 ml.
6 A total of 0.171 percent of 5,840 total coliform samples during 2010-2013 exceeded a concentration of 1,000 per 100 ml.
7 A total of 0.052 percent of 5,846 fecal coliform samples during 2010-2013 exceeded a concentration of 200 per 100 ml.

Based on the 2010-2013 data set for state-regulated waters presented in Table I.2-10, probabilities are extremely remote that any two samples collected within a 30-day period would exceed the *California Ocean Plan* 30-day geometric mean limits. As shown in the table, the 2010-2013 data indicate a probability of 0.00637 (percentile of 99.363) associated with any single sample exceeding the 30-day geometric mean standard for enterococcus. The probability of any two consecutive enterococcus samples both exceeding a concentration of 35 per 100 ml is thus 0.000041. Table I.2-11 (page I.2-17) summarizes combinations of enterococcus concentrations within any two samples required to equal or exceed the 35 per 100 ml 30-day geometric mean standard established within the *California Ocean Plan*. Based on the 2010-2013 enterococcus data at offshore PLOO stations within state-regulated waters, probabilities are extremely remote that any two consecutive samples could occur such that the 30-day geometric mean of the two samples would exceed the *California Ocean Plan* limit. Probabilities of non-compliance with the 30-day geometric mean limit would be even more remote if a third sample were to be collected.

Table I.2-11
Probability that Any Two Enterococcus Samples will a 30-Day Geometric Mean of 35 per 100 ml

Hypothetical First Sample Collected During the 30-Day Period[1]		Second Sample Collected within 30-Day Period		Combined Probability of Occurrence[5]
Enterococcus Concentration[1] (per 100 ml)	Probability of Occurrence[2]	Concentration of 2nd Sample Required to Reach 30-Day Geometric Mean Limit[3]	Probability that 2nd Sample Will Equal or Exceed the Listed Concentration[4]	
35	0.00637	35	0.00637	0.000041
75	0.00220	16	0.0139	0.000031
150	0.00089	8	0.0197	0.000018
300	0.00046	4	0.0384	0.000018
600	0.00038	2	0.0405	0.000015

1 Example of high and rare enterococcus concentrations that could occur within a receiving water sample collected within state-regulated waters. This table demonstrates that, even in the rare event that the first receiving water sample collected at a given monitoring station shows a high enterococcus value, an extremely low probability exists that the 30-day geometric mean standard would be violated if a second sample were to be collected within the 30-day period.
2 Probability of occurrence associated with the enterococcus concentration listed in column 1.
3 Enterococcus concentration in a second sample required in order for the two samples to reach the 30-day geometric mean enterococcus limit of 35 per 100 ml.
4 Probability of occurrence associated with the second sample having an enterococcus concentration at least as great as the listed 2nd sample concentration.
5 Combined probability of occurrence for the two listed sample concentrations. As indicated, in the unlikely event that a first sample shows a high enterococcus concentration, a second sample would have an extremely high likelihood of having a concentration sufficiently low so as to ensure conformance with the 35 per 100 ml 30-day geometric mean standard.

The probability of any two consecutive total coliform or fecal coliform samples both exceeding the respective *California Ocean Plan* 30-day geometric mean standards are even less than those for enterococcus, with:

- a probability of 0.0000029 that two consecutive total coliform samples will both exceed a concentration of 1,000 per 100 ml, and
- a probability of 0.00000027 that two consecutive fecal coliform samples will both exceed a concentration of 200 per 100 ml.

While only limited data are available at stations along the 60 meter and 80 meter contours (and the PLOO data base is skewed toward kelp bed stations which have more frequent bacteriological monitoring but are more remote from the PLOO diffuser), the available data indicate an overwhelming probability of compliance with *California Ocean Plan* 30-day geometric mean standards for total coliform, fecal coliform, and enterococcus throughout state-regulated waters.

I.2.3 COMPLIANCE WITH FEDERAL WATER QUALITY CRITERIA

Federal 304(a) Enterococcus Limits. As noted, Order No. R9-2009-0001 implements federal 304(a) enterococcus standards (see page I.2-3), which apply to all waters outside the state-regulated three nautical mile limit where primary contact occurs.

The significant recreational use (see Appendix I.1) that occurs off the coast of Point Loma is limited to onshore and kelp bed areas. As documented in Appendix I.1, REC-1 activities within State-regulated waters near the coastline and in or near the kelp bed include swimming, surfing, snorkeling, water and jet skiing, kayaking, or paddle boarding. Recreational fishing and SCUBA diving are also popular in nearshore and kelp bed waters.

While REC-1 use is significant in nearshore waters and the kelp bed zone, evidence is conclusive that no primary recreational use occurs outside of state-regulated waters off the Point Loma coast. The three nautical mile limit occurs approximately at the 80 meter contour, well beyond recreation SCUBA diving limits. PUD monitoring vessel crews (which are engaged in offshore activities approximately 200 days each year) have not reported a single incident of water contact recreational activities outside the three nautical mile state-regulated limit during the 30 years ocean monitoring has been conducted for the extended PLOO.

While no such primary contact recreation occurs outside the three nautical mile limit off the coast of Point Loma, it is instructive to compare observed receiving water enterococcus concentrations with the federal 304(a) limits as a means of assessing movement of the PLOO discharge plume. Table I.2-12 (page I.2-19) presents a percentile breakdown of enterococcus concentrations at PLOO receiving water monitoring stations outside the three nautical mile state-regulated limit.

In areas where primary contact occur, Table 12 of Order No. R9-2009-0001 establishes a single sample maximum enterococcus limit of 501 per 100 ml for "infrequent use." As shown in Table I.2-12, 0.12 percent of the enterococcus samples collected outside the three nautical mile limit (probability of 0.0012) exceeded an enterococcus concentration of 501 per 100 ml. While this standard is not applicable as no federally-defined primary contact recreation occurs in this offshore area, offshore monitoring data from 2010-2013 indicate an overwhelming probability of compliance with the 501 per 100 ml single sample enterococcus 304(a) limit for infrequent use.

In areas where primary contact recreation occurs, the federal 304(a) 30-day geometric mean standard for enterococcus is 35 per 100 ml. As shown in Table I.2-12, a probability of 0.0467 exists that any single offshore enterococcus sample outside the three nautical mile limit will exceed a concentration of 35 per 100 ml. The probability of any two consecutive enterococcus samples both exceeding 35 per 100 ml would thus be 0.0022 (0.22 percent).

Thus, while the 304(a) standards are not applicable as no primary contact recreation occurs, PLOO monitoring data from 2010-2013 demonstrate that an overwhelming probability exists that Point Loma receiving waters outside the three nautical mile limit comply with the 304(a) 30-day geometric mean standard for enterococcus.

Table I.2-12
Percentile Breakdown of Enterococcus, 2010-2013
PLOO Monitoring Stations Beyond State-Regulated Ocean Waters[1]

Percentile	Enterococcus Concentration[1,2] (organisms per 100 ml)
10	2
20	2
30	2
40	2
50	2
60	2
70	2
80	2
90	2
95	2
96	2
97	2
98	12
95	32
95.33[3]	35
98.65[4]	130
99.88[5]	501

[1] Enterococcus receiving water samples collected during the period January 2010 through December 2013 at all depths at offshore stations located outside the three nautical mile state-regulated limit. Includes 2010 samples collected prior to the August 1, 2010 effective date of Order No. R9-2009-0001. Sampled stations include Station Nos. F4, F5, F15, F16, F17, F21, F22, F23, F24, F25, F26, F27, F28, F29, F30, F31, F32, F33, F34, F35 and F36.

[2] Percentile statistics for 1,488 offshore receiving water enterococcus samples collected outside the three nautical mile state-regulated waters during 2010-2013.

[3] A total of 4.67 percent of the 1,488 enterococcus samples during 2010-2013 outside the three nautical mile limit exceeded a concentration of 35 per 100 ml.

[4] A total of 1.35 percent of the 1,488 enterococcus samples during 2010-2013 outside the three nautical mile limit exceeded a concentration of 130 per 100 ml.

[5] A total of 0.12 percent of the 1,488 enterococcus samples during 2010-2013 outside the three nautical mile limit exceeded a concentration of 501 per 100 ml.

2012 EPA Recreational Water Quality Criteria. In 2012, EPA issued revised water quality criteria for recreational waters (*Recreational Water Quality Criteria*, EPA 2012). As shown in Table I.2-13 (below), EPA presents criteria for two illness rates and recommends that states determine which illness rate is appropriate for their waters. For an illness risk rate of 36 per thousand, EPA establishes a 30-day geometric mean criterion for enterococcus of 35 per 100 ml - a value identical to the enterococcus 30-day geometric mean standard established within the *California Ocean Plan* (see Table I.2-1) and the federal 304(a) 30-day geometric mean criterion.

Table I.2-13
2012 EPA Recreational Water Quality Criteria for Marine Waters

Illness Rate per Primary Contact Recreator[2]	Enterococcus Concentration Criteria[1] Organisms per 100 ml	
	Statistical Threshold Value[3]	30-Day Geometric Mean[4]
36 per thousand	130	35
32 per thousand	110	30

1 Water quality criteria established by EPA in *Recreational Water Quality Criteria* (EPA 2012).
2 EPA establishes criteria for two illness risk rates, and instructs states to make a risk management decision to determine which set of criteria is appropriate for their waters.
3 The statistical threshold value (STV) approximates the 90th percentile of water quality and is intended to represent a value that is to not be exceeded more than 10 percent of the time.

As shown in Table I.2-12 (page I.2-19), a strong probability exists that Point Loma receiving waters outside the three nautical mile limit comply with the 35 per 100 ml 30-day geometric criteria. Based on 2010-2013 data collected from stations beyond the three nautical mile limit, the probability that any single enterococcus sample will exceed 35 per 100 ml is 0.0467 (95.33 percentile). The probability of two consecutive enterococcus samples exceeding 35 per 100 ml is thus 0.0022 (approximately two-tenths of one percent).

At an illness risk rate of 36 per thousand, the EPA enterococcus statistical threshold criterion (a value not to be exceeded more than 10 percent of the time) is 130 per 100 ml. PLOO monitoring data during 2010-2013 from stations outside the three nautical mile limit demonstrate compliance with the 2012 EPA criteria. As shown in Table I.2-14 (page I.2-21), a total of 1.34 percent of the 1,488 offshore enterococcus samples during 2010-2013 exceeded an enterococcus concentration of 130 per 100 ml. Enterococcus concentration at PLOO monitoring data from stations outside the three nautical mile limit thus complied with this 130 per 100 ml statistical threshold criterion (not to be exceeded more than 10 percent of the time).

Table 1.2-14
Enterococcus Samples that Exceeded 130 per 100 ml, 2010-2013
PLOO Monitoring Stations Beyond State-Regulated Ocean Waters

Year	Enterococcus Receiving Water Samples Collected Beyond State-Regulated Waters[1]		
	Number of Samples	Number of Samples Exceeding 130 per 100 ml	Percent of Samples Exceeding 130 per ml
Jan-Jul 2010[2]	186	5	2.69%
Aug-Dec 2010[3]	186	6	3.23%
2011	372	6	1.61%
2012	372	2	0.54%
2013	372	1	0.27%
Totals	1,488	20	1.34%

1 Enterococcus receiving water samples collected during the period January 2010 through December 2013 at all depths at offshore stations located outside the three nautical mile state-regulated limit. Includes 2010 samples collected prior to the August 1, 2010 effective date of Order No. R9-2009-0001. Sampled stations include Station Nos. F4, F5, F15, F16, F17, F21, F22, F23, F24, F25, F26, F27, F28, F29, F30, F31, F32, F33, F34, F35 and F36.
2 Sample collected prior to the August 1, 2010 effective date of Order No. R9-2009-0001.
3 Sample collected after the August 1, 2010 effective date of Order No. R9-2009-0001.

I.2.4 CONCLUSIONS

Regional Board and EPA Order No. R9-2009-0001 (NPDES CA0107409) regulates the discharge of treated wastewater from the Point Loma WWTP to the Pacific Ocean via the PLOO. Order No. R9-2009-0001 implements *California Ocean Plan* bacteriological REC-1 receiving water quality standards which are applicable within the three nautical mile state-regulated limit. The PLOO discharge occurs outside the three nautical mile limit, and sodium hypochlorite disinfection is implemented at the Point Loma WWTP to achieve partial disinfection. Offshore receiving water data from 2010-2013 collected as part of the City's comprehensive ocean monitoring program demonstrate virtually 100 percent compliance with the *California Ocean Plan* REC-1 standards at all offshore receiving water stations and at all monitoring depths within state-regulated waters.

Order No. R9-2009-0001 also implements receiving water bacteriological standards promulgated by EPA pursuant to Section 304(a) of the Clean Water Act which apply to "primary contact recreation" activities defined by EPA. While no such primary contact recreation activities have been documented in off the Point Loma coast beyond the limit of state-regulated waters, receiving water data from 2010-2013 demonstrate compliance with the 304(a) enterococcus standards in receiving waters outside the three nautical mile limit. Additionally, receiving water data from 2010-2013 collected at PLOO monitoring stations outside the three nautical mile limit demonstrate compliance with enterococcus water quality criteria published by EPA in 2012.

REFERENCES

City of San Diego Public Utilities Department, Environmental Monitoring and Technical Services Division. *Annual Receiving Waters Monitoring Report for the Point Loma Ocean Outfall*. 2010.

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U.S. Environmental Protection Agency (EPA). *Recreational Water Quality Criteria*. Office of Water 820-F-12-058. 2012.

U.S. Environmental Protection Agency (EPA). *Water Quality Standards Handbook.* EPA 823-B-94-005a. 1994.

Appendix J
ENDANGERED SPECIES

Renewal of NPDES CA0107409

APPENDIX J

ENDANGERED SPECIES ASSESSMENT

For

CITY OF SAN DIEGO

APPLICATION FOR MODIFICATION OF SECONDARY TREATMENT REQUIREMENTS AT THE POINT LOMA TREATMENT FACILITY

To

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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INTRODUCTION

The City of San Diego is preparing an application to the San Diego Regional Water Quality Control Board (SDRWQCB) and the U. S. Environmental Protection Agency (EPA) requesting renewal of its' National Pollution Discharge Elimination System (NPDES) permit for the discharge of treated wastewater to the Pacific Ocean from the 23,760-foot-long, 320-foot deep Point Loma Ocean Outfall. The City's application requests renewal of modified secondary treatment requirements for the Point Loma discharge in accordance with provisions of Section 301(h) and Section 301(j)(5) of the Clean Water Act (EPA 2014). The current five-year discharge permit for the modified Point Loma discharge expires in 2015 (SDRWQCB and EPA 2009). The City's Section 301 renewal application does not request any increase in currently permitted discharge flows or mass emissions. It seeks to decrease suspended solids mass emissions. Treatment and discharge operations at Point Loma have complied with all applicable state and federal standards for the protection water quality, habitat quality, marine organisms, and beneficial uses of the ocean. The proposed discharge will continue to meet or exceed these standards. This Endangered Species Assessment was prepared as part of the City of San Diego's Section 301 renewal application.

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§ 1531 et seq.) establishes protection over and conservation of endangered species and the ecosystems on which they depend (Code of Federal Regulations (CFR) 2014, U. S. Fish and Wildlife Service (USFWS) 2014a,b, U. S. National Marine Fisheries Service (NMFS) 2014a). An endangered species is a species that is in danger of extinction throughout all or a significant portion of its range. The ESA establishes procedures for nominating species for protection and prohibits actions that would jeopardize their continued existence. All federal agencies are required to implement protection programs for endangered species and to use their authority to further the purposes of the ESA.

The Endangered Species Act requires agencies to consult with the USFWS and the NMFS whenever a proposed action may affect threatened or endangered species or their designated critical habitat (USFWS and NMFS 1998, CFR 2008, 2013, 2014). The process begins with informal consultation that includes discussions and correspondence between the USFWS, NMFS, and the agency or the designated agency representative to determining whether formal consultation is required. During informal consultation, the USFWS and NMFS may suggest modifications to the action that could avoid the likelihood of adverse effects to listed species or critical habitat. If during informal consultation it is determined by the agency, with the written concurrence of the USFWS and NMFS that the action is not likely to adversely affect listed species or critical habitat, the consultation process is concluded, and no further action is necessary.

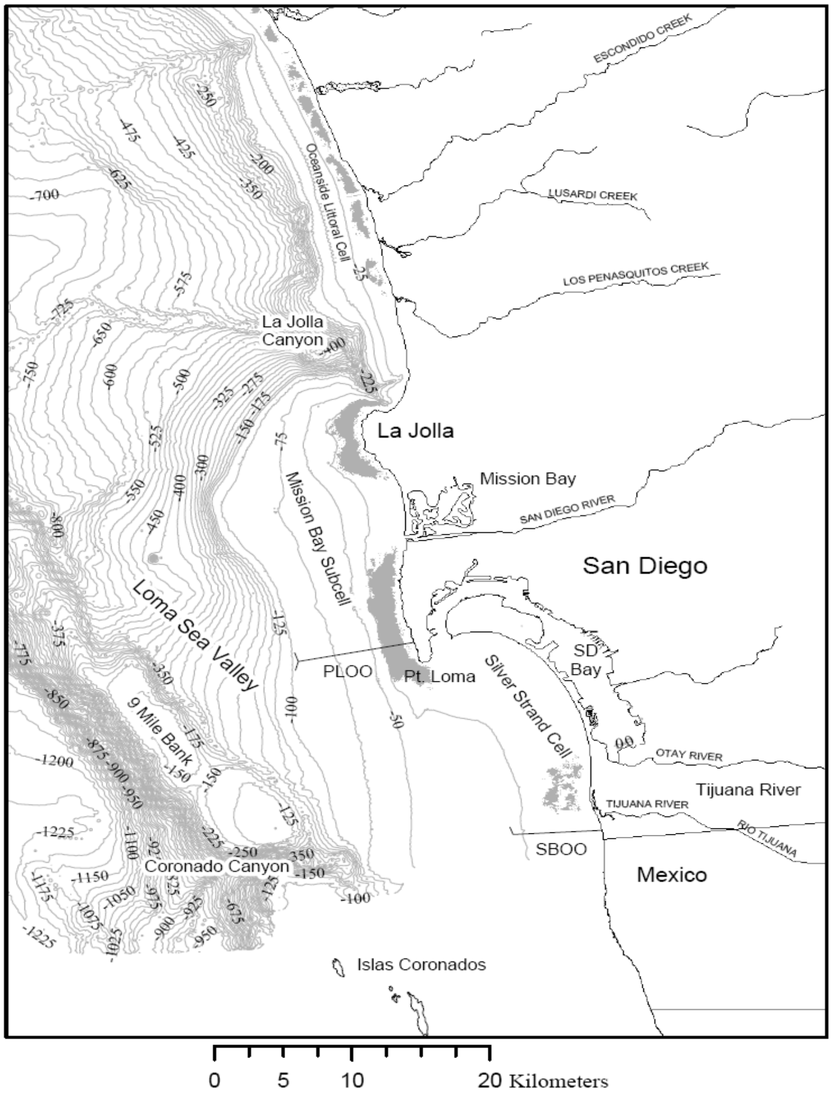
If formal consultation is required, an applicant submits a written request to initiate formal consultation to the Directors of the USFWS and NMFS that includes: (1) a description of the action to be considered; (2) a description of the specific area that may be affected by the action; (3) a description of any listed species or critical habitat that may be affected by the action; (4) a description of the manner in which the action may affect any listed species or critical habitat and an analysis of any cumulative effects; (5) relevant reports, including any environmental impact statement, environmental assessment, or biological assessment prepared; and, (6) any other relevant available information on the action, the affected listed species, or critical habitat.

In the following sections, this assessment considers the potential effects of the discharge of treated wastewater from the Point Loma Ocean Outfall on endangered species and their critical habitat. It presents the types of information and analysis detailed above as a basis for determining whether the proposed, future discharge from the Point Loma Ocean Outfall is likely, or not likely, to adversely affect listed species or critical habitat.

POINT LOMA OCEAN OUTFALL

The Point Loma Ocean Outfall discharges approximately 140 million gallons per day (mgd) of treated wastewater, generated by more than 2.2 million residents and industries (with source controls) in a 450 square mile (mi^2) (1,165 square kilometers (km^2)) area. The Point Loma Wastewater Treatment Plant has an overall capacity of 240 mgd. Treated wastewater is discharged through the Point Loma Ocean Outfall (PLOO) 4.5 miles (mi) (7.2 kilometers (km)) offshore at a depth of 320 feet (ft) (98 meters (m)) (Figure 1; note the grey areas off Point Loma and La Jolla represent kelp beds).

Figure 1. Location of the Point Loma Ocean Outfall.



The Point Loma Ocean Outfall is one of the longest and deepest ocean outfalls in the world. It was extended to its present location in 1993 and is buried in a trench from shore through the surf zone out to a distance of about 2,600 ft (792 m) offshore. Over the next 400 ft (123 m) the pipeline gradually emerges from the rock trench. Beyond 3,000 ft (914 m) offshore, the remainder of the 4.5 mi (7.2 km) pipeline rests on a bed of ballast rock on the sea floor. The end of the pipeline connects to a perforated "Y" diffuser section of two legs, each 2,500 ft (762 m) long. Wastewater is discharged through diffuser ports ranging in depth from 306 ft (93 m) to 320 ft (98 m). Mathematical models of outfall operation indicate a median (50th percentile) initial dilution of 338:1 at a discharge flow of 240 mgd (the maximum design flow). The minimum month initial dilution (the initial dilution as determined assuming zero ocean currents and using the worst case density conditions from over 13,000 density data profiles) is computed at 202:1.

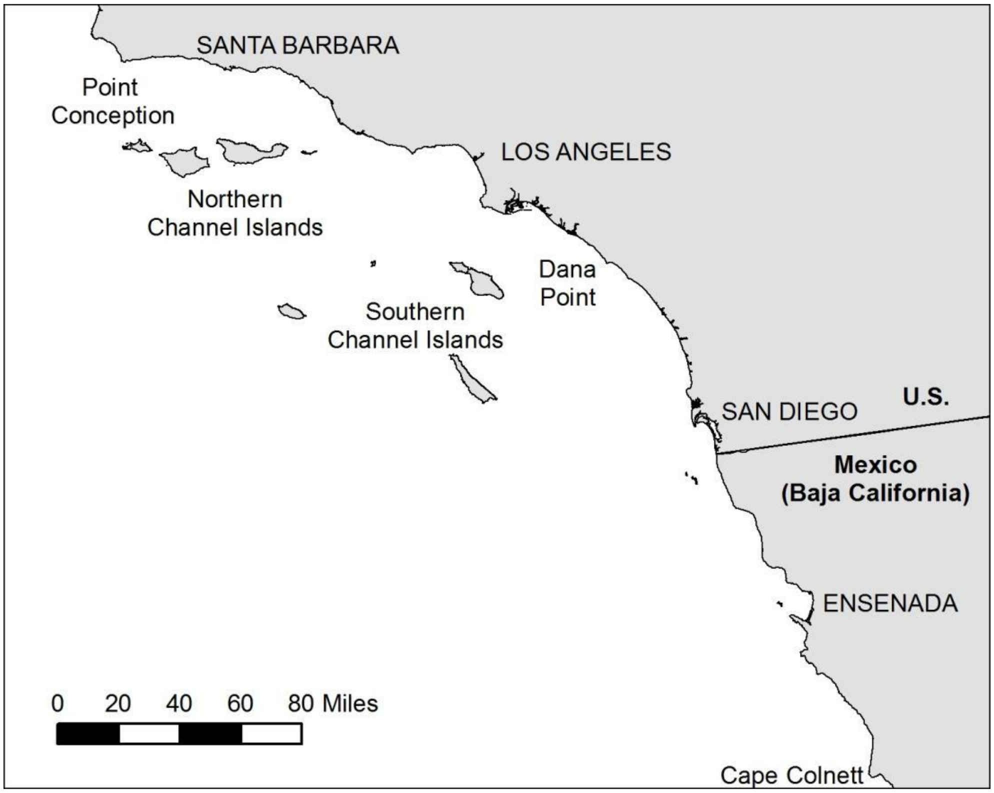
The deep discharge and high initial dilution traps discharged diluted wastewater at a depth of more than 130 ft (40 m) below the ocean surface (Rogowski et al. 2012). This keeps the outfall plume below the euphotic zone (the zone in which light penetrates) and away from the near-shore environment (Rogowski et al. 2013, City of San Diego (COSD) 2008-2014). Another favorable feature of the Point Loma Ocean Outfall is the location of the discharge near the break in the mainland shelf (Figure 1). The shelf drops precipitously immediately offshore from the diffuser facilitating plume dispersal.

The pipeline and diffusers with their supporting bed of ballast rock form an artificial reef. The pipe and rock, covered with encrusted organisms (tube worms, anemones, barnacles), provide food and shelter to a variety of fish and invertebrates. This artificial habitat covers an area of about 22 acres (9 hectares) off Point Loma (assuming a 36 ft (11m) width of pipe and ballast rock) (Wolfson and Glinski 1986).

ACTION AREA

The marine waters off the Point Loma are located in the Southern California Bight - a broad ocean embayment created by an indentation of California’s coastline south of Point Conception (Figure 2). The Southern California Bight extends from Point Conception south to Cabo Colnett, Baja California, Mexico, and west to the Santa Rosa-Cortes Ridge. The continental shelf in this area has several submarine valleys and submerged mountains whose peaks form the offshore islands. Submarine ridges and troughs in the Southern California Bight generally run northwest to southeast, with the exception of the east-west trending Santa Barbara Channel.

Figure 2. Southern California Bight.



The Southern California Bights' large urban population centers and busy harbors make it one of the most heavily utilized marine ecosystems on earth, yet the Southern California Bight supports a diverse assemblage of marine life including marine algae and plants, invertebrates, fish, sea turtles, marine mammals, sea birds, and a wide variety of habitats (Dailey et al. 1993, Schiff et al. 2000, Leet et al. 2001, Allen et al. 2005, 2006, 2011, Allen and Cross 2006, California Marine Life Protection Act (CMLPA) 2009, Pondella et al. 2012, Ranasinghe et al. 2012, Setty et al. 2012, Southern California Coastal Water Research Project (SCCWRP) 2012, 2014), United States Department of the Navy (USDON) 2013.

Marine habitats in the Southern California Bight range from sandy beaches and rocky coasts to deep, soft- and hard-bottom areas. Intertidal zones include sandy beaches, rocky shores, tidal flats, coastal marsh, and manmade structures. There are nearly 40 tidally-influenced estuaries and lagoons with associated open water, soft bottom, tidal mud flats, and eelgrass beds.

Sandy and soft-bottom substrates dominate shorelines and subtidal habitats in the southern region. These substrates lack the relief or structural complexity of hard-bottom habitats, but support species adapted to low-relief, dynamic environments. Invertebrates and bottom-dwelling fish are the most common species in soft substrate areas.

Hard-bottom habitats like rocky reefs are less common but generally have greater productivity and species diversity than soft-bottom habitats. Kelp forests are associated with shallow rock bottoms, while deep-sea corals and sponges are found in deep rock habitats. Kelp forest extending through the water column form dense surface canopies and promote high productivity and diversity of marine life.

The Southern California Bights' broad continental shelf includes channels, basins, and canyons, interspersed by shallower ridges. Underwater pinnacles and rocky outcrops are important aggregation sites for fish and other species. Marine canyons contain unique deep-water communities and provide foraging areas for seabirds and marine mammals. The marine environment surrounding the Channel Islands affords a distinctive ecological setting, with nutrient-rich waters and high-relief rocky habitats fostering substantial biodiversity.

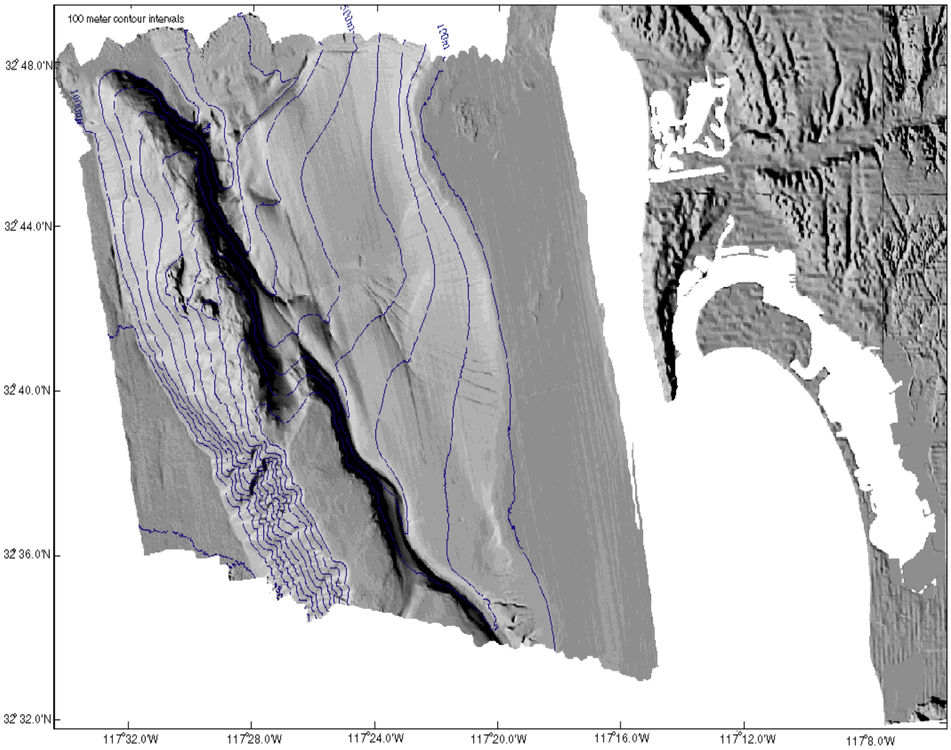
ENVIRONMENTAL SETTING

Oceanographic Conditions

Bathymetry

Point Loma's shoreline is primarily rocky reef with an occasional cobble or sand pocket beach. The principal feature of the nearshore marine environment is a large, six mile-long (10 km) kelp bed extending from the tip of Point Loma to the Mission Bay/San Diego River Jetty (Figure 1). The kelp bed grows on a pavement-like mudstone/sandstone terrace from depths of about 25 ft (7.6 m) to about 90 ft (27 m) between 1/2 mi (0.8 km) from shore and 1 mi (1.6 km) from shore. The terrace is incised by shallow surge channels and covered in parts by cobbles and boulders. The terrace edge, the remnant of a now submerged seacliff, lies in 100 ft (30 m) depths. Here the bottom relief increases and pinnacles and large boulders rise above the fine gray bottom sands (California Department of Fish and Game (CDFG) 1968). In Figure 3 below, the demarcation between the white nearer shore areas and the darker gray offshore waters corresponds roughly to this break (off Point Loma only). This also corresponds with the outer limit of the kelp bed, or about 90 ft (27 m) depth.

Figure 3. Seafloor Bathymetry off San Diego, California.



Map from: USGS 1998. Note: Each minute of latitude on the vertical axis represents 1 nautical mile.

Beyond the outer edge of the kelp bed, about 1 nautical mile (nm) from shore, the seafloor gradually slopes downward (at an angle of about 1.5 %) out to a shelf break at 350 ft, just outside of the 100 m contour line. Beyond the 100 m contour, the seafloor declines at an angle of 4% across the shelf break, then continues its gradual slope for another five miles out to a depth of 1,000 ft (305 m). This shelf area consists largely of unconsolidated bottom sediments.

Thermocline

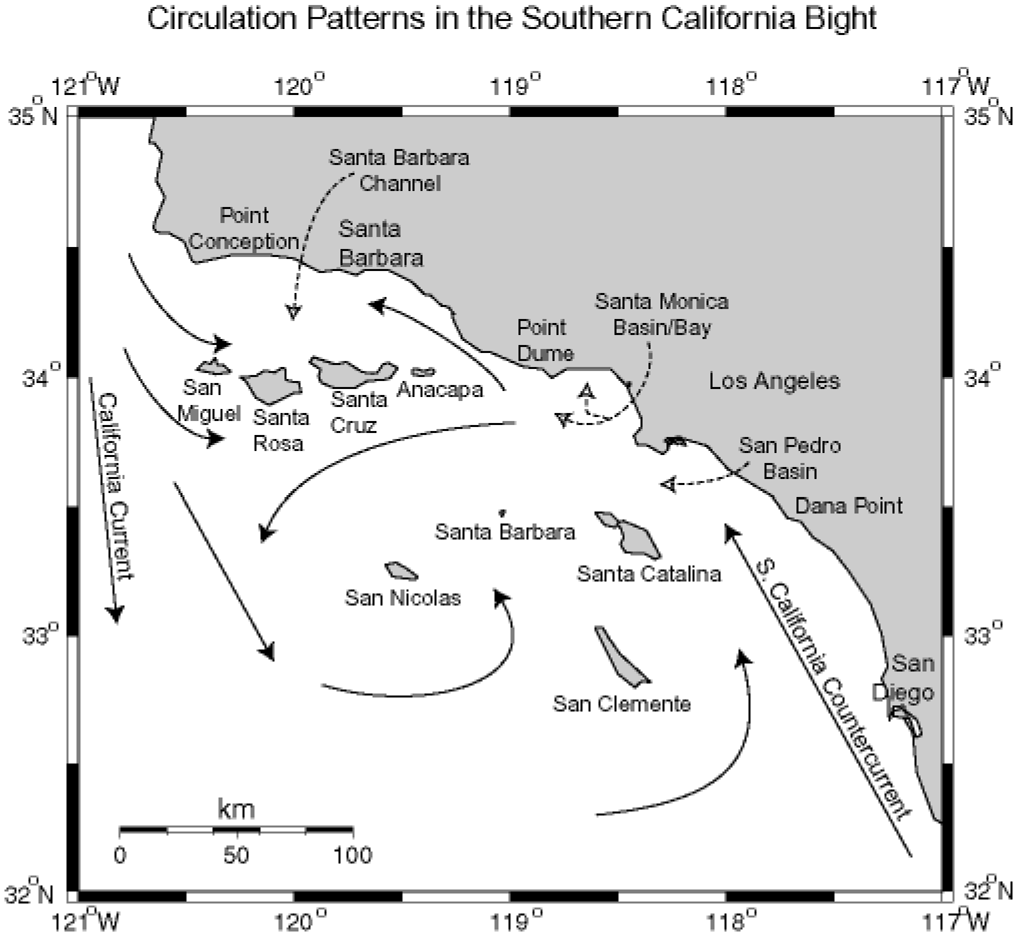
In the ocean, the thermocline, a vertical transition zone of rapidly changing temperature divides the upper layer of warmer water from the colder, deeper water (Noble 2009, California State University Long Beach (CSULB) 2013). Because density is controlled largely by temperature, the thermocline coincides with the pycnocline, a vertical zone of rapidly changing density. The density gradient across the pycnocline causes resistance to vertical mixing, restricting exchange between the surface waters and the deeper, colder waters. This phenomenon is referred to as water column stratification.

Seasonality is responsible for the main stratification patterns observed in the coastal waters off San Diego and the rest of southern California (Rogowski et al. 2012, 2013). Relatively warm waters and a more stratified water column are typically present during the dry season from May to September while cooler waters and weaker stratification characterize ocean conditions during the wet season from October to April. Winter storms bring higher winds, rain, and waves that result in a well-mixed, non-stratified water column (Hickey 1993). Surface waters begin to warm by late spring and are then subjected to increased surface evaporation. Once the water column becomes stratified, minimal mixing conditions typically remain throughout the summer and into early fall. Toward the end of the year, surface water cooling along with increased storm frequency returns the water column to well-mixed conditions. Interannual variations in the depth of the thermocline appear to be correlated with long-term climatic changes, El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and North Pacific Gyre Oscillation (NPGO) (Benjamin and Carton 1999, Schwing et al. 2002, Bjorkstedt et al. 2013, Miller et al. 2013).

Water Circulation

The cold California Current is the major surface current in the Southern California Bight (Figure 4). This broad, slowly meandering, south-moving current extends from Vancouver, Canada to the southern tip of Baja California, Mexico from shore to several hundred miles offshore (Perry et al. 2007, Noble 2009). In deep waters offshore of the continental shelf, flows are southward all year round; however, over the continental shelf, southward flows occur only in spring, summer, and fall. During winter months, flow over the shelf reverses, and water moves northward as the Southern California Countercurrent. The transitions between northward and southward flows on the shelf occur seasonally, in March/April and October/November, thus are termed the "spring transition and fall transition".

Figure 4. Circulation Patterns in the Southern California Bight.



(After Hickey, B. M., 1992, Progress in Oceanography, V30: 37-115)

Below the thermocline, the California Undercurrent flows northward with speeds ranging from 3 to 25 centimeters per second (cm/sec); the maximum water velocity occurs at a depth of 60 m (NRC 1990). This northward flow opposes the California Current at the surface and spans the entire mid-latitude eastern boundary of the North Pacific (Pierce et al. 2000). The California Undercurrent is typically found inshore of the California Current and is composed of water originating in the Equatorial Pacific (Noble 2009). The flow of the California Undercurrent is relatively weak; its maximum strength occurs during the summer months and a secondary maximum occurs in the winter (Hickey 1993, Perry et al. 2007). This water mass can be delineated from deep water contained farther offshore in the California Current because the water of the California Undercurrent contains higher nutrient concentrations and lower dissolved oxygen concentrations.

Deepwater circulation can be divided into three seasonal patterns (CSULB 2013). From December to February, flow is strengthened and partially displaces the California Current to the west. From March to June, along-shore winds strengthen and drive the surface waters to create upwelling of deep cold water to the surface along the coast. The shift offshore creates a condition in which the California Current intensifies in localized areas due to bottom topography and current strength. July to November the California Current dominates, weakening the California Undercurrent (Perry et al. 2007). In general, the water contained in the California Undercurrent does not reach the surface. However, during periods of weak California Current flow (winter months or during an El Niño event), the California Undercurrent may reach the surface offshore of Los Angeles, join the California Countercurrent and flow as far north as Vancouver Island, Canada.

Upwelling

Upwelling is a wind driven, dynamic process that brings nutrient-rich deep water to the surface and nutrient-poor surface waters offshore through the interaction of currents, density, or bathymetry (Noble 2009). In wind driven upwelling, warmer surface waters are transported perpendicular to the direction of the wind. Deep, cold water moves vertically into the euphotic zone to replace the nutrient-poor surface water that was transported offshore.

Winds that promote upwelling are generally strong along the California coastline; upwelling in this region occurs throughout the year with the strongest upwelling in the spring and summer months (Schwing et al. 2000, Perry et al. 2007). In the Southern California Bight, upwelling tends to be limited to late winter and early spring due to a reduction in wind stress. Coastal upwelling appears to be the dominant process affecting the physical and ecological structure of eastern boundary current systems, including the California Current System. Coastal upwelling substantially affects regional and local oceanic circulation, thermohaline structure and stability, and water mass exchange between the coastal and deep ocean waters. Intense upwelling has been correlated to recruitment success for commercially important fish stocks in coastal California waters.

Biological Conditions

Marine life can be conveniently grouped into categories that reflect their spatial position in the ocean. Pelagic species occupy the water column. Benthic species live directly above the bottom, on the bottom, or in the sediments. A general description of the food chain follows, beginning with the smallest organisms and ending with the largest.

Plankton

Plankton float or drift passively with currents and form the base of the oceanic food web. Plankton include a wide variety of bacteria (bacterioplankton), plant-like organisms and algae (phytoplankton), and animals (zooplankton) including fish larvae (ichthyoplankton). Although most planktonic species are microscopic, the term plankton is not synonymous with small size; some jellyfish can be as large as 10 ft (3 m) in diameter. Phytoplankton aggregate near the surface. They are grazed on by zooplankton, ichthyoplankton, and small fishes which in turn are consumed by larger fishes, birds, mammals, and man.

Phytoplankton

Marine phytoplankton are microscopic, single celled plants that use sunlight and chlorophyll to photosynthesize organic matter. Phytoplankton in the ocean's surface layers produce most of the organic matter in the sea and are crucial to overall ocean productivity. The distribution of most marine organisms is linked to phytoplankton productivity.

In general, phytoplankton are patchily distributed, occurring in regions with optimal conditions for growth. Nearshore ocean waters typically have a higher nutrient content and foster greater primary productivity and plankton biomass than open ocean waters.

In the Southern California Bight, waters from both the north and the south mix and promote increased phytoplankton abundance and diversity (Hardy 1993, Schiff et al. 2000, Kim et al. 2009). Over 280 species of phytoplankton have been reported there (Eppley 1986). The diversity of phytoplankton species in the region reflects the transition from subarctic waters in the north to more subtropical waters in the south. Highest levels of productivity occur in the spring/summer months with the lowest levels of production occurring during the winter months.

Along the California coast, there is a decrease in phytoplankton production in the surface waters during El Niño conditions due in part to a decrease of upwelling strength (Kahru and Mitchell 2000, Hernández de la Torre et al. 2004). This causes the chlorophyll maximum to occur deeper in the water column (McGowan 1984, Bjorkstedt et al. 2013, Chenillat et al. 2013). In addition, El Niño conditions weaken the California Current and tend to favor an increase in subtropical species (Leet et al. 2001). Following an El Niño, coastal phytoplankton abundance increases to long-term average levels (Lavaniegos et al. 2003, Hernández de la Torre et al. 2004). Conversely, La Niña conditions cause a shift towards more subarctic phytoplankton species (Goes et al. 2001).

Zooplankton

Zooplankton do not photosynthesize, but instead, rely upon phytoplankton as a source of food. They are taxonomically and structurally diverse, ranging in size from microscopic unicellular organisms to large multicellular organisms. Zooplankton may be herbivorous (consuming plants), carnivorous (consuming animals), detrivorous (consuming dead organic material), or omnivorous (consuming a mixed diet). Examples of zooplankton include foraminifera, pteropods, copepods, and myctophid fish.

Along the California coast the abundance of zooplankton is correlated with the strength of the California Current such that high levels of flow result in high zooplankton biomass (Dawson and Pieper 1993). Zooplankton biomass tends to reach its maximum in the summer months, coinciding with peak krill (*Euphausia*) biomass. The high abundance of euphasiids attracts whales to congregate and feed off the California and Mexico coastlines (Burtenshaw et al. 2004).

In the Southern California Bight, El Niño and La Niña conditions affect the distribution of zooplankton (Suntsov et al. 2012). During strong El Niño events, macrozooplankton biomass declines substantially (Roemmich and McGowan 1995, McGowan et al. 1998). During the 1998 El Niño event, the macrozooplankton biomass was lower than ever documented in the 1951 to

1998 record (Hayward 2000). Southern, warm-water species become more abundant during El Niño events and northern, cool-water species decline.

During La Niña conditions, macrozooplankton biomass is anomalously high and subarctic species are more abundant (Schwing et al. 2000). Increased upwelling during a La Niña event can negatively impact the recruitment of benthic nearshore organisms (urchins, barnacles, and crabs); these organisms are dependent on relaxed upwelling conditions to transport planktonic larvae onshore for settlement (Schwing et al. 2000).

Nekton

Nekton are pelagic organisms that swim freely, are generally independent of currents, and, range in size from microscopic to gigantic, such as whales. Nekton include invertebrates (e.g., squid) and vertebrates (fish, sea turtles, and marine mammals). Endangered nekton are discussed in subsequent sections.

Marine Habitats and Ecology

The Southern California Bight is influenced by two major oceanic currents: the southward-flowing, cold-water California Current and the northward-flowing, warm-water California Countercurrent (Perry et al. 2007, California State University Long Beach (CSULB) 2013). These currents mix in the Southern California Bight and strongly influence patterns of ocean water circulation, sea temperatures, and distributional trends of marine flora and fauna along the southern California coast and Channel Islands (Dailey et al. 1993, Schiff et al. 2000, Horn and Allen 1978, Leet et al. 2001, Horn et al. 2006, Miller and Schiff 2012, Ranasinghe et al. 2012, Setty et al. 2012, Koslow et al. 2013).

High species richness is a product of the region's complex oceanographic topography and the convergence of multiple, influential water masses (Noble 2009). These include (1) large scale climate processes such as the El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and North Pacific Gyre Oscillation (NPGO) that can affect long-term trends (Bjorkstedt et al. 2013, NOAA 2013), (2) the California Current System coupled with local gyres that transport distinct water masses into and out of the Southern California Bight throughout the year, and (3) seasonal changes in local weather patterns. Relatively warm waters and a more stratified water column are typically present during the dry season from May to September while cooler waters and weaker stratification characterize ocean conditions during the wet season from October to April. Winter storms bring higher winds, rain, and waves creating a well-mixed, non-stratified water column. Surface waters begin to warm by late spring and are then subjected to increased surface evaporation. Once the water column becomes stratified, minimal mixing conditions typically remain throughout the summer and into early fall. Toward the end of the year, surface water cooling along with increased storm frequency returns the water column to well-mixed conditions.

The Southern California Bight is home to more than 5,000 species of marine invertebrates, over 480 species of marine fish, 5 species of sea turtles, 39 species of marine mammals, and 195 species of coastal and offshore birds (Dailey et al. 1993, Schiff et al. 2000, Allen et al. 2005, 2006, 2011, Allen and Cross 2006, CMLPA 2009, SCCWRP 2012, 2014, USDON 2013). The diversity of marine life is greatest in southern California and declines to the north through the region (Horn and Allen 1978, Horn et al. 2006). The Point Loma area is located within a transitional zone between subarctic and subtropical water masses. Point Conception, California (34.5º North (N)) is the distinguished biogeographical boundary between subtropical species (i.e., species with preferences of temperatures above 50-68º Fahrenheit (F) (10º to 20º Centigrade (C)) of the San Diego Province and temperate species (i.e., species with temperature preferences below 59º F (15º C)) of the Oregon Province (Horn et al. 2006, Suntsov 2012).

