Chapter 3 Affected Environment

As explained in Section 1.3, the ED is designed to address and fulfill the Commission's obligations under CEQA relative to the proposed NFMP. Consistent with that charge, this Chapter describes the environmental setting in and around the nearshore fishery. The discussion in this section, for example, describes the physical environmental conditions in the vicinity of the proposed project, as well as rare and unique environmental resources in the nearshore fishery. In this regard, the discussion of the environmental setting set forth below serves as the environmental "baseline" of physical conditions the Commission will use as a gauge to determine whether environmental impacts that might occur as a result of the proposed project are significant under CEQA.

3.1 Air Quality

California's concern about air quality is second only to its concern about water quality. The State has adopted air quality standards that are as stringent as federal standards. The impacts to air quality are of greater concern in highly urbanized areas due to the existence of long-term land-based impacts. Air quality also is affected by local climatic and meteorological conditions. Therefore, in an area like the Los Angeles basin, where there are persistent temperature inversions, predominant onshore winds, long periods of sunlight, and topography that traps wind currents, the effects of pollutants are more severe than along the central California coast where these components are less influential.

Off the northern and central California coasts, the prevailing winds are northwesterly with average wind speeds between six and seven meters per second (m/s). The highest measured wind speed is approximately 22.5 m/s with peak gusts of about 29.0 m/s. Off the southern California coast, the prevailing wind direction is westerly with an average speed of about 3.5 m/s (MMS 2001).

In general, sea surface temperatures off California are slightly higher than air temperatures. This tends to result in slightly unstable atmospheres over the water. Atmospheric stability provides a measure of the amount of vertical mixing of air pollutants. Dispersion of pollutants is favored when the atmosphere is unstable. However, off northern California, the sea surface temperature in the summer season is somewhat lower than the air temperature which tends to result in stable atmospheric conditions. Stable atmospheric conditions tend to limit mixing and dispersion of air borne pollutants. Furthermore, in coastal valleys, and particularly in the Los Angeles Basin, topography and recirculating due to land/sea breeze effects, inhibit atmospheric transport and dispersion. As a result, these areas experience poor air quality when they contain significant population centers.

Air quality at a given location can be described by the concentration of various pollutants in the atmosphere. Units of concentration are generally expressed in parts per million (ppm) or micrograms per cubic meter (ug/m^3). The significance of a pollutant concentration is determined by comparing the measured concentration to an appropriate federal and/or state ambient air quality standard. The standards represent the allowable atmospheric concentrations at which the public health and welfare are protected and include a reasonable margin of safety to protect the more sensitive individuals in the population. The degree of air quality degradation is compared to the health-based standards including the California Ambient Air Quality Standards (CAAQS) and the National Ambient Air Quality Standards (NAAQS) established by the Environmental Protection Agency (EPA). The NAAQS represent maximum acceptable concentrations that may not be exceeded more than once per year, except the annual standards, which may never be exceeded. The CAAQS represent the maximum acceptable pollutant concentrations that are not to be equaled or exceeded and are established by the California Air Resources Board (CARB).

The EPA has designated all areas of the United States as having air quality better than attainment or worse than nonattainment according to the NAAQS. A nonattainment designation means that a primary NAAQS has been exceeded more that three discontinuous times in three years in a given area. An area is in nonattainment if a CAAQS has been exceeded more than once in three years.

Criteria air pollutants are defined as those for which a state or federal ambient air quality standard has been established to protect public health (Table 2.3-1). They include nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), volatile organic compounds (VOCs), and particulate matter less than 10 microns in diameter (PM_{10}). Emission offsets for new sources are required when those sources exceed set emission levels. Fuel oil combustion emits nitrogen dioxide (NO_2) and particulates. Nitrogen oxides and volatile organic compounds interact in the presence of sunlight to form ozone.

Table 2.3-1. Ambient Air Standards

Pollutant	Averaging Time	California Standards	Federal Standards	
			Primary	Secondary
Ozone (O_3)	1 hour	0.09 ppm	0.12 ppm	same as primary
	8 hour	----	0.08 ppm	same as primary
Carbon Monoxide	1 hour	20.0 ppm	35.0 ppm	----
	8 hour	9.0 ppm	9.0 ppm	----
Nitrogen Dioxide	1 hour	0.25 ppm	----	same as primary
	Annual avg.	----	0.053 ppm (100 ug/m^3)	
Sulfur Dioxide	1 hour	0.25 ppm	----	----
	3 hour	----	----	0.5 ppm
	24 hour	0.04 ppm	0.14 ppm	----
	Annual avg.	----	0.03 ppm (80 ug/m^3)	----
Lead	30 day avg.	1.5 ug/m^3	----	----
	Calendar qtr.	----	1.5 ug/m^3	same as primary
Particulate Matter (PM_{10})	24 hour avg.	50 ug/m^3	150 ug/m^3	same as primary
	Annual avg.	30 ug/m^3	50 ug/m^3	
Particulate Matter ($PM_{2.5}$)	24 hour avg.	None	65 ug/m^3	same as primary
	Annual avg.	None	15 ug/m^3	
Sulfates	24 hour	25 ug/m^3	----	----

Table 2.3-1. Ambient Air Standards				
Hydrogen Sulfide	1 hour	0.03 ppm	----	----

The region of influence for inert pollutants (pollutants other than O_3 and its precursors) is generally limited to a few miles downwind from a source. Ozone is a secondary pollutant formed in the atmosphere by photochemical reactions of previously emitted pollutants or precursors. Ozone precursors are mainly the reactive portion of volatile organic compounds and NO_x. In the presence of solar radiation, the maximum effect of these pollutants on O_3 levels can occur many miles from the source. Ozone concentrations are highest during the warmer months of the year. Inert pollutant concentrations tend to be the greatest during the winter months (CSLC 1999).

The San Francisco Bay area is a nonattainment area for ozone (MMS 2001) at the federal level and nonattainment for O_3 and PM_{10} at the State level (CSLC 1999). In 1995 through 2000, the highest measured 1-hour average ozone concentration in the area was 0.16 ppm. The federal ozone standard is 0.12 ppm for the 1-hour average and the State standard is 0.09 ppm. The South Coast Air Basin, which includes Los Angeles, is classified nonattainment for O_3, PM_{10}, NO_2, and CO. The ozone nonattainment classification is in the extreme category. The highest measured 1-hour ozone concentration in Los Angeles County for 1995 to 2000 was 0.22 ppm. San Diego County is nonattainment for ozone and is classified serious. During this period, the highest measured 1-hour average O_3 concentration was approximately 0.16 ppm.

Air quality can be affected by emissions from gas and diesel engines in commercial and sportfishing vessels engaged in the take of nearshore organisms. The calculation of emissions from Commercial Passenger Fishing Vessel (CPFV) and commercial fishing vessels can be determined using the following emission factors for diesel fuel and gasoline respectively:

Carbon Monoxide (CO) = 110 pounds/1,000 gallons fuel
Hydrocarbons (HC) = 50 pounds/1,000 gallons fuel
Nitrogen Oxides (NOx) = 270 pounds/1,000 gallons fuel
Sulfur Oxides (SOx) = 27 pounds/1,000 gallons fuel

Carbon Monoxide (CO) = 1,822 pounds/1,000 gallons fuel
Hydrocarbons (HC) = 11 pounds/1,000 gallons fuel
Nitrogen Oxides (NOx) = 96 pounds/1,000 gallons fuel
Sulfur Oxides (SOx) = 6 pounds/1,000 gallons fuel

The volume of pollution emissions released when vessels are underway is influenced by a variety of factors including power source, engine size, fuel use, operating speed, and load. The emission factors can only provide a rough approximation of daily emission rates. Most commercial vessels and CPFVs engaged in the take of nearshore fish have diesel engines. Currently, two stroke diesel engines are most common, but four cycle engines, which are more efficient and less polluting, are becoming more popular for CPFV use. Overall fishing operations are responsible for less than one percent of the daily emissions from all sources (mobile and nonmobile) in California, and do not have a significant effect on air quality in the nearshore environment. However, they do add to the cumulative exposure effects to marine organisms.

The CARB has delegated responsibility of regulating stationary emission sources to local air agencies. These agencies have developed State Implementation Plans that detail how the State will attain the standards and describe thresholds to determine if the emissions are significant. The significant criteria are generally described as increased emissions levels in either pounds per day or tons per calendar quarter. Most of the Plans have factored in construction emissions into the significance criteria and therefore do not consider construction emissions to be significant for the purpose of CEQA. Emissions from fishing activities are not considered to exceed those produced by construction activities.

3.2 Water Quality

Water quality affects all fish species either directly or indirectly through the food chain, and the health of the ecosystem is largely determined by materials in the water, sediment, and air. The quantity and type of constituents entering the water column determines if the ecosystem is degraded by these inputs. Pollutants enter the nearshore marine ecosystem from many land sources, activities occurring on the water, and underwater geologic changes. The most familiar transport mechanisms include: ocean outfall from sewage treatment plants, storm water discharges containing trash and chemicals, river inputs of sediments with nutrients and/or pesticides, thermal discharges from power plants, spills from vessel traffic, dredge material disposal, wind transport of air-borne contaminants, and construction activities. Some of the chemicals break down into harmless components in days or weeks, while others last for many decades. Some of the pollutants affect the fish immediately (such as a sewage spill depleting oxygen in the water column), while others remain in the fish for years, eventually affecting reproduction capability, feeding ability, growth potential, or physiological functions. The tissues of aquatic organisms may accumulate environmental pollutants more than one million times the concentrations in the water column.

Environmental concentrations of some pollutants have decreased over the past 20 years as a result of better water quality management practices. However, environmental concentrations of heavy metals, pesticides, and toxic organic compounds have increased due to intensifying urbanization, industrial development, and the use of new agricultural chemicals. Health advisories have been issued in California for white croaker, black croaker, California corbina, surfperch, queenfish, California scorpionfish, rockfish, kelp bass, and striped bass.

Off the northern California coast, factors affecting water quality include municipal sewage outfall and riverine input. Marine and coastal water quality along the northern California coast is generally very good (MMS 1996) with selected contaminants (heavy metals, petroleum, and chlorinated hydrocarbons) producing only localized degradation. Coastal and marine water quality off the central California coast is good with minor exceptions. Portions of Monterey Bay have degraded water quality as a result of sewage effluent and riverine input from several local rivers. Coastal and marine water quality off southern California is good, but, as with the central coast, localized areas of water quality degradation exist due to high volume point sources (municipal wastewater outfall in Los Angeles, Orange County, San Diego) coupled with the combined effects of discharges from numerous small sources. Natural petroleum seeps are recognized as significant sources of hydrocarbons in the Santa Barbara Channel area.

The National Oceanic and Atmospheric Administration (NOAA) created the National Status and Trends (NS&T) Program to monitor trends of chemical contamination in space and time and to determine biological responses to that contamination. Based on six years of results from the NS&T program, on a national scale, biologically significant concentrations of contaminants are limited primarily to urbanized estuaries (e.g., San Diego, Los Angeles, Seattle, and portions of San Francisco Bay) (NOAA 1991). All of the trace metals and groups of organic compounds can be acutely or chronically toxic to marine life and even to people under some conditions. Biological effects can sometimes be expressed as tumors, particularly in the liver of fish. Fish in Bodega Bay (Sonoma County) have been found with liver tumors, although this area is generally considered uncontaminated. This implies that fish exposed to harmful levels of contaminants in one area may be taken by a fishery in another area. In addition, the NS&T program found that older fish generally had a higher frequency of tumors than younger fish.

Toxic contaminant inputs from industrial, agricultural, and commercial activities are a high-priority concern in the changing Bay ecosystem. San Francisco Bay receives effluents from 46 publicly owned wastewater-treatment plants, 65 large industrial discharges, and as much as 40,000 tons of at least 65 contaminants each year. Many of these contaminants are toxic to plants or animals or pose threats to human health. A comprehensive study of toxic trace metals by the United States Geological Survey (USGS) has shown that contamination levels in San Francisco Bay accelerated during the 1950s. Some Bay locations are among the most highly polluted coastal sites in the United States. Contamination by silver, cadmium, lead, and selenium is especially high. These metals are of particular concern because they can impair the growth or reproduction of fish, birds, and mammals. In 1990, the USGS began a series of special investigations to describe the origins and effects of toxic contaminants in San Francisco Bay. Early results have shown that pesticides (such as diazinon) applied in the Central Valley of California are carried by rivers into the Bay at levels exceeding national guidelines. Biological tests have shown river waters to contain high levels of pesticides soon after they are applied to fields. Public concern about the effects of toxic contaminants on coastal organisms is justified. Trace metals and pesticides are periodically found in San Francisco Bay at levels that can cause toxicity or impairment of ecosystem health.

Historically, sewage treatment plants served only as a way to gather sewage from a specific geographic location and then move it into the ocean. Now, most plants remove a significant amount of solids prior to discharging into the nearshore environment. While the coastal population has significantly increased since the 1950s, the mass of wastewater pollutants discharged (subject to regulatory controls) has been somewhat reduced while the volume has continued to increase. Storm drain-associated runoff is now the largest source of unregulated pollution to the waterways and coastal areas of the United States.

Discharged contaminants do not stay in the water column indefinitely but are transported to the sediments, and even directly to the aquatic organisms through absorption across body membranes or through ingestion of contaminated prey. Pollutants most frequently associated with sewage discharges include: sediment, nutrients, bacteria, petroleum products, heavy metals, pesticides, and other potentially toxic compounds. Chemicals released to surface waters from industrial and municipal discharges continue to accumulate to harmful levels in the sediments. Discharge limits for municipal and industrial point sources are based on either technology-based limits or state-adopted standards for the protection of the water column, not necessarily for downstream protection of sediment quality.

The Environmental Protection Agency (EPA) estimates that approximately 10 percent of the sediment underlying our nation's surface water is sufficiently contaminated with toxic pollutants to pose potential risks to fish, humans, and wildlife who consume fish. This represents about 1.2 billion cubic yards of contaminated sediment out of the approximately 12 billion cubic yards of total surface sediment where many bottom dwelling organisms live, and the primary exchange between the sediment and overlying surface water occurs.

Approximately 300 million cubic yards of sediment are dredged annually from harbors and shipping channels nationwide to maintain commerce, while 3 to 12 million cubic yards of those are sufficiently contaminated to require special handling and disposal (EPA 1997). The dredging of sediments in Humboldt Bay, San Francisco Bay, Santa Monica Bay, Seal Beach, Los Angeles and Long Beach Harbors, Newport Bay, and San Diego Bay has the potential to redistribute high levels of contaminants into the coastal environment. The majority of dredging operations along the coast occur within California's port and harbor facilities. Fish are exposed to contaminants from dredge material through the disturbance and redistribution of bottom sediment at both the dredge site and the disposal site. Many pollutants in the sediments have the potential to accumulate in increasing concentrations up the food chain and, therefore, affect more than just the organisms directly exposed to the contaminant. Adverse effects to organisms living in or near the bottom can occur even when contaminant levels in the overlying water are low. Marine organisms may accumulate pollutants through direct ingestion of sediment, transport of pollutants across body membranes, uptake of dissolved contaminants present in the interstitial (pore) water, ingestion of benthic organisms, or ingestion of first-order carnivores. Contaminated sediments can affect the food chain base by eliminating food sources, and in some cases altering natural competition, which can affect the population dynamics of higher trophic levels.

Resuspension of bottom sediments occurs naturally in areas of the continental shelf when turbulence associated with currents or effects of surface waves exceed the threshold required for initiating motion of seabed materials and/or mass movement of bottom sediments occurs in response to seismic events, turbidity currents, or excess loading. Suspended sediments also occur in surface waters following storm events that produce discharges from coastal rivers. Currents may transport these river-derived sediments substantial distances alongshore or offshore from their origin. Conditions necessary to cause resuspension of bottom sediments or inputs of river-derived sediments occur episodically and at different frequencies along the coast. Potentials of frequencies of sediment suspension events also diminish with greater bottom depths due to the progressively weaker influence from turbulence associated with the passage of surface waves.

In general, turbulence sufficient to cause resuspension of bottom sediments occurs more frequently along the portion of the coast north of Point Conception. In addition, the frequency and intensity of river discharge events in the northern portion of the coast generally are expected to be greater than those in the southern portion of the coast due to latitudinal differences in typical rainfall amounts. Fishing activities associated with this plan would not affect most water quality parameters including: temperature, salinity, dissolved oxygen, nutrients, or clarity/light transmittance. Descriptions of these parameters for coastal water off California are presented in Lynn et al. 1982 and Thomas and Siebert 1974.

Harbors and marinas are another source of pollutants that enter the coastal environment. Boat repair yard services typically include the repair and maintenance of mechanical systems, structural components, upholstery, electrical systems, and finished surfaces. Typical wastes generated from these operations include oil, coolants, lubricants, cleaning agents, paints, and dusts from sanding, sand blasting, polishing, and refinishing operations. All these contaminants have been documented to have detrimental effects on marine organisms. Water within the ports provide critical shelter habitat for a wide variety of ocean and coastal species during the larval and early adult stages. However, these resources are affected by port maintenance and development activities due to dredge and fill operations, discharge of storm water containing pollutants, release of contaminants from boat bottom paint, and discharges of petroleum products from fueling docks and bilge pumps.

According to EPA, spills during boat fueling are a major contributor to pollution of the nearshore waters. Fuel is spilled onto surface waters from fuel tank air vents while fueling the vessels and discharged during bilge pumping. These are individually small, but cumulatively large amounts, and contain petroleum hydrocarbons that persist in the aquatic environment both in the water column, sediments, and body tissues of marine organisms. It also has been demonstrated that emissions produced by two-stroke engines contain substances that negatively affect fish, most severely in the early life stages. Fish and shellfish larvae are extremely sensitive to small amounts of these products.

The egg, early embryonic, and larval-to-juvenile stages of fish are the most sensitive to oil exposure (Malins and Hodgins 1981). Embryos and larvae lack the organs found in adults that can detoxify hydrocarbons, and most are not mobile enough to avoid or escape spilled oil. In addition, the egg and larval stages of many species are concentrated in the surface layers of the water, where they are more likely to be exposed to the most toxic components of an oil slick (MMS 2000).

Petroleum hydrocarbons can severely impact communities of large bottom-dwelling organisms, as well as intertidal communities that provide food and cover for fishes. Fish can accumulate hydrocarbons from contaminated food and water.

Fish have the capability to metabolize some hydrocarbons and excrete both metabolites and parent hydrocarbons from the gills and the liver. Nevertheless, oil effects to fish occur in many ways: histological damage, physiological and metabolic perturbations, and altered reproductive potential (National Research Council 1985).

Natural seeps occur through southern California, but most are found offshore of the Santa Barbara coastline. The bioclastic, organic-rich Monterey Formation has been identified as a prolific source rock for petroleum generation since the early 1900s. Natural oil, tar, and gas seepage in the nearshore and offshore areas were known to the Indian inhabitants of coastal southern California in prehistoric times. Early European explores noted the occurrence of hydrocarbon seeps, particularly along the northern coastline of the Santa Barbara Channel. Seepage oil was an important commodity to both the Indians and the early European settlers of the region (MMS 2001). Most of the offshore seepage occurs in areas where the Monterey or Sisquoc formations are exposed at or near the seafloor, and where active faulting or growing folds are observed. Between 40 and 670 barrels of oil per day naturally seep into the Santa Barbara Channel (MMS 2001). At one location, near Platform Holly, two submarine tents have been used since 1982 to trap gas and oil seepage emanating from the ocean floor. Since installation, the seep containment structures have captured in excess of six billion cubic feet of gas from an area of 20,000 square feet.

As a result of the natural release of oil, tar balls are found washing up on beaches and offshore islands. Tar balls were expected and found on the north-facing shorelines of the Channel Islands during a recent survey by USGS, however, residues also were common on the south-facing shorelines adjacent to the Santa Barbara Channel where natural oil seeps and oil-production platforms are prolific. Preliminary geochemical analyses indicate several sources for the tar residues, most of which appear to be from natural oil seeps. In collaboration with the Minerals Management Service (MMS), a field study has been initiated by USGS to assess the interrelations among oil seeps, tarballs, and produced crude oils in a coastal region of southern California from Point Arguello to Point Conception. Photograph quadrats were established at rocky intertidal areas at Boathouse and Jalama Beaches for repeated sampling of tarballs at three-month intervals during the next three years. On the sandy beaches at Boathouse and Jalama, transects were run parallel and perpendicular to the shoreline; 108 tarballs were recovered from these transects. Casmalia Beach was very clean; only seven tarballs were observed.

In addition, the possibility of oil spills associated with commercial oil production is a potential threat to the nearshore environment. The largest oil spill in the Pacific Outer Continental Shelf (OCS) region occurred in 1969, when a blowout occurred on Platform A off Santa Barbara and spilled an estimated 80,000 barrels into the Channel (Van Horn et al.1988). No spill of this magnitude has since occurred anywhere on the OCS as a number of preventive measures have been implemented (MMS 2000).

Offshore oil and gas facilities have been operating in California since the late 1800s. Concerns regarding the cumulative effects of offshore development, combined with a number of major marine oil spills throughout the world, have led to a moratorium in California on new offshore leasing in State waters (California Coastal Commission 1997). Effects to marine organisms from oil and gas exploration and development occur due to navigation risks, drilling mud and cuttings disposal, air quality, oil spills, and other ecosystem degradation. A number of undeveloped leases exist along the California coast in federal waters within the northern Santa Maria Basin, San Luis Obispo and Santa Barbara Counties.

There are 79 existing federal OCS offshore California. Forty-three of the leases are developed and 36 are undeveloped. A total of 38 fields have been discovered in the California OCS, including 14 fields in the offshore Santa Maria Basin, 22 fields in the Santa Barbara Channel, and two fields in the offshore Los Angeles Basin. As of January 1, 2000, daily production from the 43 developed federal OCS leases offshore California was 95,000 barrels of oil and 222 million cubic feet of gas. This production is attributed to 13 fields. These reserves will last approximately 10 years for oil and 16 years for gas (MMS 2001). The first California tideland oil well was drilled in 1896 in Santa Barbara County. Within 10 years, about 400 wells could be seen on the beach and just offshore. The State now administers more than 100 sites on which oil companies have developed some 1,000 wells that take oil and gas from State lands. In addition, over 1,000 wells produce oil from granted tidelands in the City of Long Beach.