The California Current system is rich in microscopic organisms (i.e., diatoms, tintinnids, and dinoflagellates) which form the base of the food chain in the area (Hardy 1993). Small coastal pelagic fish and squid depend on this planktonic food supply and in turn are fed upon by larger species. Groundfish (e.g., flatfish, roundfish, skates/sharks/chimeras, rockfish, etc.) are important recreational and commercial species (Love 2006). The shelf and slope demersal rockfish are the most specious genus of fish off the western coast of North America (Love et al. 2002). These fish are typically the dominant species in many ichthyological surveys, in terms of abundance and diversity, especially between the 20 to 200 m isobaths. Migratory species (e.g., tuna, billfish, sharks, dolphinfish, and swordfish) and coastal pelagic species (e.g., anchovies, mackerels, sardines, and squids) support extensive fisheries in the area (Hackett et al. 2009).

The diverse habitats of the Southern California Bight greatly influence the distribution marine fauna and flora in the area (Horn et al. 2006, Miller and Schiff 2012). Cross and Allen (1993) defined fish habitats in three broad categories: the pelagic zone, soft substrate habitats (i.e., bays, estuaries, open coast), and hard substrate and kelp bed habitats (i.e., rocky habitats, reefs). The pelagic zone, relating to open water, is the largest habitat in the area with 40% of the fish species inhabiting this area. This zone is subdivided into three distinct regions: epipelagic (up to 50 m deep), mesopelagic (50 to 500 m deep), and bathypelagic regions (greater than 500 m deep). The epipelagic region is inhabited by small, planktivorous schooling fish (e.g., northern anchovy), predatory schooling fish (e.g., Pacific mackerel), and large solitary predators (e.g., blue shark). Abundance of all epipelagic species changes seasonally with fish moving offshore to spawn. The mesopelagic region is characterized by steep environmental gradients and fish that are small, slow growing, long-lived, and reproduce early and repeatedly (e.g., bigeye lightfish). The bathypelagic zone is a rather uniform region containing large, sluggish, fast growing, short-lived fish, that reproduce late and typically only once (e.g., bigscale and hatchetfish) (Cross and Allen 1993, Love et al. 2009).

Typical fish utilizing soft substrates (sand, silt, and mud) include sharks, skates, rays, smelts, flatfish (flounders), gobies and northern anchovies. Regions with hard substrates and kelp beds (*Macrocystis*) are not as abundant as other benthic habitats in the Southern California Bight, but provide productive habitats for many species.

Shallow reefs (i.e., <30 m depth) are the most common type of hard substrate (i.e., coarse sand, calcareous organic debris, rocks) found in the area. These reefs also support kelp beds, which serve as nursery areas for various fish species. Rocky intertidal regions are often turbulent, dynamic environments, where organisms must cope with stresses associated with tides (e.g., changes in temperature, salinity, oxygen, and pH) and wave impact. Deep reef fish, found along deep banks and seamounts, are typically large, mobile species (e.g., rockfish and spiny dogfish).

Kelp beds promote a high diversity of associated marine organisms (Foster and Schiel 1985, Foster et al. 2013). Smaller fish feed on high plankton densities in the area, while larger fish congregate to feed on smaller species. Kelp beds are especially important habitats for young-of-the-year rockfish species, such as the kelp rockfish, whose densities positively correlate to the size of the kelp bed.

Inshore areas (bays and estuaries) provide nursery habitats and feeding grounds to a variety of species, some of commercial importance (e.g., California halibut) (Allen et al. 2006). San Diego Bay's seagrass beds are used by schooling species, such as anchovies and topsmelt (Allen et al. 2002) with the highest abundance and biomass of fish occurring in the spring (i.e., April) and summer (i.e., July). Juvenile northern anchovy, topsmelt, and slough anchovy comprise up to 79% of the fish in the Bay.

The influence of the California Current on the physical and biological environment of the Southern California Bight fluctuates significantly on a year-to-year basis (Noble 2009, Bjorkstedt et al. 2013, Koslow et al. 2013, Miller and McGowan 2013). It is also affected by larger-scale climate variations, such as ENSO, PDO, and NPGO (Dayton and Tegner 1984, 1990, Tegner and Dayton 1987, 1991, Dayton et al. 1992, Hickey 1993, Tegner et al. 1996, 1997, Horn and Stephens 2006, Parnell et al. 2010, Miller and Schiff 2012, Miller et al. 2013, NOAA 2013). These events can initiate large shifts in the global climate, atmospheric circulation, and oceanographic processes (Doney et al. 2012, Chenillat et al. 2013, U. S. National Marine Fisheries Service (NMFS) 2013a, NOAA 2013, Sydeman et al. 2013).

REGULATORY FRAMEWORK

Endangered Species Act

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§ 1531 et seq.) establishes protection over and conservation of endangered species and the ecosystems on which they depend (USFWS 2014a). An endangered species is a species that is in danger of extinction throughout all or a significant portion of its range. The ESA establishes procedures for nominating species for protection and prohibits actions that would jeopardize their continued existence. All federal agencies are required to implement protection programs for endangered species and to use their authority to further the purposes of the ESA.

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. §§ 1361 et seq.) creates the authority to protect marine mammals in waters or on lands under U. S. jurisdiction (NMFS 2014a). It defines federal responsibility for conserving marine mammals (whales, dolphins, porpoises, seals, sea lions, and sea otters). The MMPA prohibits harassing, capturing, disturbing, or, killing marine mammals except under special permit. It creates a Marine Mammal Commission, Regional offices, and Fisheries Science Centers to implement research and protection.

California Endangered Species Act

The California Endangered Species Act (CESA) of 1970, re-amended in 1984, is part of the California Fish and Game Code and is administered by the California Department of Fish and Wildlife (CDFW 2014). It establishes measures to conserve, protect, restore, and enhance endangered species and their habitats. Certain species that are not recognized as endangered under the federal Endangered Species Act may be listed as endangered under the California Endangered Species Act. The provisions included in the CESA generally parallel those in the federal ESA, but also apply to species petitioned for listing (i.e., state candidates).

ENDANGERED SPECIES

Twenty-four endangered species covered under the federal Endangered Species Act, the federal Marine Mammal Protection Act, and/or the California Endangered Species Act may occur in the vicinity of Point Loma (Table 1): eight marine mammals, seven birds, five sea turtles, two fish, and two invertebrates. Their population biology, status, and distribution are discussed in the following paragraphs.

Table 1. Endangered Species That May Occur in the Vicinity of Point Loma.

California Department of Fish and Wildlife 2014
National Marine Fisheries Service 2014a.
U. S. Fish and Wildlife Service 2014a.

Marine Mammals		
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Meaptera novaeangliae*	Endangered
Right Whale	*Eubalaena japonica*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Guadalupe Fur Seal	*Arctocephalus townsendi*	Threatened
Steller Sea Lion	*Eumetopias jubatus*	Threatened
Birds		
California Least Tern	*Sterna antillarum browni*	Endangered

Table 1. Endangered Species That May Occur in the Vicinity of Point Loma.

Light-footed Clapper Rail	*Rallus longirostris levipes*	Endangered
Western Snowy Plover	*Charadrius alexandrinus nivosus*	Threatened
Guadalupe Murrelet	*Synthliboramphus hypoleucus*	Threatened
Marbled Murrelet	*Brachyramphus marmaoratus*	Threatened
Scripps’s Murrelet	*Synthliboramphus scrippsi*	Threatened
Short-tailed Albatross	*Phoebastria albatrus*	Endangered
Sea Turtles		
Green Sea Turtle	*Celonia mydas*	Endangered
Loggerhead Sea Turtle	*Caretta caretta*	Endangered
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Endangered
Hawkbill Sea Turtle	*Eretmochelys imbricata*	Endangered
Fish		
Chinook Salmon	*Oncorhynchus tshawytscha*	Endangered
Steelhead	*Oncorhynchus mykiss*	Endangered
Mollusk		
White Abalone	*Haliotis sorenseni*	Endangered
Black Abalone	*Haliotis cracherodii*	Endangered

Whales

Marine mammals are warm-blooded, have fur or hair, breathe air through lungs, bear live young, and nurse them with milk. They have streamlined bodies and most have an insulating layer of blubber. Two types of marine mammals pass through or inhabit San Diego coastal waters; cetaceans and pinnipeds. Whales are members of the first group that also includes dolphins and porpoises (NMFS 2014b, Perrin et al. 2008). Cetaceans are entirely aquatic, have two front flippers, and tails with horizontal extensions that provide swimming power. The great whales, like blue, gray, and humpback whales, have rows of closely spaced baleen plates that filter out and trap plankton and small fish. Sperm whales, dolphins, and porpoises have teeth for grasping prey.

The second group of marine mammals, pinnipeds (sea lions and seals), regularly haul out on land to rest, breed, and give birth (NMFS 2014c). Sea lions have visible external ears and can walk on all four flippers by rotating their rear flippers forward under their body. Their swimming power comes from large front flippers. Seals have no external ears and can only crawl on land because their front flippers are small and their hind flippers cannot rotate forward. Seals swimming power comes from their large, fan-like rear flippers.

Of the eight species of great whales that may pass by Point Loma, six are endangered: the blue whale, the fin whale, the humpback whale, the right whale, the sei whale, and the sperm whale (Table 1). The other two great whales, the gray whale and the minke whale, were previously endangered but have now recovered. There are no endangered dolphins or porpoises in the San Diego area.

The gray whale, *Eschrichtius robustus*, is the most common whale observed along the San Diego coast and the most easily seen from shore (Jefferson et al. 2011). These large whales can grow to about 50 ft (15 m) long and weigh approximately 80,000 lb (35,000 kg). Gray whales are found only in the north Pacific Ocean – an Atlantic form is extinct (Jones and Swartz 2009). Gray whales occur in two genetically and spatially distinct populations on the eastern and western sides of the North Pacific Ocean (NMFS 2013a). The eastern north Pacific gray whales are the subject of the following discussion.

Each year, the gray whale undertakes the longest migration of any mammal, travelling 9,000-12,000 mi (14,500-19,300 km) from its summer feeding grounds in the Bering and Chukchi Seas to breeding and calving lagoons of Baja California and back again to the Arctic Ocean. The journey south, led by pregnant females, begins in late autumn with most whales passing Point Loma during January and February. The northern migration occurs during springtime with whales (especially mother-calf pairs) passing closer to shore than on the way south.

Gray whales usually feed in shallow waters less than 200 ft (60 m) deep (Perrin et al. 2008). They are primarily bottom feeders whose prey includes a wide range of invertebrates living on or near the seafloor. The whales filter amphipods and other crustaceans with their baleen plates. Although generally fasting during the migration and calving season, opportunistic feeding occurs in the shallow coastal waters along the migration path and in the calving lagoons. The gray whale is preyed on by killer whales. Many exhibit attack scars indicating not all attacks are fatal, however fatalities are known (Jones and Swartz 2009).

Gray whales are susceptible to entanglement in fishing gear and ship strikes. No gray whales were observed entangled in California gillnet fisheries between 2007 and 2011 (Carretta and Enriquez 2012), but previous mortality in the swordfish drift gillnet fishery has been observed and there have been recent sightings of free-swimming gray whales entangled in gillnets (Carretta et al. 2014). Although acoustic pingers are known to reduce the entanglement of cetaceans in the California drift gillnet swordfish fishery (Carretta and Barlow 2011), it is unknown whether pingers have any effect on gray whale entanglement. Most data on human-caused mortality and serious injury of gray whales is from strandings. There are few at-sea reports of entangled animals alive or dead. Strandings represent only a fraction of actual gray whale deaths (natural or human-caused), as reported by Punt and Wade (2012), who estimated that only 3.9% to 13.0% of gray whales that die in a given year end up stranding and being reported.

For 2007-2011, the most recent five-year period reported by NMFS (Carretta et al. 2013), the total mortality of eastern north Pacific gray whales attributed to ship strikes was six deaths. Additional mortality from ship strikes probably goes unreported because the whales either do not strand or have no evident signs of trauma when observed at sea.

Hunted practically to extinction, the gray whale has staged a remarkable comeback since it was listed as endangered throughout its range under the Endangered Species Act (ESA) in 1973. The species appears to have fully recovered and is thought to be close to or at its initial unexploited stock size. The gray whale species was delisted in 1994, as it was no longer considered endangered under the ESA. Its current population estimate is approximately 20,000 individuals (Carretta et al. 2014).

As with other great whales that may occur in the Point Loma region, the National Marine Fisheries Service has not designated any critical habitat for gray whales (NMFS 2013a).

Minke whales, *Balaenoptera acutorostrata*, the smallest of the baleen whales, can occur year-round off California (Carretta et al. 2014). These sleek, baleen whales feed on krill and schooling fish such as herring, pollock, and cod (Jefferson et al. 2011). Minke whales are lunge feeders, often plunging through patches of krill or shoaling fish. They frequent shallower water more often than any other whales except gray whales. Minke whales are prey for killer whales. Increasing levels of anthropogenic sound in the world’s oceans is considered a habitat concern for whales, particularly for baleen whales that communicate using low-frequency sound (McDonald et al. 2008, Hildebrand 2009, Rolland et al. 2012).

As with other whales, entanglement in commercial gillnets and ship strikes pose a threat to minke whales. Minke whales may occasionally be caught in coastal set gillnets off California and in offshore drift gillnets off California and Oregon (Carretta et al. 2014).

Ship strikes were implicated in the death of one minke whale in 1977, but the reported minke whale mortality due to ship strikes was zero for the period 2004-2008 (Carretta et al. 2014).

Although rare in California (estimated population in the low to mid hundreds (Carretta et al. 2014)), minke whales are relatively abundant elsewhere and are not listed as endangered under the Endangered Species Act. Like the gray whale, minke whales are protected under the Marine Mammal Protection Act but are not considered depleted.

The other whales that periodically traverse the area off Point Loma are deeper water species. The most spectacular of these is the blue whale, *Balaenoptera musculus*. Blue whales, the largest animal that has ever lived, can reach over 100 ft (30 m) in length and weigh as much as 330,000 pounds (lb) (150,000 kilograms (kg)) (Perrin et al. 2008). Preying almost exclusively on zooplankton, especially krill, they lunge feed and consume approximately 12,000 lb (5,500 kg) of krill per day.

The blue whale inhabits all oceans and typically occurs near the coast over the continental shelf, though it is also found in oceanic waters (Sears and Perrin 2008). The U. S. west coast is a feeding area for blue whales during summer and fall (Carretta et al. 2014). They are regularly observed in the Southern California Bight most often along the 200-m (656 ft) isobath.

Blue whales have been documented to be preyed on by killer whales (Jefferson et al. 2011). While there is little evidence that killer whales attack this species in the north Atlantic or southern hemisphere, 25 percent of photo-identified whales in the Gulf of California show rake scars from killer whale attacks (Sears and Perrin 2008).

Blue whales are susceptible to ship strikes and entanglement in fishing gear (Redfern et al. 2013). Between 1988 and 2007, 21 blue whale deaths were reported along the California coast and eight of these whales were confirmed to have died as a result of ship strikes (Berman-Kowalewski et al. 2010). The offshore drift gillnet fishery is the only fishery that is likely to entangle blue whales off southern California, although no fishery mortality or serious injuries have been observed (Carretta et al. 2013). The drift gillnet fisheries for swordfish and sharks along the Pacific coast of Baja California, Mexico may take animals from this population as well. Some gillnet mortality of large whales goes unobserved because whales swim away with a portion of the net; however, fishermen report blue and fin whales usually swim through nets without entangling and with little damage to the nets (Carretta et al. 2014).

Tagged blue whales exposed to simulated mid-frequency military sonar sounds showed significant behavioral responses, including cessation of feeding, increased swimming speeds, and movement away from the simulated sound sources, even though the simulated source levels were orders of magnitude lower than some operational military sonar systems (Goldbogen et al. 2013). This study suggests that sonar sources could disrupt feeding and displace whales from high-quality feeding areas, with negative implications for individual fitness and population health.

The current best available abundance estimate for the Eastern North Pacific stock of blue whales that occur off California, Oregon, and Washington is 1,647 (Carretta et al. 2014.)

As a result of commercial whaling, blue whales were listed as endangered under the Endangered Species Conservation Act of 1969. This protection was transferred to the Endangered Species Act in 1973. They are still listed as endangered and consequently the Eastern North Pacific stock is automatically considered as depleted under the MMPA.

Fin whales, *Balaenoptera physalus*, like blue whales, occur mainly in offshore waters (Jefferson et al. 2011). They do, however, venture closer to shore after periodic upwelling that leads to increased krill density. Recent observations show aggregations of this, second largest of the baleen whales, year-round off southern California (Carretta et al. 2014). Fin whales feed on krill, small schooling fishes, squid, and copepods. They are not known to have a significant number of predators, but in areas where killer whales are abundant, some fin whales exhibit attack scars on their flippers, flukes, and flanks.

The organochlorines DDE, DDT, and PCBs have been identified in fin whale blubber, but at lower concentrations than in toothed whales that feed at higher levels in the food chain (Marsili and Focardi 1996). Female fin whales contain lower burdens than males, likely due to mobilization and export of contaminants during pregnancy and lactation (Gauthier et al. 1997).

Fin whales are susceptible to ship strikes and entanglement in fishing gear (Carretta et al. 2014). Ship strikes were implicated in the deaths of seven fin whales during 2007-2011 (Carretta et al. 2013). During 2007-2011, there were an additional four injuries of unidentified large whales attributed to ship strikes. Documented ship strike deaths and serious injuries are derived from actual counts of whale carcasses and are considered minimum values (Carretta et al. 2013).

As with blue whales, the offshore drift gillnet fishery is the only fishery that is likely to pose a threat of entanglement for fin whales. One fin whale death has been observed in over 8,000 sets since 1990 when NMFS began observing the fishery (Carretta et al. 2014).

Moore and Barlow (2011) present evidence of increasing fin whale abundance in the California Current region. They predict continued increases in fin whale numbers over the next decade that may result in fin whale densities reaching "current ecosystem limits." The best available abundance estimate of fin whales in California, Oregon, and Washington waters is 3,051 (Carretta et al. 2014).

Historical whaling drastically reduced fin whale and other whale stocks. Populations began to recover with implementation of the International Whaling Commission, Endangered Species Act, and the Marine Mammal Protection Act. Fin whales are listed as endangered under the ESA, and as depleted under the MMPA.

Humpback whales, *Meaptera novaeangliae*, are distinguished by their long pectoral fins (flippers) and complex, repetitive vocalizations (Jefferson et al. 2011). The migratory population of humbacks present in California offshore waters during summer and fall ranges from Costa Rica to southern British Columbia (Carretta et al. 2014).   Humpback whales feed on schools of fish and krill and reach a length of 60 ft (18 m). In the southern California feeding grounds, humpback whales feed on a wide variety of invertebrates and small schooling fish. Feeding occurs both at the surface and in deeper waters, wherever prey is abundant. Humpback whales are the only species of baleen whale that cooperate when feeding in large groups (Perrin et al. 2008).

This species is known to be attacked by both killer whales and false killer whales as evidenced by toothrake scars on their bodies and fins (Jefferson et al. 2011). Humpback whales observed on the feeding grounds off Washington and California have the highest rate of rake marks of any of their observed feeding grounds.

Entanglement in fishing gear poses a threat to humpback whales throughout the Pacific Ocean. Pot and trap fisheries are the most commonly documented source of mortality and serious injury of humpback whales in U. S. west coast waters (Carretta et al. 2013). Between 2007 and 2011, there were 16 documented humpback whale interactions with pot/trap fisheries. Gillnet and unidentified fisheries accounted for 1 death and 9 serious injuries of humpback whales between 2007 and 2011 (Carretta et al. 2014). An additional number of whales are likely entangled in fishing gear from Mexican fisheries, though quantitative data are not presently available for most of these fisheries.

Humpback whales, especially calves and juveniles, are highly vulnerable to ship strikes. Younger whales spend more time at the surface, are less visible, and are found closer to shore, making them more susceptible to collisions (USDON 2013). Eight humpback whales were reported struck by vessels with four resulting deaths between 2007 and 2011 (Carretta et al. 2013). The recorded number of serious injuries and mortality from ship strikes is a fraction of the total because additional mortality from ship strikes goes unreported.

Organochlorines, including PCBs and DDE, have been identified from humpback whale blubber (Gauthier et al. 1997). As with blue whales, these contaminants are transferred to young through the placenta, leaving newborns with contaminant loads equal to that of their mothers (Elfes et al. 2010). Humpback whales feed higher on the food chain, consuming prey carrying higher contaminant loads than the krill that blue whales feed on.

The Central North Pacific stock of humpback whales is the focus of whale-watching activities in both its feeding grounds (Alaska) and breeding grounds (Hawaii) (NMFS 2013a). Regulations addressing minimum approach distances and vessel operating procedures are in place to help protect the whales; however, there is still concern that whales may abandon preferred habitats if the disturbance is too high (USDON 2013).

The estimated abundance of humpback whales in the entire Pacific Basin is about 22,000 with approximately 2,000 in California and Oregon waters (Barlow et al. 2011).

As a result of commercial whaling, humpback whales were listed as endangered under the Endangered Species Conservation Act of 1969, and again under the Endangered Species Act (ESA) in 1973. The species is still listed as endangered under the ESA and is considered as depleted under the MMPA. Based on evidence of population recovery in many areas, the species is being considered by NMFS for removal or downlisting from the ESA (NMFS 2014d).

Prior to being hunted by man, the right whale, *Eubalena japonica*, occurred from the Bering Sea to central Baja California (NMFS 2014b). It was targeted early for exploitation because it was slow moving, easy to approach, provided large quantities of meat, oil, and bone, and floated after being killed – thus the common name – the right whale to kill. Right whales are large baleen whales with adults about 50 ft (15 m) length and can weigh up to 14,000 lb (6,350 kg) (Perrin et al. 2008). They consume zooplankton, krill and copepods. Unlike other baleen whales, right whales are skimmers: they feed by removing prey from the water using baleen while moving with their mouth open through a patch of zooplankton. There are no reliable estimates of current abundance or trends for right whales in the North Pacific. They would be rarely sighted in southern California waters and highly unlikely in the Point Loma area.

The North Pacific right whale has been listed as endangered under the ESA since 1973 when it was listed as the "northern right whale." It was listed as a separate, endangered species in April 2008. The species is designated as depleted under the MMPA.

The sei whale, *Balaenoptera borealis*, is the fastest great whale and can reach speeds well over 20 miles per hour. Sei whales occur rarely in offshore waters in southern California (Carretta et al. 2014). They are present as early as May and June, but primarily are encountered during July to September and leave California waters by mid-October. Sei whales feed on a diversity of prey, including copepods, krill, fish, and cephalopods like squid, cuttlefish, and octopus (Jefferson et al. 2011).

The best current estimate of abundance for the eastern north Pacific stock of sei whales that occur off California, Oregon, and Washington waters out to 300 nautical miles (nm) is 126 animals (Carretta et al. 2014). Sei whales, like other large baleen whales, are subject to occasional attacks by killer whales. Based on the statistics for other large whales, it is likely that ship strikes and bycatch also pose a threat to sei whales along the west coast. The sei whale is listed as endangered under the ESA and as depleted under the MMPA.

The only great whale with teeth instead of baleen, the sperm whale, *Physeter macrocephalus*, is by far the most abundant worldwide. During the past 2 centuries, commercial whalers took about 1,000,000 sperm whales (NMFS 2014b). Its current population is estimated at roughly one million – four times the combined total population of the other five endangered large whale species. Sperm whales attain lengths of 60 ft (18 m) and are distinguished by an extremely large head (Perrin et al. 2008). Feeding primarily on squid and fish, sperm whales can make dives of over ten thousand feet deep lasting an hour and a half. Broadly distributed in the north Pacific, sperm whales are found year-round off California, with peak abundance in summer (Carretta et al. 2014).

Contaminants including organochlorines and several heavy metals have been identified in sperm whales, but vary widely in concentration based upon life history and geographic location with northern hemisphere individuals generally carrying higher burdens (Evans et al. 2004). Unlike other marine mammals, females appear to bioaccumulate toxins at greater levels than males, which may be related to possible dietary differences between females who remain at relatively low latitudes compared to more migratory males (Wise et al. 2009).

Bycatch of sperm whales in the California swordfish drift gillnet fishery has rarely been documented since the inception of the observer program in 1990 (Carretta 2013). This fishery has been the subject of field study every year since 1990, and through 2012 a total of 8,365 drift gillnet sets have been observed. Ten sperm whales have been recorded entangled during this time. All of the entanglements occurred from October through December in waters deeper than 4,900 ft (1,500 m), in proximity to steep continental shelf bathymetry. One sperm whale died as the result of a ship strike in Oregon in 2007 (Carretta et al. 2014).

Large populations of sperm whales exist in waters several thousand miles west and south of California, but there is no evidence that sperm whale move from there into U. S. west coast waters (Carretta et al. 2014). The most precise, recent estimate of sperm whale abundance for the California to Washington stock is 971 animals. As a result of previous whaling, sperm whales are listed as endangered under the ESA, and the California to Washington stock is considered depleted under the MMPA.

Seals and Sea Lions

The other endangered marine mammals, the Guadalupe fur seal, *Arctocephalus townsendi*, the Steller sea lion, *Eumetopias jubatus*, are occasional but uncommon visitors to San Diego offshore waters. Severely reduced by hunting in the 1800s, the Guadalupe fur seal was considered extinct by the turn of the century. A small, remnant breeding colony was discovered by Carl Hubbs of the Scripps Institution of Oceanography on Guadalupe Island in 1954 and the population has grown since then (Hubbs 1956). Guadalupe fur seals feed on crustaceans, squid and fish (NMFS 2014e). The Guadalupe fur seal breeds mainly on Guadalupe Island about 100 mi (161 km) off the Baja California coast. Guadalupe fur seals may migrate at least 230 mi (600 km) from their rookery sites, based on observations of individuals in the Southern California

Bight (Carretta et al. 2014). The Guadalupe fur seal population is now in the process of recovering (Gallo 1994).

Drift and set gillnet fisheries may cause incidental mortality of Guadalupe fur seals in Mexico and the United States. In the United States there have been no reports of mortality or injuries for Guadalupe fur seals (Carretta et al. 2014). No information is available for human-caused mortality or injuries in Mexico. The Guadalupe seal is listed as threatened under the ESA and depleted under the MMPA.

The Steller sea lion ranges from Baja California to Alaska, but prefers the colder temperate to sub-arctic waters of the North Pacific Ocean (NMFS 2014f). It is seldom seen in southern California except near the Channel Islands. Steller sea lions are opportunistic marine predators, feeding on a variety of fish including mackerel, sculpin, rockfish, salmon, squid, and octopus (Perrin et al. 2008). Among pinnipeds, they are only surpassed in size by the walrus and elephant seal. Although the Steller sea lion may be able to avoid being hit by ships, they could be subject to entanglement in fishing gear (Carretta et al. 2005).

The Steller sea lion was listed under the ESA as threatened throughout its range in 1990. On June 4, 1997, the population west of 144° W longitude was listed as an endangered Distinct Population Segment (DPS) (the Western DPS) under the ESA; the population east of 144° W remained listed as threatened as the Eastern DPS. A Final Rule to Delist the Eastern DPS was issued on November 4, 2013 (NMFS 2013b).

Birds

Of the seven species of endangered birds in Table 1, only the California least tern (*Sternula antillarum browni*) would be regularly encountered in marine waters off Point Loma. Once common along the southern California coast, the least tern population diminished to a low of about 600 pairs in the early 1970s as a result of loss of wetland habitat and increasing human disturbance (USFWS 2009). Implementation of mitigation measures following their classification as an endangered species helped the species slowly recover. The California least tern historically nested on beaches, often near estuaries. Now, active management is required to create and maintain safe nesting sites. Fencing, signs, education, and predator control are all employed to protect the species. Least terns are generally present at nesting areas between mid-April and late September, often with two waves of nesting during this time.

California least terns are distributed along the U. S. Pacific Coast from San Francisco to Baja California (USFWS 2014c). Foraging habitats include nearshore ocean waters, bays, and salt marshes. They plunge-dive to capture prey, usually within 1 mi (1.6 km) from shore in waters less than 60 ft (18 m) deep. Prey species include anchovies, smelt, and gobies. Peak foraging behavior typically occurs from the end of May through mid-July after chicks hatch. California least terns eggs, chicks, and adults are preyed upon by gulls, ravens, hawks, crows, rodents, raccoons, and coyotes. The California least tern was federally listed as endangered in 1970 and was listed as endangered by the state of California in 1971.

The 2013 California least tern breeding survey estimated 4,353-5,561 California least tern breeding pairs established 5,894 nests and produced 1,399-1,634 fledglings at 56 documented locations (Frost 2014). Camp Pendleton, Naval Base Coronado, Batiquitos Lagoon, and

Huntington State Beach represented over half of the breeding pairs. Sites with at least 90 fledgling numbers each (Alameda Point, Naval Base Coronado, Camp Pendleton, Hayward Regional Shoreline, Batiquitos Lagoon, and Huntington State Beach), contributed 67% of the state's production, and the sites with greater than 35 fledglings each (including the six previously mentioned sites plus Seal Beach, Tijuana Estuary, and Oceano Dunes), contributed 82% of the state's production. The closest California least tern breeding area to the Point Loma outfall is the Naval Base Coronado. The nesting sites there accounted for an estimated 713.5-912 breeding pairs, 1,034 nests, and 153 fledglings in 2013 (Frost 2014).

The 2013 statewide California least tern non-predation chick mortality rate was 22%, much less than that in 2012 (49%) and a reverse in the upward trend observed in the previous five years. With the exceptions of Batiquitos Lagoon and Camp Pendleton, the larger nesting colonies experienced non-predation chick mortality rates less than the average, similar to that documented in 2012. The predators known to be responsible for the greatest number of depredated least terns in 2013 were common ravens (*Corvus corax*), peregrine falcons (*Falco peregrinus*), unknown gull spp., domestic cats (*Felis catus*), American crows (*Corvus brachyrhynchos*), American kestrels (*Falco sparverius*), coyotes (*Canis latrans*), great horned owls (*Bubo virginianus*), northern harriers (*Circus cyaneus*), unknown avian spp., unknown spp., Cooper's hawks (*Accipiter cooperii*), and red-tailed hawks (*Buteo jamaicensis*).

The light-footed clapper rail, *Rallus longirostris levipes*, is a hen-sized bird with long legs and toes. It has a tawny breast, gray-brown back, and gray and white striped flanks (USFWS 2014d). They feed primarily on invertebrates such as snails, crab, insects and worms and are year-round inhabitants of coastal estuaries. Light-footed clapper rails historically ranged from Santa Barbara County to San Quintin, Baja California, Mexico. Loss and degradation of southern California wetlands resulted in the species being listed as federally endangered in 1970 and California state endangered in 1971. In the vicinity of Point Loma, light-footed clapper rails inhabit the Tijuana River Valley, the Sweetwater Marsh National Wildlife Refuge, and the San Diego River Flood Control Channel.

The light-footed clapper rail population fell to its lowest level in 1989 when only 163 pairs were recorded in eight southern California marshes. The population then slowly increased to 325 and 307 pairs censused in 1996 and 1997, respectively in 15 of 16 California coastal wetlands (Zembel et al. 1997). The thirty-fourth annual census of the light-footed clapper rail in California was conducted from 2 March to 21 June 2013 (Zembel et al. 2013). Thirty coastal wetlands were surveyed by assessing call counts from Mugu Lagoon in Ventura County, south to Tijuana Marsh National Wildlife Refuge on the Mexican border. For the second year in a row the California population of the light-footed clapper rail exceeded 500 breeding pairs. A total of 525 pairs exhibited breeding behavior in 22 marshes in 2013. This was the highest count on record, representing an increase of four pairs over the breeding population detected in 2012, and 18.5% larger than the former high count in 2007. The Tijuana Marsh National Wildlife Refuge was at its third highest recorded level with 105 breeding pairs, an increase of 4% over the 2012 breeding season but 26% lower than the record high of 142 pairs in 2007. The Tijuana Marsh National Wildlife Refuge comprised 20% of the breeding population of this rail in California.

The western snowy plover, *Charadrius alexandrinus nivosus*, is a small, pale-colored shorebird with dark patches on its upper breast (USFWS 2014e). It feeds by probing the sand at the beach-surf interface for small crustaceans and marine worms. It breeds on coastal beaches from southern Washington to southern Baja California, Mexico. In southern California, snowy plovers typically nest in association with federally endangered California least terns. The western snowy plover is threatened by habitat loss, human disturbance, and nest/egg destruction by native and introduced predators and domesticated pets. Western snowy plovers nest in San Diego Bay along the Silver Strand and at the south San Diego Bay Saltworks. They are occasional visitors to the Point Loma shoreline. A 2006 breeding season census of western snowy plovers by the USFWS observed 95 adults in San Diego Bay and Tijuana Estuary and a total of 1,723 adults state-wide (USFWS 2007). The Pacific coast population of western snowy plovers was listed as threatened under the ESA in 1993. In 2012, a 0.6 mi (0.96 km) stretch of Coronado City Beach to the south of Point Loma was designated as western snowy plover critical habitat (USFWS 2012).

The last four bird species in Table 1 – the Guadalupe murrelet, marbled murrelet, Scripps's murrelet, and short-tailed albatross are strictly sea birds, usually found well offshore in southern California waters (USDON 2013). These endangered birds would rarely be seen in the Point Loma area (UCSD 2013).

Sea Turtles

Five species of sea turtles occasionally visit San Diego ocean waters: green, loggerhead, leatherback, olive Ridley, and hawksbill – all are protected under the Endangered Species Act (Table 1). The U. S. National Marine Fisheries Service (NMFS) and the U. S. Fish and Wildlife Service (USFWS) share Federal jurisdiction for sea turtles, with NMFS having lead responsibility in the marine environment and USFWS having lead responsibility on nesting beaches (NMFS 2014g, USFWS 2014f).

Sea turtles are saltwater reptiles with streamlined bodies built for trans-oceanic navigation (Wyneken et al. 2013). Although they live most of their life in the ocean, females return to land to lay their eggs on nesting beaches. Recovery plans for the U.S. Pacific populations of sea turtles provide a wealth of information on their distribution, diet, growth, reproduction, behavior, and health (NMFS and USFWS 1998a,b,c,d,e). These plans also discuss threats to the continued existence of sea turtles and define procedures and goals for their recovery.

All five species of sea turtles forage along the California coast in the summer and early fall when sea temperatures are warmest (Eckert 1993). There are no known sea turtle nesting sites in the San Diego area or anywhere on the west coast of the United States (USDON 2013).

Most commonly seen in San Diego marine waters, the east Pacific green sea turtle, *Chelonia mydas*, nests on beaches of the Pacific coast of Mexico and ranges throughout the north Pacific Ocean (NMFS 2014h). Adults have three-foot-wide shells with a radiating pattern of brown, black, and cream colored markings and weigh about 200-300 lb (90-136 kg). The biting edge of their lower jaw is serrated. They eat algae and sea grasses. Green sea turtles are often found from July through September off the coast of California. As for the other endangered sea turtles discussed here, there is no designated green turtle critical habitat in the San Diego region.

In the past, Green sea turtles have aggregated at the southern end of San Diego Bay, attracted to the warm water effluent from a power plant (McDonald et al. 1995, McDonald et al. 2012). A 20-year monitoring program of these turtles indicated an annual abundance of between 16 and 61 turtles (Eguchi et al. 2010). Local researchers have used genetics and satellite telemetry to determine that the turtles are part of the Eastern Pacific nesting populations, and migrate thousands of miles to lay their eggs on beaches off the coast of Mexico. Within San Diego Bay, the turtles can most often be seen surfacing within the South San Diego Bay National Wildlife Refuge, which provides a protected foraging and rest area, as well as a prime study site for turtle biologists. The power plant, which had continuously operated since 1960, ceased operation in December 2010. The closure of the power plant may impact these resident turtles and alter movement patterns (Turner-Tomaszewicz and Seminoff 2012). The green turtles' greatest threat in San Diego Bay is being hit by boats traveling over the 5-mile/hour speed limit posted throughout the southern portion of the bay (Port of San Diego 2014).

The loggerhead turtle, *Caretta caretta*, is a reddish-brown sea turtle with a large head. Adult loggerheads average about 200-300 lb (91-136 kg) with shells about three-feet (1 m) wide (NMFS 2014i). They take over two decades to mature and in the northern Pacific are only known to nest in southern Japan. Their diet consists of crabs, shrimp, mollusks and jellyfish. Most recorded sightings in California are juveniles (Battey 2014).

The leatherback sea turtle, *Dermochelys coriacea*, is the largest sea turtle, reaching over six-feet in diameter and weighing as much as 1,400 lb (635 kg) (NMFS 2014j). Unlike other species which have solid shells covered with scales, the leatherbacks' shell is a bony matrix covered with a firm, rubbery skin with seven longitudinal ridges or keels (Wyneken et al. 2013). Most sea turtles are cold-blooded and prefer to live in warm waters. Leatherbacks are the exception, and are more likely to be found in colder waters at higher latitudes because of their unique ability to maintain an internal body temperature higher than that of the environment (Dutton 2006). These large sea turtles feed mostly on jellyfish and nest in the tropics and subtropics. Along the western U. S coast, leatherbacks are mostly seen in waters over the continental slope, with greatest densities off central California (NMFS 2013a). The majority of loggerheads observed in the eastern North Pacific Ocean are juveniles, believed to have come from nesting beaches in Japan (USDON 2013).

The olive Ridley turtle, *Lepodochelys olivacea*, is the smallest sea turtle in Pacific waters. Their shell is heart-shaped to round and may be colored grey-brown, black, or, olive. Olive Ridleys' are primarily carnivores and eat a wide variety of food including crab, shrimp, lobster, jellyfish, and tunicates (NMFS 2014k). In San Diego waters, loggerheads, leatherbacks, and olive Ridleys are most often seen well offshore, unlike green sea turtles which tend to hug the shoreline (USDON 2013).

Like other Pacific sea turtles, the hawksbill turtle, *Eretmochelys imbricata*, makes vast oceanic excursions and could occur off the U. S. west coast (NMFS 2014l). Hawksbills were originally considered to be omnivores, but subsequent research revealed they are primarily specialist sponge carnivores, preferring only a few species of sponge (Vicente 1994). There have been few hawksbill sightings north of Baja California Sur and its appearance in San Diego waters would be extremely unlikely (USDON 2013).

Fish

In 1997, the National Marine Fisheries Service listed the southern California Evolutionary Significant Unit of West Coast steelhead (*Oncorhynchus mykiss*) as endangered (Federal Register: 18 August 1997 [Volume 62, Number 159, Pages 43937-43954]) (NMFS 1997). In March of 1999, NMFS added nine species of salmon and steelhead to the Endangered Species list and designated critical habitat for them in 2005 (NMFS 2005a). Though most of these are Pacific northwest species, the chinook salmon and steelhead range south to California (NMFS 2014m). Chinook salmon are mostly encountered north of Point Conception.

Steelhead trout are usually dark-olive in color, shading to silvery-white on the underside with a heavily speckled body and a pink to red stripe running along their sides (USFWSg). Steelhead are born in freshwater streams and later move into the ocean where most of their growth occurs. After 1 to 4 years in the ocean, they return to their home freshwater stream to spawn. Some steelhead, however, spend their entire life in freshwater: these fish are called rainbow trout. Steelhead tend to move immediately offshore on entering the marine environment although, in general, steelhead tend to remain closer to shore than other Pacific salmon species (Beamish et al. 2005).

Steelhead occurred historically in all San Diego County watersheds that drain into the ocean (NMFS 2012). Currently, steelhead in southern California range only as far south as San Mateo Creek in northern San Diego County (USDON 2013). Both steelhead and chinook salmon are occasionally caught in ocean waters off San Diego but do not enter streams in the San Diego Metropolitan area.

Invertebrates

The white abalone, *Haliotis sorenseni*, was historically found from Punta Abreojos, Baja California, Mexico, to Point Conception, California (NMFS 2014n). Inhabiting deeper water than any other abalone species, white abalone in southern California typically occur from 60 to 195 ft (18 to 59 m), with the highest densities between 130 and 165 ft (40 and 50 m) (Butler et al. 2006). They reproduce by broadcast spawning and reach sexual maturity at age 4 to 6 years at a size of 3 to 5 inches. Newly settled individuals feed on benthic diatoms, bacterial films, and single-celled algae found on coralline algal substrates. As they grow larger, white abalone feed on drift and attached algae. Adult white abalone can reach a shell length of up to 9 inches. Except for some isolated survivors, the species is currently distributed only around the Santa Barbara Channel Islands, San Clemente Island, and along various banks far offshore from Point Loma (Stierhoff et al. 2014).

Inhabiting deeper water initially provided white abalone a refuge from divers, but a commercial fishery began in the early 1970s and together with increasing recreational take, over-harvesting lead to the collapse of the fishery in the 1980s. The state of California suspended all forms of harvesting of the white abalone in 1996 and, in 1997, and imposed an indefinite moratorium on the harvesting of all abalone in central and Southern California (NMFS 2008). The white abalone was federally listed as an endangered species on 29 May 2001 (NMFS 2001). Critical habitat is not designated for white abalone.

The black abalone, *Haliotis cracherodii*, inhabits the intertidal and shallow subtidal zones where it has been easily targeted for exploitation (NMFS 2014o). It has experienced dramatic population declines due to recreational and commercial fishing and withering syndrome disease (VanBlaricom et al. 2009). The state of California imposed a moratorium on black abalone harvesting 1993 and adopted an Abalone Recovery Management Plan 2005 (CDFG 2005). There is concern that the low remaining densities of both black and white abalone may be insufficient for continued reproductive success (VanBlaricom et al. 2009).

The black abalone was proposed as a candidate for listing as an endangered species in 2005 (NMFS 2005b) and listed as endangered under the ESA on 14 January 2009 (NMFS 2009). Critical habitat was designated for black abalone in 2011 (NMFS 2011). The designated critical habitat extends north of the Palos Verdes Peninsula and in waters surrounding Santa Catalina Island and the Channel Islands.

ENVIRONMENTAL EFFECTS

Twenty four endangered species; eight marine mammals, seven birds, five sea turtles, two fish, and two invertebrates, may occur in the Point Loma area (Table 1).

Endangered species in southern California are subject to a variety of natural and human influences (Davidson et al. 2011, Van Der Hoop et al. 2013, NOAA 2014). Changes in wide-scale oceanographic regimes can alter endangered species foraging success through impacts on prey distributions and locations, which in turn affects reproductive success and survival (O’Shea and Odell 2008, Simmonds and Eliott 2009, Salvadeo et al. 2010, 2013, Fiedler et al. 2013, NMFS 2013a). Climate shifts can transform the type and the intensity of human activities, such as fishing, shipping, oil and gas extraction, and coastal construction, all of which may have an impact on endangered species (Alter et al. 2010, Hoegh-Guldberg and Bruno 2010, Doney et al. 2012, Hazen et al. 2012). Other potential anthropogenic stressors include noise, bioaccumulation of chemicals, overfishing, marine debris, and habitat deterioration or destruction (Dayton et al. 2003, Crain et al. 2009, Halpern et al. 2009, Jackson et al. 2011, Hilborn and Hilborn 2012, NAVFAC 2013). Incidence of disease, parasitism, and adverse effects from algal blooms may also pose a threat to the health of endangered species (Brodie et al. 2006, Walsh et al. 2008, Bossart et al. 2011). These impacts have the potential to alter the physiology, behavior, growth, and reproduction of individual species, shift patterns of larval dispersal and recruitment, modify the composition of ecological communities, and, change the structure, function, productivity, and resilience of marine ecosystems.

For marine mammals and sea turtles, ship strikes and fisheries bycatch (accidental or incidental catch) are the primary cause of human-related mortality in southern California ocean waters (Carretta et al. 2013, Geijer and Read 2013). In addition to these direct effects, marine mammals and sea turtles may also be indirectly effected by noise, bioaccumulation, habitat alteration, and depletion of prey species (Redfern et al. 2013, NMFS 2013a, NOAA 2014). In 1994, the MMPA was amended to formally address these issues (16 U.S.C. 1361-1407: PL103-238:108 Stat. 532).

The Marine Mammal Protection Act requires the National Marine Fisheries Service to document human-caused mortality and injury of marine mammals as part of assessing marine mammal stocks (Roman et al. 2013, Carretta et al. 2014). A recent NMFS report summarizes records of human-caused mortality and injury from 2007 to 2011 for U. S. west coast marine mammal populations (Carretta et al. 2013). Among marine mammals, pinnipeds were most commonly injured or killed by anthropogenic activity followed by small cetaceans and large whales. The primary causes of pinniped injury and mortality were recreational hook and line fishery interactions, shootings, and entrainment into power plant water intakes. Vessel strikes and fishery-related entanglements were the most common form of mortality and injury to whales. Net fisheries accounted for most of the injuries and mortalities for small cetaceans. Sea turtles and sea birds are also at risk of entanglement in fishing gear (Carretta and Enriquez 2012). Impacts of commercial fisheries that utilize nets, pots, and traps are likely to be greater than the number of observed incidents because derelict gear can entangle animals for as long as it remains in the environment (EPA 2012, Reeves et al. 2013).

Habitat deterioration and loss is an issue for almost all coastal marine mammals (Davidson et al. 2011, Roman et al. 2013). Anthropogenic noise is a potential habitat level stressor especially in areas of industrial activity or commercial ship traffic (McDonald et al. 2008, Hildebrand 2009). Noise is a particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals (USDON 2013). It may induce marine mammals to leave a habitat, impair their ability to communicate, or cause stress (Rolland et al. 2012, Erbe et al. 2012). Noise can create behavioral disturbances and mask other sounds including the marine mammals' own vocalizations (Southall et al. 2012). With ecotourism on the rise, marine life viewing activities like whale watching have the potential to impact the behavior and migration of marine mammal populations (NMFS 2013a, NOAA 2014).