Currently, there are 23 production platforms, one processing platform, and six artificial oil and gas production islands located in the waters offshore California. Four of the platforms and six man-made production islands are located in state waters lying offshore of Santa Barbara and Orange Counties. A principal waste from oil production is produced water. Pollutants found in produced water include: oil and grease, metals, ammonia, phenols, cyanides, naphthalenes, and BTEX (benzene, toluene, ethylbenzene, and xylene) (MMS 2000). Research has demonstrated that hydrocarbons and other constituents of petroleum spills can, in sufficient concentrations, cause adverse impacts to fish (National Research Council 1985, Group of Experts on the Scientific Aspects of Marine Pollution 1993). The effects can range from mortality to sublethal effects that inhibit growth, longevity, and reproduction.

The withdrawal of ocean water by offshore water intake structures is a common coastwide occurrence in southern California and less frequently along the rest of the coast. Water may be withdrawn for providing a source of cooling water for coastal power generating stations or as a source of potential drinking water in the case of desalinization plants. Large amounts of water (often billions of gallons per day) are withdrawn from the nearshore coastal waters for the non-contact cooling of power generating plants. It is well known that millions of larval marine organisms are killed by their entrained passage through the power plants.

3.3 Geology

The Cenozoic geologic history (past 67 million years) of the Pacific coastal margin has been dominated by the interaction of oceanic and continental tectonic plates. Along the central and southern coast of California, north-northwest movement of the Pacific Plate relative to the American Plate has resulted in the formation of the San Andreas and subsidiary fault systems. Tectonic activity along these faults has dominated this region during the middle to late Cenozoic period. North of Cape Mendocino, the Gorda Plate is moving eastward beneath the continental North American Plate while the Pacific Plate is moving northwest. The Gorda, North

American, and Pacific Coastal plates form the Mendocino triple junction approximately 35 miles south-southwest of the Humboldt Bay area. These plates are bounded by the San Andreas Fault, the Mendocino Fault zone, and the Gorda Ridge. It is the subducting Gorda Plate that gives rise to the deep seismic zone which generates much of the earthquake activity in this region.

The geology along the California coast is characterized by three major stratigraphic sequences: 1) Cretaceous to lower Miocene (67 to 20 million years before present) clastic strata deposited as marine sequences in the shelf or slope environment, 2) middle to upper Miocene siliceous and calcareous (15 to 5 million years before present) strata deposited in deep-ocean environments, and 3) upper Miocene and younger (5 million years ago to present) clastic strata deposited primarily in shelf environments.

The regional geology for northern California is divided into two basins, the Eel River Basin (Cape Mendocino to Cape Blanco, Oregon) and Point Arena Basin (Point Arena to Cape Mendocino). The regional geology for central and southern California is divided into five different provinces: Central California (Eureka to Point Conception) overlaps portions of the previous two Basins), Santa Barbara Basin, Los Angeles Basin, Inner Borderlands (Channel Islands vicinity), and Outer Borderlands (Channel Islands to Mexico). Each of these provinces contain numerous faults, some which extend onshore (e.g., San Andreas Fault and San Gregorio Fault).

The main divisions of the seafloor are the shore, continental shelf, continental slope and rise, and deep-sea bottom. The continental shelf extends seaward from the shore to approximately 200 meters (m) depth. Because of the variability of the coastline and offshore topography, the distance that the shelf extends from shore varies from approximately one nautical mile to 25 nautical miles. The continental slope extends from approximately 200 m depth to an average depth of a few thousand meters. The continental slope can be further divided into upper, middle, and lower slope areas. The upper slope areas are from 200-500 m depth, middle slope between 500-1,200 m depth, and the lower slope between 1,200 and approximately 3,200 m depth.

Much of the area along the continental slope between Point Arena and Point Reyes is subject to recent slumping (McCulloch 1980). The existence of mass transport deposits indicates locations of past slope failure and zones of possible seafloor instability. Mass transport of sediments are common on the continental shelf and slope of northern California and the submarine canyons that incise the central California shelf. Mass transport is the gravity-induced downslope movement of consolidated to semi-consolidated sediments and consists of slides, slumps, and sediment creep.

The continental shelf of the greater Monterey Bay area between Point Año Nuevo and Point Sur exposes complex patterns of Mesozoic and Cenozoic rock outcrops, and coarse Quaternary sand bodies that occur in distinct depressions on the inner and mid-shelves. Exposures of familiar geologic formations from onshore central California, such as the Santa Cruz Mudstone and the Purisima and Monterey Formations, are present in the offshore. The tectonic structure mapped between Point Sal and Point Arena, offshore central California, found the main structural elements in the Monterey area include the San Andreas Fault Zone, San Gregorio Fault Zone, and the boundary of the Pacific and North American tectonic plates. A geologic map

(Vedder et al., 1986) shows that bedrock in the area of Anacapa Island is either undifferentiated sedimentary rocks of Miocene age, or volcanic rocks of Miocene age. The layering of the rocks in the data identify them as sedimentary rocks, probably of the Monterey Formation of Pliocene and Miocene age (Dibblee and Ehrenspeck, 1998).

The sea floor has representations of all major types of sediment: sand, mud, silt, hard rock outcroppings including pinnacles, cobbles and gravel, and clays. Low-relief rock outcrops (2 to 3 meters relief) provide unique habitat for a variety of fish and invertebrates. The canyons found throughout the coastal zone provide a channelized corridor for land-transported soils. The steep sides (up to 30 degrees for drops of several hundred meters along some canyons) are most likely cut into hard rock, probably the greywackes and metamorphic rocks of the Franciscan formation. Slump deposits are common in the submarine canyons off California and result from the undercutting of terrace and levee deposits by currents or by sediment transport in the canyons. The intermittent channel fill in the canyons is highly mobile and unstable.

Sediment grain size generally decreases with increasing depth off the coast, from predominantly sand-sized sediments on the continental shelf to fine-grained muds on the continental slope. The sand-to-sandy mud transition occurs at depths of 600 to 800 m. Above this depth, waves and the California undercurrent can scour the bottom, preferentially removing the finer-grained sediments. At depths below this range, the scouring effects are attenuated and fine-grained sediments have longer residence times on the bottom (Vercoutere et al. 1987). Within the depth range of 600 to 800 m, where the slope flattens from eight to four percent, the mud (silt and clay) content of the sediment increase from 12 to 55 percent. This is called the “mud line” or the mud transition that generally separates non-depositional or erosional bottoms above this depth range from more depositional regimes below this depth range.

The entire coast of California has received speculation about the presence of oil and gas reservoirs. Currently, southern California is the only area with active leases producing petroleum hydrocarbons. Test wells drilled off central and northern California resulted in positive indications of oil. The primary source of oil, and reservoir rocks of porous sandstones, are in the Monterey Formation of Middle and Late Miocene age. Additional potential hydrocarbon sources and reservoirs exist in the shales and sandstones of the younger and older rocks present. Tests drilled off Bodega Bay and Año Nuevo into the Monterey Formation to 3,000 feet deep resulted in drill cuttings coated with free tarry oil (MMS 1987). Hydrocarbon seeps in northern and central California occur exclusively on the continental shelf and upper slope in water depths of less than 700 feet (Richmond et al. 1981).

3.4 Physical Oceanography

The hydrographic conditions along the California coast are influenced by the California current system, precipitation, and river runoff. The North Pacific region is dominated by the Transitional Domain, but also is influenced by the Coastal Domain. The Transitional Domain is an east/west band of overlap between colder, lower salinity subarctic water to the north and warmer, more saline central Pacific water to the south. In this domain, water temperature in the upper layer is usually seven degrees Centigrade (^{o}C) or greater in the winter and 15^{o}C or more in the summer. The Coastal

Domain is characterized by marked localized variability in temperature and salinity. This variability is caused by local river runoff, upwelling, and mesoscale circulation features. Very nearshore tides influence the distribution of temperature and salinity through mixing. The boundary of the Coastal Domain is defined by the 32.4 parts per thousand (ppt) isohaline at 10 m depth (MMS 1987).

The dominant oceanographic feature of the waters along the west coast of the United States and Baja California, is the California Current. The California Current originates about 300 miles off the Oregon and Washington coasts between 45° and 50° North latitude and is described as a diffuse band (up to 620 miles wide), 328 to 1,640 feet deep, and slow moving (10 cm/sec) current which flows southward between late spring and early fall and northward during the winter and early spring (USFWS 1986). Within in the California Current are two poleward flows, the Coastal Countercurrent and the California Undercurrent (Neshyba et al. 1989). The northward flowing Coastal Countercurrent occurs over the continental shelf, inshore from the California Current, and typically is only 10 to 20 kilometers (km) wide with velocities less than 0.3 m/sec. It is broader and stronger in the winter when it occasionally covers the entire continental shelf and is referred to as the Davidson Current. The California Undercurrent is a strong current which flows poleward throughout the year over the slope (bottom depths of 200 to 5,000 m). However, when viewed at any given time, the California Current is made up of numerous eddies and jet-like filaments which result in a chaotic velocity field. For example, in the area between Point Arena and Bodega Bay, currents of 50 cm/sec are observed lasting for several days.

Coastal currents in a given location are strongly influenced by winds, large-scale currents occurring over a much larger area, bottom topography and the shape of the coastline, and changes in density due to heating/cooling and the input of freshwater from rivers. Winds are particularly important in influencing circulation along the California coast because they often produce intense upwelling and the energetic mesoscale circulation features associated with it. Satellite imagery frequently shows the presence of a large cyclonic counterclockwise eddy off Cape Mendocino during the summer. This eddy transports cold upwelled water originating near shore north of the cape seaward, while bringing warmer water ashore south of Cape Mendocino.

Upwelling along the west coast results from the interaction of the California Current and the winds generated by the North Pacific High. Due to the Coriolis effect, these northwesterly along-shore winds entrain surface water to the right, or away from the coast, a process known as Ekman transport. The transported water is replaced by cold, nutrient-rich subsurface water. Upwelling generally begins during the late spring (April to May) and ends in late summer early fall. This disruption of the stability of the water column is due to the transport of the deeper colder, more saline, and nutrient rich water to the surface. The offshore extent of the primary upwelling zone appears to be 6 to 12 miles along the entire coast, although continental shelf topography may cause a seaward expansion of upwelling effects. There are generally four flow states that occur during the spring to fall time period: Upwelling, Cyclonic, Relaxation, and quiescent period. The Upwelling regime is characteristic of cold, deep waters along the coast during early spring (35 percent of the year) when equatorward winds overwhelm any poleward along-shelf pressure gradient. Cyclonic flow occurs most frequently in the late spring through the summer (31 percent of the year) when upwelling favorable winds and a strong poleward along-shelf pressure gradient exist. Relaxation flow occurs most prominently in the early fall to early winter (27 percent of the year) when winds “relax” from their usual equatorward direction (MMS 2001).

In the Southern California Bight (Point Arguello to Mexico border) there are three dominant sources of water types: 1) cold, low salinity, highly oxygenated sub-arctic water brought by the California Current and ultimately the Coastal Countercurrent, 2) the moderate, saline, central north Pacific water advecting into the Bight from the west, and 3) warm, highly saline, low oxygen content (Equatorial) water entering the Bight from the south, principally through the California Undercurrent. The distribution of these waters in the Bight is such that the top 200 m is typically low in salinity and high in oxygen content, which identifies the water mass as principally sub-arctic even though temperatures range between nine to 18°C. The lower mass (below 300 m) is consistently high in salinity and low in dissolved oxygen identifying it as equatorial Pacific with temperatures between nine to five degrees C.

The circulation of the Bight is dominated by the Eastern Boundary Current of the North Pacific Gyre system, specifically the California Current, rather than by local wind forcing. The California Current carries sub-arctic water equatorward throughout the year, extends offshore a distance of about 400 km and to a depth of 300 m. The average speed is approximately 0.25 m/sec and occurs primarily during spring and summer. Nearer to the coast and within 150 km, the surface current periodically reverses to the poleward direction which is called the Coastal Countercurrent. This current is strongest during the fall and winter with its poleward flow reaching its maximum speeds typically within 50 km offshore of the coast.

Below 200 m depth, the poleward California Undercurrent exists throughout the year and is generally confined to within 100 km of the coast along the continental slope. This current originates in the eastern equatorial Pacific and brings these warm, saline, low dissolved oxygen water poleward into the Bight. Within the Bight are submarine valleys and mountains, the peaks of which form the various offshore islands that influence the movement of water masses within the Bight. A complete overturning of water masses in the Bight occurs between one to three months.

El Niño events represent an important interannual mode of variability in the oceanographic conditions along the west coast of the Pacific Ocean. These events occur at irregular intervals but usually at least once and often twice in a decade. The extent to which they alter circulation has not been fully documented but they are associated with anomalously warm water temperatures and the associated warm water biota which are transported northward with the advection of large volumes of water from the equatorial zone. The warm Pacific Current spawned an unusual series of storms from January 5 through 26, 1995, that caused heavy, prolonged, and, in some cases, unprecedented precipitation across California. This series of storms resulted in widespread minor to record-breaking floods from Santa Barbara to the Oregon border. Several stream-gaging stations used to measure the water levels in streams and rivers recorded the largest peaks in the history of their operation. El Niño events, that result in high river runoff, have been documented to spread riverine sediment plumes from the

Ventura/Santa Clara rivers south past Point Conception and to the vicinity of San Miguel Island (MMS 2001).

Both El Niño and regime changes are common, repetitive events readily observed in paleo-sediment analyses that extend back several thousand years. They also are clearly evident in time series analyses of physical factors (e.g., ocean temperatures) and indices of biological productivity (e.g., zooplankton densities). These longer-term events appear to be primarily dependent upon physical processes that are centered elsewhere in the Pacific and their effects include alterations in the physical, nutrient, and biological content of the waters entering the California Current system. Both processes also result in alterations in regional physical processes such as currents and upwelling that control local inputs of nutrients, productivity of kelp forests, and zooplankton populations that support populations of fishes and shellfishes harvested by California's commercial and recreational fisheries.

The effects of El Niño events in California include reduced input of cold, nutrient-rich waters from the north, and increased advection of warm, nutrient-poor water of subtropical origin into the southern California area. There may or may not be a reduction in winds that promote upwelling; however, nutrient input to the surface waters from upwelling is decreased due to reduced nutrients in the subsurface waters and a depressed thermocline. Thus, during El Niños, the California Current becomes less productive and more sub-tropical, and organisms enter the system from the south in greater numbers. For example, California spiny lobster and California sheephead, both have their centers of distribution off Baja California and recruit heavily to southern California (and sheephead as far north as Monterey) during strong El Niño events. During La Niñas, the environment is colder, zooplankton densities are higher, and subarctic organisms are favored. La Niña events with enhanced transport from the north result in increased recruitment of cool water fishes such as blue rockfish, in southern California.

3.5 Coastal Habitat

Coastal areas contain the most variety of habitats in California: tidepools, estuaries, bays, rocky headlands, sandy beaches, mudflats, eelgrass, surfgrass, high and low-relief rocky features, and kelp forests. These habitats also are the most highly impacted by human disturbances including: dredging and filling, draining of wetlands, pollution from point and non-point sources (including oil spills), withdrawal of water flows from streams and rivers, clearing of vegetation, damning or stoppage of water courses, diverting water channels, placement of bank stabilization structures, modifying habitat from one type to another (removing wetland for marina construction), and withdrawal of water for cooling purposes (often killing all life entrained).

Approximately one-half of the shoreline from Point Conception north along the coastline of California is rocky, forming either broad benches or cliffs. Boulder and cobble beaches are patchily distributed within this same area. Along the central coast, rocky shorelines form high cliffs and steep rocky benches. North of Point Conception, where strong and constant wave action prevails, sandy beaches are found in the lee of each point due to depositional patterns. South of Point Conception, over three-fourths of the shoreline is sandy (excluding offshore islands which are mostly rocky).

Intertidal habitats are of two principal types - rocky or sandy. Gradations, such as unstable boulders and human constructed bulkheads, wharfs, breakwaters, etc., occur but most of the coast is either sandy or rocky (including offshore stacks and islands). Biological and physical factors influence the distribution, abundance, and species composition in intertidal habitats. The more important physical factors include: exposure and impact of waves, substrate composition, texture and slope of the substrate, dessication, water temperature, and light. The more important biological factors include competition and predation.

The rocky shore intertidal substrate form a stable platform to which macroalgae and invertebrates attach and obtain a firm hold against the force of waves. Rocky intertidal organisms are characterized by interesting physiological processes which offer methods of attachment, means of surviving wave shock and coping with an alternate exposure to air and water. Adaptions are in the form of tough skins, heavy shells, strong tube feet, and horny threads by which mussels attach to the rocks. Among the cover and protection given by the larger attached plant and animals live a myriad of usually smaller invertebrates. Some attach to the larger basal organisms, while others move among the community grazing on vegetation and other filter planktonic species. Marine plants are primarily red, brown, and green algae. The sessile invertebrates include: barnacles in the upper zone, mussels in the middle zone, and anemones in the lower zone. Mobile grazers and predators include: crabs, amphipods, snails, urchins, limpets, and sea stars. During low tide, shore birds feed among the tidepools, while during high tide, fish feed on the productive intertidal community. Tidepool fish typically found include: striped surfperch, tidepool sculpin, tidepool snailfish, and cabezon. Another rocky intertidal community is dominated by surfgrass. This community occurs in the lower intertidal to subtidal areas and supports a major nursery habitat for a wide variety of fish and invertebrates.

Since the mid-1980s, the black abalone population in southern California and mid-1990s in central California has undergone major declines in abundance due to the fatal disease referred to as withering foot syndrome. Withering foot syndrome is caused by a bacterial infection which thrives in warm ocean waters. The disease caused the abalone’s foot to shrink in size to a point where it is no longer able to hold onto the rocks. The disease was first documented in the Channel Islands and at Diablo Cove where the nuclear plant discharges warm water. The El Niño conditions of the 1990s accelerated the northward and coastward spreading of the disease. Populations are less than five percent of their original level in some areas (MMS 2001).

Rocky features on the ocean floor, when compared to sandy bottom acreage are uncommon offshore California. Several hundred small rocky platforms and submerged islands can be found in the nearshore coastline off California, with the incidence of nearshore rocky areas increasing as you move north of Point Conception. Rocky features, or natural reefs, are important biologically because they support stable, long-lived, biologically diverse communities as well as provide a food source for fish and other organisms. Reefs can be as large as the offshore feature off Point Sal measuring seven miles at its widest point to small isolated pinnacles and outcrops. Subtidal rocky habitats are generally classified into two types, low- and high-relief. Low-relief is classified as rocky ledges and outcroppings less than one meter in height while high-relief are taller than one meter in height. Low-relief features contain less diverse, shorter-lived communities due to the constant or periodic disturbance by sedimentation. Most of the shallow water species prefer low-relief habitats where sediment flux is almost twice as high as on the deep reefs (MMS 2001). Communities associated with high-relief are rare. Long-lived, highly diverse biological communities found on high-relief features are characterized by the presence of a variety of long-lived organisms such as sponges, corals, and feather stars. The endangered coral has been found in a couple of locations of high-relief.

The environment of the exposed sandy intertidal is considerably less stable than that of the rocky intertidal. Every wave on the sandy beach moves large amounts of sand and, depending upon the season, may remove most of the sand overlying a hard substrate. Organisms on the surf-swept beach bury themselves for protection from being swept out to sea by waves. Most of the animals living on sandy beaches have pelagic larval stages, so the young must be set adrift and may settle in another part of the world than their parents. Food also is uncertain as little is produced in the sand itself. Sandy beaches have comparatively fewer organisms and species than the rocky habitats and population level fluctuations are far greater than found on the more stable substrate. The only marine algae that may be present are benthic diatoms. Polychaete worms, molluscs (snails and clams), crustaceans (sand crab, shrimps, and mole crab), and echinoderms (sand dollars) are the predominant invertebrates found. Surf smelt and grunion use the sandy beaches for spawning, while squid spawn in the sandy areas less than 100 feet.

Wetlands and estuaries throughout California have been severely impacted through physical alteration by commercial and residential development, upland practices in the watersheds increasing sediment load, and discharges of pollutants into the watersheds through agricultural practices and surface runoff. Coastal wetlands have lost approximately 75 percent of their original acreage in California (NOAA 1992). Estuaries are bodies of water, ranging in size from streams to large bays, which communicate with the sea through relatively narrow openings. The openings of many estuaries are closed to the sea for certain periods of time. Wetlands are the saturated lowland areas associated with the estuary, such as salt marsh or mudflat. These habitats provide areas where numerous threatened and endangered plant and animal species reside or migrate through.

Wetland, estuarine, and slough habitats consist of salt marshes, eelgrass beds, fresh and brackish water marshes, and mudflats. Wetland habitats may only occupy narrow bands along the shore, or they may cover larger expanses at the mouths of bays, rivers, or coastal streams. Wetlands and estuaries are characterized by high organic productivity, high detritus production, and extensive nutrient recycling. Portions of the wetland that are submerged during high tide provide valuable food resources and predator protection for the many larval stages that rear in estuaries. Plant species commonly associated with salt marshes include cordgrass and pickleweed.

Estuaries contain a greater diversity of both plant and animal life forms per unit surface area than any other habitat in the marine environment. Estuaries are highly productive because they constitute an area where freshwater, marine, and terrestrial habitats meet and intermingle. High levels of nutrient input from terrestrial sources, high levels of freshwater input from streams, levels of marine-origin nutrient input caused by tidal flushing, shallow depths, and high heat retention are factors supporting the greater productivity of estuaries. Because of their extremely high rate of biological productivity, estuaries are frequented by numerous species. They provide critical resting and feeding habitats for migratory shore birds and water fowl. The inhabitants of estuaries are characteristically euryhaline as they can adapt themselves to changes in the salinity of the water. More marine organisms are capable of adjusting to lower salinities than fresh or brackish water species to increased levels of salinity. Estuaries are important habitats for both resident and transitory species, provide spawning and nursery habitats, foraging areas for numerous species such as invertebrates, fishes, reptiles, birds, and mammals. Some species spawn in estuaries and their young reside there before returning to the sea, while the young of other species spawned in the ocean use estuaries for nursery habitats. On a daily or tidal-cycle, many species enter estuaries to feed. The larval and juvenile stages of the following species are documented to reside in estuaries and/or eelgrass beds: cabezon, kelp greenling, black rockfish, brown rockfish, calico rockfish, copper rockfish, kelp rockfish, and quillback rockfish (PFMC 2001).

Estuarine zone fisheries are of great economic importance across the Nation. Three-fourths of the fish species caught in the United States are supported by estuarine habitats. Clams, crabs, oysters, mussels, scallops, and estuarine and nearshore small commercial fishes contributed an average dockside revenue of $389 million nationally from 1990 to 1992 (PFMC 1998). Seventy-five percent of all commercial fish and shellfish landings are of estuarine-dependent species. At least 31 groundfish species inhabit estuaries and nearshore kelp forests for part, or all, of their life cycle.

Forage fish are small, schooling fish which serve as an important source of food for other fish species, birds, and marine mammals. Examples of forage fish species are herring, smelt, anchovies, and sardine. Many species of fish feed on forage fish. In addition, marine mammals consuming forage fish include: harbor seals, California sea lions, Stellar sea lions, harbor porpoises, Dall’s porpoise, and minke whales. Forage fish are most commonly found in nearshore waters and within bays and estuaries, although some do spend some of their lives in the open ocean.

Many threatened and endangered specie’s habitat are saltmarsh and estuaries. The California coastal areas contain more listed species (birds, fish, plants, mammals) than the rest of the west coast. The food provided is more abundant than the open ocean or provided in freshwater ecosystems. Many open-ocean species spawn in estuaries such as the great jellyfish larval polyps that rear in the sheltered waters of Elkhorn Slough (Hedgepeth 1968). Examples of other species that are found in estuaries include: oysters, sea cucumbers, octopus, midshipman, bat rays, leopard sharks, shrimps, sea pansies, sand dollars, clams, snails, crabs, sea otters, harbor seals, great egrets, great blue herons, terns, gulls, rails, pelicans, and cormorants.

Eelgrass is a perennial flowering sea plant that reproduces vegetatively and by seeds. Large mats of eelgrass provide essential habitat for many larval stages of commercial fish and crabs. Eelgrass supports a rather characteristic group of animals which live on its blades, about its base, and among its roots in the sediment. Eelgrass beds are found in estuaries from Alaska to Baja California. Many species are specialized to living on a portion of the eelgrass including snails, fixed jellyfish, and nudibranchs which live on the blades, sponges and shrimps in and around the roots, and scallops attached to clusters of eelgrass or swimming among the plants. Decaying eelgrass provides essential nutrients released into the water column and sediments to support planktonic filter feeders and benthic detrital feeders.

Almost all marine and intertidal waters, wetlands, swamps, and marshes are critical to fish. For example, seagrass beds protect young fish from predators, provide habitat for fish and wildlife, improve water quality, and control sediments. In addition, seagrass beds are critical to nearshore food web dynamics. Studies have shown seagrass beds to be among the areas of highest primary productivity in the world (PFMC 1998). This primary production, combined with other nutrients, provide high rates of secondary production in the form of fish.

Kelp forests off California are dominated by two species, the giant kelp and the bull kelp. Giant kelp can grow up to 100 feet and prefers the more calmer portions of the coast south of Point Conception. Large kelp beds have been identified in waters up to one mile offshore in the area from Point Conception to Gaviota and at San Miguel, Santa Rosa, and Anacapa Islands. Giant kelp is one of the most productive plants on earth able to grow 18 inches a day in full sunlight. While the giant kelp may live several years, the life of each frond is typically six months or less. It is to the kelp's advantage to replace old fronds with new and buoyant fronds.

Bull kelp is more resistant to the rougher waters outside protective bays and inlets. Some areas contain both species but, where colder waters dominate through out the year, bull kelp forms a monoculture forest. Bull kelp is an annual plant dying off each fall season while giant kelp is a perennial and may live seven to eight years. Kelp usually attach to rock outcrops or cobbles to stay in place, but in the Santa Barbara Channel, waters are so calm that kelp plants can become established in sandy subtidal regions by attaching themselves to worm tubes (MMS 2001). Hundred of species of animals and 400 types of sea plants have been cataloged in the kelp forests of Monterey Bay (NOAA 1997). Kelp forests provide vertical water column habitat for many types of adult and juvenile fish, marine mammals such as the sea otter, and other marine animals. Kelp forests provide critical habitat for encrusting animals such as sponges, bryozoans, and tunicates, as well as for juvenile fish, molluscs such as abalone, algae, and for other invertebrates. Fish associated with kelp forests include: greenling, lingcod, bocaccio, and many species of surfperch and rockfish. Gray whales have been reported to feed near kelp forests and to seek refuge from predatory killer whales. Kelp also provides a food resource for fish, and for grazing and detritus-feeding invertebrates such as isopods and sea urchins. Predators, such as sea stars and sea otters, are active there also.

As natural predators, the red and purple urchin have a dramatic effect on determining the health of a given kelp forest. In many areas, such as Diablo Cove, purple urchins have become overabundant preventing out reestablishment of kelp. Areas dominated by urchins are called "urchin barrens" due to the imbalance between urchins and kelp or other algae. During warm water years, or in areas influenced by warm power plant discharges, both kelp and urchins die off, but the urchins are able to tolerate higher temperatures and eventually graze the rocky areas bare of kelp and algae. Commercial taking of red urchins only exacerbates the problem by reducing the competition between red and purple urchins and eliminating the natural urchin predators such as the sheephead due to lack of prey items.

Kelp detached and transported during storms provides a source of food for other local habitats. Sandy beach fauna, from invertebrates to shore birds, utilize the kelp washed up on the beach. Kelp wrack can provide critical food resources for wintering shore birds. Kelp that sinks provides food for deep water benthic organisms which are dependent on drifting food. Kelp that detaches and forms floating rafts provides habitat for juvenile rockfish and other pelagic species.

3.6 Benthic Habitat

All bottom types are represented off California and are discussed in the Geology section. Rocky shelves, pinnacles, and boulders give way to sandy and mud bottoms as depths increase. The benthic zone includes soft-bottom habitat, hard-bottom habitat, and low- and high-relief features. Organisms associated with the different types of benthic habitat are more specialized in their adaptations than those found in the changing coastal zone. Benthic infaunal species are those that primarily live all or a major part of their life cycle living within the sediments. Demersal epifaunal species are those that live on or near the bottom.

Fish demersal species are differentiated by depth or depth-related factors. The shelf community is from depths of at least 30 to approximately 200 meters and is characterized by sanddabs, English sole, rex sole, rockfish, lingcod, pink surfperch, plainfin midshipman, skates, rays, halibut, and white croakers. Most are of commercial and recreational value. Flatfish are dominant on the shelf and upper slope at depths between 100 to 500 m in sandy and muddy bottoms. Upper and middle slope fish species are characterized by rockfish, flatfish, sablefish, hake, slickheads, and eelpouts. They range in depths from 200 to 1,200 meters deep with thorny heads, hake, slickheads, and rattails inhibiting the middle slope (500 to 1,200 m). The lower slope (1,200 to 3,200 m) taxa include rattails, thornyheads, finescale codling and eelpouts. At depths lower than 1,500 m, the numbers of fish species, densities, and biomass are expected to be extremely low (Advanced Research Projects Agency 1994) compared to those found on the upper and middle slope.

Shelf habitats off California are very rich in the number of species and abundances of infauna. This trend is influenced by upwelling and high productivity. Continental shelf communities (less than 200 m) are dominated by polychaetes of several families and other common taxa such as amphipods, gastropod snails, decapods, mysids, ostracods, brittle stars, and phoronids. Continental slope communities also are very rich, with even higher numbers of species at some depth than noted for the continental shelf areas. Key features of the slope communities include the following: 1) a marked decrease in infauna densities between approximately 800 to 1,000 m depth, corresponding to the oxygen minimum zone, followed by 2) sharp density increases to approximately 1,800 m depth, and finally 3) a gradual decrease with further increases in depth. Most of the species tend to be either deposit-feeding or detrital-feeding primarily depending on food falling of from the photic zone.

Large woody debris also plays a significant role in benthic ocean ecology, where deep-sea wood borers convert the wood to fecal matter providing terrestrial based carbon to the ocean food chain (PFMC 1998). Epifaunal communities include representatives from the following taxa: sponges, brittle stars, sea stars, sea pens, sea cucumbers, octopus, sea anemones, vase sponges, cup and branching corals, Tanner crabs, clams, and snails.

3.7 Pelagic Habitat

The continental shelf is relatively narrow off northern California. The east-west trending Mendocino Escarpment is a major submarine topographic feature off the west coast of the United States. Several submarine canyons are located offshore California with the Eel River Canyon prominent in northern California, Monterey Bay Canyon in central California, and Redondo Canyon in southern California. The pelagic habitat can be subdivided into three zones, epipelagic zone (surface to 200 m), mesopelagic (200 to 1,000 m), and bathypelagic zone (1,000 m to bottom). The epipelagic zone waters are typically well lighted, well mixed, and capable of supporting actively photosynthesizing algae. The mesopelagic zone is characterized by decreased light, temperature, and dissolved oxygen concentrations while pressure increases. The bathypelagic zone is characterized by complete darkness, lower temperatures and oxygen levels, and greater pressures as depth increases. Each of these zones is distinguished by characteristic fish assemblages.

Pelagic species spend most of their life in the open ocean but some, like herring, utilize estuaries for a portion of their life cycle. Other commercial and recreational pelagic fish species include: northern anchovy, Pacific sardine, salmon, mackerel, and albacore tuna. Squid is another important pelagic species. Coastal pelagic species are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. Several species are managed by the Pacific Fishery Management Council (PFMC) Coastal Pelagic Species Fishery Management Plan.

Pacific sardine inhabit coastal subtropical and temperate waters and, at times, has been the most abundant fish species in the California current. During times of high abundance, Pacific sardine range from the tip of Baja California to southeastern Alaska. When abundance is low, Pacific sardine do not occur in large quantities north of Point Conception, California. The central subpopulation of northern anchovy ranges from San Francisco, California to Punta Baja, Mexico. Adult and juvenile squid are distributed throughout the Alaska and California current systems, but are most abundant between Punta Eugenio, Baja California and Monterey Bay, California.

Epipelagic fish can be distinguished based on two ecological types. Oceanic forms are those that spend all or part of their life in the open ocean away from the continental shelf, while nearshore forms spend all or part of their life in water above the continental shelf. Typical epipelagic fish include fast-moving species such as tunas, mackerels, swordfish, blue sharks, thresher sharks, white sharks, and salmon, as well as schooling baitfish such as Pacific herring, northern anchovy, and juvenile rockfish. The largest schools of anchovy occur within 25 miles of the coast over deep water, often over escarpments and submarine canyons. During daylight hours of summer and fall months, large compact schools may be found at depths of 360 to 600 feet. Most mesopelagic species undergo vertical migrations often moving into the epipelagic zone at night to prey on plankton and other fish. Typical mesopelagic species include: deep-sea smelt, lanternfish, and viperfish. In addition to various mesopelagic invertebrates such as krill and copepods, the major mesopelagic fish species forming the deep scattering layer include lanternfish and bristlemouths which migrate vertically. In contrast to mesopelagic fish, bathypelagic species are largely adapted for a sedentary existence in a habitat with low levels of food and no light. Some of the species occupying the bathypelagic zone also cross into the mesopelagic zone during vertical migrations. Many of these fish have light producing organs which attract prey and potential mates. Blackdragons, dragonfish, laternfish, and tubeshoulders can be found at these depths.

Pelagic invertebrates include those species capable of movement throughout the water column and/or just above the bottom. Examples include: euphausiids, squid, pteropods, heteropods, cephalopods, and octopuses. Many of these species are either of commercial importance or are prey items for fish, seabirds, and marine mammals. Gelatinous invertebrates, such as jellyfish, salps, and tunicates, are the important prey items of sea turtles and blue rockfish. Many pelagic invertebrates are components of the deep scattering layer. The deep scattering layer is described as a layer of living organisms, ranging from almost microscopic zooplankton to copepods, shrimp, and squid. This layer is present at different depth ranges during the day (200 to 800 m) and night (generally near the surface).

Phytoplankton is generally limited in distribution from the sea surface to approximately 100 m depth corresponding to the effective range of light penetration for photosynthesis. The predominant members of the phytoplankton community are diatoms, silicoflagellates, coccolithophore, and dinoflagellates. Population increases generally occur during the summer and fall months in response to upwelling events. The upwelling bloom events are dominated by diatoms, and during non upwelling events, dinoflagellates are dominant.

Zooplankton species are not limited to the photic zone and can occur from surface waters to depths of over 400 m. Many zooplankton species are able to vertically migrate up to several hundred meters. Copepods and euphausiids dominate the zooplankton community in terms of numbers and biomass. They are critical food sources for many species including juvenile fish and mysticete whales. Commercial important crustacean larval and larval fish are members of the zooplankton community for several weeks to months.

3.8 Areas of Special Concern

3.8.1 Essential Fish Habitat (EFH)

The Pacific Fishery Management Council (PFMC) manages 90 species of fish under three Fishery Management Plans: 1) Coastal Pelagics Fishery Management Plan, 2) Pacific Salmon Fishery Management Plan, and 3) Pacific Groundfish Fishery Management Plan. The Magnuson-Stevenson Act defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” National Marine Fisheries Service guidelines state that “adverse effects from fishing may include physical, chemical, or biological alterations of the substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem." The EFH has been established for five species of coastal pelagics: Pacific sardine, Pacific mackerel, northern anchovy, jack mackerel, and market squid which is from the coast out to the edge of the Exclusive Economic Zone (EEZ) between the U.S. to Canada and U.S. to Mexico borders.

The EFH also has been established for 83 species of groundfish. EFH for Pacific Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem (PFMC 2001). Descriptions of groundfish fishery EFH for each of the 83 species and their life stages result in over 400 EFH identifications. When these EFHs are taken together, the groundfish fishery EFH includes all waters from the mean higher high water line and the upriver extent of saltwater intrusion in river mouths, along the coast of Washington, Oregon, and California seaward to the boundary of the EEZ. The seven "composite" EFH identifications are as follows: estuarine, rocky shelf, non-rocky shelf, canyon, continental slope/basin, neritic zone (33 feet and shallower), and the oceanic zone (66 feet and deeper). Life history and habitat needs for the 82 species managed under the groundfish FMP are described in the EFH appendix to Amendment 11, which is available online at http://www.ner.noaa.gov/1sustfsh/efhappendix/page1.html and is incorporated by reference.

The EFH has been established for five species of salmon: chinook, coho, chum, pink, and sockeye. The EFH for these salmon include those waters and substrate necessary for salmon production to support a long-term sustainable salmon fishery. The EFH includes all streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon. In the estaurine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within State territorial waters out to the full extent of the EEZ.

Habitat Areas of Particular Concern (HAPC) are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Currently, only Amendment 14 to the Pacific Coast Salmon Plan has addressed HAPC for chinook, coho, and pink salmon.

California's Marine Managed Areas (MMAs), such as refuges, reserves, and state reserves, are one of many tools for resource managers to use for protecting, conserving, and managing the State's valuable marine resources. MMAs can offer many benefits, including protecting habitats, species, cultural resources, and water quality; enhancing recreational opportunities; and contributing to the economy through such things as increased tourism and property values. MMAs also may benefit fisheries management by protecting representative habitats and reducing extractive uses. There are 18 classifications and subclassification of MMAs (FGC Section 36601). The mission of the State MMAs is to ensure the long-term ecological viability and biological productivity of marine ecosystems and to preserve cultural resources in the coastal areas in recognition of their intrinsic value and for the benefit of current and future generations. Six classifications for designating managed areas in the marine and estuarine environment are: marine (estuarine) reserve, marine (estuarine) park, marine (estuarine) conservation area, marine (estuarine) cultural preservation area, marine (estuarine) recreational management area, and a state water quality protection area (includes ASBS see below).

3.8.2 Sanctuaries

Refuges, preserves, and marine sanctuaries are areas that are legally defined and regulated by the State or federal government, with the primary intent of protecting marine resources for their inherent biological or ecological value. Four national marine sanctuaries, out of 11 nationwide, are found in California, Cordell Banks (designated 1989), Gulf of the Farallones (designated 1981), Monterey Bay (designated 1992), and Channel Islands (designated 1980). Marine sanctuaries were created with the passage of the Marine Protection, Research, and Sanctuaries Act of 1972. The mission of the national marine sanctuary program is “to identify, designate and manage areas of the marine environment of special national significance due to their conservation, recreational, ecological, historical, research, educational, or esthetic qualities (15 CFR Part 922).” The objectives of the sanctuary program are to: 1) preserve and protect valuable marine resources, 2) promote scientific research, 3) enhance public awareness, and 4) facilitate, to the extent compatible with the primary goal of resource protection, multiple use of these marine areas.

3.8.3 Reserves and Refuges

In addition to the federally designated national sanctuaries, several State refuges, parks, and reserves are located throughout the nearshore areas. While the nomenclature and regulations are not standard among the State’s marine reserves, the underlying intent of protecting biologically important habitats and marine life is universal. The purpose of refuges and reserves is to reduce the abuse and waste of the State’s tidepool resources by restricting general collecting of all animals living in tidepools and other areas between the high tide line and 1,000 feet below the low tide line (MMS 1987). This is achieved by prohibiting the general collection of animals and plants within the designated boundaries of preserved. The Department of Fish and Game enforces regulations in both refuges and reserves. Ecological reserves extend this level of protection to include rare or endangered wildlife and aquatic organisms, as well as specialized habitat types, both terrestrial and aquatic. Designation of individual or networks of reserves is intended to protect marine habitats, ecosystems, and living marine resources. Such reserves are created to satisfy one or more of the following purposes: natural heritage, ecosystem biodiversity, education/research, and/or fisheries management (FGC 2001 Addenda). Thus, entire ecosystems are maintained in a natural condition for the benefit of both the general public and scientific communities. The California Sea Otter Game Refuge is the largest covering 216 km of coastline between the Carmel River, Monterey County and Santa Rosa Creek, San Luis Obispo County and was established to protect the sea otter population throughout its range in California.

3.8.4 Areas of Special Biological Significance

In addition, Areas of Special Biological Significance (ASBS) have been designated by the California State Water Quality Control Board in 1974 and 1975, and are designed to protect intertidal and shallow subtidal areas. They are areas containing biological communities of such extraordinary, even though unquantifiable value, that no acceptable risk of change in their environments as a result of man's activities can be entertained (MMS 1987). ASBSs deserve special protection through the preservation and maintenance of natural water quality conditions by prohibiting the discharge of wastes into, or within the vicinity of, these special biological communities. Many of the 34 total ASBSs in the State overlap geographically with established marine life refuges and reserves. Refer to Table 2.3-2 for a list of all areas of special concern.

Table 2.3-2. Areas of Special Biological Significance in or Adjacent to the Marine Environment

Areas Of Special Biological Significance		
Redwoods National Park	Kelp Beds at Trinidad Head	
Kings Range National Conservation Area	Pygmy Forest Ecological Staircase	
Pygmy Forest Ecological Staircase	Del Mar Landing Ecological Reserve	
Kelp Beds at Saunders Reef	Bodega Marine Life Refuge	
Gerstle Cove	Pt. Reyes Headland Reserve	
Bird Rock	Duxbury Reef Reserve	
Double Point	James V. Fitzgerald Marine Reserve	
Farallon Island	Pacific Grove Marine Gardens Fish Refuge	
Ano Nuevo Point and Island	Carmel Bay	
Hopkins Marine Life Refuge	Julia Pfeiffer Burns Underwater Park	
Point Lobos Ecological Reserve	San Miguel, Santa Rosa, and Santa Cruz Islands	
Ocean Area Surrounding the Mouth of Salmon Creek	San Nicolas Island and Begg Rock	
Santa Barbara and Anacapa Island	Santa Catalina Island (4 subareas)	
Magu Lagoon to Latigo Point	Newport Beach Marine Life Refuge	
San Clemente Island	Heisler Park Ecological Reserve	
Irvine Coast Marine Life Refuge	San Diego-La Jolla Ecological Reserve	
San Diego Marine Life Refuge		
Clam Refuges (Pismo Clam Preserves)		
Pismo-Oceano Beach	Atascadero Beach	
Morro Beach		
Ecological Reserves		
Bair Island	Batiquitos Lagoon	Bolsa Chica

Table 2.3-2. Areas of Special Biological Significance in or Adjacent to the Marine Environment

Buena Vista Lagoon	Del Mar Landing	Fagan Marsh
Farallon Islands	Farnsworth Bank	Goleta Slough
Tomales Bay	Abalone Cove	San Dieguito Lagoon
San Miguel Island	Elkhorn Slough	Heisler Park
Point Lobos	Upper Newport Bay	Abalone Cove
Corte Madera Marsh	Anacapa Island	Albany Mudflats
Marin Islands	Morro Rock	San Diego-La Jolla
Redwood Shores	Carmel Bay	Santa Barbara Island
Offshore Rocks and Pinnacles	Moro Cojo	Watsonville Slough
Marine Resource Protection Act Ecological Reserves		
King Range (Punta Gorda)	Big Creek	
Vandenberg	Big Sycamore Canyon	
Natural Preserves		
Arena Rock	Big Lagoon (3 subunits)	
Brush Creek/Lagoon Lake Wetlands	Carmel River Lagoon and Wetland	
Morro Estuary	Morro Rock	
Pajaro River Mouth	Pescadero Marsh	
Point Dume	Salinas River Mouth	
Santa Clara Estuary		
Refuges		
Farallon Islands Game Refuge	California Sea Otter Game Refuge	
Pacific Grove Marine Gardens Fish Refuge	City of Encinitas Marine Life Refuge	
Doheny Beach Marine Life Refuge	Hopkins Marine Life Refuge	
Laguna Beach Marine Life Refuge	Niguel Marine Life Refuge	
Dana Point Marine Life Refuge	Bodega Marine Life Refuge	
Point Fermin Marine Life refuge	South Laguna Beach Marine Life Refuge	
San Diego Marine Life Refuge	Irvine Coast Marine Life Refuge	
Newport Beach Marine Life Refuge	Encinitas Marine Life Refuge	
Catalina Marine Science Center Marine Life Refuge		
Reserves		
Duxbury Reef	Gerstle Cove	Point Reyes Headlands
Estero de Limantour	Lover's Cove	Ano Nuevo
Point Lobos	Pismo Invertebrate	Point Cabrillo
Point Loma	Robert W. Crown	Coal Oil Point
Carpinteria Salt Marsh	Santa Cruz Island	Scripps Coastal
State Estuaries		
Morro Bay	San Diego Bay	
State Parks		
Crystal Cove	Julia Pfeiffer Burns	MacKerricher
Manchester	Russian River	Salt Point
Van Damme		

3.9 Threatened and Endangered Species

All marine mammals are protected under the federal Marine Mammal Protection Act (MMPA 1972, amended 1994) administered by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS). Additionally, NMFS and the FWS grant at-risk marine mammal stocks additional protection under the federal Endangered Species Act (ESA) with endangered, threatened, and depleted status designations. The ESA was passed to provide measures to conserve and recover listed species, thereby returning them to sustainable numbers no longer requiring the protection of ESA. The ESA contains a number of tools that are used by government agencies, local jurisdictions, user groups, and landowners to ensure that human activities are done in a way that avoids or minimizes the harmful effects of these activities.