Endangered species are also subject to bioaccumulation of toxic chemicals. Natural and synthetic chemicals enter the ocean through various sources including rivers and streams, storm drains, industrial discharges, municipal wastewater discharges, dredge and disposal activities, aerial fallout, vessel activities and spills, mineral mining, oil exploration and extraction, and through hydrothermal vents and hydrocarbon seeps (Setty et al. 2012, Hutchinson et al. 2013). Some of the chemical constituents entering the ocean remain dissolved and are distributed by ocean currents and eddies. Many are physically or chemically bound to particulate matter and settle to the bottom.

Marine organisms can absorb dissolved chemicals directly from seawater (by the gills or epidermis), and indirectly through contact with sediment, by ingesting sediment particles or suspended particulate matter, and through assimilation from food organisms (Newman 2009, Allen et al. 2011, Laws 2013). Chemical compounds accumulate in an organism's tissue if they cannot be metabolized and eliminated faster than they are absorbed. Tissue concentration can also increase as these chemicals are passed through the food web from lower to higher trophic levels (Bienfang et al. 2013, Daley et al. 2014, Weis 2014). The degree to which bioaccumulation occurs depends on the solubility, particle affinity, oxidation state, volatility, and degradability of the specific chemical (Laws 2013). These differences determine how chemical compounds are distributed within biological communities and throughout the environment (Whitacre 2014). The potential impacts of bioaccumulation by marine organisms include compromised immune response and disease resistance, altered behavior, diminished breeding success, developmental abnormalities, population declines via direct mortality, and shifts in the composition of communities by affecting top predators and keystone species (Newman 2009, NAVFAC 2013).

The species most at risk from bioaccumulation of toxic compounds are those at the highest trophic levels, especially marine mammals (O'Hara and O'Shea 2005, Tornero et al. 2014). Marine mammals are vulnerable to bioaccumulation because they have long life spans and large blubber stores that can serve as repositories for lipophilic chemicals (Moore et al. 2013). Bioaccumulation of anthropogenic contaminants may also increase susceptibility to other stressors including parasitism and disease (O'Hara and O'Shea 2005, Bossart 2011).

Marine debris is a potential threat to endangered marine mammals (EPA 2012, Howell et al. 2012). Marine debris flows into the ocean from rivers, harbors, estuaries, and, though prohibited in U. S. waters, occasionally from vessels at sea (NOAA 2008). Ingestion of debris can have fatal consequences for whales. The stomach contents of two sperm whales that stranded in California included extensive amounts of discarded fishing netting (NMFS 2013a). Another Pacific sperm whale contained nylon netting in its stomach when it washed ashore in 2004 (NMFS 2013a). Seals and sea lions are also subject to entanglement in marine debris (Carreta et al. 2013). A recent study by Oregon State University found Steller sea lions entangled with rubber bands used on crab pots, hard plastic packing bands from cardboard boxes, fishing line and hooks, and other fishing gear (OSU 2011).

Sea turtles are exposed to a wide variety of natural and anthropogenic threats (Santidrián Tomillo et al. 2012, NMFS 2013a, Wyneken et al. 2013). Nesting beaches are threatened by hurricanes and tropical storms. Hatchlings are preyed on by herons, gulls, and sharks. Juveniles and adults are eaten by sharks and other large marine predators. Sea turtles are also killed or injured by fisheries as bycatch, and by vessel strikes (Carretta et al. 2005, Hazel et al. 2007, Wallace et al. 2010, Work et al. 2010, Lewison et al. 2013). Marine debris can be detriment as well. Floating plastic garbage can be mistakenly ingested by sea turtles. Leatherback sea turtles in particular may mistake floating plastic garbage as jellyfish, an important component of the leatherback diet (Lazar and Gračan 2011). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown all life stages (Mrosovsky et al. 2009).

All the nearshore birds in Table 1 became endangered because of habitat loss and disturbance. These bay and estuarine species - California least tern, light-footed clapper rail, and western snowy plover - occasionally forage over San Diego coastal water. The primary threat to their well-being in ocean waters would be exposure to bioaccumulated toxic compounds from prey captured in the area (Arnold et al. 2007).

Regional evaluations have shown that virtually all bottom-dwelling fish populations in southern California have detectable levels of DDT and PCBs as a result of past discharge practices, now discontinued (SCCWRP 2012). The highest concentrations are on or near the Palos Verdes shelf off Whites Point in Los Angeles, an area with highly contaminated sediments, the result of historical discharge. Fish tissue burdens of DDT and PCBs decline to the north and south across the Southern California Bight. Concentrations of chlorinated hydrocarbons in fish from reference areas are now less than 5% of levels measured two decades ago (Allen et al. 2011). Contaminant burdens in fish tissues at Point Loma are comparable to those at reference sites beyond the influence of the discharge (COSD 2008-2014). Endangered birds feeding in the Point Loma area should not be exposed to a higher risk of bioaccumulation from the discharge of treated wastewater.

Of the five species of endangered sea turtles that may pass through the San Diego marine environment (Table 1), the green sea turtle would be most common and the one found closest to shore. Green turtles are subject to entrainment in coastal power plants, perhaps attracted to the lush growth of algae on the cooling water intake structures (Seminoff 2007). Green turtles have also been struck by boats and entangled in fishing gear in southern California (Carretta et al. 2005). Although capable of deep dives, most sea turtles passing San Diego would be in surface waters. They should not be exposed to the effluent plume which is normally trapped below the thermocline, especially during the summer when turtles would be most prevalent. The potential impact of discharged debris is minimized by screens in the Point Loma wastewater headworks that remove entrained material greater than an inch in diameter (COSD 2014).

The two other endangered species possibly occurring at Point Loma, the steelhead trout and black abalone, will not be jeopardized by the discharge. Steelhead trout would be transitory, and the black abalone, if present, would be well inshore of the outfall, beyond potential adverse influence.

Operation of the Point Loma ocean outfall could affect endangered species by altering physical, chemical, or biological conditions including: water quality, biological integrity (e.g., species abundance and diversity), food web dynamics (e.g., availability of prey), habitat suitability, and the health of organisms (e.g., bioaccumulation of toxic substances, disease, and parasitism).

The City of San Diego monitors changes in ocean conditions over space and time, and assesses any impacts of wastewater discharge or other man-made or natural influences on the local marine environment. Monitoring results are contained in Annual Monitoring Reports (COSD 2008-2014). The monitoring program has six components: coastal oceanographic conditions, water quality and plume dispersion, sediment conditions, macrobenthic communities, demersal fish and megabenthic invertebrates, and contaminants in fish tissues. The overall findings are summarized in the following paragraphs.

There has been no indication of change in any physical or chemical water quality parameter (e.g., dissolved oxygen, pH) attributable to wastewater discharge off Point Loma. Instead, fluctuations in oceanographic parameters have historically been associated with varying climate regimes and with natural events such as storm activity and the presence of plankton blooms.

Benthic conditions off Point Loma show some changes that may be expected near large ocean outfalls, though restricted to a relatively small, localized region near the discharge site. For example, sediment quality data have indicated slight increases over time in sulfide content and biological oxygen demand at sites nearest the discharge, where the physical presence of the outfall structure has caused relatively coarse sediment particles to accumulate. Other measures of environmental impact such as concentrations of sediment contaminants (e.g., trace metals, pesticides) show no patterns related to wastewater discharge.

Some descriptors of benthic community structure (e.g., abundance, species diversity) or indicators of environmental disturbance (e.g., brittle star populations) have shown temporal differences between reference areas and sites nearest the outfall. However, results from environmental disturbance indices such as the Benthic Response Index that are used to evaluate the condition of benthic assemblages indicate that benthic invertebrate communities in the Point Loma region remain characteristic of natural conditions.

Analyses of bottom dwelling fish and trawl-caught invertebrates reveal no spatial or temporal patterns that can be ascribed to effects of wastewater discharge. Instead, historical data (1991-2014) indicates that patterns of change in benthic communities are related to large-scale oceanographic events or specific site conditions (e.g., near dredge material disposal sites) (see Benthic Sediments and Organisms - Appendix C). The lack of physical anomalies and other symptoms of disease in local fish, as well as the low level of contaminants in fish tissues, are also indicative of a healthy marine environment.

CUMULATIVE EFFECTS

Cumulative impacts are defined in the National Environmental Protection Act (NEPA) (42 USC § 4321 *et seq*. and 32 CFR 775 respectively) as: the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).

In general, the effects of a particular action or group of actions must meet all of the following criteria to be considered cumulative impacts:

- Effects of several actions occur in a common locale or region,
- Effects on a particular resource are similar in nature, such that the same specific element of a resource is affected in the same specific way, and
- Effects are long-term as short-term impacts dissipate over time and cease to contribute to cumulative impacts.

The discharge of wastewater from commercial activities, including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., desalination plants), and storm water from drains into open ocean waters, bays, or estuaries can introduce chemical and biological constituents potentially detrimental to estuarine and marine habitats (Perry 2009, Hutchinson et al. 2013). These constituents include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, and toxic chemical compounds (Stein and Cadien 2009, Setty et al. 2012). Historically, wastewater discharges have been one of the largest inputs of these constituents into coastal waters. However, wastewater discharges have been regulated under increasingly stringent requirements over the last 40 years and mass emissions of most constituents have been significantly reduced (Lyon and Sutula 2011, SCCWRP 2012, 2014). Nonpoint source/storm water runoff, on the other hand, has not been managed as effectively and continues to be a substantial remaining source of contamination of coastal areas and the ocean (Setty et al. 2012, Howard et al. 2014).

Human activities, such as shipping, oil and gas extraction, and coastal construction have the potential to directly or indirectly affect endangered species (Alter et al. 2010, Hoegh-Guldberg and Bruno 2010, Doney et al. 2012, Hazen et al. 2012). Other possible cumulative threats to endangered species include degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, and disease (Field et al. 2003, Horn and Stevens 2006, O'Shea and Odell 2008, Pinnegar and Engelhard 2008, Crain et al. 2009, Halpern et al. 2009, Hoegh-Guldberg and Bruno 2010, Thrush and Dayton 2010, Doney et al. 2012, Hazen et al. 2012, Howell et al. 2012, SCCWRP 2012, NMFS 2013a, Howard et al. 2014, Maruya et al. 2014). Cumulative impacts could alter the physiology, behavior, growth, and reproduction of individual species, shift patterns of larval dispersal and recruitment, modify the composition of ecological communities, and, change the structure, function, productivity, and resilience of marine ecosystems.

Fishing and non-fishing activities, individually or in combination, can adversely affect endangered species (Jackson et al. 2001, 2011, Dayton et al. 2003, Chuenpagdee et al. 2003, Hanson et al. 2003, Jackson 2008, Baum and Worm 2009, Worm et al. 2009, Norse 2010, Hilborn and Hilborn 2012, NMFS 2013b, Laugen et al. 2014). Potential impacts of commercial fishing include over-fishing of targeted species, and bycatch (Dieter et al. 2003, PFMC 2004, Hseih et al. 2006, Carretta and Enriquez 2012, PFMC and NMFS 2012). Indirect effects may include removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (continued catch by lost or discarded gear), and generation of marine debris (Reeves et al. 2013). Lost gill nets, purse seines, and long-lines can foul and disrupt bottom habitats (NMFS 2013b). Recreational fishing also poses a threat because of the large number of participants and the intense, concentrated use of specific habitats (Coleman et al. 2004, Ihde et al. 2011, United Nations Food and Agricultural Organization (UNFAO) 2012, Arlinghaus et al. 2013).

Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress endangered species, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Davidson et al. 2011, Hutchinson et al. 2013, Moore et al. 2013). Natural stresses include storms and climate-based environmental shifts, such as algal blooms and hypoxia (Kim et al. 2009, SCCWRP 2013).

A number of factors influence water quality and marine ecology in the Point Loma area. Key potential influences on water quality include the Point Loma treated wastewater discharge, regional non-point source discharges, local river outflows, and other local non-point sources such as harbors, marinas, storm drains, and urban runoff (Bartlett et al. 2004, Parnell et al. 2008, Parnell and Riser 2012).

The discharge of treated wastewater at Point Loma could affect biological conditions by altering water or sediment quality. Water quality parameters are monitored at stations around the outfall, in the kelp bed, along the shoreline, and at reference stations to the north and south (City of San Diego (COSD) 2008-2014). Strong local currents and high initial dilution (>200:1) facilitate rapid mixing and dispersion of the discharged effluent. Except in the immediate vicinity of the outfall, where minor alterations in dissolved oxygen, pH, and light transmittance may occur, changes in physical and chemical parameters in surrounding ocean waters have reflected only natural alterations in oceanographic processes (e.g., upwelling, plankton blooms) and long-term regime changes like El Niño.

Unlike dissolved components of the wastewater that are swept away by the currents, particles discharged from the outfall may settle to the ocean floor. This can change the grain size and organic content of the sediments which in turn affects the abundance and diversity of marine organisms living there. Contaminants can also be introduced since many of the potentially harmful chemicals in wastewater are bound to particles.

Alterations in sediment quality in the vicinity of the Point Loma Ocean Outfall are only apparent in areas closer than 1,000 ft (300 m) from the diffusers, where coarser sediments and higher sulfide and BOD levels have been periodically detected (COSD 2008-2014). The change in grain size may be related to turbulence created as the current flows past the pipe on the bottom, wafting away the finer particles (Diener et al. 1997). The physical presence of large ocean outfalls and associated ballast materials can alter the hydrodynamic regime in surrounding areas, thus affecting sediment movement and transport, and the resident biological communities. Although periodic small increases in sulfides and BOD near the discharge site are consistent with the deposition of organic material, concentrations of other indicators of organic loading (e.g. total organic carbon, total nitrogen, total volatile solids) organic enrichment) remain low relative to reference areas (see Appendix C – Ocean Benthic Conditions).

Concentrations of chlorinated pesticides (e.g., DDT), polychlorinated biphenyl congeners (PCBs), and polycyclic aromatic hydrocarbons (PAHs) in sediments at Point Loma are generally low, the notable exception being DDE, a breakdown product of the pesticide DDT. DDE, a legacy of historical discharge, is found in sediments throughout southern California (Mearns et al. 1991, Schiff et al. 2011). Levels of DDE at Point Loma are within the range of concentrations elsewhere in the Southern California Bight (COSD 2008-2014, Schiff et al. 2011).

There is no consistent pattern of metal concentrations in the sediments as a function of distance from the outfall - cadmium, arsenic, antimony, barium, chromium, and iron are consistently higher at the northern reference stations, while mercury, aluminum and copper are consistently higher at the southern sampling stations. Concentrations of sediment metals were highly variable, with most levels within ranges reported elsewhere in the SCB (e.g., Schiff et al. 2011). While high values of various metals have been occasionally recorded at nearfield stations, there are no discernible long-term patterns that could be associated with proximity to the outfall or the onset of wastewater discharge.

The effects of the Point Loma discharge on water quality and biological conditions are evident only in deep waters (below the euphotic zone) within or near the Zone of Initial Dilution (ZID) (COSD 2008-2014). Organic enrichment of the sediments due to the outfall discharge is not occurring beyond the ZID. Contaminant loading of sediments is not evident in the discharge vicinity. Sediment chemistry is comparable to reference areas along southern California's outer continental shelf. Biological conditions do not indicate any environmentally-significant changes associated with the discharge. A balanced indigenous population of shellfish, fish and wildlife exist immediately beyond the ZID.

While significant natural variations in fish populations are observed (in response to factors such as water temperature), the Point Loma wastewater discharge is not having any significant effect on fish assemblages off Point Loma. Fish populations are healthy and lack physical abnormalities such as fin erosion or tumors. Levels of trace metals, chlorinated hydrocarbons, pesticides, and polyaromatic hydrocarbons are relatively low, with concentrations within the range found throughout the Southern California Bight. No outfall-related effects are evident from bioaccumulation data. Contaminants in fish tissues in the Point Loma area are similar to those at reference sites beyond the influence of the discharge.

The discharge of treated wastewater at Point Loma will, therefore, make a minimal, insignificant contribution to regional cumulative impacts on endangered species and their critical habitat.

CONCLUSION

Operation of the Point outfall could potentially impact endangered species through changes in environmental conditions that affect the species or their habitat. Monitoring data and research show effects of the Point Loma discharge only in deep water near the outfall where minor water and sediment quality alterations have been observed. Marine communities in the Point Loma area remain characteristic of natural conditions with no suggestion of ecologically-significant changes.

There is no indication of adverse impacts from operation of the Point Loma Ocean Outfall on environmental conditions or biological communities that could affect the health and well-being of endangered species or threaten their critical habitat. Future flows and contaminant concentrations from the Point Loma Ocean Outfall would be at or below currently permitted levels. Thus, the proposed, future discharge of treated wastewater from the Point Loma Ocean Outfall is not likely to adversely affect endangered species or their critical habitat. Consultation with the U. S. National Marine Fisheries Service and the U. S. Fish and Wildlife Service supports these findings (see Correspondence - Appendix V).

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THE CITY OF SAN DIEGO · STATE OF CALIFORNIA ·
SEMPER VIGILANS

Appendix K
ESSENTIAL FISH HABITAT ASSESSMENT

Renewal of NPDES CA0107409

APPENDIX K

ESSENTIAL FISH HABITAT ASSESSMENT

For

CITY OF SAN DIEGO

APPLICATION FOR MODIFICATION OF SECONDARY TREATMENT REQUIREMENTS AT THE POINT LOMA TREATMENT FACILITY

To

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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INTRODUCTION

The City of San Diego is preparing an application to the San Diego Regional Water Quality Control Board (SDRWQCB) and the U. S. Environmental Protection Agency (EPA) requesting renewal of its' National Pollution Discharge Elimination System (NPDES) permit for the discharge of treated wastewater to the Pacific Ocean from the 23,760-foot-long, 320-foot deep Point Loma Ocean Outfall. The City's application requests renewal of modified secondary treatment requirements for the Point Loma discharge in accordance with provisions of Section 301(h) and Section 301(j)(5) of the Clean Water Act (EPA 2014a). The current five-year discharge permit for the modified Point Loma discharge expires in 2015 (SDRWQCB and EPA 2009). The City's Section 301 renewal application does not request any increase in currently permitted discharge flows or mass emissions. It seeks to decrease suspended solids mass emissions. Treatment and discharge operations at Point Loma have complied with all applicable state and federal standards for the protection water quality, habitat quality, marine organisms, and beneficial uses of the ocean. The proposed discharge will continue to meet or exceed these standards. This Essential Fish Habitat Assessment was prepared as part of the City of San Diego's Section 301 renewal application.

The marine environment in the vicinity of Point Loma supports a wide variety of commercial fisheries. These fisheries are protected and managed by the Magnuson-Stevens Fishery Conservation and Management Act and the Sustainable Fisheries Act through their "Essential Fish Habitat" provisions (National Oceanic and Atmospheric Administration (NOAA) 2007, 2014a,b).

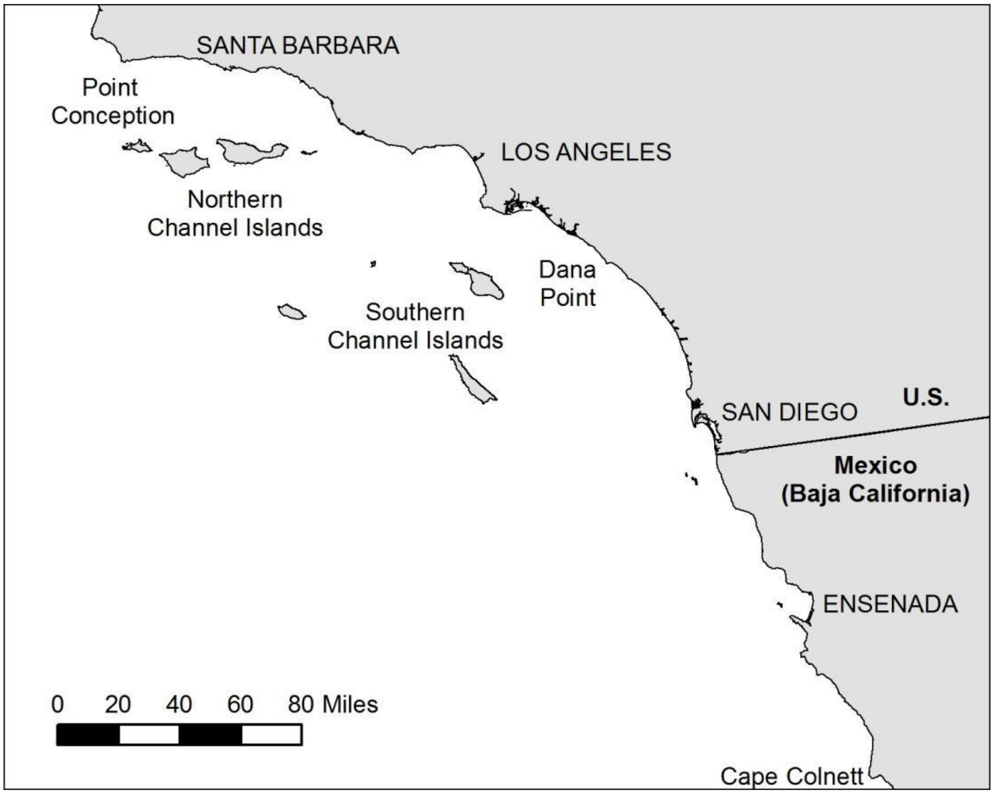
In this assessment, the term "fish" includes both cartilaginous species - sharks, skates, and rays - and bony species. Cartilaginous fish, as the name implies, have a skeleton of cartilage, which is partially calcified, but is not true bone. Bony fish also have cartilage, but their skeletons consist of calcified bone. Fish are generally categorized as pelagic (living in the water column), benthic (living on or near the ocean bottom), or demersal (associated with the ocean bottom, but also feeding in the water column).

The following sections cover the project area, the Point Loma ocean outfall, the environmental setting, commercial fisheries, the regulatory background, fishery management plans, species descriptions, life history profiles, designated Essential Fish Habitat (EFH), and potential impacts of the discharge of treated wastewater from the Point Loma ocean outfall.

Project Area

The marine waters off the Point Loma Wastewater Treatment Plant are located in the Southern California Bight - a broad ocean embayment created by an indentation of California's coastline south of Point Conception (Figure 1). The Southern California Bight extends from Point Conception south to Cabo Colnett, Baja California, Mexico, and west to the Santa Rosa-Cortes Ridge. The continental shelf in this area has several submarine valleys and submerged mountains whose peaks form the offshore islands. Submarine ridges and troughs in the Southern California Bight generally run northwest to southeast; with the exception of the east-west trending Santa Barbara Channel.

Figure 1. Southern California Bight.



The Southern California Bights' large urban population centers and busy harbors make it one of the most heavily utilized marine ecosystems on earth, yet the Southern California Bight supports a diverse assemblage of marine life including marine algae and plants, invertebrates, fish, sea turtles, marine mammals, sea birds, and a wide variety of habitats (Dailey et al. 1993, Schiff et al. 2000, Leet et al. 2001, Allen et al. 2005, 2006, 2011, Allen and Cross 2006, California Marine Life Protection Act (CMLPA) 2009, Howard et al. 2012, Pondella et al. 2012, Ranasinghe et al. 2012, Setty et al. 2012, Southern California Coastal Water Research Project (SCCWRP) 2012, 2014), United States Department of the Navy (USDON) 2013.

Marine habitats in the Southern California Bight range from sandy beaches and rocky coasts to deep, soft- and hard-bottom areas. Intertidal zones include sandy beaches, rocky shores, tidal flats, coastal marsh, and manmade structures. There are nearly 40 tidally-influenced estuaries and lagoons with associated open water, soft bottom, tidal mud flats, and eelgrass beds.

Sandy and soft-bottom substrates dominate shorelines and subtidal habitats in the southern region. These substrates lack the relief or structural complexity of hard-bottom habitats, but support species adapted to low-relief, dynamic environments. Invertebrates and bottom-dwelling fish are the most common species in soft substrate areas.

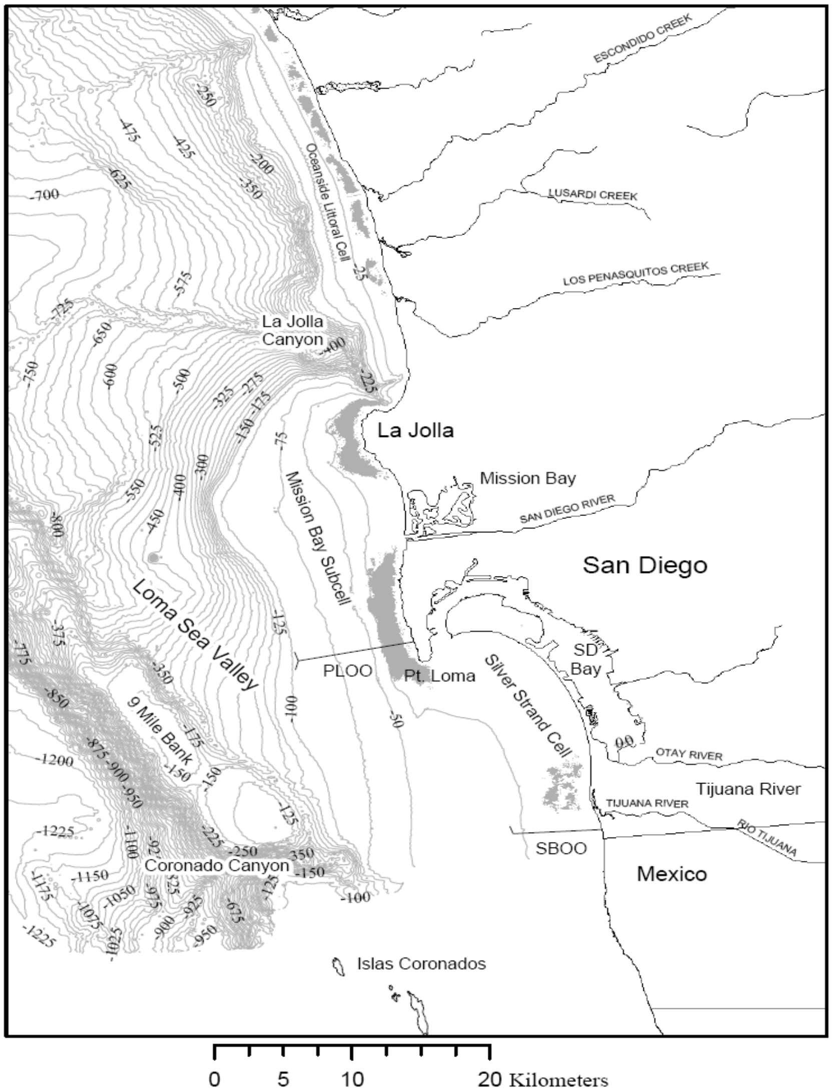
Hard-bottom habitats like rocky reefs are less common but generally have greater productivity and species diversity than soft-bottom habitats. Kelp forests are associated with shallow rock bottoms, while deep-sea corals and sponges are found in deep rock habitats. Kelp forest extending through the water column form dense surface canopies and promote high productivity and diversity of marine life.

The Southern California Bights' broad continental shelf includes channels, basins, and canyons, interspersed by shallower ridges. Underwater pinnacles and rocky outcrops are important aggregation sites for fish and other species. Marine canyons contain unique deep-water communities and provide foraging areas for seabirds and marine mammals. The marine environment surrounding the Channel Islands affords a distinctive ecological setting, with nutrient-rich waters and high-relief rocky habitats fostering substantial biodiversity.

Point Loma Ocean Outfall

The Point Loma Wastewater Treatment Plant treats approximately 140 million gallons per day (mgd) of wastewater, generated by more than 2.2 million residents and industries (with source controls) in a 450 square mile (mi^2) (1,165 square kilometers (km^2)) area. The Point Loma Wastewater Treatment Plant's overall capacity is 240 million gallons per day (mgd). Treated wastewater is discharged through the Point Loma Ocean Outfall (PLOO) 4.5 miles (mi) (7.2 kilometers (km)) offshore at a depth of 320 feet (ft) (98 meters (m)) (Figure 2; note the grey areas off Point Loma and La Jolla represent kelp beds).

Figure 2. Location of the Point Loma Ocean Outfall.



The Point Loma Ocean Outfall is one of the longest and deepest ocean outfalls in the world. It was extended to its present location in 1993 and is buried in a trench from shore through the surf zone out to a distance of about 2,600 ft (792 m) offshore. Over the next 400 ft (123 m) the pipeline gradually emerges from the rock trench. Beyond 3,000 ft (914 m) offshore, the remainder of the 4.5 mi (7.2 km) pipeline rests on a bed of ballast rock on the sea floor. The end of the pipeline connects to a perforated "Y" diffuser section of two legs, each 2,500 ft (762 m) long. Wastewater is discharged through diffuser ports ranging in depth from 306 ft (93 m) to 320 ft (98 m). Mathematical models of outfall operation indicate a median (50th percentile) initial dilution of 338:1 at a discharge flow of 240 mgd (the maximum design flow). The minimum month initial dilution (the initial dilution as determined assuming zero ocean currents and using the worst case density conditions from over 13,000 density data profiles) is computed at 202:1.

The deep discharge and high initial dilution traps discharged diluted wastewater at a depth of more than 130 ft (40 m) below the ocean surface (Rogowski et al. 2012). This keeps the outfall plume below the euphotic zone (the zone in which light penetrates) and away from the near-shore environment (Rogowski et al. 2013, City of San Diego (COSD) 2014). Another favorable feature of the Point Loma Ocean Outfall is the location of the discharge near the break in the mainland shelf (Figure 2). The shelf drops precipitously immediately offshore from the diffuser facilitating plume dispersal.

The pipeline and diffusers with their supporting bed of ballast rock form an artificial reef. The pipe and rock, covered with encrusted organisms (tube worms, anemones, barnacles) provide food and shelter to a variety of fish and invertebrates. This artificial habitat covers an area of about 22 acres (9 hectares) off Point Loma (assuming a 36 ft (11 m) width of pipe and ballast rock) (Wolfson and Glinski 1986).

ENVIRONMENTAL SETTING

The Southern California Bight is influenced by two major oceanic currents: the southward-flowing, cold-water California Current and the northward-flowing, warm-water California Countercurrent (Perry et al. 2007, California State University Long Beach (CSULB) 2013). These currents mix in the Southern California Bight and strongly influence patterns of ocean water circulation, sea temperatures, and distributional trends of marine flora and fauna along the southern California coast and Channel Islands (Dailey et al. 1993, Schiff et al. 2000, Horn and Allen 1978, Leet et al. 2001, Horn et al. 2006, Miller and Schiff 2012, Ranasinghe et al. 2012, Setty et al. 2012, Koslow et al. 2013).

High species richness is a product of the region's complex oceanographic topography and the convergence of multiple, influential water masses (Noble 2009). These include (1) large scale climate processes such as the El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and North Pacific Gyre Oscillation (NPGO) that can affect long-term trends (Bjorkstedt et al. 2013, NOAA 2013), (2) the California Current System coupled with local gyres that transport distinct water masses into and out of the Southern California Bight throughout the year, and (3) seasonal changes in local weather patterns. Relatively warm waters and a more stratified water column are typically present during the dry season from May to September while cooler waters and weaker stratification characterize ocean conditions during the wet season from October to April. Winter storms bring higher winds, rain, and waves creating a well-mixed, non-stratified water column. Surface waters begin to warm by late spring and are then subjected to increased surface evaporation. Once the water column becomes stratified, minimal mixing conditions typically remain throughout the summer and into early fall. Toward the end of the year, surface water cooling along with increased storm frequency returns the water column to well-mixed conditions.

The Southern California Bight is home to over 480 species of marine fish and more than 5,000 species of marine invertebrates (Schiff et al. 2000, Allen et al. 2005, 2006, 2011, Allen and Cross 2006, CMLPA 2009, SCCWRP 2012, 2014). The diversity of fish and invertebrates is greatest in southern California and declines to the north through the region (Horn and Allen 1978, Horn et al. 2006). The Point Loma area is located within a transitional zone between subarctic and subtropical water masses. Point Conception, California (34.5º North (N)) is the distinguished ichthyofaunal boundary between subtropical species (i.e., species with preferences of temperatures above 50-68º Fahrenheit (F) (10º to 20º Centigrade (C)) of the San Diego Province and temperate fish species (i.e., species with temperature preferences below 59º F (15º C) of the Oregon Province (Horn et al. 2006, Suntsov 2012).

The California Current system is rich in microscopic organisms (i.e., diatoms, tintinnids, and dinoflagellates) which form the base of the food chain in the area (Hardy 1993). Small coastal pelagic fish and squid depend on this planktonic food supply and in turn are fed upon by larger species. Groundfish (e.g., flatfish, roundfish, skates/sharks/chimeras, rockfish, etc.) are important recreational and commercial species (Love 2006). The shelf and slope demersal rockfish are the most specious genus of fish off the western coast of North America (Love et al. 2002). These fish are typically the dominant species in many ichthyological surveys, in terms of abundance and diversity, especially between the 20 to 200 m isobaths. Highly Migratory Species (HMS) (e.g., tuna, billfish, sharks, dolphinfish, and swordfish) and Coastal Pelagic Species (CPS) (e.g., anchovies, mackerels, sardines, and squids) support extensive fisheries in the area (Hackett et al. 2009).

The diverse habitats of the Southern California Bight greatly influence the distribution of fish and invertebrates in the area (Horn et al. 2006, Miller and Schiff 2012, McClatchie 2014). Cross and Allen (1993) defined fish habitats in three broad categories: the pelagic zone, soft substrate habitats (i.e., bays, estuaries, open coast), and hard substrate and kelp bed habitats (i.e., rocky habitats, reefs). The pelagic zone, relating to open water, is the largest habitat in the area with 40% of the fish species inhabiting this area. This zone is subdivided into three distinct regions: epipelagic (up to 50 m deep), mesopelagic (50 to 500 m deep), and bathypelagic regions (greater than 500 m deep). The epipelagic region is inhabited by small, planktivorous schooling fish (e.g., northern anchovy), predatory schooling fish (e.g., Pacific mackerel), and large solitary predators (e.g., blue shark). Abundance of all epipelagic species changes seasonally with fish moving offshore to spawn. The mesopelagic region is characterized by steep environmental gradients and fish that are small, slow growing, long-lived, and reproduce early and repeatedly (e.g., bigeye lightfish). The bathypelagic zone is a rather uniform region containing large, sluggish, fast growing, short-lived fish, that reproduce late and typically only once (e.g., bigscale and hatchetfish) (Cross and Allen 1993, Love et al. 2009).

Typical fish utilizing soft substrates (sand, silt, and mud) include sharks, skates, rays, smelts, flatfish (flounders), gobies and northern anchovies. Regions with hard substrates and kelp beds (*Macrocystis*) are not as abundant as other benthic habitats in the Southern California Bight, but provide high productivity habitats for many species.

Shallow reefs (i.e., <30 m depth) are the most common type of hard substrate (i.e., coarse sand, calcareous organic debris, rocks) found in the area. These reefs also support kelp beds, which serve as nursery areas for various fish species. Rocky intertidal regions are often turbulent, dynamic environments, where organisms must cope with stresses associated with tides (e.g., changes in temperature, salinity, oxygen, and pH) and wave impact. Deep reef fish, found along banks and seamounts, are typically large, mobile species (e.g., rockfish and spiny dogfish).

Kelp beds promote a high diversity of fish species (Foster and Schiel 1985, Foster et al. 2013). Smaller fish feed on high plankton densities in the area, while larger fish congregate to feed on smaller ones. Kelp beds are especially important habitats for young-of-the-year rockfish species, such as the kelp rockfish, whose densities positively correlate to the size of the kelp bed.

Inshore areas (bays and estuaries) provide nursery habitats and feeding grounds to a variety of species, some of commercial importance (e.g., California halibut) (Allen et al. 2006). San Diego Bay's seagrass beds are used by schooling species, such as anchovies and topsmelt (Allen et al. 2002) with the highest abundance and biomass of fish occurring in the spring (i.e., April) and summer (i.e., July). Juvenile northern anchovy, topsmelt, and slough anchovy comprise up to 79% of the fish in the Bay.

The influence of the California Current on the physical and biological environment of the Southern California Bight fluctuates significantly on a year-to-year basis (Noble 2009, Bjorkstedt et al. 2013, Koslow et al. 2013, Miller and McGowan 2013). It is also affected by larger-scale climate variations, such as ENSO, PDO, and NPGO (Dayton and Tegner 1984, 1990, Tegner and Dayton 1987, 1991, Dayton et al. 1992, Hickey 1993, Tegner et al. 1996, 1997, Horn and Stephens 2006, Parnell et al. 2010, Miller and Schiff 2012, Miller et al. 2013, NOAA 2013). The El Niño-La Niña Oscillation is the result of interannual changes in sea level pressures between the eastern and western hemispheres of the tropical Pacific; these events can initiate large shifts in the global climate, atmospheric circulation, and oceanographic processes (Doney et al. 2012, Chenillat et al. 2013, U. S. National Marine Fisheries Service (NMFS) 2013a, NOAA 2013, Sydeman et al. 2013).

El Niño conditions typically last 6 to 18 months although they can persist for longer periods of time. Under normal conditions, rainfall is low in the eastern Pacific and is high over the warm waters of the western Pacific. El Niño conditions occur when unusually high atmospheric pressure develops over the western tropical Pacific and Indian Oceans and low sea level pressure develops in the southeastern Pacific. During El Niño conditions, the trade winds weaken in the central and west Pacific; thus, the normal east to west surface water transport and upwelling along South America decreases. This results in increased (sometimes extreme) rainfall across the southern U.S. and Peru and drought conditions in the western Pacific (Field et al. 2003). La Niña is the opposite phase of El Niño in the Southern Oscillation cycle. La Niña is characterized by strong trade winds that push the warm surface waters back across to the western Pacific increasing upwelling along the eastern Pacific coastline, causing unusually cold sea surface temperatures.

The Pacific Decadal Oscillation (PDO) is a longer-term climatic pattern than El Niño with similar warm and cool phases that may persist for 20 to 30 years (Miller 1996, Benjamin and Carton 1999). PDO warm regimes increases water temperature, giving temporary advantage to warm-water species, allowing them to become more abundant and widespread (CMLPA 2009). PDO cold regimes have the opposite effect, causing cold-water species to grow more abundant and widespread, while warm-water species become less so.

During years experiencing an El Niño event, tropical species (i.e., species with temperature preferences above 68º F (20º C)) begin to migrate into the project area, while temperate species, which normally inhabit the area, move north and out of the region (Allen et al. 2005). For example, two tropical species, the Mexican barracuda and scalloped hammerhead shark, were recorded off southern California for the first time during the 1997/1998 El Niño event. Rockfish are particularly sensitive to El Niño, with these events resulting in recruitment failure and adults exhibiting reduced growth. Ultimately, a decline in biomass results and a poor overall condition in the region becomes evident, such as landings of market squid being dramatically decreased during the 1997/1998 El Niño event (Hayward 2000).

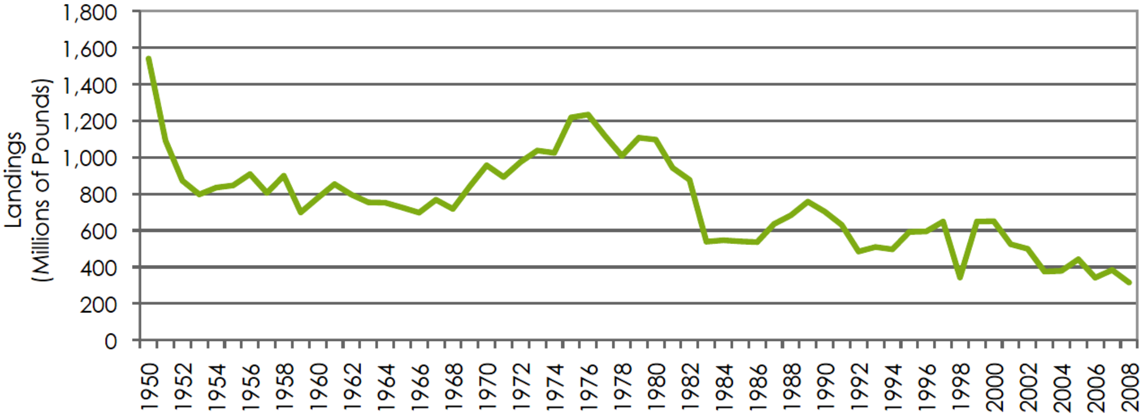
During El Niño years, San Diego Bay often becomes a refuge for subtropical/tropical species that have a normal distribution further south than the study area (Allen et al. 2002). For example, from April 1997 through July 1998, three new fish (bonefish, yellowfin goby, and longtail goby) and three new invertebrate species (arched swimming crab, Mexican brown shrimp, and a bivalve species (*Petricola hertzana*)) were recorded in the southern California estuaries of the San Diego coastal region (i.e., Tijuana Estuary and Los Peñasquitos Lagoon), while northern anchovy, the dominant species in San Diego Bay, was virtually absent during the El Niño event. Southern species moving into these areas are typically incapable of reproducing or establishing permanent populations due to the short-term nature of these events.

Past La Niña events have not had such a dramatic impact on ichthyofauna and marine invertebrate populations as El Niño events. Nevertheless, La Niña years can result in below normal recruitment for many invertebrate species (e.g., rock crabs), and larval rockfish abundance has been reportedly low during years experiencing La Niña events (Lundquist et al. 2000). Cooling trend years have increased abundance and commercial landings of herring, anchovies, and squid populations (Hayward 2000; Lluch-Belda et al. 2003, Zeidberg et al. 2006).

COMMERCIAL FISHERIES

Fisheries along the California coast have historically targeted over 285 species in four main groups: groundfish, coastal pelagic fish, highly migratory fish, and invertebrates (California Fisheries Fund 2014). Changing economic conditions and management restrictions have significantly reduced commercial fishing and fishery landings over the last half century (Figure 3, from Port of San Diego (POSD) 2009).

Figure 3. California Commercial Landings: 1958-2008.



Commercial fishing has been affected by seasonal closures, quota reductions, and restrictive long-term stock-building plans (CMLPA 2009). Salmon fishing quotas diminished following the listing of five California salmon population types under the federal Endangered Species Act (ESA). Tuna landings have fallen with the relocation of the fishery to less costly venues in Samoa and Puerto Rico. And, decreasing abalone stocks led to the total commercial fishing ban of abalone south of San Francisco in 1997.

Increasing regulation will likely reduce fisheries catch and landings in the future. The California Marine Life Management Act (MLMA) resulted in permit suspensions in nearshore fisheries.

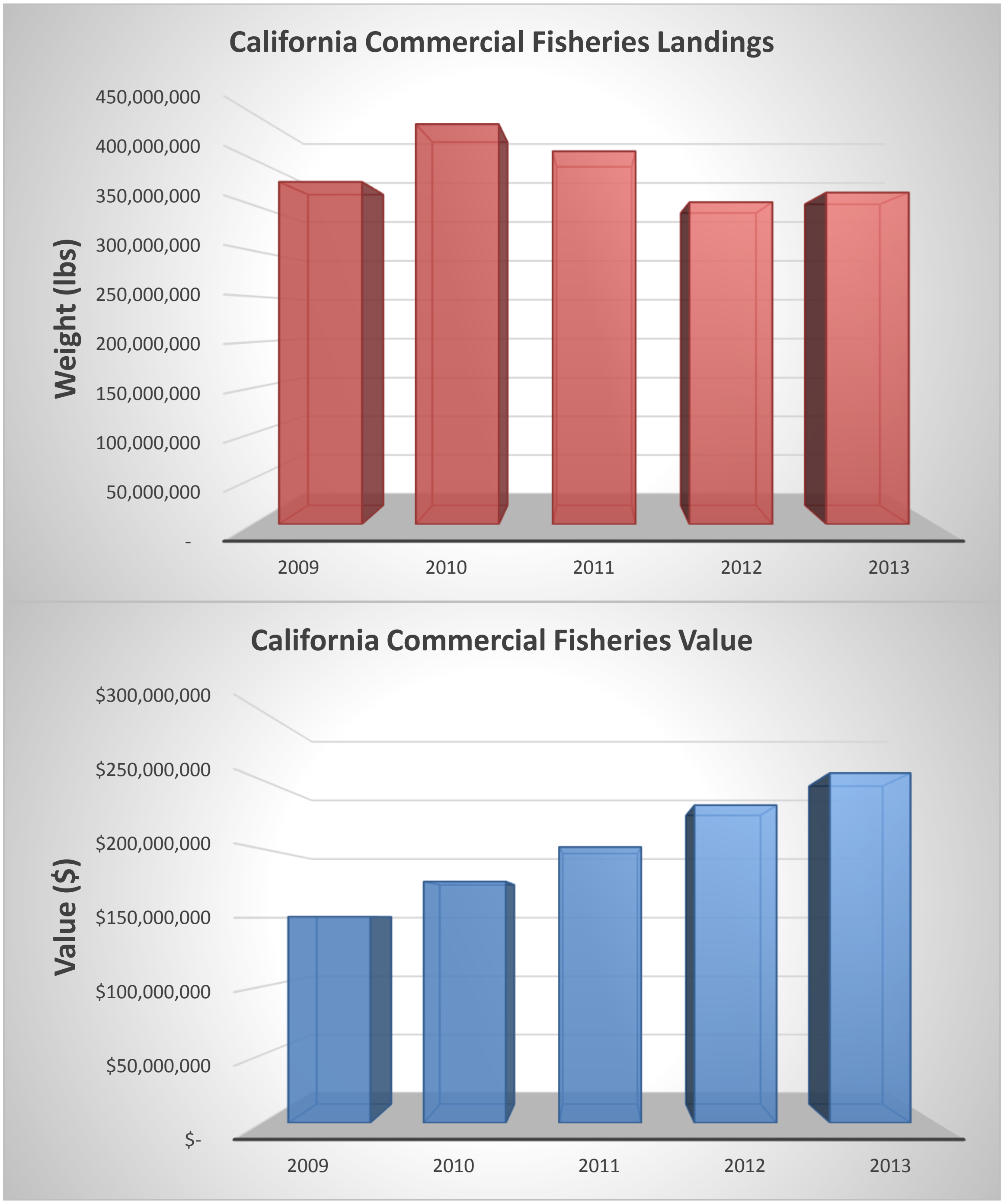
The California Marine Life Protection Act (CMLPA) authorized new protections for ocean habitats and wildlife. It created a network of marine protected (fishing-restricted) areas along the coast to help revive depleted fish stocks (National Ocean Economics Program (NOEP) 2005, 2009). The increasing use of waterfront property for recreational boating, tourism, and housing limits the availability of shore-side space for commercial fishing support facilities.

Despite the general decline of landings in California, some fisheries have been relatively resilient. For example, increased international demand for squid has enhanced landings during non-El Niño years, attracting participation from former salmon fishermen. Specialized fisheries for sea urchin, sea cucumber, Pacific herring, and live rockfish have grown in recent years as well (NOEP 2009, Hackett et al. 2009, NMFS 2014).

Even though the commercial fishing industry in San Diego has contracted, local landings continue to be important to the regional economy. There are more than 130 commercial fishermen in San Diego whose catch includes lobster, sea urchin, swordfish, spot prawn, white sea bass, rockfish, rock crab, shark, and tuna. In 2009, the Port of San Diego developed and began implementing a Commercial Fisheries Revitalization Plan to address the economic opportunities and potential constraints facing the local commercial fishing industry (POSD 2009).

From 2009 through 2013, California commercial fisheries landings stabilized at around 400 million pounds annually (Figure 4, data from CDFW 2014). The value of the California commercial fisheries catch increased steadily during the period from 150 million dollars to over 250 million dollars (Figure 4). The value is ex-vessel, that is, whole fish at wholesale price. The overall economic contribution of the product may be as much as three to four times higher as it passes through the economy (NOEP 2005, 2009, Hackett et al. 2009).

Figure 4. California Commercial Fisheries Landings and Value 2009-2013.



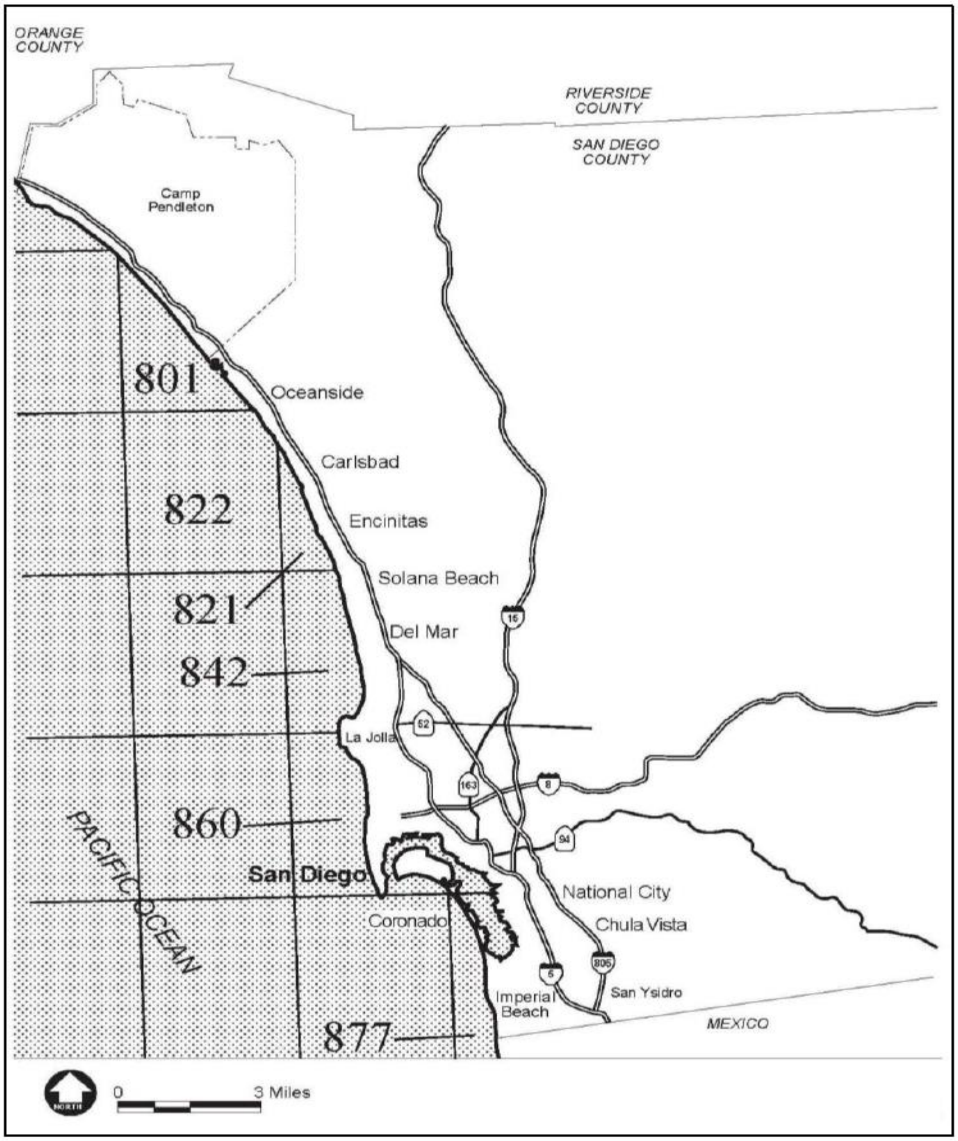
The major commercial fisheries of the Southern California Bight, their seasons, and harvest gear are listed in Table 1.

Table 1. Commercial Fisheries Groups, Seasons, and Harvest Methods.

Fishery	**Season**	**Harvest Methods**
Coastal Pelagic Species		
Anchovy, mackerels, sardine, squid	Year round, seasonal by species, some with harvest guidelines	Purse seine, drum seine, gillnet, dip net, some line gear (mackerel)
Highly Migratory Species		
Tunas, sharks, billfish, swordfish, dolphin	Year round, seasonal by species and region	Gillnet, purse seine, set net, drift net, troll, hook and line, harpoon (swordfish)
Groundfish Species		
Flatfish, rockfish, thorneyheads, roundfish, scorpionfish, skates, sharks, chimeras	Year round, seasonal by species and region	Trap, troll, gillnet, set net, hook and line
Other Finfish		
CA halibut, CA sheephead, white seabass	Year round, seasonal by species	Set gillnet, drift nets, trap, hook and line
Invertebrates		
Lobster, urchin, prawn, crab, shrimp	Year round, seasonal by species	Trap and diver

Fishery catch statistics are reported for large fishery blocks, providing sufficient ambiguity to protect commercial fishers' "secret spots". Fish blocks are 9- by 11-mile rectangles. Figure 5 depicts California Department of Fish and Wildlife (CDFW) nearshore fish blocks in the San Diego area.

Figure 5. San Diego Nearshore Fish Blocks.



From catch data supplied by commercial fishermen, CDFW reports the weight and dollar value of commercial fish landed by species in California. The fish block off Point Loma is block 860. Fish catch and value for block 860 is presented in Table 2 and Figure 6.

Table 2. Yearly Fisheries Catch Reported from Fish Block 860 (lbs).

SPECIES	2009	2010	2011	2012	2013
Barracuda, CA	2,054	397	862		158

Table 2. Yearly Fisheries Catch Reported from Fish Block 860 (lbs).

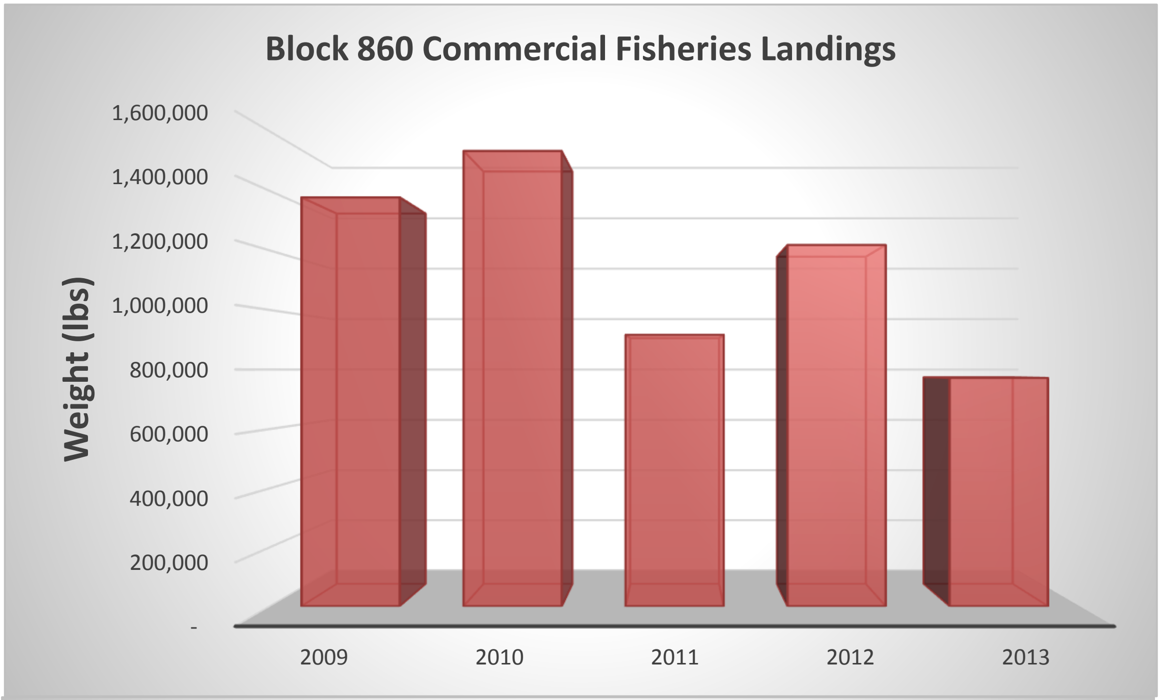
SPECIES	2009	2010	2011	2012	2013
Bass, giant sea	116	83	13		
Bonito, Pacific	138,238				
Cabezon	139	390		329	117
Crab, rock	25,250	32,177	34,869	29,047	25,004
Crab, spider	16,659	9,069	1,722	557	622
Dolphinfish				108	31
Eel, moray	2,215	3,185	38	162	57
Escolar		117			
Guitarfish	27	788	94	81	
Hagfish	59,504	4,661			
Halibut, CA	2,753	2,830	5,177	7,319	6,788
Jacksmelt	228				
Lingcod	113	130	85	20	
Lobster, CA	126,849	127,411	140,341	143,871	144,622
Louvar	119	117		22	8
Mackerel, Pacific	1,890	1		37	
Octopus	50	33	654	76	41
Opah	2,439	1,256		106	1,187
Prawn, spot	2,676	2,151	6,510	4,881	4,686
Ray, bat		4,308	611	434	15
Rockfish, all	5,079	959	2,003	12,591	1,286
Sablefish	10		473	1,399	11
Sanddab	5		47		69
Scorpionfish,CA	57	62	9	29	6
Sea cucumber	1,082	31,730	36,493	11,081	10,690
Sea star	79	158	106	146	135

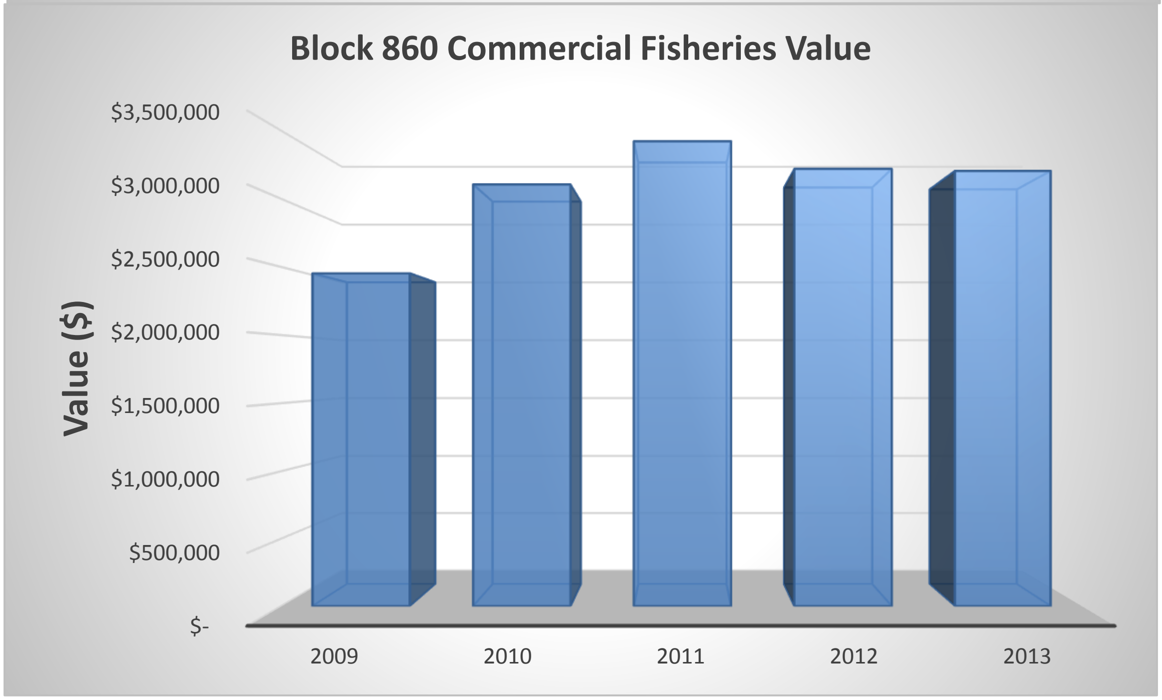
Table 2. Yearly Fisheries Catch Reported from Fish Block 860 (lbs).

SPECIES	2009	2010	2011	2012	2013
Seabass, white	1,116	5,605	14,548	11,777	8,604
Shark, leopard		424	148	384	17
Shark, shortfin mako	1,244	719	740	722	793
Shark, soupfin		39	245	42	
Shark, thresher	4,885	3,888	1,036	2,548	12,711
Sheephead	11,729	12,333	12,408	9,215	9,134
Shrimp, ghost	6	13			
Snail, sea	101		9		
Snail, top	155	48	303	346	670
Squid, market	171,406	586,439	3,144	366,022	158,753
Surfperch	11	2	7	47	41
Swordfish	6,472	2,043	191	1,230	8,792
Tuna, albacore	376	5,600	65		
Tuna, bluefin	16,403		113	1,431	470
Tuna, skipjack	749				
Tuna, yellowfin	409				246
Urchin, purple	1,556	1,169	1,375	1,009	
Urchin, red	702,362	643,341	643,364	604,297	
Whelk, Kellet	49,033	15,628	7,739	3,507	1,610
Whitefish, ocean	99	99	15	91	22
Yellowtail	566	1,188	655	3,139	4,868

Source data: California Department of Fish and Wildlife.

Figure 6. Block 860 Commercial Fisheries Landings and Value 2009-2013.





Many commercially important fisheries species are taken in block 860, with lobster and sea urchin predominating. Not all fish caught from block 860 are brought to port (landed) in San Diego. For example, the large catch of market squid from block 860 is mostly taken by Los Angeles area fishing vessels that return to ports in that area to offload their catch. Landing data specific to Point Loma is not available, so, the proportion of the catch from block 860 that contributes to San Diego's economy is not known. However, landing data are collected at the two harbors adjacent to Point Loma: Mission Bay and San Diego Bay. These data provide a better estimate of the economic contribution of Point Loma's fisheries to the local economy.

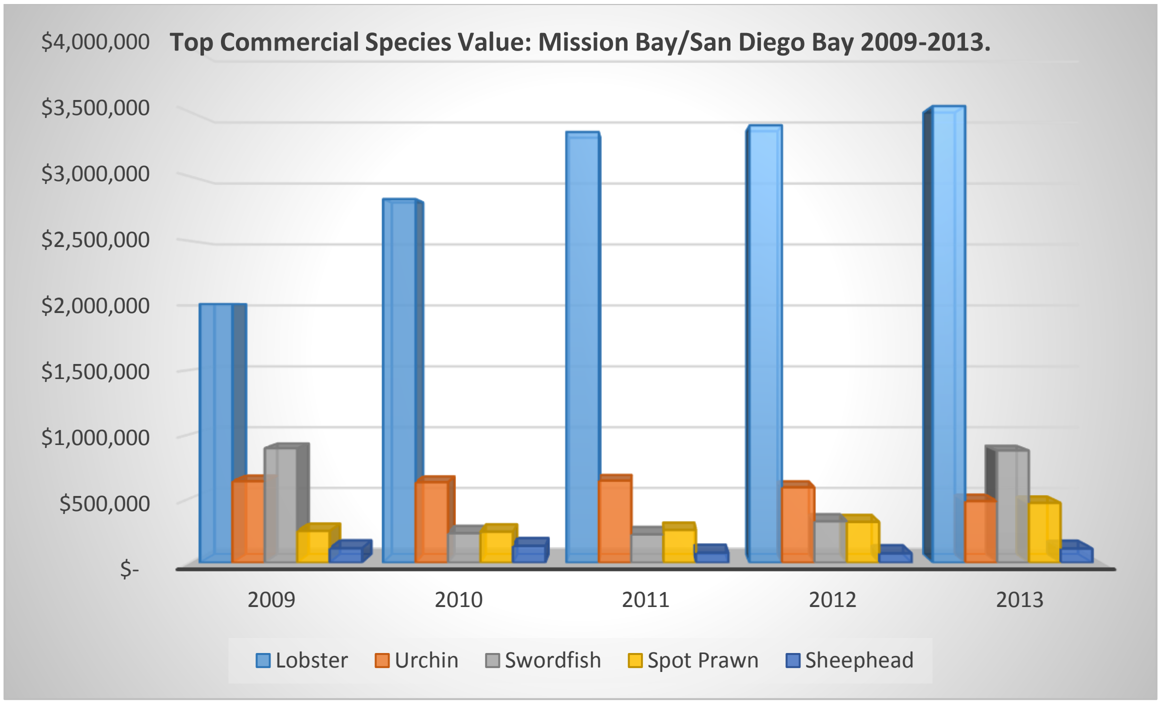
The annual dollar value for the top five commercial fisheries species landed at Mission Bay and San Diego Bay from 2009 to 2013 is presented in Table 3 and Figure 7.

Table 3. Top 5 Fisheries Species Value at Mission Bay/San Diego Bay 2009-2013.

	2009	2010	2011	2012	2013
Lobster	$ 2,010,382	$2,823,889	$ 3,343,231	$ 3,394,925	$ 3,544,437
Urchin	$ 634,020	$626,789	$ 638,895	$ 586,968	$ 479,322
Swordfish	$ 891,628	$229,385	$ 220,283	$ 322,440	$ 873,529
Spot Prawn	$ 247,025	$241,139	$ 254,588	$ 317,250	$ 465,417
Sheephead	$ 112,258	$130,656	$ 77,169	$ 72,622	$ 109,983

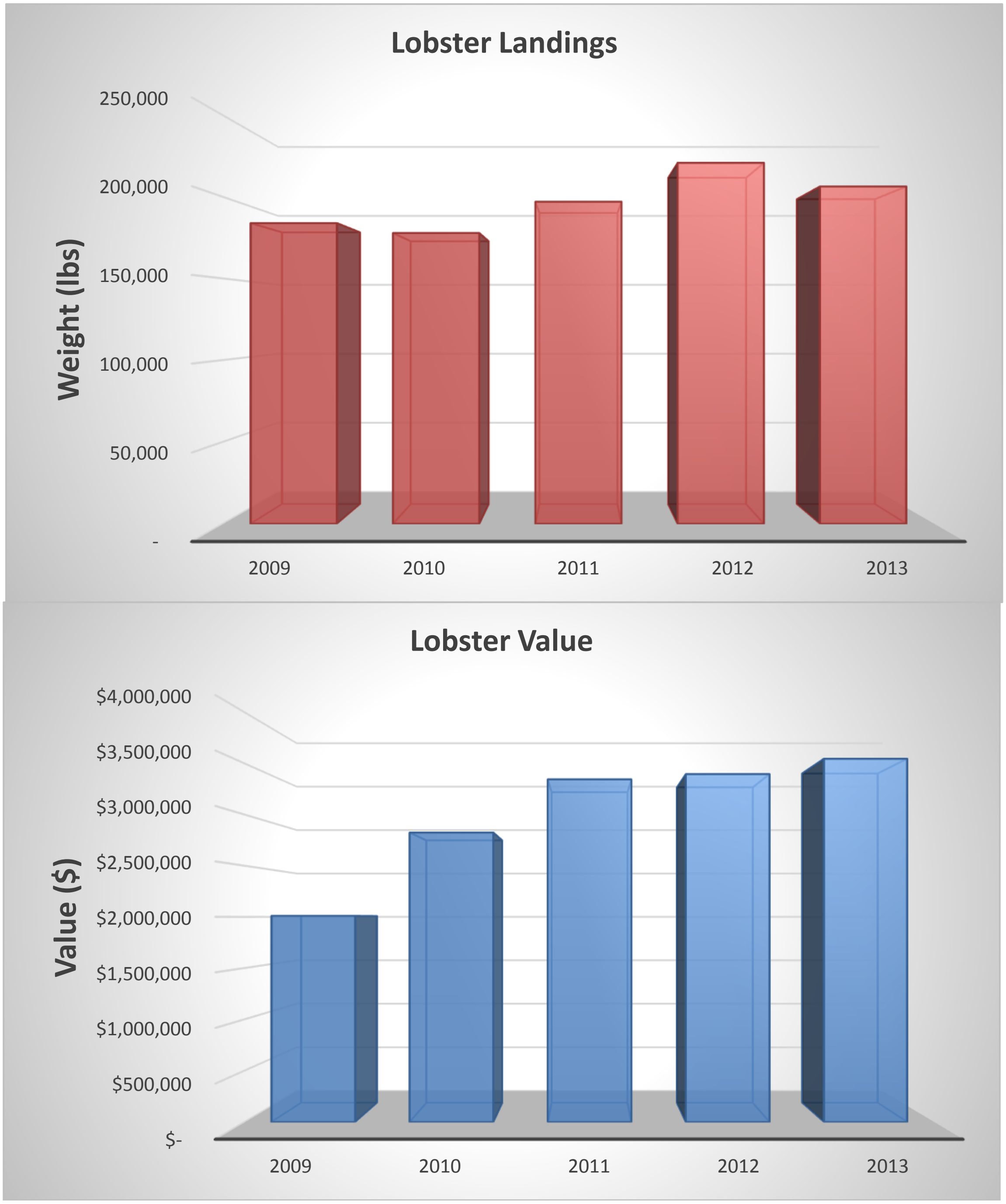
Source data: California Department of Fish and Wildlife.

Figure 7. Top Commercial Species Value: Mission Bay/San Diego Bay 2009-2013.



California spiny lobster are the premier commercial catch in San Diego. Figure 8 shows the weight and value of lobster landed at Mission Bay and San Diego Bay from 2009-2013.

Figure 8. Mission Bay/San Diego Bay Lobster Landings and Value.



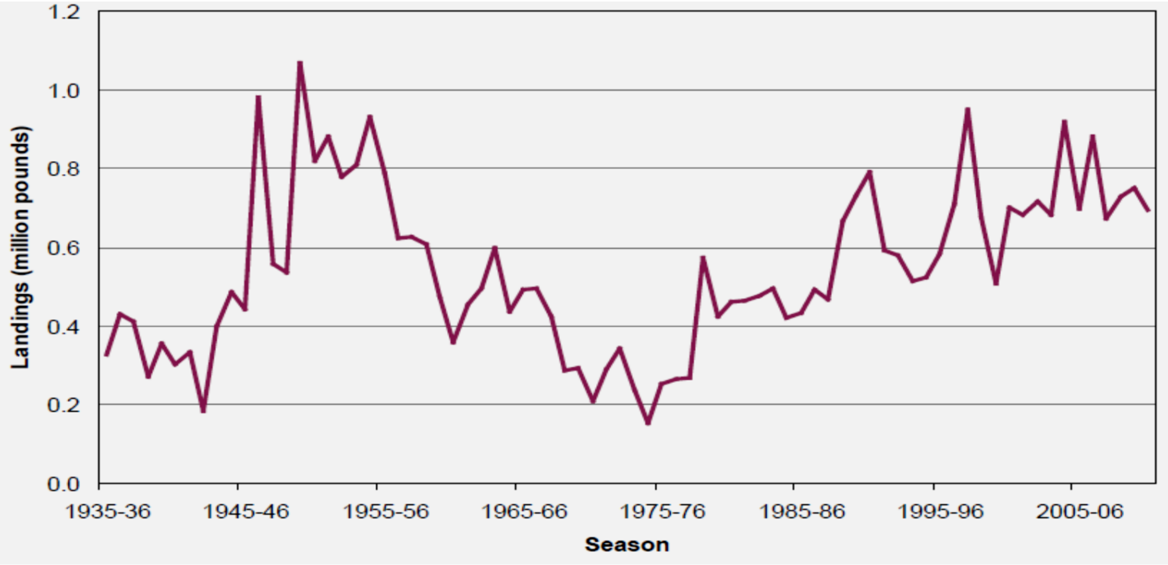
The wholesale value of lobster landed at Mission Bay and San Diego Bay averaged about three million dollars per year during the period 2009-2013. This represented more than a third of the total value of all commercial species landed in San Diego County.

The California spiny lobster (*Panulirus interruptus*) ranges from Monterey, California south to Magdelena Bay, Baja California (Mai and Hovel 2007, CDFW 2013). They occur from the intertidal zone to a depth of about 200 ft (60 m) and are usually associated with eel grass and kelp beds in rocky areas (Leet et al. 2001). Spiny lobster are a major predator of benthic invertebrates including mussels and sea urchins and act as a keystone species along rocky shores and in kelp forests. Primary predators of lobster include sheephead and black sea bass (Neilson 2011). Lobster are nocturnally-active, sheltering under rocks and in crevices during the day and foraging at night. The females migrate to shallow water during spring and summer to spawn; in fall they move to deeper water to mate.

Lobster have been fished commercially in California since the late 1800s. They are caught in traps set along the inner, middle, and outer edges of kelp beds, and over hard-bottom, mostly in depths of 30-120 ft (9-36 m). Open season runs from the 1st Wednesday in October to the 1st Wednesday after March 15. Early in the season traps are set from just outside the surf line to the inner edge of kelp beds. As winter storms approach, traps are moved farther offshore into the kelp bed and along their outer edge.

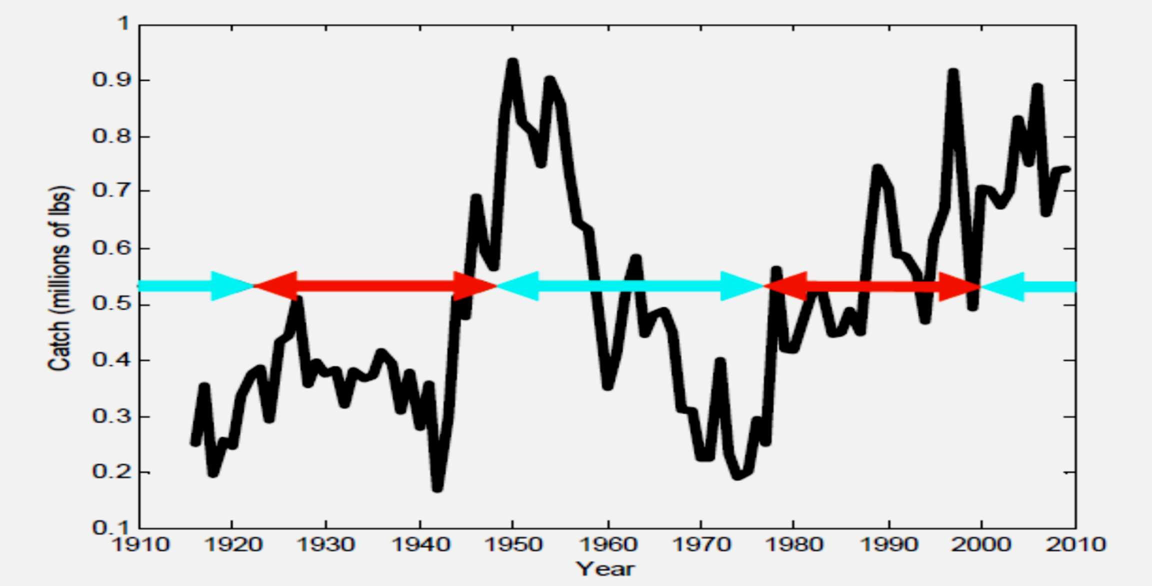
Figure 9, from CDFW 2013, shows California spiny lobster commercial landings from 1936-2011.

Figure 9. California Historical Lobster Catch.



The lobster catch in California is influenced by the prevailing oceanographic regime. Figure 10, from Neilson 2011, contrasts periods of warm and cold water associated with the Pacific Decadal Oscillation (PDO) with lobster landings from 1916 to the present.

Figure 10. Warm and Cold Water Regimes and Historical Lobster Catch.



The second most valuable seafood landed at Mission Bay and San Diego Bay from 2009-2013 was sea urchin, averaging about six hundred thousand dollars per year (Table 3, Figure 7). Although substantial, sea urchin landed value was less than a quarter of that from lobster.

Sea urchin are harvested for their roe, which is known as “uni”. Harvesting is done by divers, usually in or around kelp bed, at depths of 30-70 ft (9-21 m) using a hookah breathing system connected to a surface vessel or platform.

The overall California catch of sea urchin has varied considerably during the past 40 years (Figure 11, from CalCOFI 2013). Variations are due to a number of factors including limited development of the fishery prior to the mid-1980s, a strong 1982-1983 El Niño, a rush into the unrestricted fishery precipitated by a rapidly developing Japanese market for “uni” during the late 1980s and early 1990s, subsequent limited access permitting in response to resource depletion combined with weak El Niños in 1987 and 1992, and additional catch restrictions. The continued diminished urchin harvests in 1997-1998 were a result of the loss of kelp, their primary food source, during the prevailing strong El Niño (Wolfson and Glinski 2000). Figure 12 shows Mission Bay/San Diego Bay Urchin Landings from 2009-2013.

Figure 11. California State Urchin Catch 1970-2012.

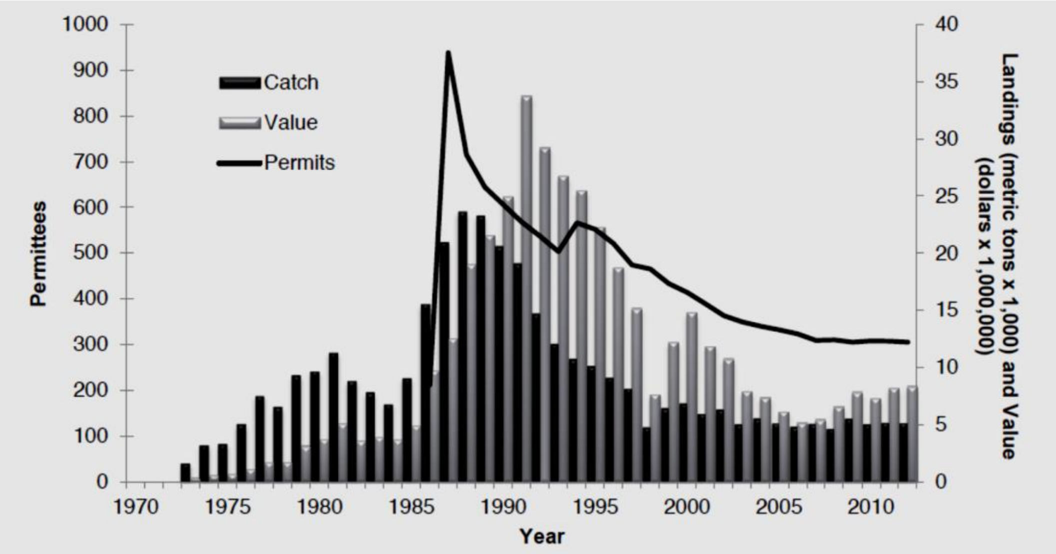
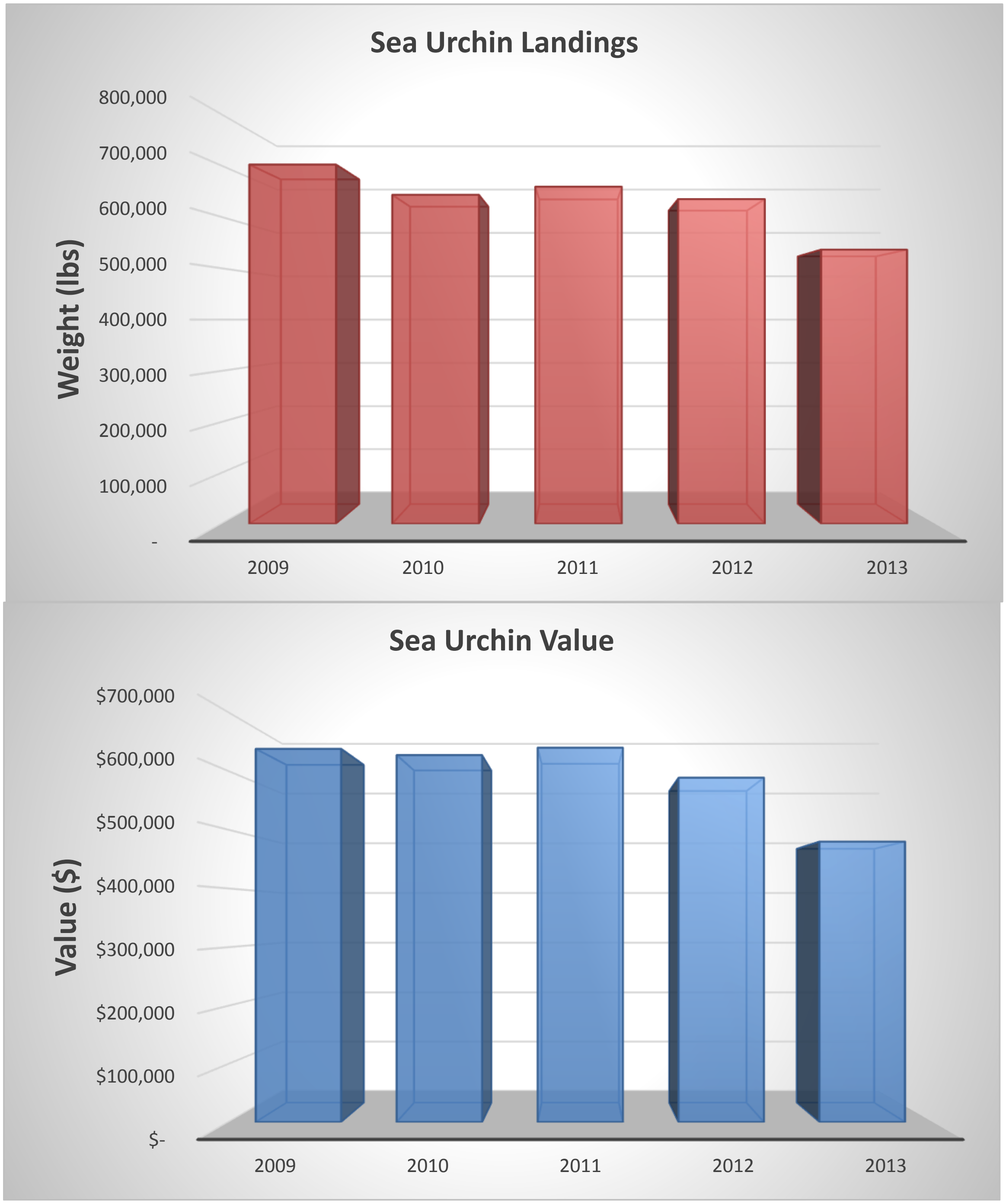


Figure 12. Mission Bay/San Diego Bay Sea Urchin Landings.



Both the lobster and urchin fisheries occur near or in the kelp beds, which are limited to maximum depths of about 90 ft (18 m) over consolidated bottom (out to about 1 mi (1.6 km) from shore). Thus, these fisheries take place at a distance of 3.5 mi (5.6 km) or greater from the Point Loma Ocean Outfall.

Swordfish was the third most valuable seafood commodity landed at Mission Bay and San Diego Bay during the five-year period from 2009-2013. Swordfish (*Xiphias gladius*) are found in tropical and temperate ocean waters (Leet et al. 2001). They migrate north from Baja California into California coastal waters in springtime then move south in the fall to spawn and over-winter. Swordfish grow to 1,200 lbs (544 kg) and 14 ft (4.3 m) in length. Adult swordfish eat squid and pelagic fish. They are caught near the surface, mostly at night.

Swordfish are taken well off Point Loma every year. Prior to the early 1980s harpooning swordfish at the surface was the primary harvest method. Only a few boats still use harpoons. West coast longliners are prohibited from fishing in the Exclusive Economic Zone, or anywhere for swordfish using this method.

Spot prawn were ranked the fourth most valuable seafood landed at ports adjacent to Point Loma from 2009-2013. Spot prawn (*Pandalus platyceros*) are shrimp. They have four bright white spots, hence the name. As of 1 April 2003 the use of trawl nets to take spot prawn has been prohibited. The season for spot prawn south of Point Arguello, Santa Barbara is closed November 1 through January 31. Today, most spot prawn are caught in traps set on the sea floor at depths of 600-1,200 ft (183-366 m). Much of the spot prawn catch off Point Loma goes to supply restaurants featuring live display.

Over the past twenty five years there has been a steady increase in demand for “live” finfish. This began primarily to serve members of the Asian community and has since grown to include many markets and Asian restaurants. The “live” finfish industry has grown as an alternate, off-season opportunity for many in the lobster fishery and increased in 1994 with the gillnet closure within 3 nm (5.6 km) of shore. Traps will catch practically any species willing to enter a small space for food. The primary target species generally weigh 1-3 lb (0.5-1.4 kg) and include sheephead, halibut, scorpionfish, cabezon, lingcod, and several members of the genus *Sebastes* (rockfish). These live fish, presented in salt water aquaria for individual selection, bring several times the value of their filleted colleagues. A “Nearshore Finfish Trap Endorsement” is required to catch finfish in baited traps for the “live” market.

Sheephead were the fifth most valuable commercial catch landed at Mission Bay and San Diego Bay from 2009-2013. The California sheephead, *Semicossyphus pulcher*, is a large, colorful wrasse. Male sheephead reach a length of 3 ft (.9 m), a weight of 36 lb (16 kg), and have a white chin, black head, and pinkish to red body. Females are smaller, with a brownish red to rose-colored body. California sheephead begin life as a female with older, larger females developing into secondary males. Female sexual maturity may occur in three to six years and fish may remain female for up to fifteen years. Timing of the transformation to males involves population sex ratio as well as size of available males and sometimes does not occur at all (Leet et al. 2001). California sheephead show high site fidelity and a small home range, but increase their movement range with warmer seasonal waters (Topping et al. 2006).

Populations of California sheephead off southern California have declined because of fishing pressure. Large males are now rare because they are sought by recreational spear fishermen. Sheephead are taken commercially by traps and kept alive for display in restaurant aquaria where patrons select a specific fish for preparation. Although most commercially landed sheephead are caught by trap some are taken by hook-and-line, and also as bycatch in the gill net fishery. The red color and soft, delicate flesh are especially prized in Asian cuisine.

Other notable commercial fisheries in San Diego marine waters include rock crabs, sea cucumbers, Kellet's Whelk, rockfish, thornyheads, white seabass, California halibut, albacore, thresher shark, sablefish, hagfish, market squid, sardines, anchovies, mackerel, giant kelp, and mariculture.

Rock crabs off Point Loma are mostly caught in traps at depths out to 300 ft (90m). The predominant species taken is the yellow rock crab, *Cancer anthonyi*. They range from Magdalena Bay, Baja California to Humbolt Bay, California, but are abundant only as far north as Point Conception. In southern California, rock crab are most common on rocky bottoms at depths of 30-145 ft (9-44 m), but are also found on open sandy bottoms where they partially bury themselves when inactive. Over sand, adults feed on live benthic prey and scavenge dead organisms that fall to the bottom.

Two species of sea cucumbers are taken in the commercial fishery: the California sea cucumber (*Parastichopus californicus*), also known as the giant red sea cucumber, and the warty sea cucumber *(P. parvimensis*). They inhabit the low intertidal to 300 ft (90 m) deep. Sea cucumbers feed on organic detritus, sea stars and other small invertebrates. The warty sea cucumber is fished almost exclusively by divers, and populations at fished sites have declined due to fishing mortality (Schroeter et al. 2011). The California sea cucumber is caught principally by trawling in southern California. A special permit to commercially fish for sea cucumbers was required beginning with the 1992-1993 fishing season. There is no significant sport fishery for sea cucumbers in California and sport fishing regulations forbid their take in nearshore areas in depths less than 20 ft (6 m) (Leet et al. 2001).

Kellet's Whelk (*Kelletia kelletii*)is a large subtidal snail that occurs intertidally to 230 ft (70 m) on rocky reefs, gravel bottoms, kelp beds, and sand from Baja California, Mexico to Monterey Bay (Leet et al. 2001). The Kellet's whelk fishery is growing rapidly. They cannot be taken within 1,000 ft (305 m) from the shore, except incidentally by lobster and/or rock crab traps.

Rockfish are non-migratory, and many species of rockfish are caught in the offshore area of Point Loma. Numerous rockfish stocks in both northern and southern California are considered depleted, and in an effort to better regulate the stocks, rockfish were divided into nearshore, shelf and slope groups in 2001. The shelf group is comprised of 32 fish of the genus *Sebastes*. They are most commonly caught by trap and hook and line over the continental shelf from depths of 120-900 ft (36-274 m). Live catches bring top prices and are often sold live to Asian restaurants.

Shortspine thornyheads (*Sebastolobus alascanus)* are found off California in waters ranging from 100-5,000 ft (30-1524 m) deep. They migrate to deeper water as they grow and are closely associated with the bottom. They are usually fished from bottom waters 1,200-4,200 ft (366-1,280 m) deep with peak abundance generally in the 1,800-3,000 ft (547-914 m) range. Like rockfish, they are members of the family Scorpaenidae and are primarily exported to Japan for sushi.

White seabass (*Atractoscion nobilis*) are the largest members of the croaker family (Sciaenidae) in California. They can grow to 90 lb (41 kg), although fish over 60 lb (27 kg) are rare. Adults school over rocky areas or near and within kelp beds. They can be caught at the surface and to depths of nearly 400 ft (122 m). Other common names for white seabass are king croaker, weakfish and sea trout (juveniles).

California halibut (*Paralichthys californicus*), a regular component of the fisheries catch off Point Loma, are a prized, non-schooling flatfish. Known as the left-eyed-flounders, about 40% are actually right-eyed. They range from Baja California to British Columbia. Halibut feed almost exclusively on anchovies and other small fish. They spawn in shallow waters from April-July. In the San Diego area they are caught in depths to about 300 ft (91 m), by hook and line, directed longline, and set gill nets in federal waters (>3 nm (5.6 km)). The best catches are usually in springtime over sandy bottom. The fishing season is mid-June to mid-March. California halibut range in size up to a maximum of about 70 lb (32 kg), although most are much smaller.

Albacore (*Thunnus alalunga*) are found worldwide in temperate waters; in the eastern Pacific they range from south of Guadalupe Island, Baja California to southeast Alaska (Eschmeyer et al. 1985). Their food varies but consists mostly of small fish, and sometimes squid and crustaceans. In southern California albacore are usually found 20-100 mi (32-160 km) offshore. Normal catch size is 20-40 lb (9-18 kg). Albacore is the most abundant tuna caught in commercial fisheries and recreational fisheries in California and along the West Coast. In the commercial fishery albacore are caught primarily using hook and line gear (jigs, bait, or trolling), but they are also taken in drift gill nets or round haul gear.

Thresher shark (*Alopias vulpinus*) is the most common and valuable shark taken in California commercial fisheries. Commercially-caught thresher shark are principally taken in offshore gill net fisheries.

Sablefish (*Anoplopoma fimbria*) are caught by trawls, nets, trap, and hook and line. Different regulations apply for each method. Sablefish are found in depths of 900-4,200 ft (274-1,280 m), with greatest densities in the 1,200-1,800 ft (366-549 m) range. Sablefish can live 50 years and can weigh up to 126 lb (57 kg). They enter the fishery as early as 1 year of age and most are taken by the trawl fishery by years 4 - 6, at a weight of less than 25 lb (11 kg). Traps and long-line hook fisheries generally catch the older, larger fish. Most of the catch is exported to Japan where it is served as sushi. In the U.S., sablefish are often marketed as black cod, the smaller ones are often filleted and sold as butterfish.

The Pacific hagfish (*Eptatretus stoutii*) is the target of an emerging commercial fishery in California (Bell 2009). Hagfish are unlike any other saltwater finfish. They have four hearts and up to 16 pairs of gill pores along their body. Hagfish feed on dead and dying fish and marine mammals, burrowing into their prey by making a hole with their rasping teeth, or entering through an existing opening (e.g., mouth or gills). They consume prey from the inside, leaving only skin and bones when finished. Moving with a snakelike motion, using their paddle-shaped tails, hagfish resembles an eel, but are not related. The hagfish produces large quantities of slime when agitated, giving it the common name "slime eel." Hagfish occur at depths ranging from 30-5,600 ft (9-1,707 m), but are more common at depths exceeding 300 ft (90 m). The California fishery began in 1982, when Koreans were looking for outside sources of hagfish due to local depletions. Prior to this, California fishermen had only considered hagfish a nuisance because they would eat and destroy their bait and catch. Commercial fishermen usually fish for hagfish at depths of 300-1,800 ft (90-589 m) using strings of baited traps.

The California market squid (*Loligo opalescens*) has been harvested since the 1860s and has become the largest fishery in California in terms of tonnage and dollars since 1993 (Zeidberg et al. 2006). Squid landings decreased substantially following the large El Niño events in 1982-1983 and 1997-1998, but not the smaller El Niño events of 1987 and 1992. Market squid are small (6 inch mantle length). They occupy the middle trophic level in California waters, and may be the state's most important marine forage species. They are short-lived (about 10 months). Market squid are primary prey for at least 19 species of fish, 13 species of birds, and six species of mammals (Morejohn et al. 1978).