NMFS is charged with the implementation of the ESA for marine and anadromous species, while the FWS implements programs and regulations for terrestrial and freshwater species. Section 7 of the Endangered Species Act of 1973 requires that Federal agencies, insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Likewise, the California Endangered Species Act policy is to conserve, protect, restore, and enhance any endangered or threatened species and its habitat. The ESA requires NMFS and the FWS to develop recovery plans for species added to the list of Threatened and Endangered (T&E) species. The Plans describe necessary conservation measures to ensure recovery of the species so that it becomes appropriate to remove the species from the T&E list. The State also designates protection to one marine mammal under the California Endangered Species Act (CESA). Additionally, the California Fish and Game Code (Section 4700) designates several marine mammal species as "fully protected."

Under ESA, an endangered species is defined in the law as "any species which is in danger of extinction throughout all or a significant portion of its range." Seven marine mammal species occurring in California waters are listed as endangered; six whales and the southern sea otter. A threatened species is "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The Steller sea lion and the Guadalupe fur seal are the only marine mammal species occurring in California waters that are listed as threatened. A candidate species is "any species being considered by the Secretary for listing as an endangered or threatened species, but not yet the subject of a proposed rule." There are no candidate marine mammal species found in California waters. The Guadalupe fur seal is listed under CESA as threatened.

The MMPA also provides designations for at-risk marine mammal stocks. A species or a stock of a species is designated as depleted when it falls below its Optimum Sustainable Population (OSP) or, if the species is listed under ESA. Six whale species and the southern sea otter are considered depleted. The MMPA also lists a stock as strategic if: 1) it is listed as a T&E species under ESA; or 2) the stock is declining and likely to be listed as threatened under the ESA; or 3) the stock is listed as depleted under the MMPA; or 4) the stock has direct human-caused mortality which exceeds that stock's Potential Biological Removals (PBR) level. The term PBR is defined as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its OSP" (Barlow et al. 1995). As mandated in the 1994 amendments to the MMPA, NMFS develops estimates of PBR's for each marine mammal stock in U.S. waters.

NMFS issues permits through the Marine Mammal Authorization Program (MMAP) to provide an exception for commercial fishers from the general taking prohibitions of the MMPA. The owner of a vessel or non-vessel gear participating in a Category I or II fishery must obtain authorization from NMFS in order to lawfully incidentally take a marine mammal in a commercial fishery, while those participating in Category III fisheries may incidentally take marine mammals without registering for or receiving an authorization (NMFS/NOAA/OPR 2001). NMFS may also issue permits for the incidental, but not intentional, taking of marine mammals listed as T&E under ESA, (those species under NMFS's jurisdiction), if NMFS determines that incidental mortality and serious injury due to commercial fishing will have a negligible impact on the affected species or stock, a recovery plan for has been or is being developed, a monitoring program has been established (where required), vessels are registered, and a take reduction plan has been developed or is being developed (NMFS/NOAA/OPR 2001). With the 1994 amendments to the MMPA, intentional takes of marine mammals are now illegal except when imminently necessary in self-defense or to save the life of another person.

3.9.1 Current Fishery Categories

Under section 118 of the MMPA, NMFS classifies all U.S. commercial fisheries into one of three categories (I, II, III) based on the level of incidental serious injury and mortality of marine mammals that occurs in each fishery (NMFS/NOAA/OPR 2001). The categorization of a fishery determines whether fishery participants will be required to comply with certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. Fisheries are listed as Category I if the annual mortality and serious injury of a marine mammal stock in a given fishery is greater than or equal to 50 percent of the PBR. Fisheries are listed as Category II if the annual mortality and serious injury of a marine mammal stock is greater than one percent and less than 50 percent of the PBR level, while Category III's annual mortality and serious injury of a marine mammal stock in a given fishery is less than or equal to one percent of the PBR level. Only participants in Category I or II are required to be registered under the MMPA (NMFS/NOAA/OPR 2001).

In California, the offshore shark-swordfish drift gill-net and the large mesh (>3.5 inches) set gill-net fishery are classified as Category I fisheries, while the anchovy, mackerel and tuna purse seine, the squid purse seine, and the California longline are classified as Category II fisheries. Class III fisheries include: small mesh (<3.5 inches) set gill-net; sardine purse seine; herring purse seine; squid dip net; salmon troll; groundfish longline/set line; shark/bonito longline/set line; groundfish trawl; shrimp trawl, lobster, prawn, shrimp, rock crab and fish pot; crab pot; sablefish pot; shrimp pot and trap; swordfish harpoon; bait pens; abalone, urchin; kelp; sea urchin, clam, octopus, oyster, sea cucumber, scallop, ghost shrimp hand dive or mechanical collection; CPFV; and finfish and shellfish live-trap/hook and line (NMFS/NOAA/OPR 2001). Category III fisheries have a remote likelihood of marine mammal interaction or no known serious injuries or mortalities with marine mammals. There is no Category classification for recreational angling.

Fisheries that have documented marine mammal mortality include the offshore groundfish trawl fisheries, purse seine fisheries for squid and other species. troll fisheries for salmon and other species, the salmon net pen fishery, and the commercial passenger fishing vessel industry (Forney et al. 2000). More than 72 percent of the marine mammals taken are California sea lions but harbor seals, northern elephant seals, and a few Steller sea lions are taken. Small cetaceans represent nearly 10 percent of the average annual take and include: short-beaked common dolphin, harbor porpoise, northern right whale dolphin, Dall's porpoise, Pacific white-sided dolphin, and Risso's dolphin (MMS 2001).

3.9.2 Marine Mammals in California Waters

The coast of California supports a rich assemblage of marine mammals with 27 species from the order Cetacea, six species from the sub-order Pinnipedia, and one species from the order Carnivora. Table 2.3-3 lists these marine mammal species and their current listing/designation status and PBR (Forney et al. 2000) level (note the "stock" designations for harbor porpoise, bottlenose dolphin, Steller sea lion, and northern fur seal). Following are brief descriptions of cetacean T&E species and cetacean species with documented fishery interactions. Pinnipeds and sea otters are discussed due to their abundance, distribution, behavior, and/or potential to interact with numerous fisheries.

Table 2.3-3. Marine Mammal Species Found in California Waters

Species	Status	PBR
HUMPBACK WHALE *(Megaptera novaeanglia*e)	FE, SS, DEP	1.7
NORTHERN RIGHT WHALE *(Eubalaena glaciali*s)	FE, SS, DEP	N/D
SPERM WHALE *(Physeter macrocephalu*s)	FE, SS, DEP	2.0
SEI WHALE *(Balaenoptera boreali*s)	FE, SS, DEP	N/D
FIN WHALE *(Balaenoptera physalu*s)	FE, SS, DEP	2.1
BLUE WHALE *(Balaenoptera musculu*s)	FE, SS, DEP	1.7
GRAY WHALE *(Eschrichtius robustu*s)		575
HARBOR PORPOISE *(Phocoena phocoen*a)(Central CA Stock)	SS	42
BRYDE'S WHALE (*Balaenoptera edeni*)		N/D
MINKE WHALE *(Balaenoptera acutorostrat*a)		4.0

Table 2.3-3. Marine Mammal Species Found in California Waters		
KILLER WHALE *(Orcinus orca)*		2.1
PYGMY SPERM WHALE *(Kogia breviceps)*		28
CUVIER'S BEAKED WHALE *(Ziphius cavirostris)*		43
BAIRD'S BEAKED WHALE *(Berardius bairii)*		2.0
SHORT-FINNED PILOT WHALE *(Globicephala macrorhynchus)*		5.7
NORTHERN RIGHT WHALE DOLPHIN *(Lissodelphis borealis)*		97
LONG-BEAKED COMMON DOLPHIN *(Delphinus capensis)*		14
SHORT-BEAKED COMMON DOLPHIN *(Delphinus delphis)*		79
BOTTLENOSE DOLPHIN *(Tursiops truncatus)* (Coastal Stock)		1.5
STRIPED DOLPHIN *(Stenella coeruleoalba)*		180
PACIFIC WHITE-SIDED DOLPHIN *(Lagenorhynchus obliquidens)*		157
RISSO'S DOLPHIN *(Grampus griseus)*		105
DALL'S PORPOISE *(Phocoenoides dalli)*		737
STELLER SEA LION *(Eumetopias jubatus)* (Eastern Stock)	FT, DEP, SS	1,368
NORTHERN FUR SEAL *(Callorhinus ursinus)* (San Miguel Stock)		100
GUADALUPE FUR SEAL *(Arctocephalus townsendi)*	FT, ST, SS, PRO	104
NORTHERN ELEPHANT SEAL *(Mirounga angustirostris)*	PRO	2,142
PACIFIC HARBOR SEAL *(Phoca vitulina richardsi)* (CA stock)		1,678
CALIFORNIA SEA LION *(Zalophus californianus californianus)*		6,591
SOUTHERN SEA OTTER *(Enhydra lutris nereis)*	FT, DEP, PRO	N/G

Status Codes
FE- Federally listed as Endangered under FESA
FT - Federally listed as Threatened under FESA
DEP - Depleted under the MMPA,
SS - Listed as a Strategic Stock
ST - State-listed as Threatened under California Endangered Species Act
PRO - Fully Protected Mammal under Fish and Game Code §4700
N/D - Insufficient data to calculate PBR
N/G- Incidental take not governed under the MMPA, FESA takes precedence in management of this species

Three groups of marine mammals are found in California waters. The cetaceans consist of two groups: the mysticetes, or large baleen whales (seven species), and the odontocetes, or toothed whales (20 species). Dolphins, porpoises, killer whales, sperm whales, and beaked whales belong to the latter group. The pinnipeds include the true seals (harbor seal) and the eared seals (sea lions and fur seals). Sea otters belong to the mustelid family which includes river otters, weasels, badgers, and skunks. Some species are purely migrants that pass through California waters on their way to calving or feeding grounds elsewhere. Some are seasonal visitors that remain for a few weeks or months, and others are resident for much or all of the year.

3.9.2.1 Humpback Whale

Humpback whales range from arctic waters south to California in the summer and can often be seen migrating along the California coast between April and November (Orr and Helm 1989). NMFS estimates that there are 905 humpback whales in the stock ranging from Mexico to Washington state (Forney et al. 2000). Migrations range from calving grounds in Hawaii and off Mexico north to Alaska to feed during summer. Whales also feed off California during the summer to fall season. Humpback prey include euphausiids and small schooling fish like anchovies, cod, sardines, and mackerel (Wynne and Folkens 1992).

The only fishery documented to interact with humpback whales is the California shark-swordfish drift gill-net fishery (FR Vol. 66 No.158 2001). In the past, two humpback deaths were attributed to entanglement in gill-net fishing gear (Heyning and Lewis 1990), and a humpback whale was observed with a 20-foot section of netting wrapped around and trailing behind it (Forney et al. 2000). In 1997, a humpback whale was snagged by a central California salmon troller and swam away with the hook trailing monofilament (Forney et al. 2000), but according to NMFS, this type of injury is not likely to be serious. Humpback whales have been killed by ship strikes; one in 1993, and one in 1995, and possibly one in 1997 (Forney et al. 2000).

3.9.2.2 Northern Right Whale

Northern right whales are considered rare in California, although they have been sighted as far south as central Baja (Ferrero et al. 2000). It is thought that northern right whales calve in temperate coastal waters during the winter months and migrate to higher latitudes during the summer (Braham and Rice 1984). A current abundance estimate for right whales in California waters is unavailable. Right whales were seen off Half Moon Bay in 1986 and 1987 (NOAA 1992). Another was observed offshore of the Big Sur coast February 27, 1998 (B. Durdos pers. comm.). Right whales are zooplankton specialists feeding on small crustaceans including copepods and euphausiids (Wynne and Folkens 1992). There are no known fishery injuries or mortalities associated with this species in California waters.

3.9.2.3 Sperm Whale

Sperm whales are present in California offshore waters year-round (Dohl et al. 1983; Barlow 1995; Forney et al. 1995), reaching peak abundance from April through mid-June and from the end of August through mid-November (Rice 1974). Sperm whales are also known to occur inshore along submarine canyons, but typically prefer deepwater zones where they feed on giant squid (80 percent of their diet), octopus, fish, shrimp, crab, and small bottom sharks (Drumm and NMML 2000). Sperm whales are deep water divers; males have been known to dive to depths of 3,936 feet. Surveys conducted in 1991, 1993, and 1996 by Barlow (1997), estimated 1,191 sperm whales off the coast of California Oregon and Washington.

NMFS has reported observed mortality and serious injury of sperm whales in the California shark-swordfish drift gill-net fishery. Two sperm whales were observed taken in the drift gill-net fishery in 1996 and 1998 (Forney et al. 2000). There is also concern that the increasing anthropogenic noise in the ocean may negatively affect sperm whales.

3.9.2.4 Sei Whale

Sei whales are considered rare in California waters and do not appear to be associated with coastal features as they are an open ocean, temperate water species. (Forney et al. 2000). There was one confirmed sighting of a sei whale in California waters during NMFS's ship surveys in 1991 to 1993 and 1996, but there are no abundance estimates of sei whales along the west coast. Sei whales feed on copepods, euphausiids, small fish and squid (Wynne and Folkens 1992).

The California shark-swordfish drift gill-net fishery is the only fishery likely to interact with sei whales, although no fishery mortalities or serious injury have been observed (Forney et al. 2000). Ship strikes may occasionally kill sei whales although none have been documented thus far.

3.9.2.5 Fin Whale

Fin whales migrate from the summer feeding grounds in the Gulf of Alaska to winter calving grounds in the Gulf of California. Fin whales are fairly common year-round in southern and central California (Dohl et al. 1983, Forney et al. 1995) with peak numbers in summer and fall. Acoustic signals from fin whales are detected year-round off northern California, Oregon, and Washington with a concentration of vocal activity between September and February (Allen 1982). Barlow (1997) estimated 1,236 fin whales off the coasts of California, Oregon and Washington. Fin whales feed on invertebrates and small schooling fish (Wynne and Folkens 1992).

In 1999, NMFS reported the mortality of a fin whale in the California shark-swordfish offshore drift gill-net fishery (NMFS observer data). Off the U. S. west coast, ship strikes accounted for single fin whale mortalities in 1991, 1996, and 1997; the average observed annual mortality for 1994 to 1998 was 0.4 animals (Forney et al. 2000).

3.9.2.6 Blue Whale

Similar to fin whales, blue whales range from the Gulf of Alaska to tropical waters and can often be seen in southern California in June through November (Forney et al. 2000) aggregating along the shelf break. Feeding aggregations often occur during the summer in Monterey Bay. Blue whales eat euphausiids (95 percent of their diet) and copepods (Drumm and NMML 2000). NMFS estimates that there are 1,950 blue whales in California (Forney et al. 2000).

The only fishery likely to interact with blue whales is the California shark-swordfish drift gill-net fishery, although no fishery mortalities or serious injurious have been observed (Forney et al. 2000). Ship strikes have been documented to kill blue whales.

3.9.2.7 Steller (Northern) Sea Lion

Steller sea lions, also known as northern sea lions, occur throughout the north Pacific ranging from northern Japan to California (Loughlin et al. 1984). The eastern stock of Steller sea lions (which includes those found in California waters) is listed as federally threatened while the western stock (Alaska) population is listed as endangered. Critical habitat identified for the sea lion includes the major California rookeries (MMS 2001). In southern and central California, Steller sea lion numbers have declined while in northern California they are stable. During 1996, NMFS counted 6,555 animals in California (Forney et al. 2000). Small breeding rookeries can be found at Año Nuevo Island, Southeast Farallon Island, Cape Mendocino, and at Cape St. George (Reeves et al. 1992). Off California, Steller sea lion sightings at sea have been concentrated in shallow waters over the shelf and upper slope (<400 m). Steller sea lions are considered opportunistic and consume a variety of fish, squid, octopus, crabs, and shrimp.

Steller sea lions have been incidentally taken in the California shark-swordfish drift gill-net fishery, as well as in groundfish trawl fisheries. Between 1994 and 1999, the estimated annual mortality was 11 from the at-sea processing vessels in the Pacific whiting fishery (PFMC 2001).

3.9.2.8 Guadalupe Fur Seal

Guadalupe fur seals breed along the western coast of Guadalupe Island, west of Baja California, Mexico, although individuals have been seen in the Channel Islands and central California. A single pup was born on San Miguel Island in 1997 (MMS 2001). Commercial sealing during the 19th century reduced this once abundant seal population to near extinction in the late 1800s (Townsend 1931). Before sealing, Guadalupe fur seals ranged as far north as from Point Conception and possibly the Farallon Islands (Fleischer 1987). Guadalupe fur seals feed on fish and squid.

Drift and set gill-net fisheries may cause incidental mortality of Guadalupe fur seals, although no fishery mortalities or serious injurious have been observed (Forney et al. 2000). Additionally, strandings data show that Guadalupe fur seals interact with hook and line fisheries as animals have been found in central and northern California with fish hooks, monofilament line, and polyfilament string (Hanni et al. 1977).

3.9.2.9 Southern Sea Otter

Southern sea otters range along the California mainland coast from Point Año Nuevo to Purisima Point and a colony exists on San Nicholas Island (Forney et al. 2000). Boolootian (1961) reported occasional sightings on Anacapa and San Miguel Islands. Aerial surveys by helicopter, in 1957 and 1958, did not reveal any sea otters around the Channel Islands, although three were observed on the mainland at Point Conception (Best and Oliphant 1965). They breed and give birth year-round in California. A spring 2000 survey revealed 2,317 animals counted along the mainland with additional animals at San Nicholas Island (USFWS 2000). Southern sea otters feed almost exclusively on marine invertebrates including clams, mussels, chitons, barnacles, starfish, abalone, urchins, crabs, octopus and squid (Miller 1974). Fishery associated mortality includes drowning in set gill-nets, lobster traps, and one individual was discovered drowned in a crab pot off Pt. Santa Cruz (Forney et al. 2000).

Southern sea otters are killed in the large mesh set gill-nets (>3.5 inches). The set gill-net fishery primarily targets halibut which accounted for 72 and 85 percent of the total set gill-net sets for fishing years 1998 to 1999 and 1999 to 2000, respectively (CDFG unpublished data). Set gill-nets also target “rockfish” which may include some species managed by the nearshore management plan. However, there is no directed set gill-net effort for the species managed under the nearshore fishery management plan. In addition, the number of “rockfish” sets represent a small component of the set gill-net fishery, accounting for 7 and 1.5 percent of the total set gill-net sets for the same years discussed above (CDFG unpublished data). In September 2000, the Director of Fish and Game ordered a prohibition of gill and trammel net fishing in several areas within central California for waters less than 60 fathoms deep. The closure was in effect for 120 days and subsequently extended, but it has since lapsed. The Department is currently working on regulations to limit all set gill and trammel net fishing from Pt. Reyes to Pt. Arguello to 60 fathoms or greater. Thus, gill-net associated mortalities are likely to decrease.

Southern sea otters have been found dead with wounds caused by boat propellers and 11 out of 1,680 carcasses, collected from 1968 to 1989, were known to have drowned as a result of becoming entangled in fishing lines. A review of sea otter mortality from 1968 to 1989 indicated that shooting accounted for 4.6 percent of the recorded deaths (MMS 2001). Nakata et al. (1998) reported that southern sea otters that died from infectious disease and other causes, such as neoplasia, emaciation, and esophageal impaction, did contain elevated concentrations of PCBs, DDTs, and butyltins. Southern sea otters are primarily found in water depths less than about 100 feet. Because of their close association with kelp beds in many nearshore areas, there is a greater potential for interaction with nearshore fisheries (within their range) than with other marine mammals.

3.9.3 Marine Turtles in California Waters

Sea turtles are long lived marine reptiles that spend their life at sea with the exception of the onshore nesting and egg incubation period. The four species of sea turtles that occasionally are present in State waters include: green, leatherback, loggerhead, and the olive ridley sea turtles. Table 2.3-4 lists the yearly number of sea turtles that have been stranded in California from1990 to 2000. All four species are protected under the ESA. Section 9.a.1.B and C of the ESA prohibits the taking of any listed species within the United States, the territorial sea of the United States, or the high seas. Taking includes the killing or injuring of any such species. Sea turtles killed or injured as a result of NFMP activities would constitute a take under the ESA and is prohibited.

Table 2.3-4. Sea turtle stranding reported to the California sea turtle stranding network (2000)

Species	Year											
	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	Total
Green sea turtle	12	6	3	7	5	3	4		8	2	10	60
Leatherback sea turtle		10	2		3	1	4	9	2	8	11	51
Loggerhead sea turtle	2		3	1	2	1	2	5	3		4	23
Olive ridley sea turtle	7	1	1	2	2		1	1	1	1	2	19
Unidentified sea turtle	1		1							2	5	9
Total	23	17	9	11	12	5	11	15	14	13	32	162

Table 2.3-4. Sea turtle stranding reported to the California sea turtle stranding network (2000)												
Species	Year											
	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	Total

Source: National Marine Fisheries Service, Southwest Region, 501 West Ocean Boulevard, Suite 4200, Long Beach, CA 90802-4213, telephone (562) 980-4000. Web sites from which information was taken. Http://swr.ucsd.edu/psd/strand/turtle/index.htm, and http://swr.ucsd.edu/psd/strand/turtle/2000.htm.