Since the decline of the anchovy fishery, market squid is possibly the largest biomass of any single marketable species in the coastal environment of California. The majority of squid landings occur around the California Channel Islands, from Point Dume to the Santa Monica Bay, and in the southern portion of the Monterey Bay (Zeidberg et al. 2006). The fishery has varied through the years due to El Niño events and rapid fluctuations in market value. El Niño events have traditionally depleted the market squid fishery and driven up the value due to poor landings (Leet et al. 2001). They are generally caught near the surface, but can be found to depths of 800 ft (244 m). During the 1990s, purse seines became the dominant gear used to harvest market squid. Currently, market squid are fished year-round with increased catch rates from September through February in southern California.

Sardines (*Sardinops sagax*) are small, pelagic, schooling fish that are members of the herring family. The California fishery peaked in 1936-1937 and vanished from southern California during the 1950s. Fishing pressure was first suspected as the cause, but it was subsequently determined that cooling ocean temperatures contributed to the decline. The late 1990s warm water cycle has brought the sardine back to southern California, where the purse seine fishing season for sardines now runs year-round.

Northern anchovy (*Engraulis mordax*) are small, short-lived pelagic fish found throughout the eastern Pacific Ocean. They are active filter feeders, and consume various types of plankton. Anchovies are ecologically important as prey for many species of birds, mammals, and fish. Historically in California, anchovy supplied a large reduction fishery, which produced fish meal, oil, and soluble protein. They are currently utilized for human consumption, bait, and pet food. Large-scale anchovy landings were first seen in the early 1900s during times of low sardine availability. Commercial landings have been low since the 1980s due to market constraints rather than biological factors.

Pacific mackerel (*Scomber japonicus*) are a schooling seasonal species in the San Diego area. In the eastern Pacific they range from Chile to the Gulf of Alaska. They feed on larval, juvenile and small fish, and, occasionally on squid and crustaceans. Dense schools of Pacific mackerel are caught in surface waters by the purse seine fleet. Most Pacific mackerel caught off California weigh less than 3 lb (1.4 kg). This fish is known as a “wet fish” because it requires minimal processing prior to canning. The catch is mainly targeted for human consumption and for use as pet food. A small amount is sold at fresh seafood markets.

Giant kelp (*Macrocystis pyrifera*) has been harvested from the Point Loma kelp bed since 1929 by cutter barges that harvest the upper kelp canopy down to a depth of about 4 ft (1.2 m) below the water surface. During the 1980s and 1990s it was the single most valuable fishery in the vicinity of Point Loma because of the high value of products created from it. Algin, extracted from kelp, is used as a binder, stabilizer, and, emulsifier in pharmaceutical products, in cosmetics and soaps, and in a wide variety of food, drink, and industrial products (McPeak and Glantz

1984). Some of the statewide kelp harvest is also used to feed abalone in mariculture operations (MBC 2013, CalCOFI 2014).

The Point Loma kelp bed, the largest kelp bed in San Diego County, was particularly important because of its proximity to the kelp processing plant in San Diego Bay. Although the poundage and landed value was proprietary, Wolfson and Glinski (2000) estimated a commercial value of $5-$10 million/year for the Point Loma kelp bed. In 2005, after 76 years of operation, the San Diego kelp harvesting and processing operation was shut down and moved to Scotland.

Kelp harvesting in California is regulated by the California Department of Fish and Wildlife. As a result of restrictions on harvesting activities, commercial kelp harvest decreased by 96 percent from 2002 to 2007 (U.S. Army Corps of Engineers (USACOE) 2013). Two kelp beds, one located from the California/Mexico International Boundary to southern tip of San Diego Bay, and one located from the southern tip of San Diego Bay to the southern tip of Point Loma, are considered open, which means they may be harvested by anyone with a kelp harvesting license. Kelp beds at Point Loma and Mission Bay are currently available for lease from the state (USACOE 2013). A proposal to lease the Point Loma kelp bed was approved by the Fish and Game Commission in April 2012, but it is unknown if it is being presently harvested (MBC 2014).

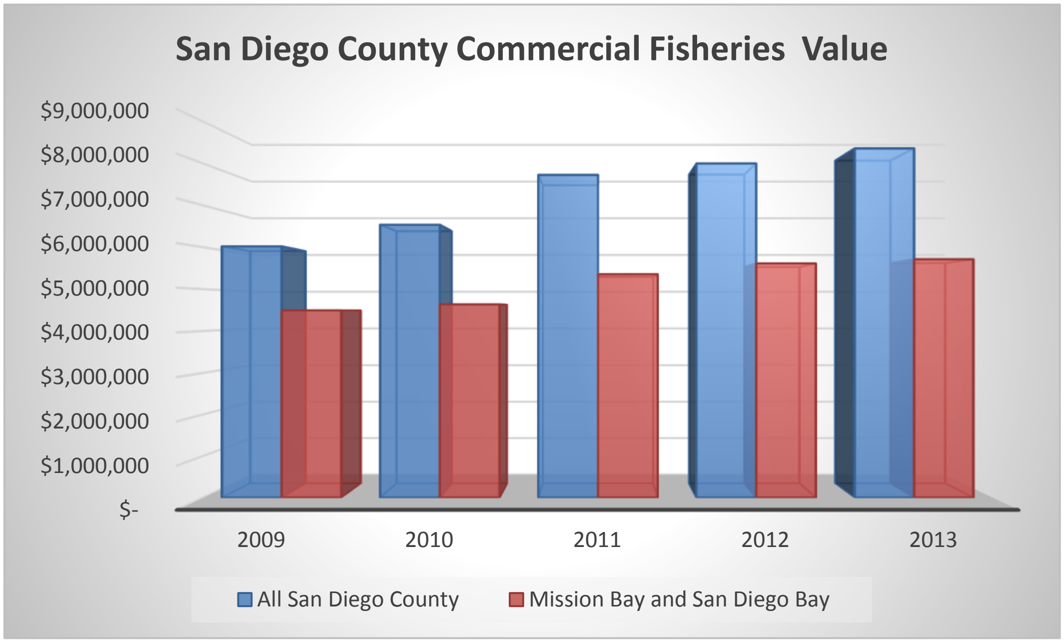
The California Department of Fish and Wildlife is the principal authority issuing permits for marine aquaculture (mariculture) in California. The California State Lands Commission and various municipal entities may grant tideland leases, but if aquaculture is involved, the operation must be registered with the CDFW.

Most mariculture in San Diego is located in lagoons and bays. The Hubbs-SeaWorld Research Institute operates a white seabass hatchery at the Agua Hedionda Lagoon in Carlsbad (27 mi (43.5 km) north of the outfall). Two additional mariculture projects are also located there: the Kent Seafarms Research Facility and Carlsbad Aquafarms, which grows mussel, oyster, clam, abalone, scallop and culinary seaweed (Carlsbad Aquafarms 2014). Sea World sponsors mariculture research at its Mission Bay facility and conducts aquaculture studies at sites in Mission Bay (Hubbs-SeaWorld Research Institute 2014).

Operation White Seabass, a partnership of the Hubbs-SeaWorld Research Institute, Southern California Edison and the San Diego Oceans Foundation, is working to enhance stocks of white seabass in San Diego coastal waters. The program begins at the hatchery in Carlsbad where the young bass are raised to a length of three inches. From there they are transferred to growout pens for a three to four month stay. Then, having reached a length of eight to ten inches, they are released. Growout pens are located in Mission Bay and San Diego Bay with the capacity for nurturing over 50,000 juvenile white seabass annually (Hubbs-SeaWorld Research Institute 2014).

The total annual value of all San Diego County commercial landings from 2009-2013 is shown in Figure 13. As with the total California commercial fisheries value, the San Diego component increased steadily over the period. Also shown in Figure 13 is the proportion of San Diego County commercial landings from Mission Bay and San Diego Bay, which made up over seventy percent of all landed value of commercial fishery species in San Diego County.

Figure 13. San Diego County Commercial Fisheries Value 2009-2013.



ESSENTIAL FISH HABITAT

The Sustainable Fisheries Act of 1996 provided a new habitat conservation tool: the Essential Fish Habitat (EFH) mandate (NOAA 2014a,b). Regional Fishery Management Councils (FMCs) are required to identify EFH for federally managed species (i.e., species covered under Fishery Management Plans (FMPs)). EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 United States Code [U.S.C.] 1802[10]). The term “fish” is defined as “finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds”. The U.S. National Marine Fisheries Service (NMFS) in 2002 further clarified EFH with the following definitions (50 Code of Federal Regulations (CFR) 600.05–600.930): “Waters” include all aquatic areas and their associated biological, chemical, and physical properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “Substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “Necessary” means the habitat required to support a sustainable fishery and the ‘Managed Species’ contribution to a healthy ecosystem; and “Spawning, breeding, feeding, or growth to maturity” covers a species’ “full life cycle” (NMFS 2002a).

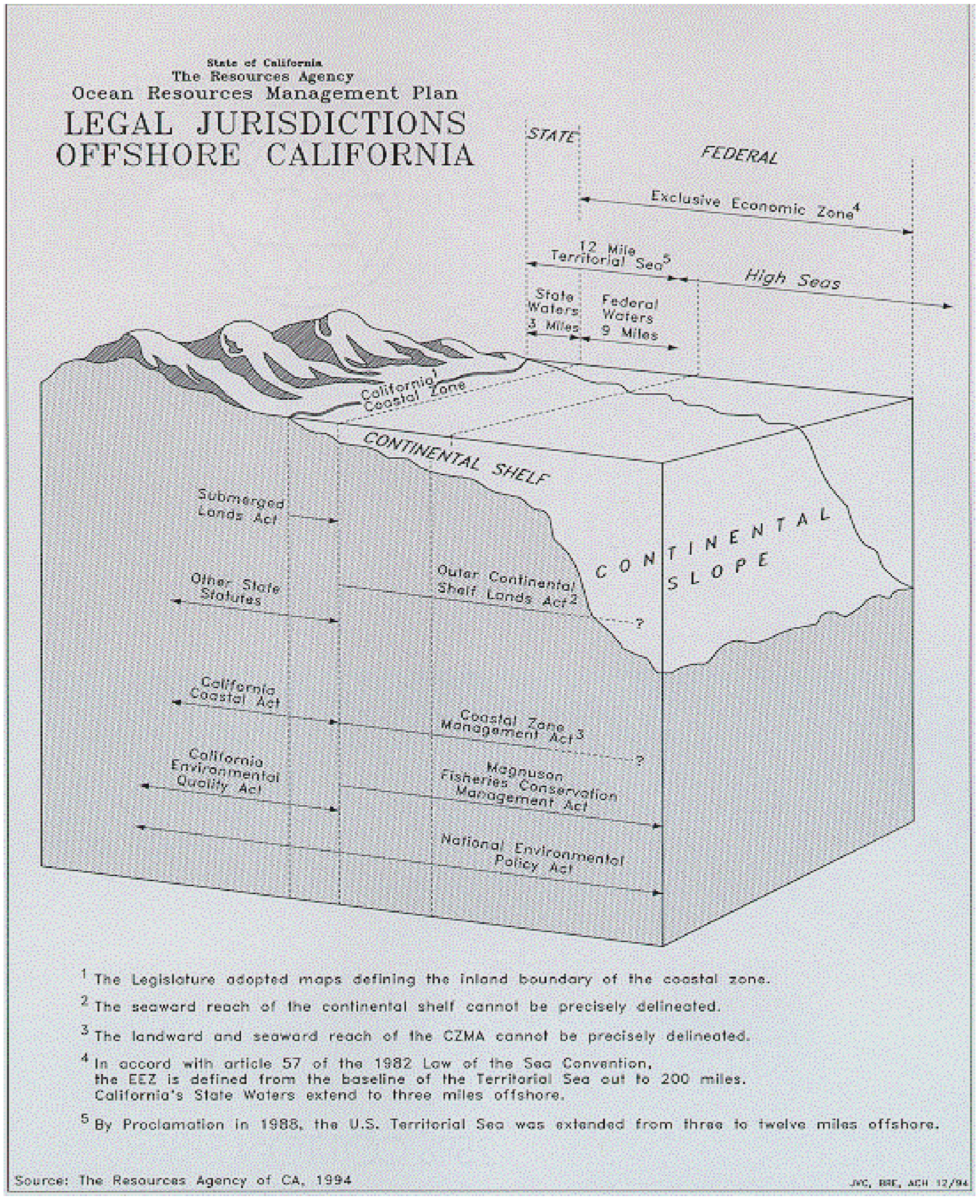
The Sustainable Fisheries Act requires that EFH be identified and mapped for each federally managed species. The NMFS and regional FMCs determine the species’ distributions by life stage and characterize associated habitats, including Habitat Areas of Particular Concern (HAPC). HAPC are discrete areas within EFH that either play especially important ecological roles in the life cycles of managed species or are especially vulnerable to degradation from human-induced activities (50 CFR 600.815[a][8]). The Sustainable Fisheries Act requires federal agencies to consult with the NMFS on activities that may adversely affect EFH. For actions that affect a threatened or endangered species, or its critical habitat, and its EFH, federal agencies must integrate Endangered Species Act (ESA) and EFH consultations.

An Essential Fish Habitat Assessment (EFHA) is a critical review of a proposed project and its' potential impacts to EFH. As set forth in the rules (50 CFR 600.920[e][3]), EFHAs must include (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species and associated species; (3) the effects of the action on EFH; and (4) proposed mitigation, if applicable. Once the NMFS learns of a federal or state activity that may have adverse effects on designated EFH, the NMFS is required to develop EFH consultation recommendations for the activity. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH (NOAA 2007).

Regulatory Background

Commercial fisheries are protected and managed by the Magnuson-Stevens Fishery Conservation and Management Act (NOAA 2007), by State and Inter-State Fisheries Management Plans (e.g., Pacific Fisheries Management Council (PFMC) 2014a), and by the California Department of Fish and Wildlife (CDFW) 2014a), prior to 2103 called the California Department of Fish and Game (CDFG). The Magnuson-Stevens Fishery Conservation and Management Act of 1976 established jurisdiction over marine fishery resources in the 200-nm (370-km) U. S. Exclusive Economic Zone (Figure 14). The Magnuson-Stevens Fishery Conservation and Management Act was reauthorized and amended by the Sustainable Fisheries Act of 1996 (NOAA 2014a). The Sustainable Fisheries Act requires that regional Fishery Management Councils (FMCs) develop and implement Fishery Management Plans (FMPs) to protect managed species included in the plans. FMPs are developed to achieve the goal of no net loss of the productive capacity of habitats that sustain commercial, recreational, and native fisheries. Magnuson-Stevens Fishery Conservation and Management Act was reauthorized in 2006 (NOAA 2007) and is periodically updated and amended (U. S. House of Representatives (USHR) 2013).

Figure 14. Legal Jurisdictions Offshore California.



[1] The Legislature adopted maps defining the inland boundary of the coastal zone.

[2] The seaward reach of the continental shelf cannot be precisely delineated.

[3] The landward and seaward reach of the CZMA cannot be precisely delineated.

[4] In accord with article 57 of the 1982 Law of the Sea Convention, the EEZ is defined from the baseline of the Territorial Sea out to 200 miles. California's State Waters extend to three miles offshore.

[5] By Proclamation in 1988, the U.S. Territorial Sea was extended from three to twelve miles offshore.

Source: The Resources Agency of CA, 1994

Fishery Management Plans

The U. S. Exclusive Economic Zone extends from the outer boundary of state waters (3 nm (5.6 km) from shore) to a distance of 200 nm (370 km) from shore. Offshore fisheries in the Southern California Bight are managed by the NOAA's National Marine Fisheries Service (NMFS) (NOAA 2014c) with assistance from the Pacific Fisheries Management Council (PFMC) (PFMC 2014a), and the Southwest Fisheries Science Center (NOAA 2014d). Inshore fisheries (less than 3 nm (5.6 km)) from shore are managed by the California Department of Fish and Wildlife (CDFW 2014a). In practice, state and federal fisheries agencies manage fisheries cooperatively with FMPs generally covering the area from coastal estuaries out to 200 nm (370 km) offshore.

Fishery Management Plans are extensive documents that are constantly revised and updated. The Pacific Coast Groundfish Fishery Management Plan, for example, originally produced in 1977, has been amended 23 times (PFMC 2014b). FMPs describe the nature, status, and history of the fishery, and, specify management recommendations, yields, quotas, regulations, and harvest guidelines. Associated Environmental Impact Statements (EISs) address the biological and socioeconomic consequences of management policies. Fishery Management Councils have web sites that present the various elements of their FMPs, current standards and regulations, committee hearings and decisions, research reports, source documents, and links to related sites (e.g., PFMC 2014a). Coverage of the ecology of marine fish, fisheries, and environmental issues in California is presented in reviews by Horn and Allen 1978,Allen et al. 2006, Horn and Stephens 2006, Horn et al. 2006, Love 2006, 2011, Butler et al. 2012, Miller and Schiff 2012, Suntsov et al. 2012, Koslow et al. 2013, Miller and McGowan 2013, and NAVFAC 2013.

Fisheries Management Plans with managed species that could occur in the vicinity of Point Loma are the Pacific Groundfish FMP (NMFS 2013b, PFMC 2011a), the Coastal Pelagic Species (CPS) FMP (PFMC 2011b), and the U. S. West Coast Fisheries for Highly Migratory Species (HMS) (PFMC 2011c) (Table 4).

Table 4. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Groundfish Management Plan Species

http://www.pcouncil.org/groundfish/fishery-management-plan/

COMMON NAME	**SCIENTIFIC NAME**
Sharks	
Big skate	*Raja binoculata*
California skate	*Raja inornata*
Leopard shark	*Triakis semifasciata*
Longnose skate	*Raja rhina*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling (Pacific flatnose)	*Antimora microlepis*
Grenadiers	
Pacific rattail (Pacific grenadier)	*Coryphaenoides acrolepis*
Roundfish	

Table 4. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Lingcod	*Ophiodon elongatus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*
Harlequin rockfish	*S. variegatus*
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*

Table 4. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
	S. serriceps
Treefish	
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberrimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*

Table 4. Federal Fishery Management Species.
Sources: PFMC 2011a, 2011b, 2011c.

Starry flounder	*Platichthys stellatus*
Coastal Pelagic Management Plan Species	
http://www.pcouncil.org/coastal-pelagic-species/fishery-management-plan-and-amendments/	
Jack mackerel	*Traxchurus symmetricus*
Krill	*euphausiids*
Pacific mackerel	*Scomber japonicus*
Pacific sardine	*Sardinops sagax*
Market squid	*Loligo opalescens*
Northern anchovy	*Engraulis mordax*
Highly Migratory Management Plan Species	
http://www.pcouncil.org/highly-migratory-species/fishery-management-plan-and-amendments/	
Sharks	
Bigeye thresher shark	*Alopias superciliosus*
Blue shark	*Prionace glauca*
Common thresher shark	*Alopias vulpinus*
Pelagic thresher shark	*Alopias pelagicus*
Shortfin mako shark	*Isurus oxyrinchus*
Tunas	
Albacore tuna	*Thunnus alalunga*
Bigeye tuna	*Thunnus obesus*
Northern bluefin tuna	*Thunnus orientalis*
Skipjack tuna	*Katsuwonus pelamis*
Yellowfin tuna	*Thunnus albacares*
Billfish	
Striped marlin	*Tetrapturus audax*
Broadbill swordfish	
Swordfish	*Xiphias gladius*
Dolphin-fish	
Dorado (mahi mahi)	*Coryphaena hippurus*

The Pacific coast groundfish fishery is the largest, most important fishery managed by the Pacific Fishery Management Council in terms of landings and value (PFMC 2014b). Groundfish managed species are found throughout the Southern California Bight. More than 90 species of bottom-dwelling marine finfish are included in the federally-managed groundfish fishery. Groundfish species include all rockfishes in the Scorpaenidae family, flatfishes such as Dover sole (*Microstomus pacificus*) and petrale sole (*Eopsetta jordani*), roundfishes such as sablefish (*Anoplopoma fimbria*) and lingcod (*Ophiodon elongatus*), and various sharks and skates. The species managed under the Pacific Groundfish Management Plan are usually found on or near the bottom; rockfish - including widow, yellowtail, canary, shortbelly, and vermilion rockfish; bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch; roundfish - lingcod, cabezon, kelp greenling, Pacific cod, Pacific whiting (hake), and sablefish; flatfish - including various soles, starry flounder, and sanddab; sharks and skates - leopard shark, soupfin shark, spiny dogfish, big skate, California skate, and longnose skate; and three other species: ratfish, finescale codling, and Pacific rattail grenadier (Table 4) (PFMC 2011a).

The groundfish species managed by the Pacific Groundfish FMP range throughout the Exclusive Economic Zone and occupy diverse habitats at all stages in their life histories. Some species are broadly dispersed during specific life stages, especially those with pelagic eggs and larvae. The distribution of other species and/or life stages may be relatively limited, as with adults of many nearshore rockfish that show strong affinities to a particular location or substrate type.

Rockfish are found from the intertidal zone out to the deepest waters of the Exclusive Economic Zone (Love et al. 2002, 2009, Butler et al. 2012). For management purposes, these species are often placed in three groups defined by depth range and distance offshore: nearshore rockfish, shelf rockfish, and slope rockfish (Table 5, from CDFG 2007).

Table 5. Rockfish Distribution in the Southern California Bight.

Shallow Nearshore Rockfish

black-and-yellow (*Sebastes chrysomelas*)
China (*S. nebulosus*)
gopher (*S. carnatus*)
grass (*S. rastrelliger*)
kelp (*S. atrovirens*)

Deeper Nearshore Rockfish

black (*Sebastes melanops*)
blue (*S. mystinus*)
brown (*S. auriculatus*)
calico (*S. dalli*)
copper (*S. caurinus*)
olive (*S. serranoides*)
quillback (*S. maliger*)
treefish (*S. serriceps*)

Table 5. Rockfish Distribution in the Southern California Bight.

Shelf Rockfish

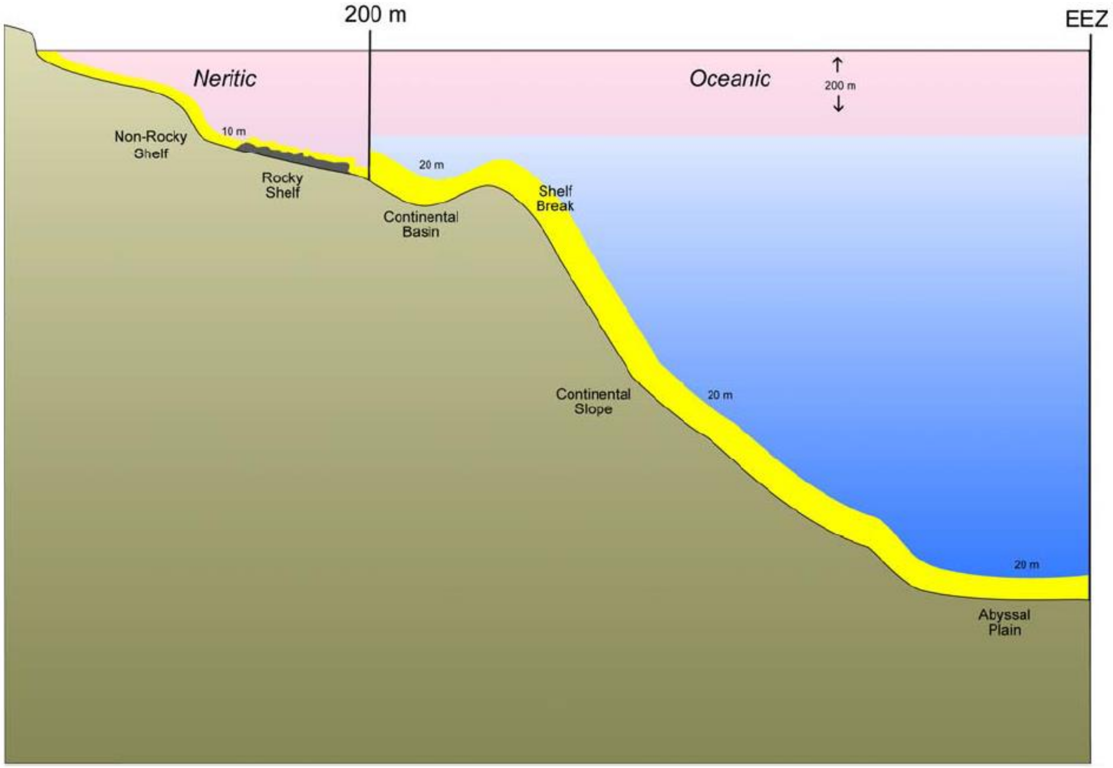
bocaccio (*Sebastes paucispinis*)
bronzespotted (*S. gilli*)
canary (*S. pinniger*)
chameleon (*S. phillipsi*)
chilipepper (*S. goodei*)
cowcod (*S. levis*)
dwarf-red (*S. rufinanus*)
flag (*S. rubrivinctus*)
freckled (*S. lentiginosus*)
greenblotched (*S. rosenblatti*)
greenspotted (*S. chlorostictus*)
greenstriped (*S. elongatus*)
halfbanded (*S. semicinctus*)
honeycomb (*S. umbrosus*)
Mexican (*S. macdonaldi*)
pink (*S. eos*)
pinkrose (*S. simulator*)
pygmy (*S. wilsoni*)
redstriped (*S. proriger*)
rosethorn (*S. helvomaculatus*)
rosy (*S. rosaceus*)
silvergrey (*S. brevispinis*)
speckled (*S. ovalis*)
squarespot (*S. hopkinsi*)
starry (*S. constellatus*)
stripetail (*S. saxicola*)
swordspine (*S. ensifer*)
tiger (*S. nigrocinctus*)
vermilion (*S. miniatus*)
widow (*S. entolemas*)
yelloweye (*S. ruberrimus*)
yellowtail (*S. flavidus*)

Slope Rockfish

aurora (*Sebastes aurora*)
bank (*S. rufus*)
blackgill (*S. melanostomus*)
darkblotched (*S. crameri*)
Pacific ocean perch (*S. alutus*)
redbanded (*S. babcocki*)
rougheye (*S. aleutianus*)
sharpchin (*S. zacentrus*)
shortraker (*S. borealis*)
splitnose (*S. diploproa*)
yellowmouth (*S. reedi*)

The nearshore rockfish spend most of their lives in relatively shallow water. This group is often subdivided into a shallow component and a deeper component. Shelf rockfish are found along the continental shelf (Figure 15, from USDON 2013). Slope rockfish occur in the deeper waters of the shelf and down the continental slope. The roundfish, flatfish, sharks, and skates covered under the Groundfish FMP are generally concentrated in shallow water while the ratfish, finescale codling, and Pacific rattail are deepsea fish (Eschmeyer et al. 1985, Leet et. al. 2001, Butler et al. 2012, CDFW 2013).

Figure 15. Pacific Coast Groundfish Ranges.



The Pacific halibut (*Hippoglossus stenolepis*), a flat groundfish, is regulated by the United States and Canada through a bilateral commission, the International Pacific Halibut Commission (IPHC) (IPHC 2014) and is therefore not in a federal FMP. The normal range of Pacific halibut is from Santa Barbara, California to Nome, Alaska. It would not usually be found in the Point Loma area.

A variety of different fishing gear is used to target groundfish including troll, longline, hook and line, pots, gillnets, and other types of gear (bottom trawls were banned in March 2006 out to a depth of 3,500 m) (Table 6 (from NMFS 2005b)). The West Coast groundfish fishery has four access components: limited entry - which limits the number of vessels allowed to participate; open access - which allocates a portion of the harvest to fishers without limited entry permits; recreational; and tribal - fishers who have federally recognized treaty rights (PFMC 2011a).

Table 6. Gear Types Used in the West Coast Groundfish Fishery.

	Trawl and Other Net	Longline, Pot, Hook and Line	Other
Limited Entry Fishery (commercial)	Mid-water Trawl, Whiting trawl, Scottish Seine	Pot, Longline	
Open Access Fishery Directed Fishery (commercial)	Set Gillnet Sculpin Trawl	Pot, Longline, Vertical hook/line, Rod/Reel, Troll/dinglebar, Jig, Drifted (fly gear), Stick	
Open Access Fishery Incidental Fishery (commercial)	Exempted Trawl (pink shrimp, spot and ridgeback prawn, CA halibut, sea cucumber), Setnet, Driftnet, Purse Seine (Round Haul Net)	Pot (Dungeness crab, CA sheephead, spot prawn) Longline, Rod/Reel Troll	Dive (spear) Dive (with hook and line) Poke Pole
Tribal	as above	as above	as above
Recreational	Dip Net, Throw net (within 3 miles)	Hook and Line methods Pots (within 3 miles) from shore, private boat, commercial passenger vessel	Dive (spear)

Managed jointly by the Pacific Fishery Management Council (PFMC) and the National Marine Fisheries Service (NMFS) under the Coastal Pelagic Species Fisheries Management Plan (CPS FMP), Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), and northern anchovy (*Engraulis mordax*) are included in complex known as the Coastal Pelagic Species (CPS). The Coastal Pelagics FMP also includes two invertebrates, market squid and krill (PFMC 2014c). The CPS inhabit the pelagic realm, i.e., live in the water column, not near the sea floor. They are usually found from the surface to 3,281 ft (1,000 m) deep.

Northern anchovy (*Engraulis mordax*) are small, short-lived fish that typically school near the surface (PFMC 2014c). They occur from British Columbia to Baja California. Northern anchovies are divided into northern, central, and southern sub-populations. The central sub-population has been the focus of large commercial fisheries in the U.S. and Mexico. Most of this sub-population is located in the Southern California Bight between Point Conception, California and Point Descanso, Mexico. Northern anchovy are an important part of the food chain for other species, including other fish, birds, and marine mammals.

Pacific sardine (*Sardinops sagax*), also a small schooling fish, have been the most abundant fish species managed under the Pacific Groundfish FMP. They range from the tip of Baja California to southeastern Alaska. Sardines live up to 13 years, but are usually captured by their 5th year.

Pacific (chub) mackerel (*Scomber japonicus*) are found from southeastern Alaska to Mexico, and are most abundant south of Point Conception, California within 20 mi (32 km) from shore. The “northeastern Pacific” stock of Pacific mackerel is harvested by fishers in the U. S. and Mexico. Like sardines and anchovies, mackerel are schooling fish, often co-occurring with other pelagic species like jack mackerel and sardines. As with other CPS, they are preyed upon by a variety of fish, mammals, and sea birds.

Jack mackerel (*Trachurus symmetricus*) grow to about 2 ft and can live up to 35 years. They are found throughout the northeastern Pacific, often well outside the Exclusive Economic Zone. Small jack mackerel are most abundant in the Southern California Bight, near the mainland coast, around islands, and over shallow rocky banks. Older, larger fish range from Cabo San Lucas, Baja California, to the Gulf of Alaska, offshore into deep water and along the coast to the north of Point Conception. Jack mackerel in southern California usually school over rocky banks, artificial reefs, and shallow rocky reefs.

Market squid (*Loligo opalescens)* range from the southern tip of Baja California to southeastern Alaska (Leet et al. 2001). They are most abundant between Punta Eugenio, Baja California, and Monterey Bay, California. Usually found near the surface, market squid can occur to depths of 2,625 ft (800 m) or more. Squid live less than a year and prefer full-salinity ocean waters. They are important forage foods for fish, birds and marine mammals.

In 2006, the PFMC included krill in the CPS and adopted a complete ban on commercial fishing for all species of krill in West Coast federal waters (PFMC 2006). Krill are small shrimp-like crustaceans that are an important basis of the marine food chain. They are eaten by many managed species, as well as by whales and seabirds.

Coastal pelagic species are harvested directly and incidentally (as bycatch) in other fisheries. Usually targeted with “round-haul” gear including purse seines, drum seines, lampara nets, and dip nets, they are also taken as bycatch in midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs. Market squid are fished nocturnally using bright lights to attract the squid to the surface. They are pumped directly from the sea into the hold of the boat, or taken with an encircling net (PFMC 2005). Market squid are harvested for human consumption and as bait in recreational fisheries.

Most of the CPS commercial fleet is located in California, mainly in Los Angeles, Santa Barbara-Ventura, and Monterey. About 75 percent of the market squid and Pacific sardine catch are exported, mainly to China, Australia (where they are used to feed farmed tuna), and Japan (where they are used as bait for longline fisheries).

The U.S. West Coast Fisheries for HMS covers 13 free-ranging species; 5 tuna - Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin; 5 sharks - common thresher, pelagic thresher, bigeye thresher, shortfin mako, and blue shark; 2 billfish - striped marlin and Pacific swordfish; and dorado (also known as dolphinfish or mahi-mahi) (Table 4) (PFMC 2011c). HMS have a wide geographic distribution, both inside and outside the Exclusive Economic Zone. They are open-ocean, pelagic species, that may spend part of their life cycle in nearshore waters. HMS are harvested by U. S. commercial fishers and by foreign fishing fleets, with only a fraction of the total harvest taken within U.S. waters (PFMC 2014d).

The Fishery Management Plan for Highly Migratory Species (HMS) includes tunas, billfish and pelagic sharks as managed species. The albacore surface hook-and-line fishery is by far the most economically important commercial HMS fishery, followed by the drift gillnet fishery for swordfish and thresher shark (NMFS 2014). HMS are also an important component of the catch for the Pacific Regions recreational commercial passenger fishing vessel fleet, and the private recreational boat fleet.

Under the HMS FMP, the PFMC monitors other species for informational purposes. In addition, some species-including great white sharks, megamouth sharks, basking sharks, Pacific halibut, and Pacific salmon - are designated as prohibited catch. If fishers targeting highly migratory species catch these species, they are required to immediately release them.

The federal Shark Conservation Act of 2010 was signed into law January 4, 2011, specifying that no shark is to be landed without fins being naturally attached (CalCOFI 2013). In addition, the State of California passed AB 376 - a bill banning the possession and sale of shark fins, beginning January 1, 2012. While shark fisheries in California are still legal, and those possessing the proper license or permit are allowed to retain shark fins under California law, sales and distribution are prohibited. Restaurants and retailers were allowed to sell stock on hand as of the implementation until July 1, 2013. There is also an exception for taxidermy.

The HMS fishery, with the exception of the swordfish drift gillnet fishery off California, is one of the only remaining open access fisheries on the West Coast. However, the PFMC is currently considering a limited entry program to control excess capacity. The use of entangling nets (set and drift gill nets, and trammel nets) in California state waters (<3 nm (5.6 km) from shore) was banned in 1994 by Proposition 132, the Marine Resources Protection Act of 1990 (FGC §8610 et seq.).

Many different gear types are used to catch HMS in California (PFMC 2011c). These include; 1) trolling lines - fishing lines with jigs or live bait deployed from a moving boat, 2) drift gillnets - panels of netting weighted along the bottom and suspended vertically in the water by floats that are attached to a vessel drifting along with the current, 3) harpoon - a small and diminishing fishery mainly targeting swordfish, 4) pelagic longlines - baited hooks on short lines attached to a horizontal line (the HMS FMP now prohibits West Coast longliners from fishing in the Exclusive Economic Zone due to concerns about the take of endangered sea turtles), 5) coastal purse seines - encircling nets closed by synching line threaded through rings on the bottom of the net (usually targeting sardines, anchovies, and, mackerel but also target tuna where available), 6) large purse seines - used in major fisheries in the eastern tropical Pacific and the central and western Pacific (this fishery is monitored by the Inter-American Tropical Tuna Commission, and, in the Exclusive Economic Zone by NMFS); and, 7) recreational fisheries - HMS recreational fishers in California include private vessels and charter vessels using hook-and-line to target tunas, sharks, billfish, and dorado.

As mentioned previously, Pacific halibut (*Hippoglossus stenolepis*) is managed by the International Pacific Halibut Commission (IPHC 2014). This large species of halibut is mainly encountered well north of the Point Loma area, and, its harvest is prohibited in the area. A smaller relative, the California halibut (*Paralichthys californicus*), is found along the coast of southern California, but is not included in a FMP.

Although FMPs are mandated for federal waters, managed species also occur in state waters. These areas in California (i.e., inshore of 3 nm) are managed under the California Marine Life Management Act (CMLMA) (CDFW 2014b). California FMPs have been produced for nearshore finfish (CDFW 2014c), white seabass (CDFWd), market squid (CDFWe), and, a spiny lobster FMP is being developed (CDFWf).

The California Nearshore Fishery Management Plan (CNFMP) (CDFW 2014c) covers both commercial nearshore fisheries and recreational fishers. The five goals of the CNFMP are to 1) ensure long-term resource conservation and sustainability 2) employ science-based decision-making 3) increase constituent involvement in management 4) balance and enhance socio-economic benefits 5) identify implementation costs and sources of funding. Five management approaches form the basis for integrated management strategies to meet the goals and objectives of the CNFMP and CMLMA. They are: the Fishery Control Rule, Management Measures, Restricted Access, Regional Management, Marine Protected Areas (MPAs), and Allocation (Table 7, from CDFW 2014c).

Table 7. Key CNFMP Management Goals and Objectives.

NFMP Goal or Objective	Fishery Control Rule	Management Measures	Restricted Access	Regional Management	MPAs	Allocation
Conserve ecosystems	Stock assessments completed					
Allow only sustainable uses	Setting TACs based on NFMP fishery control rule; inseason monitoring	Size limits on species that survive release; trip limits match capacity; limit gear				
Adjust catch allowance to reflect uncertainty	TACs based on stock assessments - black & gopher rockfish, cabezon, CA scorpionfish	Trip limits				
Match fish harvest capacity to			RA program for NFP			

Table 7. Key CNFMP Management Goals and Objectives.

NFMP Goal or Objective	Fishery Control Rule	Management Measures	Restricted Access	Regional Management	MPAs	Allocation
sustainable catch levels			species; DNSFP program			
Allocate restrictions and benefits fairly and equitably		FGC guidance to Council for regulation development		Regional discussions with constituents on proposed regulation changes		Revised as updated information is available
Minimize bycatch and mortality		Match seasons and depths for cooccurring species	Bycatch permit with trip quota; bimonthly trip limits			
Maintain, restore and preserve habitat			Allowable gear limited to hook & line, traps and dip nets	Identify appropriate habitat for 19 species; NFMP MPA criteria in MLPA Master plan design criteria		
Identify, assess, and enhance habitats					Identify appropriate habitat for 19 species	
Identify and minimize fishing that destroys habitat		CA input into Council EFH designations	NFP program gear endorsements			

Table 7. Key CNFMP Management Goals and Objectives.

NFMP Goal or Objective	Fishery Control Rule	Management Measures	Restricted Access	Regional Management	MPAs	Allocation
Employ Science based Decision making	OYs/TACs based on stock assessments					
Conduct collaborative research	CRANE					
Collect data on spatial distribution of habitats and organisms	CRANE EFI collection			Initial focus on southern California and south central regions		CRANE & Channel Islands MPA monitoring

The CNFMP covers 19 species that frequent kelp beds and reefs generally less than 120 ft (36 m) deep off the coast of California and the near offshore islands (Table 8, from CDFW 2014c).

Table 8. Managed Species - California Nearshore Fisheries Management Plan.

Black rockfish - *Sebastes melanops*
Gopher rockfish - *Sebastes carnatus*
Black & yellow rockfish - *Sebastes chrysomelas*
Grass rockfish - *Sebastes rastrelliger*
Blue rockfish - *Sebastes mystinus*
Kelp greenling – *Hexagrammos decagrammus*
Brown rockfish - *Sebastes auriculatus*
Kelp rockfish – *Sebastes atrovirens*
Cabezon - *Scorpaenichthys marmoratus*

Table 8. Managed Species - California Nearshore Fisheries Management Plan.
Monkeyface prickleback – *Cebidichthys violaceus*
Calico rockfish - *Sebastes dallii*
Olive rockfish - *Sebastes serranoides*
California scorpionfish - *Scorpena guttata*
Quillback rockfish - *Sebastes maliger*
California sheephead – *Semicossyphus pulcher*
Rock greenling - *Hexagrammos lagocephalus*
China rockfish - *Sebastes nebulosus*
Treefish - *Sebastes serriceps*
Copper rockfish - *Sebastes caurinus*

Thirteen of these species are rockfish - all of which are included in the federal Pacific Groundfish FMP. Three of the remaining six species are also covered under the Pacific Groundfish FMP. The three species not covered by the Pacific Groundfish FMP are the California sheephead (*Semicossyphus pulcher*), the rock greenling (*Hexagrammos lagocephalus*), and the monkeyface prickleback (*Cebidichthys violaceus*). These species are actively managed by the CDFW (CDFW 2014c) through catch limits, gear restrictions and monitoring.

The California sheephead is a large, colorful member of the wrasse family (Leet et al. 2001, CDFW 2013). Male sheephead reach a length of 3 ft, a weight of 36 lbs, and have a white chin, black head, and, a pink to red body. Females are smaller, with a brown-colored body (Eschmeyer et al. 1985). Sheephead populations off southern California have declined because of fishing pressure. Large males are now rare because they are sought by recreational spear fishermen. Sheephead are taken commercially by traps and kept alive for display in restaurant aquaria where patrons select a specific fish for preparation. The rock greenling is a smaller member of the lingcod family. The monkeyface prickleback, also called the monkeyface eel, is more closely related to rockfish than eels. Its elongate shape is an adaptation to living in cracks, crevices, and under boulders.

White seabass (*Atractoscion nobilis*), large members of the croaker family, occur in ocean waters off the west coasts of California and Mexico. This highly-prized species is recovering from reduced population levels in the late 1900s. The current California management strategy of the White Seabass Fishery Management Plan (WSFMP) provides for moderate commercial harvests while protecting young white seabass and spawning adults through seasonal closures, gear provisions, and size and bag limits (CDFW 2014d). The WSFMP also has a recreational fishery component with size and bag limits, and season closures. There is an ongoing white seabass hatchery program at Carlsbad, California operated by the Hubbs-Sea World Research Institute.

The hatchery provides juvenile white seabass to other field-rearing systems operated by volunteer fishermen throughout southern California.

Market squid (*Loligo opalescens*), discussed previously under the Coastal Pelagics FMP, is the state's largest fishery by tonnage and economic value (CDFW 2014e). Market squid are also important to the recreational fishery as bait and as forage for fish, marine mammals, birds, and other marine life. Squid belong to the class Cephalopoda of the phylum Mollusca. They have large eyes and strong parrot-like beaks. Using their fins for swimming and jets of water from their funnel they are capable of rapid propulsion forward or backward. The squid's capacity for sustained swimming allows it to migrate long distances.

The Abalone Recovery and Management Plan (CDFW 2014h) establishes a cohesive framework for the recovery of depleted abalone populations in southern California. All of California's abalone species are included in the plan: red abalone, *Haliotis rufescens*; green abalone, *H. fulgens*; pink abalone, *H. corrugata*; white abalone, *H. sorenseni*; pinto abalone, *H. kamtschatkana* (including *H. assimilis*); black abalone, *H. cracherodii*; and flat abalone, *H. walallensis*. The recovery and management plan for these species implements measures to prevent further population declines throughout California, and to ensure that current and future populations will be sustainable.

The decline of abalone is due to a variety of factors, primarily commercial and recreational fishing, disease, and natural predation. The recovery of a near-extinct abalone predator, the sea otter, has further reduced the possibility for an abalone fishery in most of central California. Withering syndrome, a lethal bacterial infection, has caused widespread decline among black abalone in the Channel Islands and along the central California coast. As nearshore abalone populations became depleted, fishermen traveled to more distant locations, until stocks in most areas collapsed. Advances in diving technology also played a part in stock depletion. The advent of self-contained underwater breathing apparatus (SCUBA) in the mid-1900s gave birth to the recreational fishery in southern California, which placed even more pressure on a limited number of fishing areas.

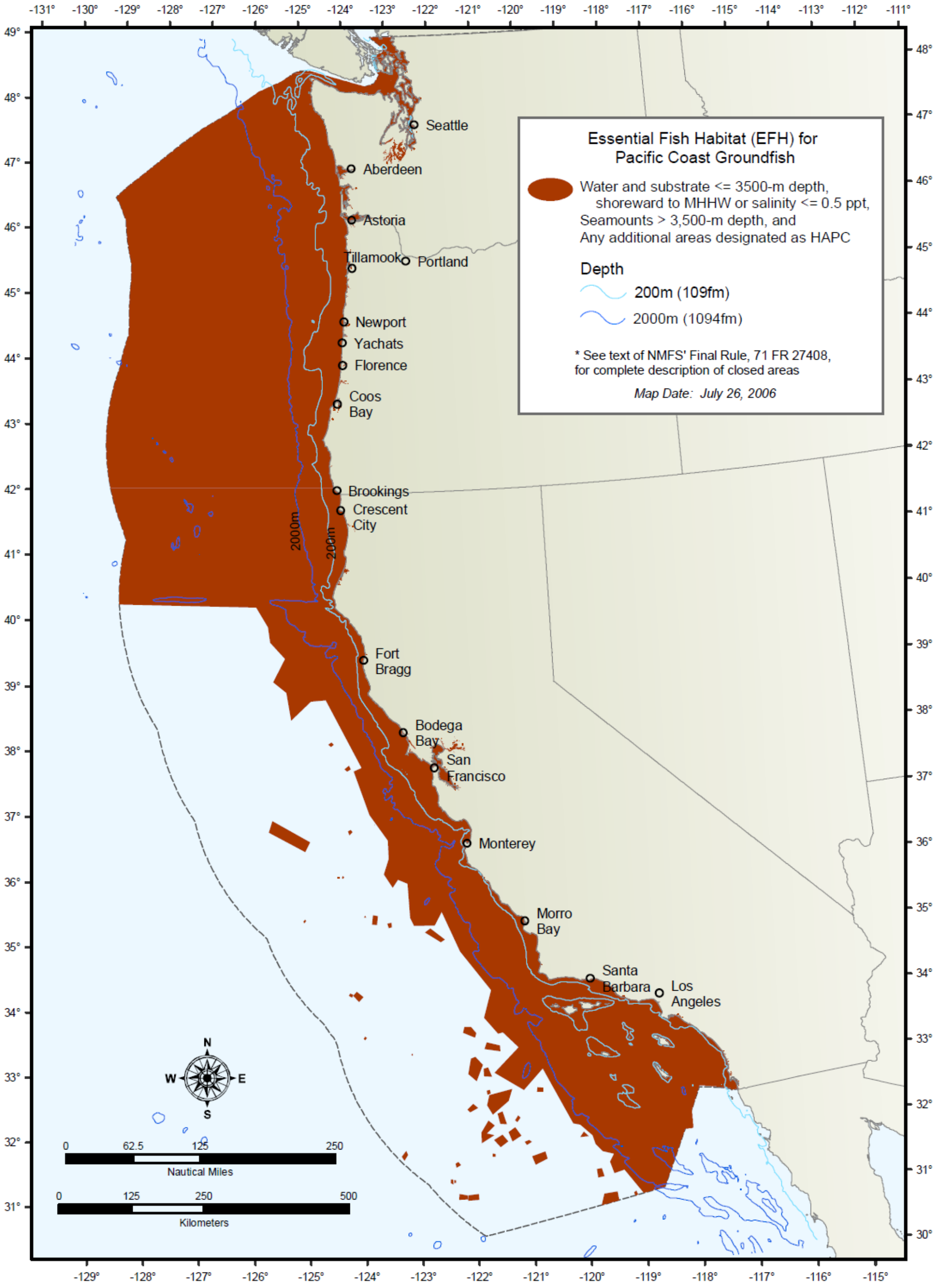
Following stock collapse, the California Fish and Game Commission closed the southern California pink, green, and white abalone fisheries in 1996 and all abalone fishing south of San Francisco in early 1997. The southern abalone fishery was closed indefinitely with the passage of the Thompson bill (AB 663) in 1997. This bill created a moratorium on taking, possessing, or landing abalone for commercial or recreational purposes in ocean waters south of San Francisco, including all offshore islands.