The following information on the distribution, and likely interaction with activities contemplated in the NFMP, was derived from the corresponding Federal Turtle Recovery plans which are referenced at the end of each section and the 2000 National Marine Fisheries Service biological opinion for the California/Oregon drift gill-net fishery. Observer programs, conducted by NMFS (1990 to 2000) have documented all four species interacting with drift gill-nets off California. The California set gill-net fishery for halibut and angel shark, has been observed to take sea turtles. Four of the observed mortalities occurred offshore of Ventura, California. Movement of this fishery offshore to beyond the 60 fathom (fm) line, may result in interactions not previously encountered by the fishery. Longline fishing gear is another documented gear type affecting turtles through entanglement and hooking (NMFS Southwest Fisheries Science Center). Turtles are known to be taken incidentally by the California-based pelagic longline fleet and the California halibut gill-net fishery (PFMC 2001). Sea turtles are vulnerable to collisions with vessels and can be killed or injured when struck. Entanglement in abandoned fishing gear can cause death or injury by drowning or loss of a limb. The discharge of garbage can be harmful as turtles have ingested plastic bags, beverage six-pack rings, styrofoam, and other items commonly found aboard fishing vessels.

Degradation and destruction of nesting beaches and in-water habitat have occurred due to many factors, including coastal development, dredging, vessel traffic, erosion control, sand mining, vehicular traffic on beaches, and artificial lighting which repels the adults and disorients the hatchlings. Direct poisoning as well as blockage of the gastrointestinal tract by ingested tar balls has been reported. Low-level chemical pollution, which may possibly cause immunosuppression, has been suggested as one factor in the epidemic outbreak of a tumor disease in green sea turtles. Plastics and other persistent debris discharged into the ocean are also recognized as harmful pollutants in the pelagic environment. Both the entanglement in, and ingestion of, the synthetic debris have been documented by NMFS.

3.9.3.1 Leatherback Sea Turtle, *Dermochelys coriacea*

The leatherback sea turtle is listed as endangered throughout its entire range under the ESA, as amended. The most recent estimate of the world population is currently 25,000 to 42,000 turtles (NMFS Biological Opinion 2000). They are highly migratory, exploiting convergence zones and upwelling areas along the continental margins and open ocean. They feed from the surface to a maximum depth of 1,000 meters (normally 50 to 84 meters) during all hours of the day and night. Sexual maturity is around 13 or 14 years. Leatherback turtles are the most common sea turtle in U.S. waters north of Mexico. Leatherbacks inhabiting the west coast of California are likely comprised of individuals originating from nesting assemblages located south of the equator in Indonesia and in the eastern Pacific (Mexico and Costa Rica). The highest density of leatherback sightings on the west coast of California is in and around Monterey Bay, corresponding most likely to a southern movement to Mexican and Costa Rican breeding grounds. Female leatherbacks apparently migrate between foraging and breeding grounds at two to three-year intervals. The high density of leatherback sightings in and around Monterey peak in August. Two leatherbacks tagged in Monterey (September 7, 2000) were documented on a southwest migratory pathway likely towards Indonesia nesting beaches. Stranding records for California, document that the 50 leatherbacks (1990 to 1999) stranded make it the most common turtle. The “Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle” states that the leatherback is the most common sea turtle in U.S. waters north of Mexico. No nesting activity in California is known.

Foraging for jellyfish in nearshore and oceanic areas, occurs throughout the northeastern Pacific. Seasonal accumulations of turtles in areas managed under the NFMP are known. However, specific critical areas have not been identified nor has the relative importance of habitats (or the distribution and size) for "foraging populations" of any age class been specified by NMFS. DNA evidence documents that leatherback turtles have transoceanic migratory patterns, with juvenile turtles leaving the natal beaches, crossing the ocean to the opposite side to feed, and then return as adults to breed and lay eggs. All of the leatherback turtles observed taken by the drift gill-net fishery were located north of point Conception from September through January, and the majority of them were found in areas of coastal upwelling.

3.9.3.2 Loggerhead Sea Turtle, *Dermochelys caretta*

The loggerhead turtle is listed as a threatened species throughout its range. The United States and Mexico (primarily Baja California south) support important developmental habitats for juvenile loggerheads. Loggerheads are a cosmopolitan species, found in temperate waters and inhabiting pelagic waters, continental shelves, bays, estuaries and lagoons. There is no documented nesting in the U.S. Pacific, and U.S. waters (principally those off California) are used as foraging grounds and as migratory corridors for a wide range of juvenile size classes. Sexual maturity ranges between 25 to 35 years. They are omnivorous, feeding on a variety of benthic prey including shellfish, crabs, oysters, jellyfish, squid, and occasionally on fish. The seasonal sightings in abundance may correspond to a larger, regional movement pattern. Sightings are typically confined to the summer months in the eastern Pacific, peaking in July to September off southern California and southwestern Baja California, Mexico where thousands are sighted feeding on the pelagic red crab (Stinson 1984; Ramirez-Cruz et al. 1991). Genetic studies have shown these animals originate from Japanese nesting stock (NMFS Biological Opinion 2000).

As they age, loggerhead turtles move inshore and forage over a variety of benthic hard- and soft-bottom habitats. With the exception of four records from Hawaii (see Insular and Pelagic Range), U.S. Pacific sightings are confined to the west coast of the continent. It is not known whether these individuals are resident or transient. No studies of distribution, abundance, or residency in waters along California have been undertaken but they are know to occur within the waters managed for the NFMP. There is limited information on mortality of loggerheads on the U.S. west coast. Occasional cold strandings occur in Washington and Oregon and incidental take by fisheries probably occurs. During1983 to 1991, two loggerhead turtles were entrained and both of these were released alive. Since 1990, all of the loggerhead turtles incidentally taken in the drift gill-net fishery were located in a concentrated area south of San Clemente Island during El Niño years, which bring northward hundreds of thousands of pelagic red crabs to the California coast. Hearing of juvenile loggerheads is most sensitive at 250 to one KHz. Sensitivity declined rapidly above one KHz and was highest at 250 Hz (MMS 2001).

3.9.3.3 Green Sea Turtle, *Chelonia mydas*

The east Pacific green turtle is listed as threatened except for the breeding population on the Pacific coast of Mexico, which is listed as endangered. There is a resident population in San Diego Bay of 50 to 60 adults which concentrate in the warm water effluent of the power plant. From 1983 to 1991, 12 green turtles were entrained off the coast of California. Boat collisions were implicated in 80 percent of green sea turtle deaths recorded in San Diego and Mission Bays (MMS 2001). This species appears to be the second most observed marine turtle along the west coast waters of the United States and green turtles are the second most commonly stranded sea turtle, and 62 percent are found in a band from southern California southward.

Adult east Pacific green turtles are primarily herbivorous, eating sea grasses and algae, and, in some areas, they may feed on a variety of marine animals. Forage areas exist in bays and inlets along the coast of Baja California (Mexico) and southern California, however, these vital areas have yet to be delineated. Green turtles attain sexual maturity at an average age of 25 years and can live up to 60 years. They feed at or near the ocean surface and their dives do not normally exceed several meters in depth. Prey items consist of molluscs, polychaetes, fish, fish eggs, jellyfish, and commensal amphipods (NMFS Biological Opinion 2000). The only green turtle taken by the drift gill-net fishery was taken north of Point Conception. Juvenile green turtles detected sound frequencies in the range of 200 to 700 Hz and displayed a high level of sensitivity at about 400 Hz (MMS 2001).

3.9.3.4 Olive Ridley Sea Turtle, *Lepidochelys olivacea*

The olive ridley turtle is listed as endangered on the Pacific coast of Mexico, and all other populations are listed as threatened. Olive ridley turtles are primarily pelagic, migrating throughout the Pacific from nesting grounds in Mexico and Central America to the north Pacific. Olive ridley turtle comprise the vast majority of sea turtle sightings (75 percent in eastern tropical Pacific study). Young turtles move offshore to occupy areas of surface current convergences until they are large enough to recruit to benthic feeding grounds. They feed on tunicates, salps, jellyfish, fish eggs, crustaceans, and small fish. Stranding records from 1990 to 1999 indicate that olive ridleys are rarely found off the coast of California, averaging 1.3 strandings annually (NMFS Biological Opinion 2000).

In the eastern tropical Pacific, the olive ridley occurs much more commonly in the open ocean than any other cheloniid (Pitman 1990), but this may only be a function of its being much more abundant than any of the other species, and, thus, increasing the likelihood of their being wayward individuals. Alternatively, olive ridleys may have a truly pelagic habit. Forage areas most likely exist along the coast of Baja California and southern California, however, these areas have not been identified

3.9.4 Fish

Several fish species and their habitats are protected under ESA. EFH and HAPC have been described in Amendment 14 of the PFMC FMP for Pacific salmon (see previous section for limited discussion). In estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within State territorial waters out to the full extent of the EEZ offshore of Washington, Oregon, and California north of Point Conception. Evolutionarily Significant Units (ESU) have been described for steelhead.

3.9.4.1 Tidewater Goby

The tidewater goby is listed as endangered under the ESA. Tidewater gobies are endemic to California and are found in shallow coastal lagoons, stream mouths, and shallow areas of bays in low salinity waters. They are a small, bottom-dwelling fish. The northern population of tidewater goby is found along coastal areas from Del Norte County (Smith River mouth area) to Los Angeles County. The southern population ranges to the Mexico border vicinity (Aqua Hedionda lagoon). Since 1994, the northern population has rebounded sharply (MMS 2001). Since the 1900s they have disappeared from 74 percent of the coastal lagoons south of Morro Bay (Swift et al. 1989).

Gobies are able to rear in low salinity waters (prefer approximately 5 ppt salinity) but can tolerate higher salinities when moving between coastal streams in the ocean. They live approximately three years and feed on crustaceans and aquatic insects.

3.9.4.2 Salmon

Salmon and steelhead populations, once abundant in California, have declined to about 10 percent or less of historical levels. Chinook, coho, and steelhead are the most abundant anadromous salmonids in California. Pink, chum, and sockeye salmon do not normally spawn in California. Historically, chinook and coho salmon were taken in the commercial fishery as far south as Point Conception as late as 1964 (Best and Oliphant 1965). Chinook salmon have four distinct runs in the State: fall, late-fall, winter, spring. Coho salmon only have one run and are most common in small coastal streams. Steelhead are migratory anadromous rainbow trout. Steelhead spawning migrations are complicated by the fact that adult steelhead may be entering rivers to spawn, or unlike salmon, returning to the ocean following spawning. Resident time in freshwater portions of rivers and streams varies between less than one year for chinook salmon and up to six years for steelhead.

Only winter-run steelhead occur along the south-central coast. They enter their home streams from November to April (depending on water flows) to spawn. Juveniles migrate to sea usually in spring and spend the next one to three years feeding. Submarine canyons and other regions of pronounced upwelling are also thought to be particularly important during El Niño events (MMS 2001). Females can spawn multiple times unlike salmon which die after spawning. Many small coastal streams are closed entirely by sand bars that build across the mouths of streams during periods of low rainfall and mild ocean conditions in summer. Heavy winter rainfall and subsequent runoff removes the bar and provides a pathway for migrating fish. The runoff provides olfactory clues to attract migrating adult salmon into the stream. Heavy runoff also serves to “flush” smolts from the estuaries into the ocean.

The Southern ESU steelhead inhabits streams and rivers from the Santa Marina River south to Malibu Creek. The critical habitat for steelhead includes all river reaches and estuarine areas accessible to listed steelhead in the coastal river basins between the two reaches described previously. The Northern ESU steelhead are federally listed as threatened, the Central California Coast ESU steelhead and South/Central California Coast ESU steelhead are federally threatened, and the Southern California ESU steelhead are federally listed as endangered. The Sacramento river winter-run chinook salmon is a State and federal listed endangered species. Chinook salmon-Central coastal ESU is federally listed as threatened. Spring-run chinook salmon are State and federal listed as threatened. Coho salmon-Central California Coast ESU is State endangered and federal threatened. Coho salmon-Southern Oregon/Northern California ESU is federal threatened. Coho salmon-No. California is a state candidate for listing and federal listed as threatened.

3.9.5 Marine and Coastal Birds

The federal ESA of 1973, as amended, provides for the conservation of threatened and endangered species of fish, wildlife, and plants. For bird species, the program is administered by the U.S. Fish and Wildlife Service. The designation of ESA species is based on the biological health of that species. Under ESA, an endangered species is defined in the law as: "any species which is in danger of extinction throughout all or a significant portion of its range." A threatened species is: "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." A candidate species is: "any species being considered by the Secretary (of Interior) for listing as an endangered or threatened species, but not yet the subject of a proposed rule." When a species is listed, the critical habitat of that species also must be designated. Critical habitats are those specific areas that are essential to the conservation of a listed species.

In addition to the ESA, all seabirds are protected under the Migratory Bird Treaty Act of 1918, which establishes a federal prohibition, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess... any migratory bird or any part, nest, or egg of any such bird " (16 U.S.C. Section 7030). The CESA also provides for the conservation of threatened and endangered species (Fish and Game Code Section 2062, 2067, 2068). Furthermore, the Legislature has declared it to be State policy to conserve, protect, restore and enhance any endangered species or any threatened species and its habitat. The Department also designates taxa as "Species of Special Concern” (SSC) when species are: with declining population levels, limited ranges, and/or continuing threats which make them vulnerable to extinction (CDFG CNDDB). The goal of designating a species as a SSC is to halt or reverse the species decline by calling attention to their plight and addressing the issues of concern early enough to secure long-term viability. Additionally, the California Fish and Game

Code (FGC) Section 3511 designates two marine seabirds as "fully protected," meaning there is no issuance of permits under FGC Section 2081 to take such species.

The coast of California supports a rich assemblage of seabirds. Seabirds spend a majority of their life at sea and are an integral part of the coastal marine ecosystem. In California waters, seabirds include members of the order Procellariiformes (storm-petrels, shearwaters, albatrosses), Pelecaniformes (pelicans and cormorants), Charadriiformes (gulls, terns, and alcids), Gaviiformes (loons), Podicipediformes (grebes), and Anseriformes (scoters). Table 2.3-5 lists seabird species likely to be in California nearshore waters and their current listing and/or designation status. Those species that are federally or state listed, or those considered SSC, are discussed in detail. Common murre, Pacific loon, common murres, Forster's tern, Heermann's gull, pigeon guillemot, western gull, Brandt's cormorant, pelagic cormorant, and the western grebe, although neither listed nor SSC, are discussed in detail as they are documented to be involved with fishery interactions and/or consume rockfish as part of their diet.

Table 2.3-5. The status of federal and state seabirds

Species	Status*
Brown pelican (*Pelecanus occidentalis*)	FE, SE, DFGFP
Black-footed albatross (*Diomeda nigripes*)	
Pink-footed shearwater (*Puffinus creatopus*)	
Sooty shearwater (*P. griseus*)	
Black-vented shearwater (*P. opisthomelas*)	
Northern fulmar (*Fulmarus glacialis*)	
Leach's storm-petrel (*Oceanodroma leucorhoa*)	
Ashy storm-petrel (*O. homochroa*)	SSC, FSC
Black storm-petrel (*O. melania*)	SSC
Least storm-petrel (*O. leucorhoa*)	
Fork-tailed storm-petrel (*O. furcata)*	SSC
Brandt's cormorant (*Phalacrocorax penicillatus*)	
Double-crested cormorant (*P. auritus*)	SSC
Pelagic cormorant (*P. pelagicus*)	
Bonaparte's gull (*Larus philadelphia*)	
Heermann's gull (*L. heermanni*)	
Ring-billed gull (*L. delawarensis*)	
California gull (*L. californicu*s)	SSC
Herring gull (*L. argentatus*)	
Western gull (*L. occidentalis*)	
Glacous-winged gull (*L.glaucescens*)	
Parasitic jaeger *(Stercorarius parasiticus)*	
Pomarine jaeger (*S. pomarinus*)	
Red phalaropes *(Phalaropus fulicaria)*	
Red-necked phalaropes (*P. lobatus*)	
Black-legged kittiwake (*Rissa tridactyla*)	
Black skimmer (*Rynchops niger*)	SSC
California least tern (*S. antillarum browni*)	FE, SE, DFGFP

Table 2.3-5. The status of federal and state seabirds	
Species	Status*
Royal tern *(Sterna maxima*)	
Elegant tern *(S. elegans*)	FSC, SSC
Common tern *(S. hirundo)*	
Arctic tern *(S. paradisaea*)	
Forster's tern *(S. forsteri*)	
Caspian tern *(S. caspia*)	
Black tern *(Chlidonias niger)*	SSC
Cassin's auklet *(Ptychoramphus aleuticus*)	
Rhinoceros auklet *(Cerorhinca monocerata*)	SSC
Pigeon guillemot *(Cepphus columba*)	
Marbled murrelet *(Brachyramphus marmoratus)*	
Xantus' murrelet *(Synthliboramphus hypoleucus*)	FSC, FPL, SSC
Common murre *(Uria aalge*)	
Tufted puffin *(Fratercula cirrhata)*	SSC
Pacific loon (*Gavia pacifica*)	
Common loon (*Gavia artica*)	SSC
Western grebe *(Aechmophorus occidentalis)*	
Clark's grebe *(A. clarki*)	
Surf scoter *(Melanitta perspicillata*)	
Black scoter *(Melanitta nigra*)	
White-winged scoter *(Melanitta fusca*)	
Bald eagle (*Haliaeetus leucocephalus*)	ST, DFGFP, FPD

*acronyms explained below

Acronym	Definition		
FE	Federally listed as endangered under ESA	FSC	Federal species of concern
FT	Federally listed as threatened under ESA	SSC	State species of special concern
FPL	Petitioned for federal listing under ESA	DFGFP	Fully protected under FGC §3511
SE	State listed as endangered under CESA	FPD	Federally proposed for delisting
ST	State listed as threatened under CESA		

3.9.5.1 California Brown Pelican

The California brown pelican was listed as an endangered species under the ESA in 1970 and by the California Fish and Game Commission in 1971 because of decreased population numbers and extensive reproductive failures. These resulted from the effects of DDT and other chlorinated hydrocarbons in the late 1960s. Additionally, they are a fully protected species under FGC Section 3511.

California brown pelicans are found in estuarine, marine subtidal, and pelagic waters along the California coast. California brown pelicans breed in the Southern California Bight (SCB) at West Anacapa Island and Santa Barbara Island in the Channel Islands and several islands off Baja California. During the non-breeding season, birds disperse along the coast as far north as Vancouver, British Columbia and south to El Salvador. Pelicans are colonial nesters and require nesting grounds free from human disturbance and mammalian predators, and be in proximity to adequate food supplies (Gress and Anderson 1983). Nest sites are located on steep, rocky slopes and bluff edges and are comprised of sticks or debris. Communal roost sites are essential habitat for California brown pelicans (Gress and Anderson 1983) because, unlike other seabirds, California brown pelicans have wettable plumage (Rijke 1970) which can become heavy and hypothermic in cold water if they do not come ashore regularly to dry and recondition their plumage. Roost site selection is based on minimal disturbances and microclimate features that aid in thermoregulation. California brown pelicans congregate in traditional high quality roosts at night with major night roosts supporting hundreds to thousands of pelicans (Briggs et al. 1987). Substantial numbers (averaging in the thousands) roost on South Farallon Island and feed in the surrounding waters during the fall and winter.

California brown pelicans are diving birds that feed almost exclusively on fish and dive from 6 to12 meters (m) in the air. In the past, northern anchovies were found to comprise 92 percent of the diet of California brown pelicans nesting in the SCB (Gress et al. 1980, Gress and Anderson 1983). In recent years, however, Pacific sardine populations have been increasing and may now be common items in the California brown pelican diet. They also have been documented to feed on northern anchovies, herring, sardines, mackerels, minnows, and silversides within 11 km of the coast (MMS 2001, Johnsgard 1993).

California brown pelicans are known to interact with fishing activities involving various hook-and-line gear. In the Commercial Passenger Fishing Vessel (CPFV) fishery they are attracted to the bait which is used for chumming, as well as baited lines. Pelicans may get hooked in the mouth, or other body parts, when they go after the bait. When they are hooked, the hook is either yanked out, or the line is cut leaving the hook in the bird. If the hook is yanked out of the pelican's mouth, it may rip the gullet resulting in a hole. Captured fish slip through the hole and the bird can die from starvation. Hooks forcibly removed may lead to infection. When lines are cut, the pelican may end up with fishing line wrapped around its' wings and/or feet. When the bird flies back to its nesting or roosting site, the line can become entangled in vegetation or debris, grounding or hobbling the bird, where it dies from exposure and starvation or, the line cuts off circulation and the bird eventually loses a foot, leg, or wing.

During the Department's 2001 CPFV observer program in San Diego County, brown pelicans were hooked on 33 percent of the observed trips (a total of 62 birds hooked during 119 trips over a four month period). One-third of these trips, rockfish were a target species. Hooking of brown pelicans also was recorded during CPFV observer programs in central California (from Morro Bay to Bodega Bay and in a few years up to Eureka in northern California) from 1987 to 1998 (DFG CPFV unpublished data). Entanglements occur in other hook-and-line fisheries, both recreational and commercial, aside from the CPFV fishery. In the fall of 2001, a concentration of bait fish around the City of Santa Cruz wharf, resulted in the accidental entanglement of brown pelicans which were attracted to that bait being fished for by recreational fishermen. Over 170 brown pelicans were rescued, 40 of which subsequently died or were euthanized (International Bird Rescue Research Center unpublished data). California brown pelicans also may be taken on longline gear. Pelicans may be attracted to the baited hooks as the gear is being set, and become hooked at the surface where they are dragged underwater and drowned. California brown pelicans are harassed by owners and workers on bait barges where they are considered a nuisance.

The California brown pelican also may be affected by nearshore fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, whistles, etc.) near known rookeries and roosting sites. The recovery plan for the California brown pelican (FWS 1983) describes the negative effects of disturbance. Although California brown pelicans are large seabirds, they are nonetheless disturbed by events which are out of the ordinary. This includes not only direct human disturbance, but loud noises as well. This conclusion is bolstered by additional work on disturbance effects upon wintering brown pelicans (Jaques and Anderson 1988). They found that not only are pelicans sensitive to subtle movements by researchers, they also are cautious about choosing a roosting site, and even appear to rely on other species such as gulls for sentinels. In 1999, California brown pelican productivity declined noticeably on Anacapa Island (Gress pers. comm.). It is hypothesized by FWS that this decline was attributed to the presence of market squid fishing vessels, and the associated bright lights and noise near the rookeries during the breeding season, which could have caused undue stress and resulted in nest abandonment.

3.9.5.2 California Least Tern

The California least tern is both state and federally listed as endangered, and is a fully protected species under FGC Section3511. California least terns are small migratory colonial nesting seabirds that arrive at breeding sites in southern California around April and depart in August. Nesting starts in mid-May. Breeding colonies are located along marine and estuarine shores from San Francisco Bay to San Diego County. Wintering areas are unknown but are suspected to be the coast of South America (Massey 1977). California least terns nest on the ground on open sand or gravel. Clutch size is usually two to three eggs and a single brood is raised yearly (Rigney and Granholm 1990). Both parents incubate the eggs which hatch in 20 to 25 days. The semiprecocial young are tended by both parents, are mobile at three days, and can fly by 28 days (Rigney and Granholm 1990). Active management is necessary at nesting sites to deter predators and human disturbance.

California least terns feed on small fish in shallow nearshore waters or in shallow estuaries or lagoons. Most feeding takes place in the early morning and late afternoon. As with other terns, California least terns hover in the air then dive for fish near the surface. Terns are not capable of deep dives, however, they may exploit nearshore fishery operations where they feed on scavenged or discarded fish, or bait fish used for chumming. In the CPFV fishery, terns may get hooked in the mouth or other body parts when they go after bait. When they get hooked, the hook is either yanked out or the line is cut leaving the hook in the bird. Effects of line entanglement is similar to that described for the California brown pelicans. The Department’s CPFV observer program documented ten least terns hooked (8 percent of observed trips) from May through August 2001. Terns also may be taken on longlines. The birds are attracted to the baited hooks as the gear is being set and become hooked at the surface where they are dragged underwater and drown. Terns also may be affected by ancillary marine fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, whistles, etc.) near rookeries and roosting sites.

3.9.5.3 Marbled Murrelets

Marbled murrelets are listed as federally threatened and State endangered due to small population numbers and loss of old-growth forests as nesting habitat. They breed along the coasts of the north Pacific Ocean from Japan, across the Aleutians, and south to central California (Harrison 1983). In California, they occur year-round in marine subtidal and pelagic habitats from the Oregon border to Point Sal in Santa Barbara County, although during the nesting season they are concentrated closer to breeding areas (Sanders 2000). Marbled murrelets are the only California alcid to breed inland where they use dense stands of old-growth coastal coniferous forest for nesting and roosting. The estimated 1,600 breeding individuals nest in the northern California counties of Del Norte and Humboldt (approximately 42 percent of the population) and in the central California counties of San Mateo and Santa Cruz (approximately 44 percent of the population) (Carter et al. 1992). In the breeding season, marbled murrelets forage close to shore in shallow waters (<500 meters from shore), usually less than 95 feet deep, while in the nonbreeding season, they often forage farther from shore (Sealy 1972). Marbled murrelets feed by diving and pursuing small fish such as sand lance, northern anchovy, herring, juvenile rockfish, and capelin, and euphausiids (Burket 1995, MMS 2001). Marbled murrelets are monogamous, solitary nesters that lay one egg from mid-May to mid-June. The young fledge from early July through early September. Marbled murrelets are threatened with habitat loss from logging and vulnerable to contamination from oil spills along the coast.

In the past, marbled murrelets were taken in the nearshore set gill and trammel net fisheries in central California (Carter et al. 1995). Gill-net closures implemented in 1987 and 1990 have likely protected these birds from additional gill-net mortality (no additional mortalities have been documented since 1987). However, there have been reported mortalities of marbled murrelets in the sport hook-and-line fisheries off Santa Cruz (Carter et al. 1995).

3.9.5.4 Bald Eagle

The bald eagle is federally petitioned for delisting from threatened status, is State listed as endangered, and is a fully protected species under FGC Section3511. Bald eagles are found seasonally along the coast and offshore islands of California. They require large bodies of water and adjacent snags or other perches so they can swoop from hunting perches or soaring flight to pluck fish from the water (Polite and Pratt 1990). Bald eagles also scavenge dead fish, water birds, and mammals. A recovery plan is currently in place that establishes geographical goals for population enhancement. More than 30 eagles have been released at Santa Catalina Island and some live on the mainland near Santa Barbara County. Bald eagles feed on fish, but do not dive underwater nor rest on the water (as seabirds do), thus, interactions with nearshore fishermen are possible, but not likely.

3.9.5.5 Xantus' Murrelets

Xantus' murrelets are considered a SSC by the Department, and there is an effort for a State listing due to its small population size and limited breeding range, as well as declining world population size (estimated as less than 10,000 birds) and known threats to colonies. Xantus' murrelets are small birds that feed on larval fish including northern anchovies, sardines, rockfish, Pacific sauries, and crustaceans, and forage in the immediate vicinity of the colony during the nesting season (Hunt et al. 1979). The world population of Xantus's murrelet is concentrated in four major breeding areas in California and Baja California, Mexico. All California colonies occur in the Channel islands, with the largest colony at Santa Barbara Island. Xantus' murrelets return to the nesting islands in February and disperse from islands by mid-July. They nest in rock crevices along steep cliff edges, under bushes, on the ground in vegetation, in burrows, under debris piles, and under human made structures. Daylight hours are spent on nests or foraging at sea, whereas nest site selection, incubation shift changes, and fledging all occur under cover of night (Hunt et al. 1979). The precocial chicks leave their nests with their parents under the cover of night at two days of age and are dependent on their parents for an extended period of time (Gaston and Jones 1998). Since murrelets are known to be attracted to bright light sources, particularly on foggy nights (Whitworth et al. 1997, Carter et al. 1999), chicks and parents may become disoriented by bright artificial lights, resulting in separation of the dependent chicks from parents. Chicks that get lost at night, or those who leave the nest during the day, are often fed upon by western gulls.

Population numbers have been declining for the past 20 years. Because Xantus' murrelets spend a substantial amount of time in the water, they are vulnerable to oil spills, contamination by marine pollution, and entanglement in fishing gear (Carter et al. 2000). Predators include the barn owl, peregrine falcon, western gull, deer mice, and introduced predators such as feral cats and black rats. No direct studies on sensitivity to humans have been conducted on Xantus' murrelets. However, their nesting abundance and distribution can be correlated with human activities (Keitt 2000), and human impacts and disturbance are considered one impediment to population increases in Baja California. Human generated noise and disturbance are another cumulative impact for these specialized birds that evolved on island or offshore rock environments, far from human disturbance.

3.9.5.6 Rhinoceros Auklets

Rhinoceros auklets are considered a SSC by the Department due to small population numbers in the State. Rhinoceros auklets feed on small fish, crustaceans, and cephalopods by diving and pursuing their prey underwater (Cogswell 1977). Food habit studies conducted by the Point Reyes Bird Observatory (unpublished data), indicate that, in some years, juvenile rockfish are an important part of rhinoceros auklets' diets with the most common rockfish species eaten in central California being blue, yellowtail, and widow.

Rhinoceros auklets are colonial, monogamous nesters that breed along the coast of the north Pacific Ocean (Harrison 1983). In California, approximately 1,800 birds nest in burrows and crevices (Sowls et al. 1980) on offshore islands from the Oregon border south to San Miguel Island (Carter et al. 1992). The largest colonies are located on offshore rocks in Del Norte County and in central California at the Farallon Islands.

Rhinoceros auklets are nocturnal and mostly enter and leave the burrow at night, a mechanism thought to reduce predation. They lay one egg, which is incubated by both parents for one month. The semiprecocial young remain in their burrow for 35 to 45 days, then leave for the sea before reaching adult size (Harrison 1978).

Rhinoceros auklets are sensitive to human disturbance and are vulnerable to oil spills. Because of their nocturnal habits, rhinoceros auklets are accustomed to flying in total darkness and may become disoriented in bright lights. This may cause them to crash into lighted boats which can result in direct mortality or the birds either falling stunned and/or injured into the water or landing on the deck (Dick and Donaldson 1978). Injured birds become easy targets for predation during the subsequent daylight hours.

3.9.5.7 Ashy, Black, and Fork-tailed Petrels

Three species of storm-petrels, ashy, black, and fork-tailed are considered SSC by the Department. Storm-petrels breed on offshore islands off the coasts of North and South America, in most oceans. Storm-petrels are nocturnal when departing or entering the breeding colonies, highly-pelagic seabirds that feed on small invertebrates (young squid, euphausiids, crab larvae) and small fish at the ocean's surface. It is thought that the nocturnal habits at the nesting colonies help reduce predation by gulls who are normally diurnal (Ainley et al. 1974, Watanuki 1980, Storey and Grimmer 1986). They are colonial breeders, nesting in burrows or crevices in rocks. Storm-petrels are monogamous, lay a single egg, and both parents participate in raising the nidicolous young. The adults may only return with food to the young every few nights, thus, foraging trips may last several days. Since they come and go by night, they are rarely seen by man and other potential predators. The chicks are abandoned by the parents about a week before they have fully fledged. The young birds leave the nests to feed once their flight feathers are completely developed.

Because of their nocturnal habits, storm-petrels are accustomed to flying in total darkness and may become disoriented by, and attracted to bright artificial lights (Verheijen 1958, Reed et al. 1985, Telfer et al. 1987). This may cause them to crash into lighted boats resulting in direct mortality and/or fall into the water or on the deck, making them susceptible to predation similar to effects noted for rhinoceros auklets previously. Storm-petrels are known to be attracted to and strike lighted long line vessels fishing at night in the southern hemisphere (Weimerskirch et al. 2000), lighted vessels at night in Alaska (Williams, pers. comm.), and artificial night-lighting in Hawaii (Reed et al. 1985, Telfer 1987).

Ashy storm-petrels are starling sized seabirds and are restricted to the north-east Pacific ocean breeding on islands from predominantly central to southern California with a few small colonies in Baja California. All but one of the world's 18 known nesting locations of ashy storm-petrels is in California. Approximately one-half of the world population, estimated at less than 10,000 individuals, nest at the Farallon Islands, and the other half at the Channel Islands, primarily San Miguel, Santa Barbara, and Santa Cruz Islands (Carter et al. 1992). The breeding period is from April through November, although ashy storm-petrels may visit their nesting colonies year-round. Dispersal in the non-breeding season is thought to be limited and large numbers congregate each fall in Monterey Bay. Populations of ashy storm-petrels have declined by an estimated 34 percent over the past 20 years at the Farallon Islands (Sydeman et al. 1998) (long-term trends are not available at the Channel Islands). Factors in the decline include loss of habitat from invasive non-native plants, introduction of feral cats, house mice, and other non-native animals, decline in zooplankton in the SCB, and increased predation by owls and western gulls (Sydeman 1998, Nur 1999). In addition, ashy storm-petrels are known to be sensitive to human disturbance.

Black storm-petrels are found in the north-east Pacific Ocean and primarily breed on offshore islands south of California (Harrison 1983). A small population, estimated at 274 individuals, breeds from April to October on Santa Barbara Island (Carter et al. 1992). Black storm-petrels, like all storm-petrels, only come to land for nesting, otherwise they remain over the open sea. After breeding, birds move generally south, some crossing the equator (Kucera 1990), however in warm-water years large numbers move as far north as Monterey Bay and Point Reyes (Harrison 1983).

Fork-tailed storm-petrels are widely distributed in the northern Pacific Ocean, breeding on islands from the sea of Okhotsk, Russia, across the Aleutian Islands, and south to northern California (Harrison 1983). They only come to land for nesting, otherwise they remain over the open sea. In California, the estimated breeding population of 410 birds breed on six small islets off Del Norte and Humboldt counties (Kucera 1990) from March to September (Carter et al. 1992). Individuals are observed as far south as southern California in the non-breeding season.

Because of their feeding methods and nocturnal habits, storm-petrels are not likely to become entangled in fishing gear, although they could be taken on longlines. However, there are documented interactions of in-flight strikes with lighted fishing vessels. This has become an issue with the southern California squid purse seine fishery where the use of bright lights (30,000+ watts) is thought to increase the mortality of ashy storm-petrels nesting in the Channel Islands. Storm-petrels accustomed to flying in total darkness may become disoriented in bright lights, causing them to crash into boats resulting in direct mortality, and/or fall into the water or on deck, thus making them susceptible to predation, and worst case, the birds may avoid the colony and not return to their nests as nocturnal species are known to reduce colony attendance during daylight conditions. This disrupts the feeding and chick care routine. If the birds return to the islands in the bright lights, they may be more susceptible to natural nocturnal predators such as barn owls. Additionally, storm-petrels may be affected by marine fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, whistles, etc.) near rookeries and roosting sites.

3.9.5.8 Double-Crested Cormorant

The Double-crested cormorant is considered a SSC by the Department. Double-crested, Brandt's, and pelagic cormorants, are year-long residents along the coast of California. Cormorants roost on offshore rocks, islands, cliffs, wharfs, and jetties where they dry out their plumage. All three species feed mainly on mid-water to bottom-dwelling fish (including rockfish), diving from the water's surface to pursue prey underwater. They forage principally in nearshore marine and estuarine waters less than 50 m deep, at short distances from nesting or roosting sites (Ainley et al. 1981, Hebshi 1998).

Double-crested, Brandt's, and pelagic cormorants nest on rocky headlands along the coast and at offshore islands form the northern border of California to Santa Barbara county and on the Channel Islands. Double-crested cormorant estimated breeding population is 10,000 individuals in California (Carter et al. 1995). Breeding efforts of Brandt's cormorants have been positively correlated with abundance of juvenile rockfish on the Southeast Farallon Island (Nur and Sydeman 1999). The breeding season encompasses January through September for all three species. Depending on latitude, eggs can be laid as early as February to April. All three cormorant species are monogamous colonial nesters with clutch sizes ranging from two to seven eggs. Incubation is performed by both parents and the young are altricial. Population declines of double-crested cormorants occurred throughout the 1900s and continue in some colonies due to habitat loss, marine pollution, human disturbance, and introduced predators (Carter et al. 1995). Predators on eggs and young include crows, ravens, and western gulls. Human disturbance of breeding colonies is known to cause nest abandonment and increased predation of eggs and young by gulls (Granholm 1990). Roosting sites on offshore rocks, islands, cliffs, wharfs, and jetties are important habitat for cormorants because their feathers are not completely waterproof and they need to dry them daily (Johnsgard 1993).

Large mesh (>3.5 inches) set gill-nets are known to incidentally take all three species of cormorants (Julian and Beeson 1998) and are known to interact with fishing activities involving various hook-and-line gear. In the CPFV fishery, they are attracted to the bait, which is used for chumming as well as baited lines. The cormorants may get hooked in the mouth or other body parts as they go after bait. When they get hooked, the hook is either yanked out or the line is cut leaving the hook in the bird. During the Department's 2001 CPFV observer program in San Diego County, double-crested cormorants were hooked on 13 percent of observed trips (19 birds hooked during 19 trips over a four-month period). One third of those trips, rockfish were a targeted species. Effects of line entanglement is similar to that described for the California brown pelicans. Cormorants also may be taken on longlines. The birds are attracted to the baited hooks as the gear is being set, and become hooked at the surface where they are dragged underwater and drown. Because they are deep divers and pursue their prey underwater, there is additional opportunity for interaction with nearshore fisheries. In 1998, Point Reyes Bird Observatory personnel documented hooking of cormorants by rockfish and lingcod long line vessels near the Farallon Islands (unpublished data).

Cormorants also may be affected by ancillary fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, whistles, etc.) near rookeries and roosting sites. It has been documented that the small vessels used in the nearshore live trap fishery are disturbing nesting Brandt's cormorants at the Hurricane/Castle Rock and Point Reyes colonies (Parker et al 2000, Rojek and Parker 2000). Disturbance of breeding colonies is known to cause nest abandonment and increased predation of eggs and young by gulls (Granholm 1990).

3.9.5.9 Black Skimmers

Black skimmers are considered to be a SSC by the Department. The black skimmer is a migratory colonial nesting seabird that arrives at breeding sites along the southern California coast (and inland at the Salton Sea) by late April and departs by October, although some birds are resident year-round (Beedy 1990). The number of nesting colonies have increased along the coast, most likely due to colony protection and use of artificial nesting sites (Carter et al. 2001). Black skimmers feed on small fish and crustaceans in calm, shallow waters by flying along the water's surface with their lower mandible cutting the surface (Cogswell 1977). Nesting takes place on the ground, on open sand or gravel, often in the vicinity of other nesting seabirds such as gulls and terns. Clutch size is usually four to five eggs and a single brood is raised yearly. The semiprecocial young, are fed by both parents and the young are dependent upon their parents until a month after they are ready to fly (Erwin 1977). Preferred nesting habitats are beaches and sand bars where interactions with humans are likely to occur.

3.9.5.10 Elegant Terns

Elegant terns are both a federal and Department SSC. Elegant terns are a migratory colonial nesting seabird that arrives at a few breeding sites along the southern California coast in June and depart by October (Beedy 1990). The number of nesting colonies have increased along the coast, most likely due to colony protection and use of artificial nesting sites (Carter et al. 2001). The preferred habitats are inshore coastal waters, bays, estuaries, and harbors; but never inland (Beedy 1990). After the breeding season, birds may disperse along the entire California coast but most migrate south as far as South America. Elegant terns feed on fish by diving into shallow nearshore waters as well as estuaries, bays, and lagoons.

3.9.5.11 Black Terns

Black terns are considered a SSC by the Department. Black terns are restricted to freshwater habitats while breeding, but can be found at bays, salt ponds, river mouths, and pelagic waters during spring and fall migration (Beedy 1990) where they may forage in the coastal zone. Colonies formally occurred at interior lakes in California, but numbers have declined due to loss of foraging and nesting sites as well as pesticide pollution (Beedy 1990).

3.9.5.12 California Gulls

California gulls are considered a SSC by the Department. California gulls nest primarily inland (on islands in lakes) although they do nest in San Francisco Bay (Carter et al. 2001) and visit the coast in the nonbreeding season (late summer to March). Along the coast, California gulls prefer sandy beaches, mudflats, rocky intertidal, and pelagic areas of marine and estuarine habitats, and wetlands (Rigney 1990). California gulls are omnivorous and feed on garbage, carrion, fish, earthworms, insects, and brine shrimp (Rigney 1990). The breeding population in California has declined due to human-related habitat changes at interior colonies and associated introductions of predators (Rigney 1990, Carter et al. 1992).

Gulls are not capable of deep dives. However, they may exploit nearshore fishery operations where they feed on scavenged or discarded fish, or bait fish used for chumming. In the CPFV fishery, gulls may get hooked in the mouth or other body parts when they go after bait. When they get hooked, the hook is either yanked out or the line is cut leaving the hook in the bird. Effects of line entanglement is similar to that described for the California brown pelicans. In Washington, immature gulls were documented to interact with the sport salmon hook-and-line fishery, with four entanglements/hookups observed out of 1,000 observations (S. Jeffries pers. comm.). Gulls also may be taken on longlines. The birds are attracted to the baited hooks as the gear is being set and become hooked at the surface where they are dragged underwater and drown.

Additionally, behavior patterns of gull may be influenced by fishery activities. For example, gulls, which are normally diurnal, are known to forage at night in the vicinity of squid fishing boats where they are attracted by the activity and bright lights. Gulls may be affected by ancillary marine fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, whistles, etc.) near rookeries and roosting sites.

3.9.5.13 Tufted Puffins

Tufted puffins are considered a SSC by the Department. In California, they breed on offshore islands in northern California (estimated at 276 birds), at the Farallon Islands, and have recently recolonized southern California where they have not been seen since the early 1900s (Carter et al. 2001). Tufted puffins feed on medium-sized fish (e.g. smelt, herring, and sea perch), some crustaceans, and squid, by diving and pursuing their prey underwater (Cogswell 1977). Tufted puffins are colonial nesters who nest in burrows on island cliffs or on grassy island slopes. They lay one egg which is incubated for approximately 45 days. The semiprecocial young is tended by both parents and remain in the burrow for approximately two months. Fledglings depart for the sea alone, at night (Gaston and Jones 1998). An unidentified puffin was documented to be taken (reported as dead) by at-sea processing trawl vessels in the Pacific whiting fishery in 1996 (PFMC 2001).

3.9.5.14 Common Loon

The common loon is considered an SSC by the Department. The common loon is a fairly common transient in marine subtidal and nearshore habitats along the coast of California during their wintering season, approximately September through May (Granholm 1990). It does not nests in California (Cogswell 1977), but nests in the northern US and Canada. The birds dive for food; the common loon as deep as 193 feet (Palmer 1962). For the most part, they consume fish while in the wintering grounds.

Large mesh set gill-nets are known to incidentally take common loons (Julian and Beeson 1998). Loons may interact with fishing activities involving various hook-and-line gear. The birds may get hooked in the mouth or other body parts as they pursue bait or catch. If they get hooked, the hook is either yanked out or the line is cut, leaving the hook in the bird. Effects of line entanglement are similar to that described for the California brown pelicans. Loons also may be taken on longlines. The birds are attracted to the baited hooks as the gear is being set and become hooked at the surface and are dragged underwater and drown.

3.10 Non-listed Species

3.10.1 Marine Mammals

3.10.1.1 Gray Whale

Gray whales range from the Baja Peninsula in Mexico to the Gulf of Alaska and can be observed off the coast of California during their southerly migration during late fall to early winter, and on their northerly migration between February and April. Abundance estimates from a census conducted in 1997/98 yielded 26,635 animals (Forney et al. 2000). Gray whales usually occur from 1.5 to 12 miles offshore, but can be found within a few hundred yards from shore and are frequently observed in kelp beds (MMS 2001). Gray whales are the only benthic feeding whale and feed by swimming slowly along the seafloor sucking sediment and prey (Wynne and Folkens 1992). Gray whales do not usually feed during migration (Swartz 1986).

Commercial and recreational anglers fish in these same areas during the early spring months, but there are no documented interactions with nearshore fisheries. In California, there have been several gray whale mortalities and injuries associated with gill-net gear including one death reported in 1998 from the California shark-swordfish drift gill-net fishery as well as reports of animals found swimming, floating, or stranded with gill-net gear attached to their bodies in 1996 and 1997. During the same time there have been several reports of gray whales entangled in crab-pot gear resulting in one death, one released alive, and one release with unknown injuries (Ferrero et al. 2000). Gray whales are particularly vulnerable to ship strikes because of their nearshore migration routes (Forney et al. 2000).

3.10.1.2 Harbor Porpoise

Harbor porpoise are found in coastal and inland waters from Point Conception, California to Alaska. Harbor porpoise along the west coast are not migratory and do not move extensively between California, Oregon, and Washington (Calambokidis and Barlow 1991). Harbor porpoise in Washington and British Columbia are known to feed on schooling fish and invertebrates including Pacific herring, mackerel, smelt, eelpout, grunt, croaker, and eulachon (Fitch and Brownell 1968, Gearin et al. 1994, Wynne and Folkens 1992). Based on aerial surveys, it is estimated that there are approximately 5,700 harbor porpoise in central California (Forney 1999).