Designated Essential Fish Habitat

The National Marine Fisheries Service and the Pacific Fishery Management Council designate Essential Fish Habitat and develop Fishery Management Plans for all fisheries occurring within the Southern California Bight from Point Conception to the U.S./Mexico border. The Sustainable Fisheries Act contains provisions for identifying and protecting habitat essential to federally Managed Species. The FMPs identify EFH, describe EFH impacts (fishing and non-fishing), and suggest measures to conserve and enhance EFH (NMFS 2010). The FMPs also designate Habitat Areas of Particular Concern (HAPC) where one or more of the following criteria are demonstrated: (a) important ecological function; (b) sensitivity to human-induced environmental degradation; (c) development activities stressing the habitat type; or (d) rarity of habitat.

Essential fish habitat for groundfish managed species includes all waters and substrate from the high tide line or the upriver extent of saltwater intrusion to: 1) depths of 11,483 ft (3,500 m), 2) seamounts in depths greater than 11,483 ft (3,500 m), and 3) areas designated as HAPC not already identified by the above criteria (PFMC 2011a, NMFS 2013b, Figure 16, from PFMC 2012). With respect to EFH, nearshore areas are considered to be shallower than 120 ft (36 m) with offshore areas beyond that depth. The continental shelf is considered to begin at the 656 ft (200 m) contour.

Figure 16. Groundfish Essential Fish Habitat.



The Pacific Groundfish FMP divides EFH into seven composite habitats including their waters, substrates, and biological communities: 1) <u>estuaries</u> - coastal bays and lagoons, 2) <u>rocky shelf</u> - on or within 33 ft (10 m) of rocky bottom (excluding canyons) from the high tide line to the continental shelf break, 3) nonrocky shelf - on or within 33 ft (10 m) of unconsolidated bottom (excluding the rocky shelf and canyons) from the high tide line to the continental shelf break, 4) canyon - submarine canyons, 5) continental slope/basin - on or within 66 ft (20 m) of the bottom of the continental slope and basin below the shelf break extending to the westward boundary of the Exclusive Economic Zone, 6) neritic zone - the water column more than 33 ft (10 m) (narrow yellow band above) above the continental shelf, and 7) oceanic zone - the water column more than 66 ft (20 m) (wide yellow band above) above the continental slope and abyssal plain, extending to the westward boundary of the Exclusive Economic Zone (Table 9, from PFMC 2011a and PFMC 2014b).

Table 9. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Flatfish							
Curlfin Sole			A, SA	E		A, SA	E
Dover Sole			A, SA, J	L, E		A, SA, J	L, E
English Sole	A*, SA, J*, L*, E	A*, SA, J*	A*, SA, J*	L*, E		A*	
Petrale Sole			A, J	L, E		A, SA	L, E
Rex Sole	A		A, SA	E		A, SA	L, E
Rock Sole		A*, SA*, J*, E*	A*, SA*, J*, E*	L		A*, SA*, J*, E*	
Sand Sole			A, SA, J	L, E			
Pacific Sanddab	J, L, E		A*, SA, J	L, E			L, E
Rockfish							
Aurora Rockfish			A, MA, LJ			A, MA, LJ	L
Bank Rockfish		A, J	A, J		A, J	A, J	
Black Rockfish	A*, SJ*	LJ*	LJ*	A*, SJ*			A*

Table 9. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Black-and-yellow Rockfish		A*, MA, LJ*, SJ*, P		L*			
Blackgill Rockfish		LJ		SJ, L		A, LJ	S, LJ
Blue Rockfish		A*, MA, LJ*	LJ*	SJ*,L			
Bocaccio	SJ*, L	A*, LJ*	A*, LJ*	SJ*, L	LJ*	A*, LJ*	
Bronzespotted Rockfish						A	
Brown Rockfish	A*, MA, J*, P	A*, MA, J*, P					
Calico Rockfish	A, J	A, J	A, J				
Canary Rockfish		A, P		SJ*, L		A, P	SJ*, L
Chilipepper		A, LJ, P	A, LJ, P	SJ*, L		A, LJ, P	
China Rockfish		A, J, P		L			
Copper Rockfish	A*, LJ*, SJ*, P	A*, LJ*		SJ*, P			
Cowcod		A, J	J	L			
Darkblotched Rockfish		A, MA, LJ, P	A, MA, LJ, P			A, MA, P	SJ, L
Flag Rockfish		A, P					

Table 9. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Gopher Rockfish		A*, MA, J*, P	A*, A, J*, P				
Grass Rockfish		A*, J*, P					
Greenblotched Rockfish		A, J, P	A, J, P		A, J, P	A, P	
Greenspotted Rockfish		A, J, P	A, J, P				
Greenstriped Rockfish		A, P	A, P				
Honeycomb Rockfish		A, J, P			J		
Kelp Rockfish	SJ*	A*, LJ*, P		SJ*			
Mexican Rockfish		A	A	L			L
Olive Rockfish		A*, J*, P			A*, P		
Pacific Ocean Perch		A, LJ	A, LJ	SJ	A	A, P	SJ, L
Pink Rockfish		A	A			A	
Redbanded Rockfish			A			A	
Redstripe Rockfish		A, P				A, P	
Rosethorn Rockfish		A, P	A, P			A, P	
Rosy Rockfish		A, J, P					
Rougheye Rockfish		A	A			A	
Sharpchin Rockfish		A, P	A, P			A, P	L
Shortbelly Rockfish		A*, P	A*, P		A*, P	A*, P	

Table 9. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Silverygray Rockfish		A*	A*			A*	
Speckled Rockfish		A, J, P			A, P	A, P	
Splitnose Rockfish			A, J*, P			A, P	
Squarespot Rockfish		A, P			A, P		
Starry Rockfish		A, P				A, P	
Stripetail Rockfish			A, P			A, P	
Tiger Rockfish		A				A	
Treefish		A					
Vermilion Rockfish		A, J*	J*		A	A	
Widow Rockfish		A, MA, LJ,P	A, MA, LJ, P	SJ*, L	A, MA, LJ, P	A, MA, P	SJ*, L
Yelloweye Rockfish		A, P				A, P	
Yellowtail Rockfish		A, MA, LJ, P	A, MA, LJ, P	SJ*		A, MA, P	SJ*
<u>Scorpionfish</u>							
California Scorpionfish	E	A, SA, J	A, SA, J	E			
<u>Thornyhead</u>							
Longspine Thornyhead						A, SA, J	L, E
Shortspine Thornyhead			A			A, SA	L, E
<u>Roundfish</u>							

Table 9. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Cabezon	A, SA, LJ, SJ*, L, E	A, SA, LJ, E		SJ*, L			SJ*, L
Kelp Greenling	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E		SJ*, L			SJ*, L
Lingcod	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E	A*, LJ*	SJ*, L		A*	
Pacific Cod	A, SA, J, L, E		A, SA, J, E	A, SA, J, L		A, SA, E	A, SA, J, L
Pacific Hake (Whiting)	A, SA, J, L, E			A, SA, J, L, E			A, SA, L, E
Pacific Flatnose					A	A	
Pacific Grenadier			A, SA, J			A, SA, J	L
Sablefish	SJ	A	A, LJ	SJ, L	A, LJ	A, SA	SJ, L, E
<u>Skates/Sharks/ Chimeras</u>							
Big Skate			A, MA, J, E			A, MA	
California Skate	A, MA, J, E		A, MA, J, E			A, MA, J, E	

Table 9. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2011a). * = Associated with macrophytes, algae, or seagrass. (PFMC 2014b).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope and Basin	Ocean
Longnose Skate			A, MA, J, E			A, MA, J, E	
Leopard Shark	A, MA, J, P	A, MA, J, P	A, MA, J, P	A, MA, J, P			
Soupfin Shark	A, MA, J, P	A, MA, J	A, MA, J, P	A, MA, J, P	A, MA, J		A, MA, J
Spiny Dogfish	A, LJ, SJ, P	A, MA, LJ	A, LJ, P	A, LJ, SJ	A	A, MA	A
Spotted Ratfish	A, MA, J	A, MA, J E	A, MA, J E			A, MA, J, E	

The Pacific Fisheries Management Council has identified six HAPC types. One of these types, certain oil rigs in Southern California waters, was disapproved by NMFS. The current five HAPC types are: estuaries, canopy kelp, seagrass, rocky reefs, and “areas of interest” (e.g., submarine features, such as banks, seamounts, and canyons) (Table 10, Figure 17, from PFMC 2014e).

Table 10. EFH and HAPC in the Southern California Bight.

Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) (PFMC 2014e).

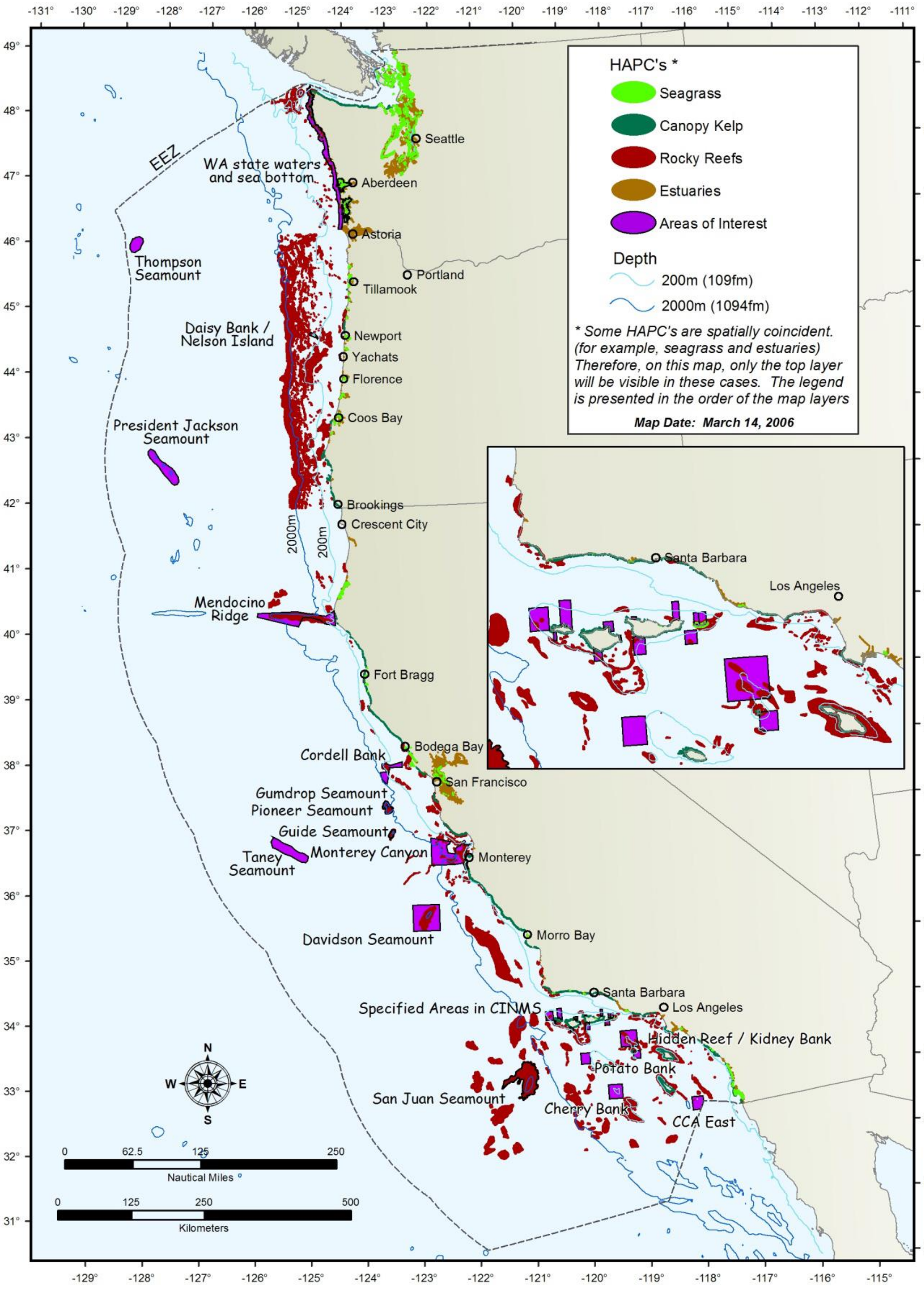
	EFH	HAPC
Pacific Groundfish	Marine and estuarine waters less than or equal to 11,483 ft (3,500 m) to mean higher high water level or the upwater extent of seawater intrusion, seamounts in	Estuaries, canopy kelp, sea grass, rocky reefs, and other areas of interest.

Table 10. EFH and HAPC in the Southern California Bight.

Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) (PFMC 2014e).

	EFH	HAPC
	depths greater than 3,500 m, and areas designated as HAPC not identified by the above criteria.	
Coastal Pelagic Species	All marine and estuarine waters above the thermocline from the shoreline offshore to 200 nm offshore.	No HAPC designated.
Highly Migratory Species	All marine waters from the shoreline offshore to 200 nm offshore.	No HAPC designated.
Pacific Coast Salmon	North of project area.	North of project area.

Figure 17. Groundfish Habitat Areas of Particular Concern.



EFH identified for managed Coastal Pelagic Species is wide-ranging. It includes the geographical range where they are currently found, have been found in the past, and may be in the future (PFMC 2011b). In the Southern California Bight, the CPS EFH constitutes all marine and estuarine waters above the thermocline from the shoreline offshore to the limits of the Exclusive Economic Zone with no HAPC designated (PFMC 2011b). The thermocline is an area in the water column where water temperature changes rapidly, usually from colder at the bottom to warmer on top. The CPS live near the surface primarily above the thermocline, and within a few hundred miles of the coast, so their designated EFH (Table 11) is less complex than for Groundfish Managed Species. The PFMC is presently considering identifying EFH and possibly Habitat Areas of Particular Concern (HAPC) for two individual krill species, *Euphausia pacifica* and *Thysanoessa spinifera*, and for other species of krill (PFMC 2008).

Table 11. Coastal Pelagic Species Essential Fish Habitat.

Coastal Pelagic Species and Lifestages Associated with EFH designations. A = Adults, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2014c).

Group/Species	Coastal epipelagic	Coastal mesopelagic	Coastal benthic
Krill	E, L, J, A		
Northern anchovy	E, L, J, A		
Mackerels	E, L, J, A		
Sardine	E, L, J, A		
Market Squid	L, J, A		E

Only market squid are significantly associated with benthic environments; the females lay their eggs in sheaths on sandy bottom in 33-165 ft (10-50 m) depths (PFMC 2011b). The CPS are found in shallow waters and within bays and even brackish waters, but are not considered dependent upon these habitats. They prefer temperatures in the 50-82.4 °F (10-28 °C) range with successful spawning and reproduction occurring from 57-61 °F (14-16 °C). Larger, older individuals are generally found farther offshore and farther north than younger, smaller individuals. All lifestages of CPS species are found in the Southern California Bight.

EFH for Highly Migratory Species (Table 12) such as tuna, sharks and billfish is even more extensive than for CPS (PFMC 2011c). HMS range widely in the ocean, in area and depth. They are usually not associated with the features typically considered fish habitat (estuaries, seagrass beds, rocky bottoms). Their habitat selection appears to be less related to physical features and more to temperature ranges, salinity levels, oxygen levels, and currents. For the U.S. West Coast Fisheries for Highly Migratory Species, EFH occurs throughout the Southern California Bight (PFMC 2011c). The PFMC has currently identified no HAPC for HMS.

Table 12. Highly Migratory Species Essential Fish Habitat.

Highly Migratory Species and Lifestages Associated with EFH Designations. A = Adults, SA = Sub-Adults, LJ = Late Juveniles, N= Neonate, EJ = Early Juveniles, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2014d**)**.

Group/Species	Coastal epi-pelagic	Coastal meso-pelagic	Oceanic epi-pelagic	Oceanic meso-pelagic
Sharks				
Blue Shark			N, EJ, LJ, SA, A	
Shortfin Mako			N, EJ, LJ, SJ, A	
Thresher Sharks	LJ, SA, A	LJ, SA, A	LJ, SA, A	LJ, SA, A
Tunas				
Albacore			J, A	
Bigeye Tuna			J, A	J, A
Northern Bluefin			J	
Skipjack			A	
Yellowfin			J	
Billfish				
Striped Marlin			A	
Swordfish				
Broadbill Swordfish			J, A	J, A
Dolphinfish				
Dorado			J, SA, A	

Rockfish Conservation Areas, closed to fishing, have been established to protect sensitive Pacific coast groundfish habitat (Figure 18, from PMFC 2011a). Bottom trawling was prohibited in March 2006 in these areas out to depths of 11,482 ft (3,500 m). In Cowcod Conservation Areas (Figure 19, from PMFC 2012), bottom trawling and other bottom fishing activities are prohibited in waters greater than 120 ft (36 m). Within these conservation areas, cowcod and other “overfished” federal groundfish species, are protected with very low incidental catch limits (CMLPA 2009). The conservation areas are expected to remain closed until “overfished” stocks are rebuilt or a new management approach is adopted.

Figure 18. Essential Fish Habitat Conservation Areas.

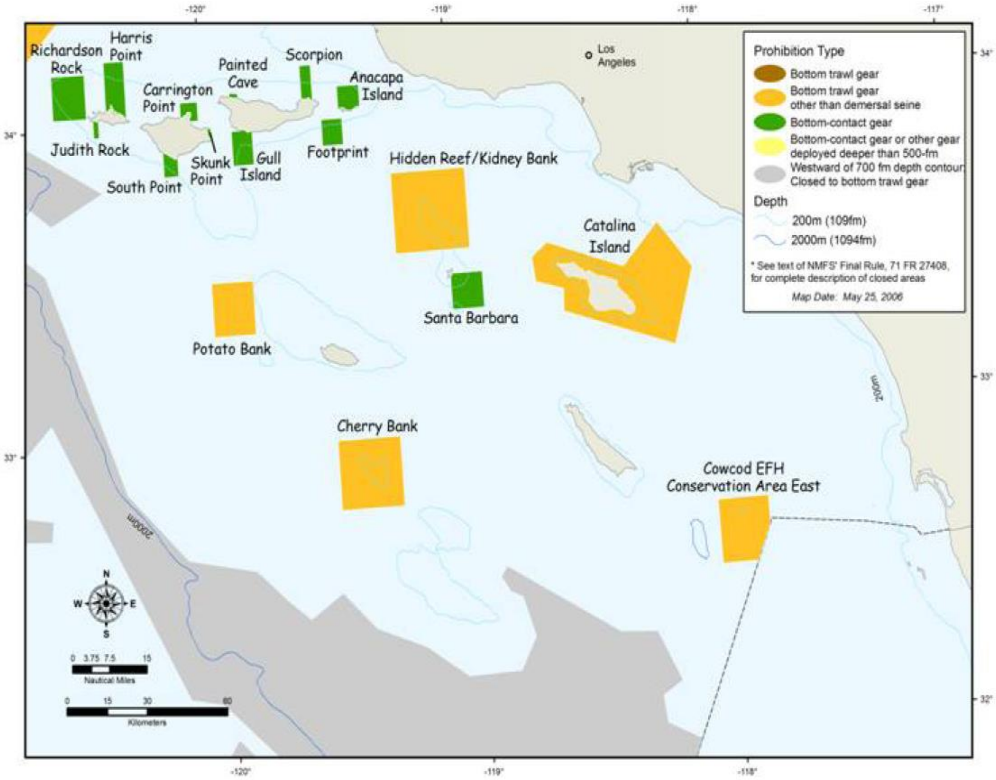
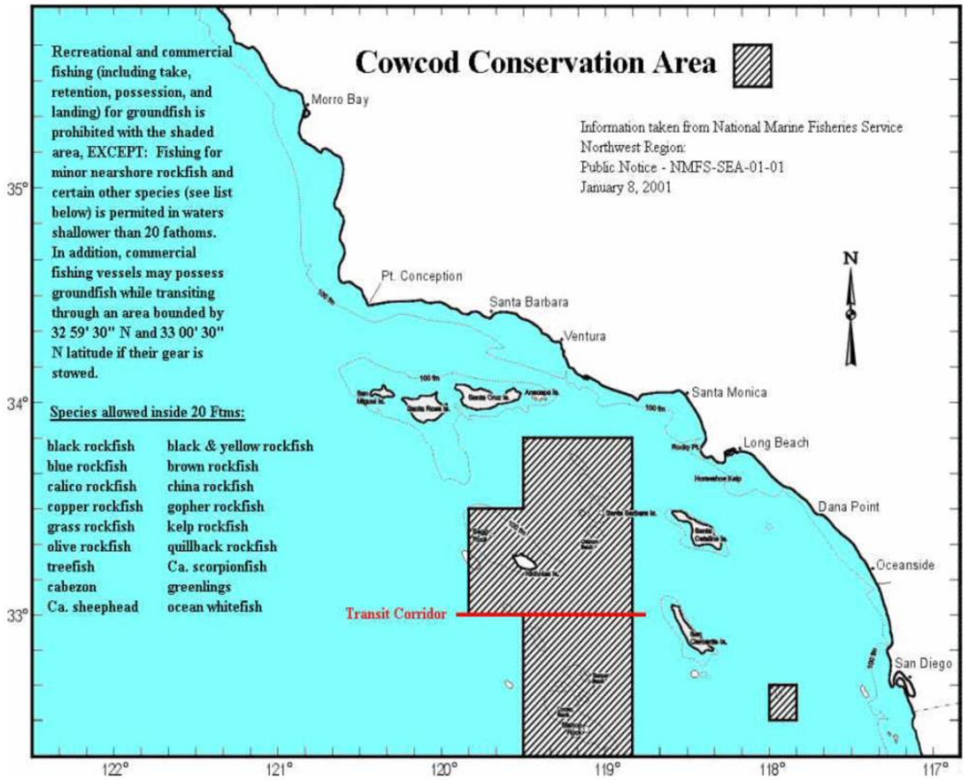


Figure 19. Cowcod Conservation Area.



Essential Fish Habitat Impacts

EFH regulations require analysis of potential impacts that could have an adverse effect on EFH and managed species (NMFS 2002a,b). Adverse effect is defined as an impact that reduces the quality and/or quantity of essential fish habitat (NMFS 2004a,b). Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

The Point Loma ocean outfall could have physical impacts associated with the presence of the pipeline and diffusers on the ocean bottom, and chemical and biological impacts associated with the discharge of treated wastewater.

Physical Impacts

The Point Loma outfall pipeline is buried in a trench through the surf zone out to a distance of about 2,600 ft (792 m) offshore. Over the next 400 ft (123 m) it gradually emerges from the trench and beyond 3,000 ft (914 m) offshore it lies in a bed of ballast rock on the ocean floor. At its terminus, the pipeline connects to the diffuser section with two legs, each 2,500 ft (762 m) long. The outfall pipe and diffusers with their supporting bed of ballast rock form an artificial reef. The pipe and rock, covered with encrusting organisms (tube worms, anemones, barnacles), provide food and shelter to a variety of fish and invertebrates (Wolfson and Glinski 1986). This artificial habitat covers an area of about 22 acres (9 hectares) off Point Loma (assuming a 36-ft (11-m) width of pipe and ballast rock). Catches of rockfish could be enhanced over this area, but would probably be too small to be discernible in recreational or commercial landings.

The pipeline and diffusers represent a potential hazard to commercial fishermen using traps that can snag on the pipe and ballast rock. Lobster, crab, and fish traps are used throughout the area (Parnell et al. 2010). Since the location of the pipeline and diffusers is well-marked on navigation charts and commercial vessels are equipped with accurate positioning systems it is possible to place fishing gear a safe distance away. Nevertheless, commercial trap fishermen target the pipe area, apparently choosing to risk higher gear-loss for a better yield per trap next to the high-relief rocky habitat created by the pipe and ballast rock.

Chemical and Biological Impacts

The Point Loma Ocean Outfall monitoring program provides an extensive database on marine water quality and marine biology beginning with pre-design studies in the late 1950s' (COSD 2008-2014). The monitoring program at Point Loma was not designed as a research program, but, instead, was established to determine compliance with local, state, and federal environmental regulations. Even so, the monitoring program has generated data with considerable utility for scientific inquiry. For example, Conversi and McGowan (1992) analyzed 15 years of water transparency data at 7 monitoring stations to evaluate the influence of anthropogenic influences (sewage discharge) and natural oceanographic events. They concluded that anthropogenic activities had not affected transparency, while natural factors such as seasonality and distance from the coast had.

Underwater research has been conducted in the Point Loma kelp bed, 3.5 mi (5.6 km) inshore of the outfall, since the mid 1950's when Wheeler North of the California Institute of Technology and his associates at the Scripps Institution of Oceanography (SIO) began long-term investigations of kelp bed ecology (Neushul 1959, North 1964, North and Hubbs 1968). Professors Paul Dayton and associates at SIO have done ecological surveys at fixed locations in the Point Loma kelp bed since 1971 (e.g., Dayton and Tegner 1984, 1990, Dayton et al. 1992, 2003, Tegner et al. 1995, 1996, 1997, Tegner and Dayton 1987, 1991, Steneck et al. 2002, Graham 2000, 2004, Hewitt et al. 2007, Parnell and Riser 2012, Parnell et al. 2005, 2008, 2010). Their research has demonstrated that large-scale, low-frequency episodic changes in oceanographic climate control kelp forest community structure. The Point Loma kelp bed also serves as a site for SIO and San Diego State University graduate student research (e.g., Neushul 1959, Gerodette 1971, Deysher 1984, Graham 2000, Mai and Hovel 2007), and for ongoing unpublished research on CA spiny lobster movements in the Point Loma kelp bed by Hovel, Lowe, Loflen, and Palaoro.

With the single exception of a temporary break in the pipeline conveying wastewater to the offshore outfall whose effect was limited in magnitude and extent (Tegner et al. 1995), there has been no indication in the extensive research on the Point Loma kelp bed ecosystem of any impact of discharged wastewater. Nor is there any suggestion in the historical fisheries catch of outfall impacts.

As a result of regulations promulgated by the San Diego Regional Water Quality Control Board, *Macrocyctis* kelp beds have been mapped quarterly in by the Region Nine Kelp Survey

Consortium since 1983 (e.g., MBC 2013, 2014). The kelp survey consortium also tracks the ecological impact of anthropogenic and natural influences on local kelp beds including the effects of ocean wastewater discharges. Results of the most recent kelp survey (MBC 2014) show the Point Loma kelp bed decreased slightly (by 4%) in 2013 though it still exceeded 2 mi^2 (5 km^2) in area. The most recent report of the Kelp Survey Consortium (MBC 2014) concludes: “There was no apparent correlation between kelp bed growth, or lack thereof, with the various discharges in the region, and there was no evidence to suggest any perceptible influence of the various dischargers on the persistence of the region’s giant kelp beds.”

These studies and data sets were not devised to specifically elucidate outfall effects. The Point Loma monitoring program was, however, intended to do precisely that. The following section briefly reviews monitoring program results related to the impact on EFH and fisheries species.

The discharge of treated wastewater at Point Loma could affect EFH and fisheries species by altering water or sediment quality. Water quality parameters are monitored at stations around the outfall, in the kelp bed, along the shoreline, and at reference stations to the north and south (City of San Diego (COSD) 2008-2014). Strong local currents and high initial dilution (>200:1) facilitate rapid mixing and dispersion of the discharged effluent. Except in the immediate vicinity of the outfall, where minor alterations in dissolved oxygen, pH, and light transmittance may occur, changes in physical and chemical parameters in surrounding ocean waters have reflected only natural alterations in oceanographic processes (e.g., upwelling, plankton blooms) and long-term regime changes like El Niño.

Unlike dissolved components of the wastewater that are swept away by the currents, particles discharged from the outfall may settle to the ocean floor. This can change the grain size and organic content of the sediments which in turn affects the abundance and diversity of marine organisms living there. Contaminants can also be introduced since many of the potentially harmful chemicals in wastewater are bound to particles.

Alterations in sediment quality in the vicinity of the Point Loma Ocean Outfall are only apparent in areas closer than 1,000 ft (300 m) from the diffusers, where coarser sediments and higher sulfide and BOD levels have been periodically detected (COSD 2008-2014). The change in grain size may be related to turbulence created as the current flows past the pipe on the bottom, wafting away the finer particles (Diener et al. 1997). The physical presence of large ocean outfalls and associated ballast materials can alter the hydrodynamic regime in surrounding areas, thus affecting sediment movement and transport, and the resident biological communities. Although periodic small increases in sulfides and BOD near the discharge site are consistent with the deposition of organic material, concentrations of other indicators of organic loading (e.g. total organic carbon, total nitrogen, total volatile solids) organic enrichment) remain low relative to reference areas (see Appendix C – Ocean Benthic Conditions).

Concentrations of chlorinated pesticides (e.g., DDT), polychlorinated biphenyl congeners (PCBs), and polycyclic aromatic hydrocarbons (PAHs) in sediments at Point Loma are generally low, the notable exception being DDE, a breakdown product of the pesticide DDT. DDE, a legacy of historical discharge, is found in sediments throughout southern California (Mearns et al. 1991, Schiff et al. 2011). Levels of DDE at Point Loma are within the range of concentrations elsewhere in the Southern California Bight (COSD 2008-2014, Schiff et al. 2011).

There is no consistent pattern of metal concentrations in the sediments as a function of distance from the outfall - cadmium, arsenic, antimony, barium, chromium, and iron are consistently higher at the northern reference stations, while mercury, aluminum and copper are consistently higher at the southern sampling stations. Concentrations of sediment metals were highly variable, with most levels within ranges reported elsewhere in the SCB (e.g., Schiff et al. 2011). While high values of various metals have been occasionally recorded at nearfield stations, there are no discernible long-term patterns that could be associated with proximity to the outfall or the onset of wastewater discharge.

Changes in sediment quality should also be reflected in the types of species living on and in the sediment. Two elements of the monitoring program provide this type of information: 1) benthic infauna, and 2) demersal (bottom-dwelling) fish and megabenthic invertebrates. Benthic infauna are collected by taking grab samples of the bottom. Demersal fish and invertebrates are gathered by trawling across the bottom. Living in close association with the sediments, these groups are classic indicators of altered conditions. Also, many important fisheries species live on the bottom and/or feed there.

The infaunal community around the outfall is dominated by an ophiuroid-polychaete assemblage typical of this depth and sediment type in southern California (Ranasinghe et al. 2012). There is, however, some indication of discharge effect at the monitoring station closest to the outfall. Abundance of the ophiuroid *Amphiodia* which is sensitive to organic enrichment has decreased, though this has not been the case for other pollution sensitive species. There has been a concomitant decrease in *Amphiodia* region-wide. Other changes in community structure may be related to the presence of the outfall structure itself, rather than the influence of discharged wastewater, and to large-scale oceanographic events like El Niño (Posey and Ambrose 1994, Zmarzly et al. 1994, Diener et al. 1997, Linden et al. 2007, COSD 2008-2014). Whatever the reason, infaunal communities near the Point Loma outfall remain similar to those observed prior to discharge and are comparable to natural indigenous communities (see Appendix C – Ocean Benthic Conditions).

Trawl samples at Point Loma are dominated by small flatfish and sea urchins. Though inherently more variable than infaunal data, the trawl data also indicate that normal oceanographic processes control the abundance and diversity of demersal fish and megabenthic invertebrates living around the outfall (COSD 2008-2014). Patterns in abundance, biomass, and species composition have remained stable since monitoring began. The fish collected by trawling are healthy, with few parasites and a low level or absence of fin rot, tumors, and other physical abnormalities.

One of the most important elements of the Point Loma monitoring program from the EFH and fisheries perspective is the measurement of chemical contaminants in fish tissues. Fish can accumulate pollutants from: 1) absorption of dissolved chemicals in the water, 2) ingestion of contaminated suspended particles or sediment particles, and 3) ingestion of contaminated food (Allen 2006, Newman 2009, Allen et al. 2011, Laws 2013). Incorporation of contaminants into an organism’s tissue is called bioaccumulation (Weis 2014, Whitacre 2014). Contaminants can also be concentrated as they are passed through the food web when higher trophic level organisms feed on contaminated prey (Bienfang et al 2013, Daley et al. 2014). Bioaccumulation has potential ecological and human health implications (Klasing and Brodberg 2008, 2011, Walsh et al. 2008, California Office of Environmental Health Hazard Assessment (OEHHA) 2014a,b).

The Point Loma Ocean Outfall monitoring program targets two types of fish for assessment of contaminant levels: flatfish and rockfish. Samples are taken at various distances from the outfall and at reference stations to the north and south. Flatfish and rockfish at Point Loma have concentrations of metals in liver and muscle tissue characteristic of values detected throughout the Southern California Bight (Mearns et al. 1991, Allen et al. 2011). There is no apparent relationship between higher metal levels and proximity to the outfall. Elevated levels of arsenic were found in fish species at both outfall and reference stations. The source of this arsenic appears to be vents from natural hot springs off the coast of northern Baja California. A variety of man-made compounds including DDT (and its derivatives) and PCBs are routinely found in fish tissue throughout the area. These chlorinated hydrocarbons are ubiquitous in southern California, but their concentration in sediments and organisms is steadily decreasing in most areas (Mearns et al. 1991, Allen et al. 2011, Setty et al. 2012, SCCWRP 2014). Samples taken near the outfall do not have higher levels of DDT and PCBs than at reference sites.

The EPA and United States Food and Drug Administration (FDA) establish limits for the concentration of contaminants like arsenic, DDT and PCBs in seafood sold for human consumption (EPA 2014b, FDA 2014). There have been no warnings, advisories, harvest closures, or, restrictions on seafood taken from the Point Loma ocean area (personal communication with the staff of the San Diego County Environmental Health Services Department; California State Department of Public Health; California State EPA Office of Environmental Health Hazard Assessment; and the U.S. Food and Drug Administration, San Diego Branch).

In summary, monitoring data show effects of the Point Loma discharge only in deep water near the outfall where minor water and sediment quality alterations have been observed. Marine communities in the Point Loma region remain characteristic of natural conditions with no suggestion of environmentally-significant changes.

Cumulative Impacts

Cumulative impacts are defined in the National Environmental Protection Act (NEPA) (42 USC § 4321 *et seq*. and 32 CFR 775 respectively) as: the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).

In general, the effects of a particular action or group of actions must meet all of the following criteria to be considered cumulative impacts:

- Effects of several actions occur in a common locale or region,
- Effects on a particular resource are similar in nature, such that the same specific element of a resource is affected in the same specific way, and
- Effects are long-term as short-term impacts dissipate over time and cease to contribute to cumulative impacts.

The discharge of wastewater from commercial activities, including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., desalination plants), and storm water from drains into open ocean waters, bays, or estuaries can introduce chemical and biological constituents potentially detrimental to estuarine and marine habitats (Perry 2009, Hutchinson et al. 2013). These constituents include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, and toxic chemical compounds (Crain et al. 2009, Stein and Cadien 2009, Setty et al. 2012). Historically, wastewater discharges have been one of the largest inputs of these constituents into coastal waters. However, wastewater discharges have been regulated under increasingly stringent requirements over the last 40 years and mass emissions of most constituents have been significantly reduced (Lyon and Sutula 2011, SCCWRP 2012, 2014). Nonpoint source/storm water runoff, on the other hand, has not been managed as effectively and continues to be a substantial remaining source of contamination of coastal areas and the ocean (Setty et al. 2012, Howard et al. 2014).

Climate shifts can transform the type and the intensity of human activities, such as shipping, oil and gas extraction, and coastal construction, all of which may affect endangered species (Alter et al. 2010, Hoegh-Guldberg and Bruno 2010, Doney et al. 2012, Hazen et al. 2012). Other possible cumulative threats to EFH and fisheries species include degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, and disease (Field et al. 2003, Horn and Stevens 2006, O'Shea and Odell 2008, Pinnegar and Engelhard 2008, Crain et al. 2009, Halpern et al. 2009, Hoegh-Guldberg and Bruno 2010, Thrush and Dayton 2010, Doney et al. 2012, Hazen et al. 2012, Howell et al. 2012, SCCWRP 2012, NMFS 2013a, Howard et al. 2014, Maruya et al. 2014). Cumulative impacts have the potential to alter the physiology, behavior, growth, and reproduction of individual species, shift patterns of larval dispersal and recruitment, modify the composition of ecological communities, and, change the structure, function, productivity, and resilience of marine ecosystems.

In addition, fishing and non-fishing activities, individually or in combination, can adversely affect EFH and fisheries species (Jackson et al. 2001, 2011, Dayton et al. 2003, Chuenpagdee et al. 2003, Hanson et al. 2003, Jackson 2008, Baum and Worm 2009, Worm et al. 2009, Norse 2010, Hilborn and Hilborn 2012, NMFS 2013b, Laugen et al. 2014). Potential impacts of commercial fishing include over-fishing of targeted species, and bycatch, both of which negatively affect fish stocks (Barnette 2001, NRC 2002, Dieter et al. 2003, PFMC 2004, Hseih et al. 2006, Carretta and Enriquez 2012, PFMC and NMFS 2012). Mobile fishing gears such as bottom trawls (now prohibited to deeper than 3,500 ft) disturb the seafloor and reduce structural complexity (Johnson 2002, Lindholm et al. 2011). Indirect effects of trawls include increased turbidity; alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (continued catch by lost or discarded gear), and generation of marine debris (Hamilton 2000, Reeves et al. 2013). Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats (NMFS 2013b). Recreational fishing also poses a threat because of the large number of participants and the intense, concentrated use of specific habitats (Coleman et al. 2004, Ihde et al. 2011, United Nations Food and Agricultural Organization (UNFAO) 2012, Arlinghaus et al. 2013).

Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Davidson et al. 2011, Hutchinson et al. 2013, Moore et al. 2013). Natural stresses include storms and climate-based environmental shifts, such as algal blooms and hypoxia (Kim et al. 2009, SCCWRP 2013).

Allen et al. (2005) analyzed fish population trends from 20- to 30-year fish databases (e.g., power generating station fish impingement and trawl monitoring, recreational fishing, and publicly owned treatment work (POTW) trawl monitoring). Combined, these databases provided information on 298 species of fish. A number of long-term environmental databases (e.g., CalCOFI oceanographic data, shoreline temperature, coastal runoff, and POTW effluent contaminant mass emissions) were used to identify influential, independent environmental variables (e.g., Pacific Decadal Oscillation (PDO); El Niño-Southern Oscillation (ENSO); offshore temperature; upwelling in the north, Southern California Bight, and south; coastal runoff; and contaminant mass emissions). Most southern California fish had population trends that followed changes in natural oceanic variables not anthropogenic inputs. The most important environmental variables were PDO (positive and negative responses), upwelling in the Southern California Bight, offshore temperature, and ENSO. The PDO was the dominant influence for most species in these databases, with the presence or absence of upwelling during the warm regime having an important effect on others (Mills and Walsh 2013). Recent analyses of long-term fish population dynamics in the Southern California Bight also indicate that the primary driver of shifting trends in local fish populations is natural climatological change rather than anthropogenic influence (Miller and Schiff 2012, Koslow et al. 2013, Miller and McGowan 2013).

Removal of fish by fishing can profoundly influence individual populations, their survival, and the composition of the community in which they live (Jackson 2008, Jackson et al. 2011, Hilborn and Hilborn 2012). In a seminal study of retrospective data, Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records spanning 10,000 years, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer term data and information, they concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance to coastal ecosystems including pollution, degradation of water quality, and anthropogenic climatic change.

A number of factors influence water quality and biological conditions in the Point Loma area. Key potential influences on water quality include the Point Loma treated wastewater discharge, regional non-point source discharges, local river outflows, and other local non-point sources such as harbors, marinas, storm drains, and urban runoff (Bartlett et al. 2004, Parnell et al. 2008, Parnell and Riser 2012).

The effects of the Point Loma discharge on water quality and biological conditions are evident only in deep waters (below the euphotic zone) within or near the Zone of Initial Dilution (ZID) (COSD 2008-2014). Organic enrichment of the sediments due to the outfall discharge is not occurring beyond the ZID. Contaminant loading of sediments is not evident in the discharge vicinity. Sediment chemistry is comparable to reference areas along southern California's outer continental shelf. Biological conditions do not indicate any environmentally-significant changes associated with the discharge. A balanced indigenous population of shellfish, fish and wildlife exist immediately beyond the ZID.

While significant natural variations in fish populations are observed (in response to factors such as water temperature), the Point Loma wastewater discharge is not having any significant effect on fish assemblages off Point Loma. Fish populations are healthy and lack physical abnormalities such as fin erosion or tumors. Levels of trace metals, chlorinated hydrocarbons, pesticides, and polyaromatic hydrocarbons are relatively low, with concentrations within the range found throughout the Southern California Bight. No outfall-related effects are evident from bioaccumulation data. Contaminants in fish tissues in the Point Loma area are similar to those at reference sites beyond the influence of the discharge.

Based on scientific research and oceanographic monitoring at Point Loma, the impact on Essential Fish Habitat from the discharge of treated wastewater is expected to be minimal. There will be no significant cumulative, incremental, or synergistic effects on present or reasonably foreseeable future uses of the Point Loma marine environment.

CONCLUSIONS

The proposed operation of the Point Loma ocean outfall will not reduce the quality or quantity of Essential Fish Habitat. Extensive monitoring and scientific studies indicate little or no alteration of physical, chemical, or biological conditions of the waters or substrates. Impacts on marine organisms, prey species, their habitat, and other ecosystem components are minimal. Wastewater discharged from the outfall makes an insignificant contribution to regional cumulative impacts on EFH or fisheries species. Thus, the discharge of treated wastewater from the Point Loma Ocean Outfall will not have an adverse effect on Essential Fish Habitat.

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Appendix L
PROPOSED MONITORING PROGRAM

Renewal of NPDES CA0107409

APPENDIX L

PROPOSED MONITORING PROGRAM

Proposed Monitoring and Reporting Program for the Point Loma Ocean Outfall Discharge

January 2015

APPENDIX L

PROPOSED MONITORING PROGRAM

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List of Abbreviations

California Ocean Plan	2012 *Water Quality Control Plan, Ocean Waters of California*
CEC	constituents of emerging concern
EPA	United States Environmental Protection Agency (also USEPA)
LC50	50 percent lethal concentration
MMP	*Model Monitoring Program for Large Ocean Discharges in Southern California*
MRP	Monitoring and Reporting Program
NOEC	no observed effects concentration
NPDES	National Pollutant Discharge Elimination System
PCR	polymerase chain reaction (technology for DNA sequencing)
PLOO	Point Loma Ocean Outfall
Point Loma WWTP	Point Loma Wastewater Treatment Plant
POTW	public owned treatment works
Regional Board	Regional Water Quality Control Board, San Diego Region
SBOO	South Bay Ocean outfall
SCB	Southern California Bight
SCCWRP	Southern California Coastal Water Research Project
SIO	Scripps Institution of Oceanography
TST	Test of Significant Toxicity
TUa	acute toxicity units
TUc	chronic toxicity units

APPENDIX L

PROPOSED MONITORING PROGRAM

ABSTRACT

Monitoring and Reporting Program No. R9-2009-0001 establishes the current influent monitoring, effluent monitoring, whole effluent toxicity testing, receiving water monitoring, and reporting requirements for the Point Loma Ocean Outfall (PLOO) discharge and surrounding areas. Only a few minor changes are proposed to the core program regarding benthic monitoring and sediment toxicity testing. The City also proposes to continue full participation in the Southern California Bight regional monitoring programs, as well as several other regional monitoring efforts. Additionally, the City will continue to pursue its enhanced ocean monitoring efforts via special projects that address more specific receiving water quality or other discharge-related issues. Finally, the City will continue to work with the San Diego Regional Water Quality Control Board (Regional Board) to further align and improve the Point Loma and South Bay outfall monitoring programs and to address the goals and recommendations of the Regional Board's *Framework for Monitoring and Assessment in the San Diego Region* (Busse and Posthumus 2012) and the *San Diego Water Board Practical Vision* (Regional Board, 2013).