The harbor porpoise stock in central California is considered strategic, owing to increased mortality in the large mesh (>3.5 inches) set gill-net fishery. The entanglement of harbor porpoise in the set gill-net fishery has increased since the early 1990s. From 1996 through 1998, it is estimated that 63 harbor porpoise were incidentally killed in the fishery, the average annual mortality exceeding the PBR. Mortality estimates for the months of January through September 1999 show that 123 harbor porpoise were killed in the fishery (Forney et al. 2000). The set gill-net fishery primarily targets halibut which accounted for 72 and 85 percent of the total set gill-net sets for fishing years 1998 to 1999 and 1999 to 2000, respectively (CDFG unpublished data). Some set gill-nets target "rockfish" which may include some species managed by the nearshore management plan. However, there is no directed set gill-net effort for the species managed under the nearshore fishery management plan. In addition, the number of "rockfish" sets represent a small component of the set gill-net fishery, accounting for 7 and 1.5 percent of the total set gill-net sets for the same years discussed above (CDFG unpublished data).

In September 2000, the Director of Fish and Game ordered a prohibition of gill and trammel net fishing in several areas within central California for waters less than 60 fathoms deep. The closure was in effect for 120 days and was extended, but it has since lapsed. The Department is currently working on regulations to limit all set gill and trammel net fishing from Pt. Reyes to Pt. Arguello to 60 fathoms or greater. Thus, set gill-net associated mortalities are likely to decrease. Additionally, there are efforts underway to encourage the voluntary use of “pingers,” which have proven successful in reducing harbor porpoise mortalities on the east coast. Harbor porpoise are not found in southern California and they are not subject to gill-net mortality in northern California as there is no set gill-net activity in northern California. Aside from set gill-nets, there are no other known fishery-related injuries or mortalities of harbor porpoise.

3.10.1.3 Risso’s Dolphin

Risso’s dolphins are distributed world-wide in temperate waters and are commonly seen off the west coast on the shelf in the southern California bight and in the slope and offshore waters (Forney et al. 2000). Highest densities tend to occur along the shelf break. It is estimated that there are approximately 16,500 Risso’s dolphins in California, Oregon, and Washington. Risso’s dolphins consume squid and small fish.

There is documented mortality of unknown extent for Risso's dolphins in the squid purse seine fishery off southern California (Heyning et al. 1994). This mortality is likely intentional rather than incidental with fishermen killing the animals to protect gear and catch. With the 1994 amendments to the MMPA intentional takes are now illegal. There is also documented mortality of Risso’s dolphins in the shark-swordfish drift gill-net fishery (FR Vol. 66 No. 158 2001).

3.10.1.4 Short-finned Pilot Whale

Short-finned pilot whales were commonly seen off California up until the 1982 to 1983 El Niño event. Since that time, sightings have been rare despite increased survey efforts (Forney et al. 2000). In 1993, there were six sightings of pilot whales off California, two of these were south of Point Conception (MMS 2001). NMFS estimates the California, Oregon, and Washington population of pilot whales at 970 animals. Short-finned pilot whales consume squid and small fish.

There is documented mortality of short-finned pilot whales in the shark-swordfish drift gill-net fishery. Historically, short-finned pilot whales were also killed in squid purse seine operations (Miller et al. 1983, Heyning et al. 1994). This mortality is likely intentional rather than incidental with fishermen killing the animals to protect gear and catch. With the 1994 amendments to the MMPA intentional takes are now illegal. No recent mortality of short-finned pilot whales has been reported, presumably because short-finned pilot whales are no longer common in the areas utilized by the squid fishery and/or the fishery is not being observed for marine mammal mortality despite the fact that it has expanded markedly since 1992.

3.10.1.5 Bottlenose Dolphin

Bottlenose dolphins are distributed worldwide in tropical and temperate waters. In California, NMFS separates bottlenose dolphins into two stocks, offshore and coastal, based on their distribution. Coastal dolphins generally are found within a kilometer or two of shore. NMFS estimates that there are approximately 950 offshore bottlenose dolphins in California, Oregon, and Washington, and 169 coastal dolphins in California waters (Barlow 1997). Offshore bottlenose dolphins consume predominantly squid, while coastal bottlenose dolphins eat a variety of fish, squid, and crustaceans (Drumm and NMML 2000).

Bottlenose dolphin have documented interactions with the California thresher shark/swordfish drift gill-net fishery, as well as the anchovy, mackerel, tuna purse seine, and herring purse seine fishery (FR Vol. 66 No. 158 2001). Offshore bottlenose dolphins are often associated with Risso's dolphins and short-finned pilot whales, thus, they may also experience some mortality in the squid fishery as well (Heyning et al. 1994). Because of their selective use of the coastal habitat, coastal bottlenose dolphins may be susceptible to other fishery related injury and mortality. In southern California, coastal bottlenose dolphins have been found to have high levels of pollutants in their system. DDT residue levels , measured in California coastal bottlenose dolphins were found to be among the highest of any cetacean examined (MMS 2001).

3.10.1.6 Pacific White-sided Dolphin

Pacific white-sided dolphins are primarily found in shelf and slope waters off the west coast. It is estimated that there are approximately 25,000 animals in California, Oregon, and Washington. They appear to occur primarily off California in cold water months and move northward to Oregon and Washington as waters warm in late spring or summer. Pacific white-sided dolphins feed on a variety of small schooling fish and squid (Wynne and Folkens 1992). They have taken hake (depths of greater than 400 ft), cephalopods, and anchovies (400 to 650 foot depth), and white seaperch (Fitch and Brownell 1968).

There is documented mortality and injury in the shark-swordfish drift gill-net fishery and the domestic groundfish trawl fishery. Between 1994 and 1999, the estimated annual mortality was one from the at-sea processing vessels in the Pacific whiting fishery (PFMC 2001).

3.10.1.7 Dall's Porpoise

Dall's porpoise are found in temperate waters and are commonly seen in shelf, slope, and offshore waters in California. The population for California, Oregon, and Washington is estimated at 117,500 animals (Forney et al. 2000). Data from MMS pelagic marine mammal database indicate highest annual densities in shelf waters along the Big Sur coast, over the shelf and slope in southern California (MMS 2001). Dall's porpoise feed on a variety of fish and squid (Wynne and Folkens 1992). There is documented mortality and injury in the shark-swordfish drift gill-net fishery and the domestic groundfish trawl fishery. Between 1994 and 1999, the estimated annual mortality was 32 from the at-sea processing trawl vessels in the Pacific whiting fishery (PFMC 2001).

Pinnipeds

Four species of pinnipeds breed in California and are present year-round in southern California. San Miguel and San Nicholas are the largest pinniped rookeries on the west coast south of Alaska (MMS 2001). All pinnipeds must come ashore at least once a year to breed and pup. Males, which are much larger than females, generally haul out on rookeries first and attempt to establish territories. Pregnant females arrive, give birth, mate, and then begin making trips to sea to feed, regularly returning to feed the pups. Pinnipeds feed mainly on schooling fish and squid.

3.10.1.8 Northern Fur Seal

Northern fur seals occur throughout the North Pacific ranging from Japan to southern California (Ferrero et al. 2000). Only the eastern Pacific stock (Alaska) of northern fur seals is considered depleted under the MMPA. The primary rookeries are found in the Bering Sea, although there is a small breeding colony on San Miguel Island (approximately 4,500 animals) that represents less than one percent of the population. In 1999, the most recent estimate for the San Miguel stock was approximately 4,300 animals (Forney et al. 2000). Northern fur seals feed primarily at night on schooling fish and squid (Wynne and Folkens 1992). There have been no reports of mortality in any observed fishery along the west coast since 1994 (Forney et al. 2000), however, interactions have occurred with the California thresher shark/swordfish drift gill-net fishery and the California groundfish trawl fishery (FR Vol. 66 No. 158 2001). Fur seals have stranded in central and northern California with net abrasions around the neck, fish hooks, and monofilament line (Hanni et al, 1997, Forney et al. 2000).

3.10.1.9 Northern Elephant Seal

Northern elephant seals breed on offshore islands in California and Baja California, Mexico from December to March (Stewart et al. 1994), and range along the coast up to Alaska in the non-breeding season. The population has increased exponentially in the past century (Reeves et al. 1992) and, in 1996, the California stock was estimated to be 84,000 animals (Forney et al. 2000). Northern elephant seals feed on deepwater fish, squid, and octopus.

Northern elephant seals have been incidentally taken in the California shark-swordfish gill-net fishery and the large mesh set gill-net fishery (>3.5 inches). The set gill-net fishery primarily targets halibut which accounted for 72 and 85 percent of the total set gill-net sets for fishing years 1998 to 1999 and 1999 to 2000, respectively (CDFG unpublished data). Set gill-nets also target “rockfish” which may include some species managed by the nearshore management plan. However, there is no directed set gill-net effort for the species managed under the nearshore fishery management plan. In addition, the number of “rockfish” sets represent a small component of the set gill-net fishery, accounting for 7 and 1.5 percent of the total set gill-net sets for the same years discussed above (CDFG unpublished data). Northern elephant seals may also interact with hook and line fisheries as stranding data reported to the California Marine Mammal Stranding Network in 1995 to 1998 included two injuries attributed to hook and line gear (Forney et al. 2000). In 1998 and 1999, a dead northern elephant seal (each year) was documented to be taken by the at-sea processing trawl vessels in the Pacific whiting fishery (PFMC 2001). California strandings data from 1995 to 1998 attributed one boat collision injury, five deaths from car collisions at Piedras Blancas (recent measures have been taken to prevent further car collision deaths), and three deaths from shootings (Forney et al. 2000). It should be noted that 1994 amendments to the MMPA made intentional lethal take of any marine mammal illegal except where imminently necessary to protect human life. The total human-caused mortality and serious injury (fishery related plus other sources) for this stock is less than their PBR (Forney et al. 2000).

3.10.1.10 Pacific Harbor Seal

Pacific harbor seals range in the north east Pacific from central Baja California, Mexico, to Alaska. In California, they are one of the more commonly observed pinnipeds, hauling out on rocks, reefs, mud flats, and beaches where they are subject to disturbance and harassment by humans. Pacific harbor seals pup along the coast of California and on offshore islands from February through June. Harbor seals are considered opportunistic feeders and consume a variety of fish (including rockfish and the listed steelhead), squid, octopus, and crustaceans. The population of Pacific harbor seals in California is estimated to be at least 30,000 animals based on 1995 estimates (Forney et al. 2000).

The vast majority of Pacific harbor seal mortalities in California fisheries occurs in the large mesh set gill-net fishery. The set gill-net fishery primarily targets halibut which accounted for 72 and 85 percent of the total set gill-net sets for fishing years 1998 to 1999 and 1999 to 2000, respectively (CDFG unpublished data). Set gill-nets also target "rockfish" which may include some species managed by the nearshore management plan. However, there is no directed set gill-net effort for the species managed under the nearshore fishery management plan. In addition, the number of "rockfish" sets represent a small component of the set gill-net fishery, accounting for 7 and 1.5 percent of the total set gill-net sets for the same years discussed above (CDFG unpublished data). Additionally, Pacific harbor seals are killed and/or injured in the purse seine fisheries for squid, anchovy, mackerel, and tuna and groundfish trawl fisheries. Between 1994 and 1999, the estimated annual mortality for harbor seals was five for the at-sea processing trawl vessels in the Pacific whiting fishery (PFMC 2001). Stranding data has shown that additional mortality and injuries are caused by hook-and-line fisheries (fishing line as well as fishing hooks).

Pacific harbor seals are known to interact with other fishing operations including the salmon troll and CPFV fisheries where they follow the vessels to feed on bait used to chum for sportfish, and to depredate hooked fish (Miller et al. 1983). Although now illegal, mortality associated with these fisheries is likely intentional with fishermen killing the animals to protect gear and catch. California strandings data for 1995 to 1998 showed additional mortality of Pacific harbor seals with 20 deaths from entrainment in power plants, 10 deaths and two injuries from boat collisions, nine deaths from shootings (Forney et al. 2000). The total fishery mortality and serious injury for this stock is less than their PBR (Forney et al. 2000). Organic pollutants are known to cause reproductive failure in harbor seals (MMS 2001).

3.10.1.11 California Sea Lion

The California sea lion is the most commonly recognized and most abundant pinniped in California. California sea lions are a migratory species that range from southern Mexico to Canada. They breed during July primarily at the Channel Islands in southern California, although some breeding occurs at Año Nuevo Island and the Farallon Islands. After the breeding season, adult and sub-adult males migrate north, although some remain at haul-out sites in central and northern California then return south in March to May. Movements of females are unknown. Recent 1999 population estimates, based on pup counts with a multiplication factor, ranged from 204,000 to 214,000 animals (Forney et al. 2000). The California sea lion is considered an opportunistic feeder and eats schooling fish (anchovy and sardine), rockfish, squid, flatfish, salmon (including those salmon hooked in the commercial and recreational fishery), spiny dogfish shark, and lamprey.

California sea lions are incidentally killed in the set and drift gill-net fisheries. It is estimated that 1,228 sea lions were killed in the large mesh (>3.5 inches) set gill-net fishery in 1998. The set gill-net fishery primarily targets halibut which accounted for 72 and 85 percent of the total set gill-net sets for fishing years 1998 to 1999 and 1999 to 2000, respectively (CDFG unpublished data). Set gill-nets may also target "rockfish" which may include some species managed by the nearshore management plan. However, there is no directed set gill-net effort for the species managed under the nearshore fishery management plan. In addition, the number of "rockfish" sets represent a small component of the set gill-net fishery, accounting for 7 and 1.5 percent of the total set gill-net sets for the same years discussed above (CDFG unpublished data). Mortality also occurs in the salmon troll and in the round haul fisheries for herring, anchovy, mackerel, sardine, tuna, squid, and the CPFV fishery (Miller et al. 1983, NMFS 1995). Interactions also have been documented with the California groundfish trawl fishery (FR Vol. 66 No. 158 2001). Between 1994 and 1999, the estimated annual mortality for California sea lions was five from the at-sea processing trawl vessels in the Pacific whiting fishery (PFMC 2001). Although illegal, the mortality associated with these fisheries is likely intentional with fishermen killing the animals to protect gear and catch. California sea lions also interact in trap fisheries including lobster, crab, and live-fish traps where they depredate the traps and damage or destroy them.

California sea lions are the primary species involved with the CPFV fishery (Miller et al. 1983) and they are occasionally hooked when they depredate catches. Additionally, California sea lions are entangled in fishing gear and debris. Strandings data for 1998 (California, Oregon and Washington) showed three mortalities from boat collisions, 30 deaths from entrainment in power plants, and 70 deaths and eight injuries from shootings (Forney et al. 2000). Algal blooms along the coast resulting in the production of domoic acid have been responsible for additional California sea lion deaths. The total human-caused mortality and serious injury (fishery related plus other sources) for the California sea lion stock is less than their PBR (Forney et al. 2000). In 1998, an outbreak of domoic acid toxicity resulting from a bloom of the diatom *Pseudonitzchia australis* affected tens of California sea loins along the California coast (MMS 2001).

3.10.2 Marine and Coastal Birds

3.10.2.1 Common Murre

The common murre breeds in both the north Pacific and north Atlantic oceans. The common murre is found year-long in marine subtidal and nearshore habitats off rocky coasts and islands of northern and central California, with small numbers observed in southern California (Cogswell 1977). They are diurnal feeders which prey on fish by pursuing them underwater. Prey items include sand lance, juvenile rockfish, Ammodytes spp., Pacific herring, sardines, and anchovies, as well as crustaceans and cephalopods (Sowls et al. 1980). Diet studies conducted by the Point Reyes Bird Observatory (unpublished data) on South Farallon Island indicate that juvenile rockfish are delivered to chicks, with the percentage varying year to year. Numbers vary from year to year, but, when juvenile rockfish are abundant, they are the most common prey item in the chick's diet (Sydeman et al. In press).

Common murres are colonial, monogamous nesters, who nest on cliff ledges of rocky islands and seacoasts, and on the flat tops of low rocky islands from the Oregon border to Monterey County. The largest colonies are found on offshore rocks in Del Norte and Humboldt counties and at the Farallon Islands. Eggs are laid on the bare ground or rock from late April to late June. The eggs hatch from late May to mid-July, and the young fledge from mid-June to mid-August (Sowls et al. 1980). The altricial young remains at the nest for one month, then jumps to the ocean below. Thereafter, the half-grown, flightless chick is accompanied and fed at sea by the male parent for about two months (Gaston and Jones 1998, Sowls et al. 1980).

Common murre populations declined substantially in central California (estimated 52.6 percent between 1980 to 1982 and 1986) due to high mortality in gill-nets, oil spills, and El Niño events (Carter et al. 2001). Oil spills and entanglement are still threats to the viability of local colonies. The most severe population declines occurred at colonies which were located nearest to areas of highest gill-net mortality (Carter et al. 2001). Population numbers have increased through the 1990s, but are still substantially lower than historical levels (Carter et al. 2001). Large mesh set gill-nets are known to take alcids incidentally and have previously taken common murres in central California (Carter et al. 1995, Julian and Beeson 1998). Hooking of common murres was recorded during CPFV observer programs in central California (from Morro Bay to Bodega, and in a few years up to Eureka in northern California) from 1987 to 1998 (DFG, unpublished data). Common murres have been documented being caught by salmon fisherman along the central California coast and are likely to be involved in hook-and-line fishery interactions. There is a potential for the other alcids to interact with hook-and-line nearshore fishing activities (entanglements), but no data exist to qualify or quantify these events.

Nesting sites can be disturbed by boats, low-flying aircraft, and intruding humans depending on the proximity to the colony, timing, frequency and duration of the disturbance (Thayer et al. 1999, Parker et al. 2000, Rojek and Parker 2000). When adults are disturbed, they may knock eggs and chicks off nesting ledges, or leave them vulnerable to predation from western gulls and ravens. It has been documented that the small vessels used in the nearshore live trap fishery are disturbing nesting common murres at Hurricane/Castle Rock, Monterey County, and Point Reyes, Marin County, colonies (Hampton and Kelly 2001). Documentation and data have shown that continued and increasing boat disturbance often results in the loss of chicks and eggs. While this documentation is limited to four colonies that are being actively monitored, there is no reason to believe that similar disturbance patterns do not exist at other colonies as well.

3.10.2.2 Western Grebes

Western grebes are a common marine bird along the California coastline from October to May in marine subtidal and estuarine waters (Cogswell 1977). They breed in the interior of western North America and migrate to the Pacific coast for the winter (Harrison 1983). Western grebes eat mostly fish while diving to pursue their prey in waters at least four feet deep (Lawrence 1950). They are strictly a nearshore bird occurring almost entirely in waters less than 50 meters deep. These nearshore birds are known to rest on water, usually well offshore, and often dive to escape danger and disturbance (Palmer 1962).

Large mesh set gill-nets are known to take western grebes incidentally (Julian and Beeson 1998). Grebes may interact with fishing activities involving various hook-and-line gear. The birds may get hooked in the mouth or other body parts as they are going after bait or catch. If this occurs, the hook is either yanked out or the line is cut leaving the hook in the bird. Effects of line entanglement are similar to that described for the California brown pelicans. Grebes also may be taken on longlines. The birds are attracted to the baited hooks as the gear is being set and become hooked at the surface and are dragged underwater and drown.

3.10.2.3 Western Gull

The western gull breeds along the Pacific coast from British Columbia to central Baja, California, Mexico (Carter et al. 1992). The largest breeding numbers (estimated at about 61,800 birds) occur in California. The Farallon Islands harbor the largest colony in the world and large numbers are also found in the Channel Islands (Carter et al. 1992). Western gulls do not disperse far from their breeding range in the winter. They are omnivorous and feed on garbage, fish, cephalopods, euphausiids, offal, and birds and eggs, including auklets, petrels, gull chicks, and eggs. Rockfish are included in their diets, and, at the South Farallon Islands, studies have shown that western gulls forage on 0-age class rockfish and anchovies during the chick rearing period (Ainley et al. 1990, Sydeman et al. 1997, Sydeman et al. In press).

Their numbers have increased in the past few decades, likely due to the increased use of human and fishing garbage disposal sites for food and reduced human disturbance (Carter et al. 2001a). As a result, increased predation on rare birds, such as Ashy storm-petrels on the Farallon Islands where western gull numbers have reached saturation, could become a threat to those petrels with small population numbers (Nur et al. 1999). Data from the Department’s CPFV observer program from May through August 2001 in San Diego County documented 11 birds hooked (eight percent of observed trips). In 1998, Point Reyes Bird Observatory personnel (unpublished data) documented hooking of western gulls by rockfish and lingcod longline vessels near the Farallon Islands.

Additionally, behavior patterns of gulls may be influenced by fishery activities. For example, gulls, which are normally diurnal, are known to forage at night in the vicinity of squid fishing boats, where they are attracted by the activity and bright lights. Artificial lighting may also increase lighting and foraging abilities of gulls on nesting colonies, resulting in increased levels of predation on those nocturnal seabirds. Gulls also may be affected by ancillary marine fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, whistles, etc.) near rookeries and roosting sites.

3.10.2.4 Heermann's Gull

Heermann's gulls nest in the Gulf of California and Baja, California, Mexico (Carter et al. 1992). A few nesting attempts have been recorded in California. They are a common visitor to California, from the Mexican border to Monterey Bay in the summer and fall, after they disperse from breeding grounds. Heermann's gulls prefer to feed in kelp beds, rocky shorelines, and sandy beaches, where they fed on fish, shrimp, mollusks, and crustaceans, as well as scavenge on shorelines (Beedy 1990). Data from the Department's CPFV observer program from May through August 2001 documented 47 birds hooked (19 percent of observed trips).

3.10.2.5 Forster's Tern

Forster's terns primarily breed in interior North America, although colonies are found in San Francisco and San Diego bays (Carter et al. 1992). They are a common tern species along the coast from May to September. They feed on fish, aquatic insects, crustaceans, and small amphipods (Ridney and Granholm 1990). Data from the Department's CPFV observer program from May through August 2001 documented three birds hooked (three percent of observed trips).