L.1 INTRODUCTION

The history of changes to the PLOO Monitoring and Reporting Program (MRP) for the present deepwater (~100 meters) PLOO discharge site are detailed in a series of four successive Monitoring and Reporting Programs (MRPs) adopted by the Regional Board and the U.S. Environmental Protection Agency (EPA) associated with NPDES Permit No. CA107409. These MRPs include:

- the original MRP in Order No. 95-106 adopted in 1995, although pre-discharge monitoring began several years earlier in July 1991,
- a slightly corrected or modified MRP in Order No. R9-2002-0025 adopted in 2002,
- a significantly modified MRP in Addendum No. 1 to Order No. R9-2002-0025 adopted in 2003, and
- the present MRP in Order No. R9-2009-0001 adopted in 2009.

Addendum No. 1 to Order R9-2002-0025 was adopted in June 2003 and resulted in significant modifications to the PLOO monitoring program in order to incorporate the recommendations of the *Model Monitoring Program for Large Ocean Discharges in Southern California* developed by the Southern California Coastal Water Research Project (SCCWRP) between 1998 and 2001 (Schiff et al. 2002). These changes, along with a few additional minor modifications or administrative corrections implemented with the adoption of the current MRP in June 2009 (Order No. R9-2009-0001) brought the PLOO monitoring program into full alignment with the SCCWRP Model Monitoring Program.

The City remains committed to maintaining a comprehensive and robust ocean monitoring and reporting program for the San Diego coastal region, and to coordinating with the Regional Board to further improve the program in line with the Regional Board's monitoring goals, objectives, and direction presented within:

- *Framework for Monitoring and Assessment in the San Diego Region* (Regional Board Resolution No. R9-2012-0069; adopted December 2012), and
- the *San Diego Water Board Practical Vision*, adopted by the Regional Board on November 13, 2013.

In concert with this Regional Board monitoring direction, only minor modifications are proposed to the existing monitoring program for the Point Loma region, all of which are designed to address (1) the regional perspective included in the above "Framework for Monitoring and Assessment" and (2) changes in the 2012 *California Ocean Plan* (see Appendix U).

L.2 BASIS OF THE EXISTING MONITORING PROGRAM

Monitoring Framework. The City of San Diego was a full participant with SCCWRP, federal and state regulators (e.g., Regional Board, EPA), other large ocean dischargers in southern California (e.g., Los Angeles County Sanitation Districts, Orange County Sanitation District, City of Los Angeles), and the local environmental community (e.g., Bay Council) during the development of the *Model Monitoring Program for Large Ocean Discharges in Southern California* (MMP). Although the focus of the MMP was towards large public owned treatment works (POTWs), much of the design and framework also applies to smaller POTWs (see SCCWRP 2007).

In addition to modifying the PLOO monitoring program, the Regional Board has implemented the MMP design in NPDES permits issued to major wastewater dischargers within the San Diego region. These include the permits and associated MRPs for the South Bay Water Reclamation Plant (Order No. R9-2013-0006, NPDES No. CA0109045) and South Bay International Wastewater Treatment Plant (Order No. R9-2014-0009, NPDES No. CA0108928), which together discharge commingled effluent to the Pacific Ocean via the South Bay Ocean Outfall (SBOO).

MMP Elements. The MMP design involves three main elements:

1) Core Monitoring, which focuses on assessing effluent and receiving water compliance with applicable state and federal regulations.
2) Regional Monitoring, which focuses on conducting or participating in larger-scale surveys of the San Diego region or the entire Southern California Bight, and that often involve multiple agencies and/or academic organizations.
3) Special Projects (*aka* Strategic Process Studies), which are typically more focused studies designed to address and answer specific questions about some aspect of the ocean environment.

A key aspect of this approach to monitoring is the adaptive nature of the program. The core program element retains much of the historically-imposed ocean outfall monitoring requirements and provides for specific sampling locations where designated constituents are measured and monitored over time. The core program is directed toward assessing compliance with federal standards established by EPA and state-wide standards established within the *California Ocean Plan*. Additionally, this portion of the program is critical to assessing long-term temporal changes in local marine environmental conditions and to determining whether any such changes may be due to either anthropogenic or natural influences.

Whereas core monitoring remains somewhat static, regional surveys and special projects are dynamic in their ability to adapt and change to address emerging questions and concerns. In this way, the monitoring is flexible to insure the best uses of resources and to adapt when new information becomes available. A special project may result in a one-time final report with additional actions necessary or it may generate the need to add a new element to the core program to insure the issue is fully addressed. At the same time a special project may result in the reduction or realignment of a part of the core program if the regulatory agencies conclude that the special monitoring information is more valuable (or replaces the need for) core monitoring elements. However, any such changes to the core program would only occur upon concurrence and approval of the Regional Board and EPA.

Consistency with Recent Regional Board Direction. Both the MMP and current MRP established within Order No. R9-2009-0001 are consistent with the *Framework for Monitoring and Assessment in the San Diego Region* (Busse and Posthumous, 2012) and the *San Diego Water Board Practical Vision* (Regional Board, 2013). These two strategic documents herald a change in the past Regional Board practice of focusing monitoring on individual discharges to a new approach that is focused on:

- assessing the safety and health of receiving waters,
- identifying unsatisfactory conditions and the causes of the conditions, and
- determining the effective of management or corrective actions.

In accordance with this approach, the *San Diego Water Board Practical Vision* and *Framework for Monitoring and Assessment in the San Diego Region* direct that a "question-based" monitoring format be implemented to address the following:

M1: Conditions Monitoring and Assessment (Is the water safe and healthy?)
M2: Stressor Identification Monitoring (What pollutants are causing the problem?)
M3: Source Identification Monitoring (What is the source of the stressor pollutants?)
M4: Performance Monitoring (Are implemented corrective actions effective?)

The current comprehensive MRP established within Order No. R9-2009-0001 incorporates each of the MMP elements, and also implements the question-based approach addressed within the adopted Regional Board monitoring guidance. As a result, only minor modification to the existing PLOO MRP is proposed.

L.3 STATUS OF THE EXISTING MONITORING PROGRAM

Core Monitoring Program. The details and requirements of the current core PLOO monitoring program are established in the MRP of Order No. R9-2009-0001, which was adopted on June 10, 2009. A copy of this program is attached to this appendix as Attachment L1. Only a few minor modifications to this program are proposed (see Section L.4 on page L-7).

Regional Surveys. The City of San Diego has been and will continue to be a full participant in the comprehensive surveys of the Southern California Bight (SCB) that are coordinated by SCCWRP approximately every five years. Four such projects have been successfully completed to date, including the Southern California Bight Pilot Project in 1994 and subsequent Bight'98, Bight'03 and Bight'08 programs in 1998, 2003 and 2008, respectively. Final reports for these projects are available from the City or SCCWRP website (www.sccwrp.org). Sampling for most aspects of the subsequent SCB regional program, Bight'13, began in the summer of 2013, while additional sampling, analysis and report preparation is currently underway. The City is actively involved in multiple portions of the Bight’13 program.

In addition to the five bight-wide programs described above, the City regularly participates in several other regional activities as well. One such study is that the City participates with other southern California ocean dischargers in an ongoing regional survey of the SCB coastal kelp beds ranging from the USA/Mexico border to Point Conception, Additionally, the City jointly funds a remote sensing program of the San Diego/Tijuana coastal region with the International Boundary and Water Commission (see Special Projects below). Finally, the City has also conducted annual region-wide benthic surveys off the coast of San Diego since 1995 as part of the regular South Bay outfall monitoring requirements in order to augment the 5-year SCB surveys. Although this effort is presently only a requirement of the MRPs associated with the SBOO discharge, the City recommends adding this requirement to the Point Loma programs since these surveys span both the SBOO and PLOO regions (see section L.4 herein).

Special Projects. The City of San Diego during the past 10 years or more has been actively working on, supporting, or collaborating with other researchers or agencies on a large number of important special projects or enhanced ocean monitoring studies. Many of these projects were identified as the result a scientific review of the City's Ocean Monitoring Program and environmental monitoring needs for the region that was conducted by a team of scientists from the Scripps Institution of Oceanography and several other institutions (SIO 2004), as well as in consultation with staff from the Regional Board, EPA, SCCWRP and others. Examples of special projects or enhanced monitoring efforts that have been recently completed, are presently underway, or that are just being initiated include:

- ***Point Loma Ocean Outfall Plume Behavior Study:*** This project was designed to determine the characteristic fates of the PLOO wastewater plume in the coastal waters off Point Loma using a combination of observational and modeling approaches. The study was successfully completed in 2012 and resulted in several important conclusions and recommendations (see Appendix F in this application). The City is currently in the process of implementing the major recommendations of this study (see next project below).

- ***Oceanographic Mooring Systems for the Point Loma and South Bay Ocean Outfalls:*** This project addresses the primary recommendation of the Point Loma plume behavior study described above, as well as similar study completed several years ago for the South Bay outfall region. The study involves design and installation of a real-time ocean observing system that will span both outfall regions. Funding has been secured and the project is scheduled to begin in 2015 with an installation schedule in summer 2015 for the SBOO real-time oceanographic mooring and Winter 2015-2016 for the PLOO mooring. This project is being conducted in partnership between the City and the Ocean Time Series Group of SIO who presently operates a similar mooring system off Del Mar. The project is expected to significantly enhance the City's environmental monitoring capabilities in order to address current and emerging issues relevant to the health of San Diego's coastal waters, including plume dispersion, subsurface current patterns, ocean acidification, hypoxia, nutrient sources, and coastal upwelling.

- ***Deep Benthic Habitat Assessment Study:*** This project represents an ongoing, long-term project designed to assess the condition of deeper (greater than 200 meters) continental slope habitats off San Diego. A summary report of the current status of this project for data collected from 2003 through 2013 is included in Appendix C.5 of this application. A more comprehensive project report and paper for peer-reviewed publication are targeted for completion in 2015-2016.

- ***San Diego Sediment Mapping Study:*** This represents a two-phased project conducted in collaboration with SCCWRP in which sampling was conducted in 2004 for Phase 1 and in 2012 for Phase 2. Phase 1 was designed to estimate spatial variance in sediment quality and macrobenthic community condition over an area spanning both the PLOO and SBOO monitoring regions (greater than 400 square kilometers). In contrast, the goal of Phase 2 was to utilize an optimal resolution (spacing) of sample sites derived in part from Phase 1 results to generate a completed map of sediment chemistry conditions within a more restricted 30 square kilometer area surrounding the PLOO. The findings for Phase 1 and the preliminary results from Phase 2 are included as a summary report in Appendix C.4 of this application. A more comprehensive final project report is expected to be completed by the end of 2015.

- ***Remote Sensing of the San Diego/Tijuana Coastal Region:*** This project represents a long-term effort funded jointly by the City and International Boundary and Water Commission since 2002 to utilize satellite and aerial imagery observations to better understand regional water quality conditions off San Diego. The project is conducted by Ocean Imaging (Solana Beach, CA), and is focused on detecting and tracking the dispersion of wastewater plumes from local ocean outfalls and nearshore sediment plumes originating from stormwater runoff or outflows from local bays and rivers. The last five annual monitoring reports for this project are included in Appendix H of this application, while a comprehensive multi-year report and paper for peer-reviewed publication are expected to be completed by the end of 2015.

- ***San Diego Kelp Forest Ecosystem Monitoring Project:*** This project represents continuation of a long-term commitment by the City (e.g., funded since 1992) to support this important research conducted by the Scripps Intuition of Oceanography. Overall, this work is essential to assessing the health of San Diego's kelp forests and to monitoring the effects of wastewater discharge on the local coastal ecosystem relative to other factors. The final project report for the most recent 4-year agreement (2010-2014) with SIO is included in Appendix G of this application, while work on a new 5-year agreement through June 2019 is currently underway.

In addition to the above, the City is continuing to work with SCCWRP and/or its fellow membership agencies on numerous other projects of regional importance, including detecting and assessing the effects of Contaminants of Emerging Concern (CECs) on coastal ecosystems, developing rapid testing techniques for bacterial analysis, wet weather epidemiological studies in nearshore waters, and expanding and developing new capabilities in advanced molecular technologies such as real-time PCR, DNA sequencing and gene expression.

L.4 PROPOSED MONITORING PROGRAM MODIFICATIONS

Only a few minor modifications or changes are proposed to the existing monitoring requirements established in Order No. R9-2009-0001.

In 2020, EPA endorsed the peer-reviewed Test of Significant Toxicity (TST) 2-concentration hypothesis testing approach within *National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document* (EPA 833-R-10-003) as an improved hypothesis-testing tool to evaluate data from EPA's toxicity test methods. (EPA, 2010) The TST hypothesis testing approach has been demonstrated to reduce statistical uncertainty associated with determining compliance, and has been extensively tested using EPA's toxicity test methods.

In anticipation of the adoption of TST throughout EPA Region 9, the City of San Diego recommends that, during the upcoming NPDES permit period, PLOO toxicity compliance be based on the current procedures established within Order No. R9-2009-0001, but that the TST procedures also be performed on a side-by-side basis. The City recognizes the merit of implementing this side-by-side approach of analyzing toxicity using the TST protocols in conjunction with the standard protocols, and pledges to cooperate with EPA to modify bioassay study parameters and protocols in order to maximize the utility of this side-by-side approach. However, the City of San Diego stands ready to implement whichever toxicity testing methodology is required by EPA as part of the renewed PLOO NPDES permit.

Additional Proposed Modifications. In 2014, the Regional Board adopted ocean monitoring program changes for the SBOO within:

- Order No. R9-2013-0006 as amended by Order No. R9-2014-0071 for the South Bay Water Reclamation Plant; and
- Order No. R9-2014-0009 for the South Bay International Wastewater Treatment Plant.

Monitoring program changes to the SBOO monitoring program included revisions to (1) core sediment and infauna monitoring, (2) benthic surveys, and (3) sediment toxicity. The SBOO monitoring program changes were implemented by the Regional Board to further the goals and objectives of the Regional Board's *Framework for Monitoring and Assessment in the San Diego Region*, the *San Diego Water Board Practical Vision*, and changes incorporated in the 2012 *California Ocean Plan*.

To ensure consistency with the goals and objectives of these plans, the City requests that similar modifications to the PLOO ocean monitoring plan be implemented, including:

1) ***Core Sediment and Infauna Monitoring:*** Reduce infauna sampling at the 12 primary core and 10 secondary core benthic stations to a single sample per station to match sediment sampling. Present benthic sampling requirements are two infaunal samples and one sediment sample per station per survey. However, the second infaunal sample (replicate) is of little value since it does not have a corresponding sediment sample. A similar change was recently made to the core benthic sampling requirements for the SBOO monitoring program detailed in the Orders referenced above. Additionally, this change will provide sufficient resources to allow for addition of the random benthic survey described below.

2) ***Random Benthic Survey:*** Add requirement of the annual survey of 40 randomly selected benthic stations each year to correspond to the existing requirement in the SBOO monitoring program. The permit language should indicate that this will be a single, joint effort of the PLOO and SBOO monitoring programs since the survey spans both regions. This change will also be consistent with the regional framework objectives.

3) ***Sediment Toxicity:*** Add a requirement for the City to prepare and submit a Sediment Toxicity Monitoring Plan for the PLOO region to implement an on-going acute sediment toxicity monitoring program for the PLOO region in conformance with the requirements of the 2012 *California Ocean Plan*. The City recommends that the permit language for this new requirement be similar to that included in the recently amended Order for the South Bay Water Reclamation Plant (i.e., Order No. R9-2013-0006 as amended by Order No. R9-20014-0071).

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SEMPER VIGILANS

Attachment L1
Monitoring and Reporting Program
No. R9-2009-0001

Renewal of NPDES CA0107409

ATTACHMENT E – MONITORING AND REPORTING PROGRAM

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ATTACHMENT E – MONITORING AND REPORTING PROGRAM (MRP)

The Code of Federal Regulations Section 122.48 requires that all NPDES permits specify monitoring and reporting requirements. Water Code Sections 13267 and 13383 also authorize the Regional Water Quality Control Board (San Diego Water Board) to require technical and monitoring reports. This MRP establishes monitoring and reporting requirements, which implement the federal and California regulations. In addition, the Discharger must establish a monitoring and reporting program that meets the requirements of CWA Section 301(h) and 40 CFR Section 125.63.

I. GENERAL MONITORING PROVISIONS

A. Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified below and, unless otherwise specified, before the monitored waste stream joins or is diluted by any other waste stream, body of water, or substance. Monitoring points shall not be changed without notification to, and the approval of, the San Diego Water Board and United States Environmental Protection Agency (USEPA). Samples shall be collected at times representative of "worst case" conditions with respect to compliance with the requirements of Order No. R9-2009-0001.

B. Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that the accuracy of the measurement is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ±5 percent from true discharge rates throughout the range of expected discharge volumes.

C. Monitoring must be conducted according to USEPA test procedures approved at 40 CFR Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants*, as amended, unless other test procedures are specified in Order No. R9-2009-0001 or this MRP, or by the San Diego Water Board and USEPA.

D. All analyses shall be performed in a laboratory certified to perform such analyses by the California Department of Public Health or a laboratory approved by the San Diego Water Board.

E. Records of monitoring information shall include information required under Standard Provision, Attachment D, Section IV.

F. All monitoring instruments and devices used by the Discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy. All flow measurement devices shall be calibrated at least once per year, or more frequently, to ensure continued accuracy of the devices. Annually, the Discharger shall submit to the Executive Officer a written statement signed by a registered professional engineer certifying that all flow measurement devices have been calibrated and will reliably achieve an accuracy with a maximum deviation of less than ±5 percent from true discharge rates throughout the range of expected discharge volumes.

G. The Discharger shall have, and implement, an acceptable written quality assurance (QA) plan for laboratory analyses. An annual report shall be submitted by March 30 of each year which summarizes the Quality Assurance activities for the previous year. Duplicate chemical analyses must be conducted on a minimum of ten percent of the samples or at least one sample per month, whichever is greater. A similar frequency shall be maintained for analyzing spiked samples. When requested by USEPA or the San Diego Water Board, the Discharger will participate in the NPDES discharge monitoring report QA performance study. The Discharger should have a success rate equal or greater than 80 percent.

H. Analysis for toxic pollutants, including acute and chronic toxicity, with performance goals based on water quality objectives of the *Water Quality Control Plan for Ocean Waters of California, California Ocean Plan* (Ocean Plan) shall be conducted in accordance with procedures described in the Ocean Plan and restated in this MRP.

I. A composite sample is defined as a combination of at least eight sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period. For volatile pollutants, aliquots must be combined in the laboratory immediately before analysis. The composite must be flow proportional; either the time interval between each aliquot or the volume of each aliquot must be proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot. Aliquots may be collected manually or automatically. The 100 milliliter minimum volume of an aliquot does not apply to automatic self-purging samplers.

J. A grab sample is an individual sample of at least 100 milliliters collected at a randomly selected time over a period not exceeding 15 minutes.

K. All influent, effluent, and receiving water data shall be submitted annually to USEPA for inclusion in the STORET database. The data shall be submitted in an electronic format specified by USEPA.

II. MONITORING LOCATIONS

The Discharger shall establish the following monitoring locations to demonstrate compliance with the effluent limitations, discharge specifications, and other requirements in this Order:

Table E-1. Monitoring Station Locations***

Discharge Point Name	Monitoring Location Name	Monitoring Location Description (include Latitude and Longitude when available)	Depth (m)
--	INF-001	A location upstream of plant return streams, where a representative sample of the influent can be obtained	--
--	EMG-001	A location where a representative sample of the Tijuana Cross-Border Emergency Connection can be obtained.	--
001	EFF-001	A location where a representative sample of the effluent can be obtained	--
--	RS-001	A location where a representative sample of a return stream can be obtained; for multiple return streams, the return streams shall be sampled and composited based on each return streams contributing flow (flow weighted).	--
OFFSHORE MONITORING STATIONS			
--	F-001	32.637683 N; 117.240316W	18[1]
--	F-002	32.756966 N; 117.272733W	18[1]
--	F-003	32.781833 N; 117.272416W	18[1]
--	F-004	32.594533 N; 117.26875W	60[2]
--	F-005	32.611683 N; 117.26965W	60[2]
--	F-006	32.630833 N; 117.2736W	60[2]
--	F-007	32.651134 N; 117.279994W	60[2]
--	F-008	32.67215 N; 117.283W	60[2]
--	F-009	32.68555 N; 117.286316W	60[2]
--	F-010	32.705419 N; 117.290658W	60[2]
--	F-011	32.725544 N; 117.294632W	60[2]
--	F-012	32.746583 N; 117.302066W	60[2]
--	F-013	32.765383 N; 117.3072W	60[2]
--	F-014	32.781559 N; 117.311423W	60[2]
--	F-015	32.5941 N; 117.28645W	80[3]
--	F-016	32.611833 N; 117.290066W	80[3]
--	F-017	32.630016 N; 117.294166W	80[3]
--	F-018	32.649766 N; 117.298333W	80[3]
--	F-019	32.66785 N; 117.306833W	80[3]
--	F-020	32.685416 N; 117.310966W	80[3]
--	F-021	32.7038 N; 117.318687W	80[3]
--	F-022	32.72273 N; 117.320902W	80[3]
--	F-023	32.741883 N; 117.330416W	80[3]
--	F-024	32.761216 N; 117.33645W	80[3]

--	F-025	32.77895 N; 117.343583W	80[3]
--	F-026	32.593766 N; 117.3122W	98[4]
--	F-027	32.611783 N; 117.321383W	98[4]
--	F-028	32.629287 N; 117.323721W	98[4]
--	F-029	32.647815 N; 117.32493W	98[4]
--	F-030	32.66567 N; 117.32483W	98[4]
--	F-031	32.684668 N; 117.328353W	98[4]
--	F-032	32.701416 N; 117.334166W	98[4]
--	F-033	32.720466 N; 117.339916W	98[4]
--	F-034	32.7389 N; 117.349366W	98[4]
--	F-035	32.7577 N; 117.363383W	98[4]
--	F-036	32.776783 N; 117.374566W	98[4]
KELP MONITORING STATIONS			
--	A-001	32° 39.56'; 117° 15.72'	18[1]
--	A-006	32° 41.56'; 117° 16.18'	18[1]
--	A-007	32° 40.53'; 117° 16.01'	18[1]
--	C-004	32° 39.95'; 117° 14.98'	9[5]
--	C-005	32° 40.75'; 117° 15.40'	9[5]
--	C-006	32° 41.62'; 117° 15.68'	9[5]
--	C-007	32° 42.98'; 117° 16.33'	18[1]
--	C-008	32° 43.96'; 117° 16.40'	18[1]
SHORELINE BACTERIA STATIONS			
--	D-004	At the southernmost tip of Point Loma just north of the lighthouse. 32° 39.94'; 117° 14.62'	--
--	D-005	Directly in front of the Point Loma Wastewater Treatment Plant where the outfall enters the ocean. 32° 40.85'; 117° 14.94'	--
--	D-007	Sunset Cliffs at the foot of the stairs seaward of Ladera Street. 32° 43.16'; 117° 15.44'	--
--	D-008	Ocean Beach at the foot of the stairs seaward of Bermuda Street. 32° 44.22'; 117° 15.32'	--
--	D-009	Just south of the Ocean Beach pier at the foot of the stairs seaward of Narragansett. 32° 44.80'; 117° 15.24'	--
--	D-010	Ocean Beach just north of west end of Newport Avenue, directly west of main lifeguard station. 32° 44.95'; 117° 15.18'	--
--	D-011	North Ocean Beach, directly west of south end of Dog Beach parking area at Voltaire St terminus, south of stub jetty. 32° 45.24'; 117° 15.16'	--

--	D-012	Mission Beach, directly west of main lifeguard station in Belmont Park located at the west end of Mission Bay Drive. 32° 46.28'; 117° 15.21'	--
OFFSHORE SEDIMENT STATIONS			
Primary Core Stations			
--	B-009	32° 45.33'; 117° 21.70'	98
--	B-012	32° 46.36'; 117° 22.30'	98
--	E-002	32° 37.45'; 117° 19.09'	98
--	E-005	32° 38.38'; 117° 19.28'	98
--	E-008	32° 38.91'; 117° 19.34'	98
--	E-011	32° 39.40'; 117° 19.42'	98
--	E-014	32° 39.94'; 117° 19.49'	98
--	E-017	32° 40.48'; 117° 19.54'	98
--	E-020	32° 40.96'; 117° 19.67'	98
--	E-023	32° 41.47'; 117° 19.77'	98
--	E-025	32° 42.38'; 117° 20.07'	98
--	E-026	32° 43.82'; 117° 20.57'	98
Secondary Core Stations			
--	B-008	32° 45.50'; 117° 20.77'	88
--	B-011	32° 46.57'; 117° 21.35'	88
--	E-001	32° 37.53'; 117° 18.35'	88
--	E-007	32° 39.00'; 117° 18.65'	88
--	E-019	32° 41.04'; 117° 19.18'	88
--	B-010	32° 45.22'; 117° 22.16'	116
--	E-003	32° 37.29'; 117° 20.09'	116
--	E-009	32° 38.75'; 117° 20.06'	116
--	E-015	32° 39.88'; 117° 19.91'	116
--	E-021	32° 40.89'; 117° 20.00'	116
TRAWL AND RIG FISH STATIONS			
--	SD-007 (Zone 4)	32° 35.06'; 117° 18.39'	100
--	SD-008 (Zone 3)	32° 37.54'; 117° 19.37'	100
--	SD-010 (Zone 1)	32° 39.16'; 117° 19.50'	100
--	SD-012 (Zone 1)	32° 40.65'; 117° 19.81'	100
--	SD-013 (Zone 2)	32° 42.83'; 117° 20.25'	100
--	SD-014 (Zone 2)	32° 44.30'; 117° 20.96'	100
Rig fish stations shall be located in an area centered around the following sites.			
--	RF-001	32° 40.32'; 117° 19.78'	107
--	RF-002	32° 45.67'; 117° 22.02'	96

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[1] Discrete depths for bacteria samples include: 1m, 12m, and 18m.
[2] Discrete depths for bacteria samples include: 1m, 25m, and 60m.
[3] Discrete depths for bacteria samples include: 1m, 25m, 60m, and 80m.
[4] Discrete depths for bacteria samples include: 1m, 25m, 60m, 80m, and 98m.
[5] Discrete depths for bacteria samples include: 1m, 3m, and 9m.

III. INFLUENT AND EMERGENCY CONNECTION MONITORING REQUIREMENTS

A. Monitoring Location INF-001 and EMG-001

Influent monitoring is required to determine the effectiveness of pretreatment and non-industrial source control programs, to assess the performance of treatment facilities, and to evaluate compliance with effluent limitations. As such, influent monitoring results must accurately characterize raw wastewater from the entire service area of the treatment facilities, unaffected by in-plant return or recycle flows or the addition of treatment chemicals. Influent monitoring shall be conducted at INF-001 and EMG-001 (when flow is present) as shown in the table below.

Table E-2. Influent and Emergency Connection Monitoring at INF-001 and EMG-001

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Flow rate	MGD	recorder/totalizer	Continuous	1
Biochemical Oxygen Demand (5-day @20°C) (BOD_5)	mg/L	24-hr composite	1/Day at INF-001 1/Week at EMG-001	1
Volatile Suspended Solids	mg/L	24-hr composite	1/Day at INF-001 1/Week at EMG-001	1
Total Dissolved Solids (TDS)	mg/L	24-hr composite	1/Day at INF-001 1/Week at EMG-001	1
Temperature	°C	grab	1/Day at INF-001 1/Week at EMG-001	1
Floating Particulates	mg/L	24-hr composite	1/Day at INF-001 1/Week at EMG-001	1
TABLE A PARAMETERS				
Oil and Grease	mg/L	grab	1/Day at INF-001 1/Week at EMG-001	1
Total Suspended Solids	mg/L	24-hr composite	1/Day at INF-001 1/Week at EMG-001	1
Settleable Solids	ml/L	grab	1/Day at INF-001 1/Week at EMG-001	1
Turbidity	NTU	grab	1/Day at INF-001 1/Week at EMG-001	1
pH	units	grab	1/Day at INF-001 1/Week at EMG-001	1
TABLE B PARAMETERS FOR PROTECTION OF MARINE AQUATIC LIFE				
Arsenic, Total Recoverable	µg/L	24-hr composite	1/Week	1
Cadmium, Total Recoverable	µg/L	24-hr composite	1/Week	1
Chromium (VI) , Total Recoverable[2]	µg/L	24-hr composite	1/Week	1
Copper, Total Recoverable	µg/L	24-hr composite	1/Week	1
Lead, Total Recoverable	µg/L	24-hr composite	1/Week	1
Mercury, Total Recoverable[12]	µg/L	24-hr composite	1/Week	1
Nickel, Total Recoverable	µg/L	24-hr composite	1/Week	1
Selenium, Total Recoverable	µg/L	24-hr composite	1/Week	1
Silver, Total Recoverable	µg/L	24-hr composite	1/Week	1
Zinc, Total Recoverable	µg/L	24-hr composite	1/Week	1

Cyanide, Total Recoverable[3]	µg/L	24-hr composite	1/Week	[1]
Ammonia (as N)	µg/L	24-hr composite	1/Week	[1]
Phenolic Compounds (nonchlorinated)	µg/L	24-hr composite	1/Week	[1]
Phenolic Compounds (chlorinated)	µg/L	24-hr composite	1/Week	[1]
Endosulfan[11]	µg/L	24-hr composite	1/Week	[1]
Endrin	µg/L	24-hr composite	1/Week	[1]
HCH[4]	µg/L	24-hr composite	1/Week	[1]
Radioactivity	pci/l	24-hr composite	1/Month	[1]
TABLE B PARAMETERS FOR PROTECTION OF HUMAN HEALTH – NONCARCINOGENS				
Acrolein	µg/L	grab	1/Month	[1]
Antimony	µg/L	24-hr composite	1/Month	[1]
Bis(2-chloroethoxy)methane	µg/L	24-hr composite	1/Month	[1]
Bis(2-chloroisopropyl) ether	µg/L	24-hr composite	1/Month	[1]
Chlorobenzene	µg/L	grab	1/Month	[1]
Chromium (III), Total Recoverable[2]	µg/L	24-hr composite	1/Month	[1]
Di-n-butyl Phthalate	µg/L	24-hr composite	1/Month	[1]
Dichlorobenzenes[5]	µg/L	24-hr composite	1/Month	[1]
Diethyl Phthalate	µg/L	24-hr composite	1/Month	[1]
Dimethyl Phthalate	µg/L	24-hr composite	1/Month	[1]
4,6-dinitro-2-methylphenol	µg/L	24-hr composite	1/Month	[1]
2,4-dinitrophenol	µg/L	24-hr composite	1/Month	[1]
Ethylbenzene	µg/L	grab	1/Month	[1]
Fluoranthene	µg/L	24-hr composite	1/Month	[1]
Hexachlorocyclopentadiene	µg/L	24-hr composite	1/Month	[1]
Nitrobenzene	µg/L	24-hr composite	1/Month	[1]
Thallium, Total Recoverable	µg/L	24-hr composite	1/Month	[1]
Toluene	µg/L	grab	1/Month	[1]
Tributyltin	µg/L	24-hr composite	1/Month	[1]
1,1,1-trichloroethane	µg/L	grab	1/Month	[1]
TABLE B PARAMETERS FOR PROTECTION OF HUMAN HEALTH – CARCINOGENS				
Acrylonitrile	µg/L	grab	1/Month	[1]
Aldrin	µg/L	24-hr composite	1/Week	[1]
Benzene	µg/L	grab	1/Month	[1]
Benzidine	µg/L	24-hr composite	1/Month	[1]
Beryllium	µg/L	24-hr composite	1/Month	[1]
Bis(2-chloroethyl) Ether	µg/L	24-hr composite	1/Month	[1]
Bis(2-ethlyhexyl) Phthalate	µg/L	24-hr composite	1/Month	[1]
Carbon Tetrachloride	µg/L	grab	1/Month	[1]
Chlordane	µg/L	24-hr composite	1/Week	[1]
Chlorodibromethane	µg/L	24-hr composite	1/Month	[1]
Chloroform	µg/L	grab	1/Month	[1]
DDT[6]	µg/L	24-hr composite	1/Week	[1]
1,4-dichlorobenzene	µg/L	24-hr composite	1/Month	[1]

3,3'-dichlorobenzidine	µg/L	24-hr composite	1/Month	[1]
1,2-dichloroethane	µg/L	grab	1/Month	[1]
1,1-dichloroethylene	µg/L	grab	1/Month	[1]
Dichlorobromomethane	µg/L	24-hr composite	1/Month	[1]
Dichloromethane	µg/L	grab	1/Month	[1]
1,3-dichloropropene	µg/L	24-hr composite	1/Month	[1]
Dieldrin	µg/L	24-hr composite	1/Week	[1]
2,4-dinitrotoluene	µg/L	24-hr composite	1/Month	[1]
1,2-diphenylhydrazine	µg/L	24-hr composite	1/Month	[1]
Halomethanes[7]	µg/L	24-hr composite	1/Month	[1]
Heptachlor	µg/L	24-hr composite	1/Month	[1]
Heptachlor Epoxide	µg/L	24-hr composite	1/Month	[1]
Hexachlorobenzene	µg/L	24-hr composite	1/Month	[1]
Hexachlorobutadiene	µg/L	24-hr composite	1/Month	[1]
Hexachloroethane	µg/L	24-hr composite	1/Month	[1]
Isophorone	µg/L	24-hr composite	1/Month	[1]
N-nitrosodimethylamine	µg/L	24-hr composite	1/Month	[1]
N-nitrosodi-N-propylamine	µg/L	24-hr composite	1/Month	[1]
N-nitrosodiphenylamine	µg/L	24-hr composite	1/Month	[1]
PAHs[8]	µg/L	24-hr composite	1/Month	[1]
PCBs[9]	µg/L	24-hr composite	1/Week	[1]
1,1,2,2-tetrachloroethane	µg/L	grab	1/Month	[1]
TCDD equivalents[10]	µg/L	24-hr composite	1/Month	[1]
Tetrachloroethylene	µg/L	grab	1/Month	[1]
Toxaphene	µg/L	24-hr composite	1/Week	[1]
Trichloroethylene	µg/L	grab	1/Month	[1]
1,1,2-trichloroethane	µg/L	grab	1/Month	[1]
2,4,6-trichlorophenol	µg/L	24-hr composite	1/Month	[1]
Vinyl Chloride	µg/L	grab	1/Month	[1]
Remaining priority pollutants[13]	µg/L	24-hr composite	1/Month	[1]

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[1] As required under 40 CFR 136.

[2] Dischargers may, at their option, meet this limitation (or apply this performance goal) as a total chromium limitation (or performance goal).

[3] If a Discharger can demonstrate to the satisfaction of the San Diego Water Board (subject to USEPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations (or performance goals) for cyanide may be met by the combined measurement of free cyanide, simple alkali metals cyanides, and weakly complexed organometalic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by the approved method in 40 CFR 136.

[4] HCH (hexachlorocyclohexane) represents the sum of the alpha, beta, gamma (lindane), and delta isomers of hexachlorocyclohexane.

[5] Dichlorobenzenes represent the sum of 1,2- and 1,3-dichlorobenzene.

[6] DDD (dichlorodiphenyldichloroethane), DDE (dichlorodiphenyldichloroethylene), and DDT (dichlorodiphenyltrichloroethane) represent the sum of 4,4'DDT; 2,4'DDT; 4,4'DDE; 2,4'DDE; 4,4'DDD; and 2,4'DDD.

[7] Halomethanes represent the sum of bromoform, bromomethane (methyl bromide), and chloromethane (methyl chloride).

[8] PAHs (polynuclear aromatic hydrocarbons) represent the sum of acenaphthylene; anthracene; 1,2-benzanthracene; 3,4-benzofluoranthene; benzo[k]fluoranthene; 1,12-benzoperylene; benzo[a]pyrene; chrysene; dibenzo[ah]anthracene; fluorene; indeno[1,2,3-cd]pyrene; phenanthrene; and pyrene.

[9] PCBs (polychlorinated biphenyls) represent the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Arolclor-1254, and Arcolor-1260.

[10] TCDD equivalents represent the sum of concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as shown by the table below. USEPA Method 1613 shall be used to analyze TCDD equivalents.

Isomer Group	**Toxicity Equivalence Factor**
2,3,7,8 – tetra CDD	1.0
2,3,7,8 – penta CDD	0.5
2,3,7,8 – hexa CDD	0.1
2,3,7,8 – hepta CDD	0.01
octa CDD	0.001
2,3,7,8 – tetra CDF	0.1
1,2,3,7,8 – penta CDF	0.05
2,3,4,7,8 – penta CDF	0.5
2,3,7,8 – hexa CDFs	0.1
2,3,7,8 – hepta CDFs	0.01
Octa CDF	0.001

[11] Endosulfan shall mean the sum of alpha-endosulfan, beta-endosulfan, and endosulfan sulfate.

[12] USEPA Method 1631E, with a quantitation level of 0.5 ng/L, shall be used to analyze total mercury.

[13] Also including the 301(h) pesticides listed at 40 CFR 125.58(p).

IV. EFFLUENT MONITORING REQUIREMENTS

Effluent monitoring is required to determine compliance with the permit conditions and to identify operational problems and improve plant performance. Effluent monitoring also provides information on wastewater characteristics and flows for use in interpreting water quality and biological data. The effluent sampling station shall be located where representative samples of the effluent can be obtained. The sampling station shall be located downstream from any in-plant return flows and from the last connection through which waste can be admitted to the outfalll. If more than one analytical test method is listed for a given parameter, the Discharger must select from the listed methods and corresponding Minimum Level. The Discharger shall monitor effluent at EFF-001 as follows.

Table E-3. Effluent Monitoring

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Flow rate	MGD	recorder/totalizer	Continuous	1
BOD_5@20°C	mg/L	24-hr composite	1/Day	1
	% removal[13]	calculate	1/Day	1
Volatile Suspended Solids	mg/L	24-hr composite	1/Day	1
Total Dissolved Solids	mg/L	24-hr composite	1/Day	1
Temperature	°C	grab	1/Day	1

Total Residual Chlorine[15]	µg/L	Continuous[12]	Continuous	[1]
Floating Particulates	mg/L	24-hr composite	1/Day	[1]
TABLE A PARAMETERS				
Oil and Grease	mg/L	grab	1/Day	[1]
Total Suspended Solids	mg/L	24-hr composite	1/Day	[1]
	% removal[13]	calculate	1/Day	[1]
Settleable Solids	ml/L	grab	1/Day	[1]
Turbidity	NTU	grab	1/Day	[1]
pH	units	grab	1/Day	[1]
Total Coliform	CFU/100ml	grab	1/Week	
Fecal Coliform	CFU/100ml	grab	1/Week	
Enterococcus	CFU/100ml	grab	1/Week	
TABLE B PARAMETERS FOR PROTECTION OF MARINE AQUATIC LIFE				
Arsenic, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Cadmium, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Chromium (VI) , Total Recoverable [2]	µg/L	24-hr composite	1/Week	[1]
Copper, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Lead, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Mercury, Total Recoverable[14]	µg/L	24-hr composite	1/Week	[1]
Nickel, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Selenium, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Silver, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Zinc, Total Recoverable	µg/L	24-hr composite	1/Week	[1]
Cyanide, Total Recoverable [3]	µg/L	24-hr composite	1/Week	[1]
Ammonia (as N)	µg/L	24-hr composite	1/Week	[1]
Phenolic Compounds (nonchlorinated)	µg/L	24-hr composite	1/Week	[1]
Phenolic Compounds (chlorinated)	µg/L	24-hr composite	1/Week	[1]
Endosulfan[11]	µg/L	24-hr composite	1/Week	[1]
Endrin	µg/L	24-hr composite	1/Week	[1]
HCH[4]	µg/L	24-hr composite	1/Week	[1]
Radioactivity	pci/l	24-hr composite	1/Month	[1]
TABLE B PARAMETERS FOR PROTECTION OF HUMAN HEALTH – NON CARCINOGENS				
Acrolein	µg/L	grab	1/Month	[1]
Antimony	µg/L	24-hr composite	1/Month	[1]
bis(2-chloroethoxy)methane	µg/L	24-hr composite	1/Month	[1]
Bis(2-chloroisopropyl) ether	µg/L	24-hr composite	1/Month	[1]
Chlorobenzene	µg/L	grab	1/Month	[1]
Chromium (III)[2]	µg/L	24-hr composite	1/Month	[1]
Di-n-butyl Phthalate	µg/L	24-hr composite	1/Month	[1]
Dichlorobenzenes[5]	µg/L	24-hr composite	1/Month	[1]
Diethyl Phthalate	µg/L	24-hr composite	1/Month	[1]
Dimethyl Phthalate	µg/L	24-hr composite	1/Month	[1]

4,6-dinitro-2-methylphenol	µg/L	24-hr composite	1/Month	[1]
2,4-dinitrophenol	µg/L	24-hr composite	1/Month	[1]
Ethylbenzene	µg/L	grab	1/Month	[1]
Fluoranthene	µg/L	24-hr composite	1/Month	[1]
Hexachlorocyclopentadiene	µg/L	24-hr composite	1/Month	[1]
Nitrobenzene	µg/L	24-hr composite	1/Month	[1]
Thallium, Total Recoverable	µg/L	24-hr composite	1/Month	[1]
Toluene	µg/L	grab	1/Month	[1]
Tributyltin	µg/L	24-hr composite	1/Month	[1]
1,1,1-trichloroethane	µg/L	grab	1/Month	[1]
TABLE B PARAMETERS FOR PROTECTION OF HUMAN HEALTH – CARCINOGENS				
Acrylonitrile	µg/L	grab	1/Month	[1]
Aldrin	µg/L	24-hr composite	1/Week	[1]
Benzene	µg/L	grab	1/Month	[1]
Benzidine	µg/L	24-hr composite	1/Month	[1]
Beryllium	µg/L	24-hr composite	1/Month	[1]
Bis(2-chloroethyl) Ether	µg/L	24-hr composite	1/Month	[1]
Bis(2-ethlyhexyl) Phthalate	µg/L	24-hr composite	1/Month	[1]
Carbon Tetrachloride	µg/L	grab	1/Month	[1]
Chlordane	µg/L	24-hr composite	1/Week	[1]
Chlorodibromethane	µg/L	24-hr composite	1/Month	[1]
Chloroform	µg/L	grab	1/Month	[1]
DDT[6]	µg/L	24-hr composite	1/Week	[1]
1,4-dichlorobenzene	µg/L	24-hr composite	1/Month	[1]
3,3'-dichlorobenzidine	µg/L	24-hr composite	1/Month	[1]
1,2-dichloroethane	µg/L	grab	1/Month	[1]
1,1-dichloroethylene	µg/L	grab	1/Month	[1]
Dichlorobromomethane	µg/L	24-hr composite	1/Month	[1]
Dichloromethane	µg/L	grab	1/Month	[1]
1,3-dichloropropene	µg/L	24-hr composite	1/Month	[1]
Dieldrin	µg/L	24-hr composite	1/Week	[1]
2,4-dinitrotoluene	µg/L	24-hr composite	1/Month	[1]
1,2-diphenylhydrazine	µg/L	24-hr composite	1/Month	[1]
Halomethanes[7]	µg/L	24-hr composite	1/Month	[1]
Heptachlor	µg/L	24-hr composite	1/Month	[1]
Heptachlor Epoxide	µg/L	24-hr composite	1/Month	[1]
Hexachlorobenzene	µg/L	24-hr composite	1/Month	[1]
Hexachlorobutadiene	µg/L	24-hr composite	1/Month	[1]
Hexachloroethane	µg/L	24-hr composite	1/Month	[1]
Isophorone	µg/L	24-hr composite	1/Month	[1]
N-nitrosodimethylamine	µg/L	24-hr composite	1/Month	[1]
N-nitrosodi-N-propylamine	µg/L	24-hr composite	1/Month	[1]
N-nitrosodiphenylamine	µg/L	24-hr composite	1/Month	[1]
PAHs[8]	µg/L	24-hr composite	1/Month	[1]
PCBs[9]	µg/L	24-hr composite	1/Week	[1]

1,1,2,2-tetrachloroethane	µg/L	grab	1/Month	[1]
TCDD equivalents[10]	µg/L	24-hr composite	1/Month	[1]
Tetrachloroethylene	µg/L	grab	1/Month	[1]
Toxaphene	µg/L	24-hr composite	1/Week	[1]
Trichloroethylene	µg/L	grab	1/Month	[1]
1,1,2-trichloroethane	µg/L	grab	1/Month	[1]
2,4,6-trichlorophenol	µg/L	24-hr composite	1/Month	[1]
Vinyl Chloride	µg/L	grab	1/Month	[1]
Remaining priority pollutants[16]	µg/L	24-hr composite	1/Month	[1]

[1] As required under 40 CFR 136.

[2] Dischargers may, at their option, meet this limitation (or apply this performance goal) as a total chromium limitation (or performance goal).

[3] If a Discharger can demonstrate to the satisfaction of the San Diego Water Board (subject to USEPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations (or performance goals) for cyanide may be met by the combined measurement of free cyanide, simple alkali metals cyanides, and weakly complexed organometalic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by the approved method in 40 CFR 136

[4] HCH (hexachlorocyclohexane) represents the sum of the alpha, beta, gamma (lindane), and delta isomers of hexachlorocyclohexane.

[5] Dichlorobenzenes represent the sum of 1,2- and 1,3-dichlorobenzene.

[6] DDD (dichlorodiphenyldichloroethane), DDE (dichlorodiphenyldichloroethylene), and DDT (dichlorodiphenyltrichloroethane) represent the sum of 4,4'DDT; 2,4'DDT; 4,4'DDE; 2,4'DDE; 4,4'DDD; and 2,4'DDD.

[7] Halomethanes represent the sum of bromoform, bromomethane (methyl bromide), and chloromethane (methyl chloride).

[8] PAHs (polynuclear aromatic hydrocarbons) represent the sum of acenaphthylene; anthracene; 1,2-benzanthracene; 3,4-benzofluoranthene; benzo[k]fluoranthene; 1,12-benzoperylene; benzo[a]pyrene; chrysene; dibenzo[ah]anthracene; fluorene; indeno[1,2,3-cd]pyrene; phenanthrene; and pyrene.

[9] PCBs (polychlorinated biphenyls) represent the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Arolclor-1254, and Arcolor-1260.

[10] TCDD equivalents represent the sum of concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as shown by the table below. USEPA Method 1613 shall be used to analyze TCDD equivalents.

Isomer Group	**Toxicity Equivalence Factor**
2,3,7,8 – tetra CDD	1.0
2,3,7,8 – penta CDD	0.5
2,3,7,8 – hexa CDD	0.1
2,3,7,8 – hepta CDD	0.01
octa CDD	0.001
2,3,7,8 – tetra CDF	0.1
1,2,3,7,8 – penta CDF	0.05
2,3,4,7,8 – penta CDF	0.5
2,3,7,8 – hexa CDFs	0.1
2,3,7,8 – hepta CDFs	0.01
Octa CDF	0.001

[11] Endosulfan shall mean the sum of alpha-endosulfan, beta-endosulfan, and endosulfan sulfate.

[12] Continuous monitoring for total residual chlorine becomes effective 6 months after the adoption date of this Order. At a minimum, daily grab samples shall be taken until continuous monitoring becomes possible (not to exceed 180 days following the adoption of this Order).

[13] Percent removal shall be calculated and reported based on mass for the Point Loma WTP and System-Wide:

Point Loma WTP % removal = (Influent mass – effluent mass) / Influent mass
Where:
Influent mass (lbs/day) = Influent flow (MGD) x influent parameter concentration (mg/L) x 8.34
Effluent mass (lbs/day) = Effluent flow (MGD) x effluent parameter concentration (mg/L) x 8.34

System-Wide % removal = [((System Influents–Return Streams) – Outfall Discharge)/(System Influents-Return Streams)] X 100
Where:
System Influents = Point Loma WTP influent, North City Water Reclamation Plant (NCWRP) Influent Pump Station, and NCWRP Influent from Penasquitos Pump Station.
Return Streams = NCWRP Filter Backwash, NCWRP Plant Drain, NCWRP Secondary and Un-disinfected Filtered Effluent Bypass, NCWRP Final Effluent, and MBC Centrate.

[14] USEPA Method 1631E, with a quantitation level 0.5 ng/l, shall be used to analyzed total mercury.

[15] Continuous monitoring is required. Within 180 days of the effective date of this permit, the Discharger shall begin continuous monitoring for total chlorine residual. Until that time, at least four grab samples per day, representative of the daily discharge, shall be collected immediately prior to entering the PLOO and analyzed for total chlorine residual. ***

[16] Also including the 301(h) pesticides listed at 40 CFR 125.58(p).

For system-wide percent removal the TSS and BOD_5 concentration, together with flow rate, of each stream shall be measured daily and a system-wide removal rate calculated according to the above formula. In the event that a flow rate measurement, TSS concentration, or BOD_5 concentration is not obtained from a stream, the median value for the previous calendar year for that stream shall be used as a surrogate number to allow completion of the calculation. The Discharger shall be required to flag values where surrogate numbers are used in their self-monitoring reports submitted to the Executive Officer. The failure to obtain a value may still be considered a violation of the permit that could result in enforcement action depending on the frequency of failures and efforts by the Discharger to prevent such failures.

V. WHOLE EFFLUENT TOXICITY TESTING REQUIREMENTS

The Discharger shall conduct acute and chronic toxicity testing on effluent samples collected at Effluent Monitoring Station EFF-001 in accordance with the following schedule and requirements:

Table E-4. Whole Effluent Toxicity Testing

Test	Unit	Sample	Minimum Test Frequency
Acute Toxicity	TU_a	24-Hr Composite	2/Year
Chronic Toxicity	TU_c	24-Hr. Composite	1/Month

A. Chronic Whole Effluent Toxicity Testing Requirements

1. Monitoring Frequency for Chronic Toxicity

The Discharger shall conduct monthly chronic toxicity tests on 24-hour composite effluent samples. For the initial three suites of chronic toxicity tests, the Discharger shall split a 24-hour composite effluent sample and concurrently conduct toxicity tests using a fish, an invertebrate, and an alga species. After the initial screening period, the Discharger shall conduct routine monthly toxicity testing using the most sensitive species. Every other year, the Discharger shall re-screen at a different time from the prior years. Re-screening can be limited to one month, if results are the same as the previous three-month screening. However, if results of the re-screening are different, then the Discharger shall conduct two additional months of re-screening to determine the most sensitive species and then conduct routine monthly toxicity testing using the most sensitive species.

Chronic toxicity test samples shall be collected for each point of discharge at the designated NPDES sampling station for the effluent (i.e., downstream from the last treatment process and any in-plant return flows where a representative effluent sample can be obtained). A split of each sample shall be analyzed for all other monitored parameters at the minimum frequency of analysis specified by the effluent monitoring program.

2. Marine and Estuarine Species and Chronic Test Methods

Species and short-term test methods for estimating the chronic toxicity of NPDES effluents are found in the first edition of *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (EPA/600/R-95/136, 1995), as amended, and applicable water quality standards. The Discharger shall conduct a static renewal toxicity test with the topsmelt, *Atherinops affinis* (Larval Survival and Growth Test Method 1006.01); a static non-renewal toxicity test with the giant kelp, *Macrocystis pyrifera* (Germination and Growth Test Method 1009.0); and a toxicity test with one of the following invertebrate species:

a. Static renewal toxicity test with the mysid, *Holmesimysis costata* (Survival and Growth Test Method 1007.01);
b. Static non-renewal toxicity test with the Pacific oyster, *Crassostrea gigas*, or the mussel, *Mytilus* spp., (Embryo-larval Shell Development Test Method 1005.0);
c. Static non-renewal toxicity test with the red abalone, *Haliotis rufescens* (Larval Shell Development Test Method);
d. Static non-renewal toxicity test with the purple sea urchin, *Strongylocentrotus purpuratus*, or the sand dollar, *Dendraster excentricus* (Embryo-larval Development Test Method); or
e. Static non-renewal toxicity test with the purple sea urchin, *Strongylocentrotus purpuratus*, or the sand dollar, *Dendraster excentricus* (Fertilization Test Method 1008.0).

If laboratory-held cultures of the topsmelt, *Atherinops affinis*, are not available for testing, then the Discharger shall conduct a static renewal toxicity test with the inland silverside, *Menidia beryllina* (Larval Survival and Growth Test Method 1006.01), found in the third edition of *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA/821/R-02/014, 2002; Table IA, 40 CFR Part 136).

3. Quality Assurance for Chronic Toxicity Testing

a. Quality assurance measures, instructions, and other recommendations and requirements are found in the test methods manuals previously referenced. Additional requirements are specified, below.

b. For this discharge, a mixing zone or dilution allowance is authorized. The chronic instream waste concentration (IWC) for this discharge is 0.4878% effluent. A series of at least five effluent dilutions and a control shall be tested. At minimum, the dilution series shall include and bracket the IWC.

c. Effluent dilution water and control water should be prepared and used as specified in the test methods manual *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (EPA/600/R-95/136, 1995) and/or *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA/821/R-02/014, 2002). If the dilution water is different from test organism culture water, then a second control using culture water shall also be used. If the use of artificial sea salts is considered provisional in the test method, then artificial sea salts shall not be used to increase the salinity of the effluent sample prior to toxicity testing without written approval by the Executive Officer and USEPA.

d. If organisms are not cultured in-house, then concurrent testing with a reference toxicant shall be conducted. If organisms are cultured in-house, then monthly reference toxicant testing is sufficient. Reference toxicant tests and effluent toxicity tests shall be conducted using the same test conditions (e.g., same test duration, etc.).

e. If either the reference toxicant or effluent toxicity tests do not meet all test acceptability criteria in the test methods manual, then the Discharger must resample and retest within 14 days.

f. Following Paragraph 10.2.6.2 in *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA/821/R-02/014, 2002), all chronic toxicity test results from the multi-concentration tests required by this permit must be reviewed and reported according to USEPA guidance on the evaluation of concentration-response relationships found in *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing* (40 CFR 136) (EPA/821/B-00-004, 2000).

g. Because this permit requires sublethal hypothesis testing endpoints from test methods in *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (EPA/600/R-95/136, 1995), within-test variability must be reviewed for acceptability and a variability criterion (upper %MSD bound) must be applied, as directed under each test method. Based on this review, only accepted effluent toxicity test results shall be reported on the DMR form. If excessive within-test variability invalidates a test result, then the Discharger must resample and retest within 14 days.

h. Because this permit provides for a sublethal hypothesis testing endpoint from Method 1006.0 in *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA/821/R-02/014, 2002), within-test variability must be reviewed for acceptability and variability criteria (upper and lower PMSD bounds) must be applied, as directed under Section 10.2.8 - Test Variability of the test methods manual *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms*. Under Section 10.2.8, the calculated percent minimum significant difference (PMSD) for both reference toxicant test and effluent toxicity test results must be compared with the upper and lower PMSD bounds variability criteria specified in Table 6 - Variability Criteria (Upper and Lower PMSD Bounds) for Sublethal Hypothesis Testing Endpoints Submitted Under NPDES Permits, following the review criteria in Paragraphs 10.2.8.2.1 through 10.2.8.2.5 of the test methods manual. Based on this review, only accepted effluent toxicity test results shall be reported on the DMR form. If excessive within-test variability invalidates a test result, then the Discharger must resample and retest within 14 days.

i. If the effluent is chlorinated and discharged without further treatment, then chlorine shall not be removed from the effluent sample prior to toxicity testing without written approval by the Executive Officer and USEPA.

4. Reporting of Chronic Toxicity Monitoring Results

a. A full laboratory report for all toxicity testing shall be submitted for the month in which the toxicity test was conducted and shall also include the toxicity test results as TUc = 100/NOEC and as EC25 (or IC25), reported according to the test methods manual chapter on report preparation and test review; the dates of sample collection and initiation of each toxicity test; water quality measurements monitored in the Toxicology Lab concurrently with the toxicity test(s); and progress reports on accelerated testing and TRE/TIE investigations.

b. The Discharger shall notify the San Diego Water Board and USEPA in writing within 14 days of exceedance of the chronic toxicity effluent limit. This notification shall describe actions the Discharger has taken or will take to investigate, identify, and correct the causes of toxicity; the status of actions required by this permit; and schedule for actions not yet completed; or reason(s) that no action has been taken.

B. Acute Whole Effluent Toxicity Testing Requirements

1. Monitoring Frequency for Acute Toxicity

The Discharger shall conduct semi-annual acute toxicity tests on 24-hour composite effluent samples. For the initial three suites of acute toxicity tests, performed concurrently, the Discharger shall split a 24-hour composite effluent sample and conduct toxicity tests using a fish and an invertebrate. After the initial screening period, the Discharger shall conduct routine semi-annual toxicity testing using the most sensitive species. Every other year, the Discharger shall re-screen at a different time from the prior years. Re-screening can be limited to one month, if results are the same as the previous three-month screening. However, if results of the re-screening are different, then the Discharger shall conduct two additional months of re-screening to determine the most sensitive species and then conduct routine semi-annual toxicity testing using the most sensitive species.

Acute toxicity test samples shall be collected for each point of discharge at the designated NPDES sampling station for the effluent (i.e., downstream from the last treatment process and any in-plant return flows where a representative effluent sample can be obtained). A split of each sample shall be analyzed for all other monitored parameters at the minimum frequency of analysis specified by the effluent monitoring program.

2. Marine and Estuarine Species and Acute Test Methods

The Discharger shall conduct 96-hour static renewal toxicity tests with the following vertebrate species:

a. The topsmelt, *Atherinops affinis* (Larval Survival and Growth Test Method 1006.0 in the first edition of Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms (EPA/600/R-95/136, 1995) (preferred for Pacific Coast waters);

b. The Inland silverside, *Menidia beryllina*; Atlantic silverside, *Menidia menidia*; or Tidewater silverside, *Menidia peninsulae* (Acute Toxicity Test Method 2006.0);

c. The sheepshead minnow, *Cyprinodon varigatus* (Acute Toxicity Test Method 2004.0);

And the following invertebrate species:

d. The West Coast mysid, *Holmesimysis costata* (Table 19 in the acute test methods manual) (preferred for Pacific Coast waters);

e. The mysid, *Americamysis bahia* (Acute Toxicity Test Method 2007.0).

Where not indicated, above, species and short-term test methods for estimating the acute toxicity of NPDES effluents are found in the fifth edition of *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (EPA/821/R-02/012, 2002; Table IA, 40 CFR Part 136).

3. Quality Assurance for Acute Toxicity Testing

a. Quality assurance measures, instructions, and other recommendations and requirements are found in the test methods manual previously referenced. Additional requirements are specified, below.

b. For this discharge, a mixing zone or dilution allowance is authorized such that the critical IWC is set at a % effluent value lower than 100% effluent. The acute instream waste concentration (IWC) for this discharge is 15.57% effluent. A series of at least five effluent dilutions and a control shall be tested. At minimum, the dilution series shall include and bracket the IWC.

c. Effluent dilution water and control water should be prepared and used as specified in the test methods manual *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (EPA/821/R-02/012, 2002); and/or, for *Atherinops affinis*, *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (EPA/600/R-95/136, 1995). If the dilution water is different from test organism culture water, then a second control using culture water shall also be used. If the use of artificial sea salts is considered provisional in the test method, then artificial sea salts shall not be used to increase the salinity of the effluent sample prior to toxicity testing without written approval by the Executive Officer and USEPA.

d. If organisms are not cultured in-house, then concurrent testing with a reference toxicant shall be conducted. If organisms are cultured in-house, then monthly reference toxicant testing is sufficient. Reference toxicant tests and effluent toxicity tests shall be conducted using the same test conditions (e.g., same test duration, etc.).

e. If either the reference toxicant or effluent toxicity tests do not meet all test acceptability criteria in the test methods manual, then the Discharger must resample and retest within 14 days.

f. Following Paragraph 12.2.6.2 of the acute test methods manual, all acute toxicity test results from the multi-concentration tests required by this permit must be reviewed and reported according to USEPA guidance on the evaluation of concentration-response relationships found in *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing* (40 CFR 136) (EPA/821/B-00/004, 2000).

g. Within-test variability of individual toxicity tests should be reviewed for acceptability and variability criteria (upper and lower PMSD bounds) should be applied, as directed under Section 12.2.8 - Test Variability of the test methods manual, *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms.* Under Section 12.2.8, the calculated percent minimum significant difference (PMSD) for both reference toxicant test and effluent toxicity test results must be compared with the upper and lower PMSD bounds variability criteria specified in Table 3-6 - Range of Relative Variability for Endpoints of Promulgated WET Methods, Defined by the 10th and 90th Percentiles from the Data Set of Reference Toxicant Tests, taken from *Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination System Program* (EPA/833/R-00/003, 2000). Based on this review, only accepted effluent toxicity test results shall be reported on the DMR form. If excessive within-test variability invalidates a test result, then the Discharger must resample and retest within 14 days.

h. Because this permit provides for a 96-hour LC50 endpoint from Method 1006.0 in *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (EPA/600/R-95/136, 1995), with-in test variability must be reviewed for acceptability and a variability criterion (upper %MSD bound) must be applied, as directed under the test method. Based on this review, only accepted effluent toxicity test results shall be reported on the DMR form. If excessive within-test variability invalidates a test result, then the Discharger must resample and retest within 14 days.

i. If the effluent is chlorinated and discharged without further treatment, then chlorine shall not be removed from the effluent sample prior to toxicity testing without written approval by the Executive Officer and USEPA.

j. Where total ammonia concentrations in the effluent are >5 mg/l, toxicity may be contributed by unionized ammonia. pH drift during the toxicity test may contribute to artifactual toxicity when ammonia or other pH-dependent toxicants (e.g., metals) are present. This problem is minimized by conducting toxicity tests in a static-renewal or flow-through mode, as outlined in Paragraph 9.5.9 of the acute test methods manual.

k. pH drift during the toxicity test may contribute to artifactual toxicity when pH-dependent toxicants (e.g., ammonia, metals) are present in an effluent. To determine whether or not pH drift during the toxicity test is contributing to artifactual toxicity, the Discharger shall conduct three sets of parallel toxicity tests, in which the pH of one treatment is controlled at the pH of the effluent and the pH of the other treatment is not controlled. Like a TIE, this test shall begin within 14 days of receipt of test results indicating acute toxicity exceedance. Testing shall be conducted as described in Section 11.3.6.1 of the test methods manual, *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA/821/R-02/013, 2002). Toxicity is confirmed to be artifactual and due to pH drift when no toxicity above the toxicity effluent limit is observed in the treatments controlled at the pH of the effluent. If toxicity is confirmed to be artifactual and due to pH drift, then, following written approval by the Executive Officer and USEPA, the Discharger may use the procedures outlined in Section 11.3.6.2 of the test methods manual to control sample pH during the toxicity test.

4. Reporting of Acute Toxicity Monitoring Results

a. A full laboratory report for all toxicity testing shall be submitted as an attachment to the DMR for the month in which the toxicity test was conducted and shall also include: the toxicity test results—LC50; TUa = 100/LC50—reported according to the test methods manual chapter on report preparation and test review; the dates of sample collection and initiation of each toxicity test; all results for effluent parameters monitored concurrently with the toxicity test(s); and progress reports on TRE/TIE investigations.

b. The Discharger shall notify the San Diego Water Board and USEPA in writing within 14 days of exceedance of an acute toxicity effluent performance goal. This notification shall describe actions the Discharger has taken or will take to investigate, identify, and correct the causes of toxicity; the status of actions required by this permit; and schedule for actions not yet completed; or reason(s) that no action has been taken.

VI. LAND DISCHARGE MONITORING REQUIREMENTS – NOT APPLICABLE

VII. RECLAMATION MONITORING REQUIREMENTS – NOT APPLICABLE

VIII. RECEIVING WATER MONITORING REQUIREMENTS – SURFACE WATER AND GROUNDWATER

A. Core Monitoring

There are five components to the Core Monitoring Program: general water quality monitoring and bacteriological monitoring of shoreline, kelp bed, and offshore waters; offshore sediment monitoring for grain size, chemistry, and benthic infauna community structure; offshore monitoring for fish and megabenthic invertebrate communities, and contaminant body burdens of fishes; and nearshore monitoring of kelp bed canopy cover.

1. General Water Quality Monitoring of Shoreline, Kelp Bed and Offshore Waters

The general water quality monitoring program is designed to help evaluate the fate of the wastewater plume under various conditions and to determine if Ocean Plan water quality standards are being met. The Discharger shall monitor the receiving water at the offshore, kelp bed, and shoreline monitoring stations, as follows:

Table E-5. General Water Quality Monitoring Requirements

Parameter	Units	Sample Type	Minimum Sampling Frequency			Required Analytical Test Method
			Offshore Stations	Kelp Stations	Shoreline Stations	
Temperature	°C	Profile	1/Quarter	5/Month	--	[1]
Salinity	ppt	Profile	1/Quarter	5/Month	--	[1]
Dissolved Oxygen	mg/L	Profile	1/Quarter	5/Month	--	[1]
Light Transmittance	%	Profile	1/Quarter	5/Month	--	[1]
Chlorophyll a	µg/L	Profile	1/Quarter	5/Month	--	[1]
pH	units	Profile	1/Quarter	5/Month	--	[1]
Ammonium	mg/L	Grab	1/Quarter	1/Quarter	--	[3]
Visual Observations[2]	--	Visual	1/Quarter	5/Month	5/Month	--

[1] As specified in 40 CFR 136.3.

[2] Visual observations shall note the presence or absence of floatable materials of sewage origin. Observations of wind (direction and speed), weather (e.g., cloudy, sunny, or rainy), and tidal conditions (e.g., high or low tide) shall be recorded. Observations of water color, discoloration, oil and grease, turbidity, odor, materials of sewage origin in the water or on the beach shall be recorded. These observations shall be recorded whenever a sample is collected. Further, the nature and extent of primary contact recreation use in federal waters must be noted and reported.

[3] Shall be monitored in State jurisdictional waters only, at the same discrete depths specified for bacterial monitoring in Table E-1.

Within 180 days of the effective date of this permit, the Discharger shall develop and implement a methodology for data analysis which identifies and logically evaluates out-of-range occurrences (ORO) for compliance with Ocean Plan water quality standards for transmissivity, dissolved oxygen, and pH, at offshore water quality stations. Data should be statistically evaluated by stratum (e.g., above, within, below pycnocline) and station. Sampling date reference station(s) should be identified using ocean current measurements and the location of the wastewater plume, etc. For analysis and discussion, stations may be grouped into relevant zones. The total number of out-of-compliance (OOC) events should be summed by parameter and the percentage of OROs and OOC calculated based on comparison with the total number of observations. Coordination with the State and San Diego Water Boards, USEPA, and SCCWRP is encouraged.

2. Bacteriological Monitoring of Shoreline, Kelp Bed and Offshore Waters

The bacteriological monitoring program is designed to help evaluate the fate of the wastewater plume under various conditions, to determine if Ocean Plan water quality standards for recreational waters are being met, and to address issues of beach water quality at the shoreline. The Discharger shall monitor the receiving water at the offshore, kelp bed, and shoreline monitoring stations, as follows:

Table E-6. Bacteriological Monitoring Requirements

Parameter	Units	Sample Type	Minimum Sampling Frequency			Required Analytical Test Method
			Offshore Stations	Shoreline Stations	Kelp Stations	
Total Coliform	CFU/100ml	Grab	--	5/Month	5/Month	[1,2]
Fecal Coliform	CFU/100ml	Grab	--	5/Month	5/Month	[1,2]
Enterococcus	CFU/100ml	Grab	1/Quarter	5/Month	5/Month	[1,2]

[1] As specified in 40 CFR 136.3.

[2] Shall be monitored at all applicable discrete depths specified for bacterial monitoring in Table E-1.

[3] Total coliform, fecal coliform, and enterococcus shall be sampled at the eight kelp bed stations at least five times per month, such that each day of the week is represented over a two month period.

3. Offshore Sediment Monitoring

The physical and chemical properties of sediments and the biological communities that live in or on these sediments are monitored to evaluate potential effects of the PLOO discharge and compliance with narrative water quality standards in the Ocean Plan. The core sediment monitoring program is designed to assess spatial and temporal trends. At the direction of the San Diego Water Board and USEPA, the requirement for sampling the secondary stations for the offshore sediment monitoring program can be relaxed to allow Discharger participation in Bight-wide regional monitoring efforts, or to accommodate Strategic Process Studies.

Twice per year (January and July), sediment samples for grain size and chemistry shall be collected from the offshore sediment monitoring locations specified in Table E-1, which consists of 12 primary stations and an additional 10 secondary stations. Sediment grab samples shall be taken using a 0.1 square meter modified Van Veen grab sampler. Samples for grain size and chemical analyses shall be taken from the top 2 centimeters of the grab. These samples shall be analyzed for the list of constituents, below. Chemical analysis of sediment shall be conducted using USEPA approved methods, methods developed by NOAA's National Status and Trends for Marine Environmental Quality, or methods developed in conjunction with the Southern California Bight Regional Monitoring Program. For chemical analysis of sediment, sample results shall be reported on a dry weight basis.

Table E-7. Offshore Sediment Chemistry Monitoring

Parameter	Units	Type of Sample	Minimum Frequency
Sediment grain size	µm	grab	2/Year[2]
Total Organic Carbon	Percent	grab	2/Year[2]
Total Nitrogen	Percent	grab	2/Year[2]
Acid Volatile Sulfides	mg/kg	grab	2/Year[2]
METALS			
Aluminum, Total Recoverable	mg/kg	grab	2/Year[2]
Antimony, Total Recoverable	mg/kg	grab	2/Year[2]
Arsenic, Total Recoverable	mg/kg	grab	2/Year[2]
Cadmium, Total Recoverable	mg/kg	grab	2/Year[2]

Parameter	Units	Type of Sample	Minimum Frequency
Chromium, Total Recoverable	mg/kg	grab	2/Year[2]
Copper, Total Recoverable	mg/kg	grab	2/Year[2]
Iron, Total Recoverable	mg/kg	grab	2/Year[2]
Lead, Total Recoverable	mg/kg	grab	2/Year[2]
Manganese, Total Recoverable	mg/kg	grab	2/Year[2]
Mercury, Total Recoverable	mg/kg	grab	2/Year[2]
Nickel, Total Recoverable	mg/kg	grab	2/Year[2]
Selenium, Total Recoverable	mg/kg	grab	2/Year[2]
Silver, Total Recoverable	mg/kg	grab	2/Year[2]
Tin, Total Recoverable	mg/kg	grab	2/Year[2]
Zinc, Total Recoverable	mg/kg	grab	2/Year[2]
PCBs AND CHLORINATED PESTICIDES			
PCBs[1]	ng/kg	grab	2/Year[2]
2,4-DDD	ng/kg	grab	2/Year[2]
4,4-DDD	ng/kg	grab	2/Year[2]
2,4-DDE	ng/kg	grab	2/Year[2]
4,4-DDE	ng/kg	grab	2/Year[2]
2,4-DDT	ng/kg	grab	2/Year[2]
2,4-DDT	ng/kg	grab	2/Year[2]
Aldrin	ng/kg	grab	2/Year[2]
Alpha-Chlordane	ng/kg	grab	2/Year[2]
Dieldrin	ng/kg	grab	2/Year[2]
Endosulfan	ng/kg	grab	2/Year[2]
Endrin	ng/kg	grab	2/Year[2]
Gamma-BHC	ng/kg	grab	2/Year[2]
Heptachlor	ng/kg	grab	2/Year[2]
Heptachlor Epoxide	ng/kg	grab	2/Year[2]
Hexachlorobenzene	ng/kg	grab	2/Year[2]
Mirex	ng/kg	grab	2/Year[2]
Trans-Nonachlor	ng/kg	grab	2/Year[2]
POLYCYLIC AROMATIC HYDROCARBONS			
Acenapthene	µg/kg	grab	2/Year[2]
Acenaphthylene	µg/kg	grab	2/Year[2]
Anthracene	µg/kg	grab	2/Year[2]
Benzo(a)anthracene	µg/kg	grab	2/Year[2]
Benzo(o)fluoranthene	µg/kg	grab	2/Year[2]
Benzo(k)fluoranthene	µg/kg	grab	2/Year[2]
Benzo(ghi)pyrelene	µg/kg	grab	2/Year[2]
Benzo(a)pyrene	µg/kg	grab	2/Year[2]
Benzo(e)pyrene	µg/kg	grab	2/Year[2]
Biphenyl	µg/kg	grab	2/Year[2]
Chrysene	µg/kg	grab	2/Year[2]
Dibenz(ah)anthrace	µg/kg	grab	2/Year[2]
Fluoranthene	µg/kg	grab	2/Year[2]
Fluorene	µg/kg	grab	2/Year[2]

Parameter	Units	Type of Sample	Minimum Frequency
Ideno(123cd)pyrene	µg/kg	grab	2/Year[2]
Naphthalene	µg/kg	grab	2/Year[2]
1-Methylnaphthalene	µg/kg	grab	2/Year[2]
2-Methylnaphthalene	µg/kg	grab	2/Year[2]
2,6-Dimethylnaphthalene	µg/kg	grab	2/Year[2]
2,3,5-Trimethylnaphthalene	µg/kg	grab	2/Year[2]
Perylene	µg/kg	grab	2/Year[2]
Phenanthrene	µg/kg	grab	2/Year[2]
1-Methylphenanthrene	µg/kg	grab	2/Year[2]
Pyrene	µg/kg	grab	2/Year[2]

[1] For sediment and fish tissue PCBs shall mean the sum of the following congeners: 18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, and 206. These represent consensus based numbers developed by agencies participating in offshore regional monitoring programs in Southern California. These 41 congeners are thought to represent the most-important PCB congeners in terms of mass and toxicity.

[2] To occur in January and July.

Twice per year (January and July), sediment samples for benthic infauna community structure shall be collected from the offshore sediment monitoring locations specified in Table E-1, which consists of 12 primary stations and an additional 10 secondary stations. Two replicate samples shall be taken using a 0.1 square meter modified Van Veen grab sampler. These samples shall be separate from those collected for grain size and chemistry. The samples shall be sieved using a 1.0-mm mesh screen. The benthic organisms retained on the sieve shall be fixed in 10 percent buffered formalin and transferred to at least 70 percent ethanol within two to seven days for storage. All retained benthic infauna organisms shall be counted and identified to as low a taxon as possible. This enumeration and identification of organisms continues the historical database developed by the Discharger.

Analysis of benthic community structure shall include determination of the number of species, number of individuals per species, and total numerical abundance present. The following parameters shall be calculated for each grab sample and summarized by station as appropriate:

a. Number of species per 0.1m^2 (species richness);
b. Total (cumulative) number of species per station;
c. Total numerical abundance;
d. Benthic response index (BRI);
e. Swartz's 75% dominance index;
f. Shannon's diversity index (H'); and
g. Pielou's evenness index (J').

4. Fish and Invertebrate Monitoring

Epibenthic trawls shall be conducted to assess the structure of demersal fish and megabenthic invertebrate communities, while the presence of priority pollutants in fish will be analyzed from species captured using both trawling and rig fishing techniques. Single community trawls for fish and invertebrates shall be conducted semi-annually at six trawl stations specified in Table E-1. These stations represent two areas near Discharge Point No. 001 (Stations SD-010 and SD-012), two areas upcoast of Discharge Point No. 001 (Stations SD-013 and SD-014), and two areas downcoast of Discharge Point No. 001 (SD-007 and SD-008). Trawls shall be conducted using a Marinovich 7.62 m (25 ft) head rope otter trawl, using the guidance specified in the field manual developed for the Southern California Bight Regional Monitoring Surveys. Captured organisms shall be identified at all stations.

All fish and megabenthic invertebrates collected by trawls should be identified to species if possible. For fish, community structure analysis shall consist of determining the total wet weight and total number of individuals per species, the total numerical abundance of all fish, species richness, species diversity (H'), and multivariate pattern analyses (e.g., ordination and classification analyses). The presence of any physical abnormalities or disease symptoms (e.g., fin erosion, external lesions, tumors) or parasites shall also be recorded. For invertebrates, community structure shall be summarized as the total number of individuals per species, the total numerical abundance of all invertebrates, species richness, and species diversity (H').

Chemical analyses of fish tissues shall be performed annually on target species collected at or near the trawl and rig fishing stations. The various stations are classified into zones for the purpose of collecting sufficient numbers of fish for tissue analyses. Trawl Zone 1 represents the nearfield zone, defined as the area within a 1-km radius of stations SD-010 and/or SD-012; Trawl Zone 2 is considered the northern farfield zone, defined as the area within a 1-km radius of stations SD-013 and/or SD-014; Trawl Zone 3 represents the LA-5 disposal site zone, and is defined as the area centered within a 1-km radius of station SD-008; Trawl Zone 4 is considered the southern farfield zone, and is defined as the area centered within a 1-km radius of station SD-007. Rig Fishing Zone 1 is the nearfield area centered within a 1-km radius of Station RF-001; Rig Fishing Zone 2 is considered the farfield area centered within a 1-km radius of station RF-002. There are no depth requirements for these six zones with regards to the collection of fishes for tissue analysis.

Liver tissues shall be analyzed annually (i.e., during October) from fishes collected in each of the above four trawl zones. No more than a maximum of five 10-minute (bottom time) trawls shall be required per zone in order to acquire sufficient numbers of fish for composite samples; these trawls may occur anywhere within a defined zone. Three replicate composite samples shall be prepared from each trawl zone, with each composite consisting of tissues from as least three individual fish of the same species. These liver tissues shall be analyzed for the presence and concentrations of lipids, PCB (congeners), chlorinated pesticides, and the following three metals: mercury, arsenic and selenium. The species of fish targeted for tissue analysis from the trawl sites shall be primarily flatfish, including, but not limited to, the longfin sanddab (*Citharichthys xanthostigma*) and the Pacific sanddab

(*Citharichthys sordidus*). If sufficient numbers of these primary species are not present in a zone, secondary candidate species such as other flatfish or rockfish may be collected as necessary.

Muscle tissues shall be analyzed annually (i.e., during October) from fishes collected in each of the above two rig fishing zones in order to monitor the uptake of pollutants in species and tissues that are consumed by humans. These species shall be representative of those caught by recreational and/or commercial fishery activities in the region. All fish shall be collected by hook and line or by setting baited lines or traps within the two rig fishing zones described above. The species targeted for analysis at the rig fishing sites shall be primarily rockfish, which may include, but are not limited to, the vermilion rockfish (*Sebastes miniatus*) and the copper rockfish (*Sebastes caurinus*). If sufficient numbers of these primary species are not present or cannot be caught in a particular zone, secondary target species (e.g., rockfish, scorpionfish) may be collected and analyzed as necessary. Three replicate composite samples of the target species shall be obtained from each zone, with each composite consisting of a minimum of three individual fish. Muscle tissues shall be removed from the composites and analyzed for the presence and concentrations of lipids, PCB (congeners), chlorinated pesticides, and the following nine metals: arsenic, cadmium, chromium, copper, lead, mercury, selenium, tin and zinc.

5. Kelp Bed Canopy Monitoring

Kelp bed monitoring is intended to assess the extent to which the discharge of waste may affect the aerial extent and health of coastal kelp beds. The Discharger shall participate with other ocean Dischargers in the San Diego Region in an annual regional kelp bed photographic survey. Kelp beds shall be monitored annually by means of vertical aerial infrared photography to determine the maximum aerial extent of the region's coastal kelp beds within the calendar year. Surveys shall be conducted as close as possible to the time when kelp bed canopies cover the greatest area. The entire San Diego Region coastline, from the international boundary to the San Diego Region/Santa Ana Region boundary shall be photographed on the same day. The images produced by the surveys shall be presented in the form of a 1:24,000 scale photo-mosaic of the entire San Diego Region coastline. Onshore reference points, locations of all ocean outfalls and diffusers, and the 30-foot (MLLW and 60-foot (MLLW) depth contours shall be shown. The aerial extent of the various kelp beds photographed in each survey shall be compared to that noted in surveys of previous years. Any significant losses which persist for more than one year shall be investigated by divers to determine the probable reason for the loss.

B. Strategic Process Studies

Special studies are an integral part of the permit monitoring program. They differ from other elements of the monitoring program in that they are intended to be short-term and are designed to address specific research or management issues that are not addressed by the routine core monitoring elements.

The scope of the special studies shall be determined by the Discharger in coordination with the Executive Officer and the USEPA. The Discharger may include input from whatever sources they deem appropriate. Each year, the Discharger shall submit proposals for strategic process studies to the Executive Officer and the USEPA by September 30, for the following year's monitoring effort (July through June). The following calendar year, detailed scopes of work for the proposals, including reporting schedules, shall, if requested by the Executive Officer, be presented by the Discharger at a spring San Diego Water Board meeting. Upon approval by the Executive Officer and the USEPA, the Discharger shall implement the special study. Reporting requirements and deadlines for the results of the special project studies will be determined and set at the time of project approval. Strategic studies conducted during the period of this permit shall be at a level of effort equal to that under Order No. R9-2002-0025, unless the Executive Officer, USEPA, and the Discharger agree otherwise.

C. Regional Monitoring

The Discharger shall participate in regional monitoring activities coordinated by the Southern California Coastal Water Research Project (SCCWRP). The procedures for Executive Officer and USEPA approval shall be the same as detailed above for the strategic process studies. The intent of regional monitoring activities is to maximize the efforts of all monitoring partners using a more cost-effective monitoring design and to best utilize the pooled scientific resources of the region. During these coordinated sampling efforts, the Discharger's sampling and analytical effort may be reallocated to provide a regional assessment of the impact of the discharge of municipal wastewater to the Southern California Bight. Anticipated modifications to the monitoring program will be coordinated so as to provide a more comprehensive picture of the ecological and statistical significance of monitoring results and to determine cumulative impacts of various pollution sources. The Discharger has participated in regional monitoring efforts in 1994, 1998, 2003, and 2008, and will participate in the regional monitoring effort planned for the timeframe around 2013. The level of effort will be provided to the Executive Officer and USEPA for approval. Proposed regional monitoring activities are defined by the Bight Steering Committee for the regional monitoring effort years.

The Discharger will be responsible for submitting the data collected during their portion of the regional monitoring program according to the prescribed schedule and procedures set by the Bight Steering Committee for that project's effort. Detailed analyses of these data will not be required separately by the Discharger, since they will participate in the analysis and write-up of the complete results from regional monitoring efforts. The final results will be published as part of the comprehensive monitoring effort for the Bight regional monitoring surveys.

It is anticipated that regional monitoring efforts will occur at five-year intervals.

D. Monitoring Location RS-001

1. The Discharger shall monitor return streams at RS-001 as follows:

Table E-8. Return Stream Monitoring Requirements

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method
Flowrate	MGD	Recorder/totalizer	Continuous	[1]
Total Suspended Solids	mg/L	24-hr Composite	1/Day	[1]
BOD_5@20°C	mg/L	24-hr Composite	1/Day	[1]

[1] As specified in 40 CFR 136.3.

IX. REPORTING REQUIREMENTS

A. General Monitoring and Reporting Requirements

1. The Discharger shall comply with all Standard Provisions (Attachment D) related to monitoring, reporting, and recordkeeping.

2. Reports of marine monitoring surveys conducted to meet receiving water monitoring requirements of this MRP shall include, as a minimum, the following information:

   a. The Discharger shall comply with all Standard Provisions (Attachment D) related to monitoring, reporting, and recordkeeping.

   b. The Discharger shall report all instances of noncompliance not reported under Attachment D, Sections III, V, and VI, of Order No. R9-2009-0001, at the time the monitoring reports are submitted.

   c. By July 1 of each year, the Discharger shall submit an annual report to the San Diego Water Board and USEPA that contains tabular and graphical summaries of the effluent and receiving water monitoring data obtained during the previous year. The Discharger shall discuss the compliance record and corrective actions taken, or which may be needed, to bring the discharge into full compliance with the requirements of this permit. The report shall restate, for the record, the laboratories used by the Discharger to monitor compliance with this permit, and provide a summary of performance relative to the permit requirements. Lists of analytical methods used to monitor pollutants should include available CAS numbers and published MDLs/MLs for the analytical methods.

   d. By April 1 of each year, the Discharger shall submit an annual report to the San Diego Water Board; USEPA Region 9; State Water Board, Division of Water Quality, Regulations Unit; and the San Diego County Department of Health Services, Hazardous Materials Division, describing its pretreatment activities over the previous calendar year, as specified elsewhere in this Order.

e. By April 1 of each year, the Discharger shall submit an annual report to the San Diego Water Board; USEPA; State Water Board, Division of Water Quality, Regulations Unit; and Arizona Department of Environmental Quality, describing its biosolids activities over the previous calendar year, as specified elsewhere in this Order.

f. Reports of marine monitoring surveys conducted to meet receiving water monitoring requirements of this MRP shall include, as a minimum, the following information:

   i. A description of climatic and receiving water characteristics at the time of sampling (weather observations, floating debris, discoloration, wind speed and direction, swell or wave action, time of sampling, tide height, etc.).

   ii. A description of sampling stations, including differences unique to each station (e.g., station location, sediment grain size, distribution of bottom sediments, rocks, shell litter, calcareous worm tubes, etc.).

   iii. A description of the sample collection and preservation procedures used in the survey.

   iv. A description of the specific method used for laboratory analysis.

   v. An in-depth discussion of the results of the survey. All tabulations and computations shall be explained.

The annual report for all receiving water monitoring is due by July 1 and shall include detailed descriptions of the statistical designs and statistical analyses of all collected data. Methods may include, but are not limited to, various multivariate analyses such as cluster analysis, ordination, and regression. The Discharger should also conduct additional analyses, as appropriate, to elucidate spatial and temporal trends in the data.

B. Self Monitoring Reports (SMRs)

1. At any time during the term of this permit, the State or San Diego Water Board may notify the Discharger to electronically submit Self-Monitoring Reports (SMRs) using the State Water Board's California Integrated Water Quality System (CIWQS) Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). Until such notification is given, the Discharger shall submit hard copy SMRs. For this purpose, a hard copy signed penalty of perjury statement accompanying a CD with a single file in PDF format (including the certification specified in Section V.B. 5 of Attachment D) shall qualify as a hard copy SMR. The CIWQS Web site will provide additional directions for SMR submittal in the event there will be service interruption for electronic submittal.

2. The Discharger shall report in the SMR the results for all monitoring specified in this MRP under Sections III through IX. The Discharger shall submit monthly SMRs

including the results of all required monitoring using USEPA-approved test methods or other test methods specified in this Order. If the Discharger monitors any pollutant more frequently than required by this Order, the results of this monitoring shall be included in the calculations and reporting of the data submitted in the SMR.

3. Monitoring periods and reporting for all required monitoring shall be completed according to the following schedule:

Table E-9. Monitoring Periods and Reporting Schedule

Reports	Report Period	Report Due
MONTHLY REPORTS Influent and effluent Solids removal/disposal Receiving water quality Tijuana cross-border emergency connection (when flowing)	Monthly	By the 1st day of 2nd following month (e.g., March 1 for January)
QUARTERLY REPORTS Sludge analysis	January-March April-June July-September October-December	June 1 September 1 December 1 March 1
SEMI-ANNUAL REPORTS Pretreatment report	January-June July-December	September 1 March 1
ANNUAL REPORTS Pretreatment report Sludge analysis QA report Flow measurement Outfall inspection Receiving waters monitoring Kelp report	January-December	April 1 April 1 April 1 July 1 July 1 July 1 October 1

4. Reporting Protocols. The Discharger shall report with each sample result the applicable reported Minimum Level (ML) and the current Method Detection Limit (MDL), as determined by the procedure in Part 136. For each numeric effluent limitation or performance goal for a parameter identified in Table B of the Ocean Plan, the Discharger shall not use a ML greater than that specified in Appendix II of the Ocean Plan.

   The Discharger shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

   a. Sample results greater than or equal to the reported ML shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).

b. Sample results less than the RL, but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported.

For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (+ a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.

c. Sample results less than the laboratory's MDL shall be reported as "Not Detected," or ND.

d. Dischargers are to instruct laboratories to establish calibration standards so that the ML value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the Discharger to use analytical data derived from extrapolation beyond the lowest point of the calibration curve.

5. Compliance Determination. Compliance with effluent limitations for reportable pollutants shall be determined using sample reporting protocols defined above and in Attachment A of this Order. For purposes of reporting and administrative enforcement by the Regional and State Water Boards, the Discharger shall be deemed out of compliance with effluent limitations if the concentration of the reportable pollutant in the monitoring sample is greater than the effluent limitation and greater than or equal to the reported Minimum Level (ML).

6. Multiple Sample Data. When determining compliance with a measure of central tendency (arithmetic mean, geometric mean, median, etc.) of multiple sample analyses and the data set contains one or more reported determinations of "Detected, but Not Quantified" (DNQ) or "Not Detected" (ND), the Discharger shall compute the median in place of the arithmetic mean in accordance with the following procedure:

a. The data set shall be ranked from low to high, ranking the reported ND determinations lowest, DNQ determinations next, followed by quantified values (if any). The order of the individual ND or DNQ determinations is unimportant.

b. The median value of the data set shall be determined. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, then the median is the average of the two values around the middle unless one or both of the points are ND or DNQ, in which case the median value shall be the lower of the two data points where DNQ is lower than a value and ND is lower than DNQ.

7. The Discharger shall submit SMRs in accordance with the following requirements:

a. The Discharger shall arrange all reported data in a tabular format. The data shall be summarized to clearly illustrate whether the facility is operating in compliance with interim and/or final effluent limitations. The Discharger is not required to duplicate the submittal of data that is entered in a tabular format within CIWQS. When electronic submittal of data is required and CIWQS does not provide for entry into a tabular format within the system, the Discharger shall electronically submit the data in a tabular format as an attachment.

b. The Discharger shall attach a cover letter to the SMR. The information contained in the cover letter shall clearly identify violations of the WDRs; discuss corrective actions taken or planned; and the proposed time schedule for corrective actions. Identified violations must include a description of the requirement that was violated and a description of the violation.

c. SMRs must be submitted to the San Diego Water Board, signed and certified as required by the Standard Provisions (Attachment D), to the address listed below:

Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

C. Discharge Monitoring Reports (DMRs)

1. As described in Section IX.B.1 above, at any time during the term of this permit, the State or San Diego Water Board may notify the Discharger to electronically submit SMRs that will satisfy federal requirements for submittal of Discharge Monitoring Reports (DMRs). Until such notification is given, the Discharger shall submit DMRs in accordance with the requirements described below.

2. DMRs must be signed and certified as required by the standard provisions (Attachment D). The Discharger shall submit the original DMR and one copy of the DMR to the State Water Board address listed below, and one copy of the DMR to the USEPA address listed below:

STANDARD MAIL	FEDEX/UPS/ OTHER PRIVATE CARRIERS
State Water Resources Control Board Division of Water Quality c/o DMR Processing Center PO Box 100 Sacramento, CA 95812-1000	State Water Resources Control Board Division of Water Quality c/o DMR Processing Center 1001 I Street, 15th Floor Sacramento, CA 95814

U.S. EPA, Region 9
ATTN: WTR-7, NPDES/DMR
75 Hawthorne Street
San Francisco, CA 94105

3. All discharge monitoring results must be reported on the official USEPA pre-printed DMR forms (EPA Form 3320-1). Forms that are self-generated will not be accepted unless they follow the exact same format of USEPA Form 3320-1.

D. Other Reports

1. The Discharger shall report the results of any acute and chronic toxicity testing, TRE/TIE, Antidegradation Analysis, Treatment Plan Capacity Study, Sludge Disposal Report, Pretreatment Report, and Collection System Report of Non-compliance, as required by Special Provisions – VI.C. of this Order. The Discharger shall submit reports with the first monthly SMR scheduled to be submitted on or immediately following the report due date.