3.10.2.6 Pigeon Guillemont

Pigeon guillemots are found along the coast of the north Pacific Ocean. In California, they nest in rock crevices and burrows along the coast and on islands from the Oregon border to Santa Barbara County and on the Channel Islands south to Santa Barbara Island (Carter et al. 1992). The largest colony is found at the South Farallon Islands. They feed primarily on fish in the nearshore waters close to breeding colonies. Juvenile rockfish are included in their diets, and species identified as prey include blue, black, canary, yellowtail, and shortbelly rockfish (Follett and Ainley 1976). When rockfish are abundant, juvenile rockfish are the most common prey item in their diets (Sydeman et al. In press). Pigeon guillemots are sensitive to disturbance at their nesting sites, and will readily abandon nests if disturbed during incubation or chick brooding (Sowls et al. 1980). In 1998, Point Reyes Bird Observatory (unpublished data) documented hooking of pigeon guillemots by rockfish and lingcod longline vessels near the Farallon Islands.

3.10.2.7 Brandt's and Pelagic Cormorants

Brandt's cormorant, and pelagic cormorants are year-long residents along the entire coastline of California. These species feed mainly on mid-water to bottom-dwelling fish, including juvenile rockfish, diving from the surface to pursue prey underwater. They forage principally in nearshore waters less than 50 m in depth, at short distances from nesting or roosting sites (Ainley et al. 1981, Hebshi 1998). Breeding efforts of Brandt's cormorants have been positively correlated with abundance of juvenile rockfish on the Southeast Farallon Island (Nur and Sydeman 1999). Coastal cormorant species nest on rocky headlands and on offshore islands from the northern border of California to Santa Barbara County and on the Channel Islands.

The breeding season can start as early as January (for pelagic cormorants) and is completed by September. Cormorants are monogamous colonial nesters with clutch sizes ranging from two to seven eggs. Incubation is performed by both parents and the young are altricial. Predators on eggs and young include crows, ravens, and western gulls. Human disturbance of breeding colonies is known to cause nest abandonment and increased predation of eggs and young by gulls (Ellison and Cleary 1978, Manuwal 1978). Roosting sites on offshore rocks, islands, cliffs, wharfs, and jetties are important habitat for cormorants because, unlike other seabirds, their feathers are not completely waterproof and they need to dry them daily (Johnsgard 1993).

Large mesh (greater than3.5 in. or 8.9 cm) set gill nets are known to incidentally take cormorants (Julian and Beeson 1998, Forney et al. 2001) and both species are known to interact with fishing activities involving various hook-and-line gear. Effects of line entanglement are similar to that described for the California brown pelicans. In the CPFV fishery they are attracted to the bait which is used for chumming, as well as baited lines. In addition, cormorants may be taken on longlines. The birds are attracted to the baited hooks as the gear is being set, and become hooked at the surface and dragged underwater and drowned. Because they are deep-divers and pursue their prey underwater, there is additional opportunity for interaction with nearshore fisheries. In 1998, Point Reyes Bird Observatory (unpublished data) documented hooking of cormorants by rockfish and lingcod longline vessels near the Farallon Islands.

Cormorants also may be affected by ancillary fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, whistles, etc.) near rookeries and roosting sites. It has been documented that the small vessels used in the nearshore live trap fishery are disturbing nesting Brandt's cormorants at the Hurricane/Castle Rock, Monterey County, and the Point Reyes, Marin County, colonies (Parker et al. 2000, Rojek and Parker 2000). Disturbance of breeding colonies is known to cause nest abandonment and increased predation of eggs and young by gulls (Manuwal 1978, Granholm 1990).

3.10.2.8 Pacific Loons

Loons are large, foot-propelled diving birds which are highly migratory. Pacific loons nest in freshwater in arctic and subarctic regions. The Pacific loon dives for food to depths of 66 feet (Palmer 1962). They are fairly common transients in marine subtidal and nearshore habitats along the coast of California during their wintering season, approximately September through May (Harrison 1983, Granholm 1990). For the most part, fish are consumed while in the wintering grounds.

Large mesh set gill nets are known to incidentally take Pacific loons (Julian and Beeson 1998). Loons may interact with fishing activities involving various hook-and-line gear. Effects of line entanglement are similar to that described for the California brown pelicans. Loons also may be taken on longlines. The birds are attracted to the baited hooks as the gear is being set and become hooked at the surface and are dragged underwater and drown.

3.11 Target Fishes for this NFMP

Fish generally are classified into either coastal, benthic, or pelagic habitats. Fish species, other than the 19 species that are the focus of this FMP, are described in the previous habitat sections. A brief description follows of the 19 species, as more details are given in Chapter 2 of this FMP. Further information on acceptable biological catch and optimum yield are found in “Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Proposed Groundfish Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2002 Pacific Coast Ground Fishery” (PFMC 2001) and are incorporated by reference.

Complex relationships exist between marine plant and animal communities. These relationships differ considerably among different habitats and communities. Many nearshore fish species are highly dependent upon particular types of habitat and may show little large-scale movement after they recruit to these areas. The life histories and habitat affinities of many nearshore fish focuses fishing effort by both recreational and commercial fishermen in certain habitat types. Coastal areas close to harbors and ports face zonal depletion as fishermen range up and down the coast after nearshore fish species. The closest nearshore rocky areas and kelp forests suffer the greatest effects of continuous fishing effort. Localized removals of large portions of the nearshore biomass of individual species may have significant short-term and long-term effects on both a population and community-wide scale, within these particular habitats and also, to an unknown extent, outside these habitats.

Fishery Information

The nearshore area provides opportunities for a broad variety of consumptive uses which includes recreational and commercial fishing. Consumptive uses often involve some type of an active market where the goods or services are traded, such as seafood markets or charter fishing services that cater to the end-user or consumer. These active markets provide convenient means to assess the value of the particular resource activity in terms of money spent on goods or services. Commercial and recreational fishing goods and services are bought and sold and thus generate revenues that produce a ripple effect in the California economy. Money or revenues resulting from these user-sectors stimulate further economic growth throughout the state of California in the form of economic output, earnings, and employment. Thus the economic contribution of a user-sector can be estimated as an end result contribution to the state, through the use of economic multipliers. For a full discussion of fishery socioeconomics refer to the appropriate section of the NFMP.

Commercial or recreational fishermen engaged in the take of nearshore fishes may dispose of trash and other items while fishing or traveling to and from fishing areas. Evidence suggests that marine vessel and fishing activity are a primary source of human-generated debris in the SCB (Moore and Allen 1998). Marine debris such as plastics and styrofoam can cause death or injury to animals in the marine environment when ingested or when it entangles an organism (NOAA 1998). Marine species are under great stress from environmental degradation, resource exploitation, and competing economic concerns. Of the United States fisheries for which the population status is known, 43 percent are over-utilized and 39 percent are fully-utilized (California Coastal Commission 1996).

In general, marine habitats that have been less altered by fishing and other activities are more complex in structure and more productive in lower level organisms such as worms and crustaceans than highly altered habitats. Marine habitats with greater complexity at lower trophic levels and with greater structural complexity tend to support a more complex mix of fish species in greater abundances than altered habitats (PFMC 1998). High relief rock piles that are not accessible to trawl gear are usually accessible to commercial longline and recreational hook-and-line gear. Similarly, marine canyons that have not been trawled may be used by commercial longliners. Longline gear has been seen to disturb or remove marine plants, corals, and sessile organisms. Trawl gear, particularly doors and foot ropes, can alter marine habitat complexity. Thus, there is hardly any habitat that is not altered by commercial or recreational fishers.

As rockfish stocks have been fished down to lower levels, there is little evidence of new increases in stocks of short-lived species that do not rely on high habitat complexity. Thus, alterations to rockfish habitat may not be accompanied by improvements in stocks that are better adapted to the altered habitat. For this reason, protection of rockfish and rockfish habitat is extremely important to long-term sustainability of the groundfish fishery (PFMC 1998).

Gear used in the commercial and recreational fisheries of California can affect the nearshore environment. Almost 100 percent of nearshore finfish are taken by line gear north of Cape Mendocino while there is approximately a 50/50 split between line and trap gear south of Point Conception. Fishing gear was found to be the most common type of benthic debris of the SCB, from Point Dume, Ventura County, to Dana Point, Orange County (Moore and Allen 1998). Lost fishing gear (referred to as ghost fishing), such as gill-nets and traps, can continue to capture target and non-target fishes and invertebrates, resulting in undocumented losses of these fishes and losses of potential prey species for nearshore fishes and invertebrates. Lost or discarded monofilament or other line used in fishing activities can cause death or injury to marine mammals if they become entangled (High 1984). The lost shiny hooks may be attractive to fish or other marine animals and cause injury if ingested.

A study of the long-term effects of trawling on the benthos of the eastern Bering Sea found that sedentary megafauna were more abundant in the untrawled areas, and that overall diversity and niche breadth of sedentary organisms was reduced (NMFS 2001). In addition, they found that a single trawl pass affected the dominant features on the seafloor, displacing a significant number of boulders and removing or damaging large epifaunal invertebrates. In a review of 22 studies worldwide (as described in NMFS 2001), findings were that despite their wide geographic range, from tropical to boreal, all studies showed similar classes of impacts. They found that mobile fishing gear reduced habitat complexity in three ways: 1) epifauna are removed or damaged, 2) sedimentary bedforms are smoothed and bottom roughness is reduced, and 3) taxa which produce structure, including burrows and pits, are removed.

Longline gear, monitored off Alaska, has observed longlines entangled scallops and corals, bringing those animals to the surface during line retrieval (PFMC 1998). Lost horizontal set longline gear set in the nearshore lower intertidal areas has resulted in entanglement of north coast recreational abalone divers (Moore pers. comm.). Pot gear may damage demersal plants and animals as it settles, and longlined pots may drag through and damage bottom fauna during gear retrieval (PFMC 1998). Gill and trammel nets, now prohibited from the nearshore area, have been shown to result in incidental deaths of marine mammals, birds, and non-target fish and invertebrates. Gill-nets used by commercial fishers can be lost, and these nets will continue for a time to capture invertebrates, birds, marine mammals, turtles, and fish. In addition, contact with netting may cause physical trauma to untargeted catch, such as fish that are too small to be caught in the net. Physical trauma can lead to disease susceptibility. For example, lesions on northern anchovy and Pacific sardine used as live bait are associated with net abrasions incurred during capture and transport (Chen et al. 1995).

Effort by the recreational component of the fishery in the mid-to-late 1990s was generally lower than that observed in the 1980s and early 1990s, but this trend was not observed in all areas. For instance, the average number of trips reported on CPFV logs from the Crescent City-Eureka area was slightly higher for 1993 to1998 than for 1980 to 1992, while the average number of trips from the Ventura to Santa Barbara and Los Angeles to San Diego areas remained about the same. Nearshore rockfish landings had a dramatic decrease in numbers from the 1980s to the 1990s. Landings in the 1980s were primarily due to the recreational fishery with a small contribution by the commercial fishery.

During the 1990s, recreational landings showed a marked decrease while commercial landings increased slightly. Despite this fluctuation, commercial landings remained lower than recreational landings. From 1983 to 1989, 4,427,640 lb (2,008 mt) of rockfish were landed on average by the recreational fishery per year, while the commercial fishery landed on average only 617,400 lb (280 mt). For 1993 to 1999, average annual recreational landings decreased to 1,777,230 lb (806 mt), while average annual commercial landings increased to 950,355 lb (431 mt). Recreational landings in the Southern California Bight and Santa Maria Basin land about 60 percent of the total recreational catch in California. The landings for these two areas account for about five percent of the total recreational landings in the continental United States (MMS 2001). From 1985 to 2000, annual salmon landings averaged 91,600 fish for CPFVs and 93, 600 fish for private boats that included an annual average effort of 86,200 CPFV trips and 128,300 private boat trips (Leet et al. 2001). According to the Marine Recreational Fisheries Statistics Survey (MRFSS) program, marine recreational fishing trips declined by 26.4 percent between 1993 and 1998 in southern California (MMS 2001). Private/rental boat trips declined 18.4 percent, charter/party boats declined 42.6 percent and shore fishing trips declined 21.4 percent.

In the 1980s, nearshore fishing activity was primarily conducted by recreational fishermen. Nearshore finfish were taken by angling or spear fishing from CPFVs, private/rental boats, beaches, banks, and man-made structures such as piers and jetties. Some commercial fishing activities (using gill-nets, trammel nets, and hook-and-line) also occurred. However, the target species for the commercial activities were generally the deepwater rockfishes.

California's commercial fishing industry ranks among the top five seafood producing states in the nation (California Seafood Council 2001).The commercial landings at ports within the southern and central California account for about four percent of the total U.S. catch. Los Angeles area ports rank among the top 10 ports in the U.S. in quantity and value of commercial catch (MMS 2001). The primary commercial fishing gears used in harvesting the19 nearshore finfish species are hook-and-line and trap. Gill and trammel nets, and trawls targeting other species occasionally take nearshore species in areas outside State waters. Within the hook-and-line category, there are a variety of methods used in the nearshore fishery, including rod-and-reel, vertical hook-and-line, stick gear, and set longline. Fishing gear designed to take fish live, like hook-and-line and trap gear, require less capital outlay than that for gears used in many other fisheries. In addition, commercial fishermen can successfully harvest live fish from kayaks or very small boats requiring a relatively modest capital outlay. As the fishery grew, landings escalated from 52,000 to 988,000 pounds from 1989 to 1995 with the number of live-fish fishermen statewide rising from 70 to nearly 700 during the same period (MMS 2001).

Presently, there are 1,014 nearshore and finfish trap permittees in California, with an estimated total fleet harvest capacity of more than 2,400 tons (or roughly 24 times the current harvest allocation for 2001). However, the number of commercial fishermen that have landed nearshore species has declined from pre-1999 counts for all gear types (Table 2.3-6). Other fisheries that use traps include: "rock" and Dungeness crab, spiny lobster, and shrimp.

Table 2.3-6. Number of commercial fishermen in California with landings of nearshore finfish market categories by gear and total number of landings per year, 1989-1999[1,2,3,4]

Gear	Number of landings	Year										
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gill &	< 25	361	279	239	185	146	69	79	66	65	64	56
trammel	25 - 49	24	15	17	16	10	2	7	5	7	6	8
net	$50	2	4	2	1	1		1	2	2	2	1
	Total	387	298	258	202	157	71	87	73	74	72	65
Hook &	< 25	1648	1376	1331	1339	1125	699	880	834	900	718	602
line	25 - 49	51	80	114	108	87	44	86	78	73	72	68
	$50	33	50	50	62	48	10	46	56	42	45	43
	Total	1732	1506	1495	1509	1260	753	1012	968	1015	835	713
Trap	< 25	98	61	59	87	107	131	180	357	261	213	163
	25 - 49		1	1	4	7		1	6	9	8	6
	$50							2	4	3	3	1
	Total	98	62	60	91	114	131	183	367	273	224	170

Table 2.3-6. Number of commercial fishermen in California with landings of nearshore finfish market categories by gear and total number of landings per year, 1989-1999[1,2,3,4]

Notes:
1. Participation is based on only those landing receipts from trips targeting nearshore fish and using hook-and-line, gill or trammel net, or trap gear. Trips that were targeting salmon, albacore, crab, lobster, shrimp or prawns but landed nearshore market categories as incidental take, were excluded from the estimates of participation in the fishery. Those landings are considered bycatch and are reported elsewhere.
2. Nearshore market categories are defined as cabezon, California scorpionfish, California sheephead, kelp greenling, monkeyface prickleback, and the following rockfish market categories: black, black-and-yellow, blue, brown, calico, china, copper, copper “whitebelly”, gopher, grass, kelp, olive, quillback, treefish, group black/blue, group bolina, group gopher, group nearshore rockfish, group red rockfish, group small rockfish, and group unspecified rockfish.
3. A landing is defined as all receipts from one boat with the same date of landing.
4. Based on California commercial landing receipt data as of 26 May 2000

Depending on the species sought and the season, trawlers of the Santa Barbara Channel drag anywhere from the 50 to 150 fathom depth contour along the coastline, along the Channel Islands, and along topographic features of the seafloor in midchannel. In 1960, the Santa Barbara trawl fishermen pushed rockfish landings (principally bocaccio and chilipepper rockfish) beyond four million pounds.

In the past, comparatively low prices were paid to commercial fishermen (ex-vessel value) for rockfish, cabezon, California sheephead and greenlings, especially in comparison to premium fish such as salmon and California halibut. However, since 1991 a market has developed for live and high-quality fresh fish. Fish buyers and consumers are willing to pay high prices for these products. For example, the average ex-vessel value of cabezon was less than $0.50 per pound in 1989 when most fish were landed dead, but was $3.80 per pound in 1999 when most fish were landed live. The nearshore fishery, fishing methods, and target species are now driven by this demand for live and high quality fresh fish. This has markedly changed the revenue potential for this fishery over the last 10 or 12 years, as shown in Table 2.3-7.

Table 2.3-7. Commercial nearshore finfish landings and value by year for nineteen nearshore finfish species and all commercial gear types (excluding trawl)

Year	Pounds landed	Value ($)	Value/pounds ratio
1989	6,499,439	3,925,761	0.60
1990	7,563,254	4,735,678	0.63
1991	7,504,582	5,103,869	0.68
1992	6,704,447	5,002,397	0.75
1993	5,179,340	4,626,544	0.89
1994	1,595,987	1,833,840	1.15
1995	2,890,186	4,200,306	1.45
1996	2,740,887	4,411,758	1.61
1997	2,565,162	4,263,103	1.66
1998	2,346,037	4,405,981	1.88

Table 2.3-7. Commercial nearshore finfish landings and value by year for nineteen nearshore finfish species and all commercial gear types (excluding trawl)			
1999	1,341,257	3,721,838	2.77

In the early years of this live and premium-quality finfish fishery (late 1980s and early 1990s), much of the effort occurred outside kelp beds. Fishing with rod and reel within the beds was difficult. Trapping for fish within kelp beds occurred, but for the most part, trapping effort within kelp beds was low. Then, in the mid 1990s, the live and premium-quality finfish fishers developed a special gear, stick gear, that allowed efficient fishing within kelp forests. As the use of this stick gear expanded, the commercial harvest from within kelp beds increased, raising concerns over the continued productivity of the nearshore and the need to assess the total harvest and the overall health of the stock of these species.

Landings of the 19 nearshore finfish species, in pounds, decreased nearly 80 percent from 1989 to 1999 (Table 2.3-7). However, the total revenues from nearshore landings only decreased by five percent during the same time span. This sustained revenue, in the face of diminished landings, is the result of pronounced demand and high prices for live or high quality fresh fish. Total landings for nearshore fish caught by traps peaked in 1997 and then showed a downward trend in the late 1990s. By 1999, total trap gear landings for nearshore market categories was only 66 percent of that observed in 1997, but it was almost four times higher than that observed in 1989. Trap gear landings for the California sheephead market category peaked in 1997, and then decreased with the 1999 landings to 41 percent of that observed in 1997. Landings of the cabezon market category significantly increased in 1995 and then steadily increased through the late 1990s.

The nearshore commercial finfish fishery is divided around nine major ports primarily due to biogeographical and economic factors (Table 2.3-8). The ports with the highest average value for nearshore species landed in 1989 through 1999 were Morro Bay and Santa Barbara, with 23 and 24 percent, respectively, of the average total value. The maximum pounds landed by nearshore fishermen at each port indicates the fishing potential or harvest capacity of the fleet. As shown in Table 2.3-8, the maximum pounds landed in each port, 1989 through 1999, are two-to-three-times the average pounds landed for each respective port.

Table 2.3-8. Average commercial landings, pounds, and value, for nearshore finfish species over years 1989 through 1999, all gears except trawl

Port area	Average pounds	Average value	Maximum pounds	Maximum value	Average price/pound
Eureka	532,033	307,324	1,265,270	630,733	0.58
Fort Bragg	734,402	606,060	1,840,338	1,255,252	0.83
Bodega Bay	232,582	189,761	457,413	346,121	0.82
San Francisco	311,855	345,948	696,561	753,339	1.11
Monterey	326,730	306,767	818,007	761,975	0.94
Morro Bay	649,702	1,057,894	1,305,903	2,122,196	1.63
Santa Barbara	511,007	1,077,989	999,544	2,140,046	2.11

Los Angeles	202,665	393,549	582,945	1,014,974	1.94
San Diego	127,442	212,469	345,815	520,265	1.67
Totals	3,628,421	4,497,761	8,311,796	9,544,900	

Both recreational and commercial nearshore fisheries target fishes in and around kelp beds. Kelp beds are a common feature in the nearshore along much of the California coastline. Giant kelp comprises the bulk of the kelp beds in southern California, although forests of elk kelp are present off San Diego County. While giant kelp is present in central and northern California nearshore areas, bull kelp is the primary kelp along the north coast of the state. The life histories of these two primary species of kelp are quite different and similar environmental effects may result in different levels of significance to the two species. Giant kelp is a perennial which can grow as much as 2 feet per day, and approximately 160,000 tons are harvested each year in southern California. In contrast, bull kelp is an annual with a much smaller total coastal biomass, which can only support limited harvest at specific times of the year. Boat traffic through kelp beds can damage or cut loose kelp fronds. In general, this has no lasting effect on the kelp beds as a whole (Feder et al. 1974); it may, however, result in loss of bull kelp flowering structures which may potentially limit annual reproductive success of that bed. Rod-and-reel and stick gear may be used in or adjacent to kelp beds and could potentially remove kelp fronds or even detach kelp holdfasts from the bottom substrate. Due to the growth characteristics of giant kelp, the effects on these kelp beds by fishing activities and vessels are considered less than significant. However, the effects on north coast bull kelp beds could potentially be more significant since fishing effort, especially recreational, tends to be concentrated within a relatively small radius around north coast ports.

Charter fishing trips are an additional mainstay of harbor businesses. Harbors provide services for recreational boaters including boat ramps, boat maintenance yards, fueling docks, fish cleaning areas, boat slips, and disposal facilities. Most of the marinas in California are full and have long waiting lists. However, overnight berths are available in the marinas for transient boaters. Recreational fishing pursued include: private boat or skiff fishing, party boat fishing, spear fishing, pier and shore fishing, and shell fishing. Most of the skiff fishing is targeting rockfish or sanddabs (NOAA 1992). Party boat fishing includes rockfish and salmon trips.

Surfing, diving and snorkeling activities are more frequent in the warm waters off southern California, but does occur throughout the coast. Divers in northern California target sea urchins, abalone (non SCUBA only), rock crabs and rockfish by spear (MMS 1987). The most popular diving areas in central California are from Cannery Row at Monterey to Pt. Lobos State Underwater Reserve just south of Carmel. Diving in Monterey Bay is estimated at 65,000 dives per year, mostly associated with shore-entry diving (Advanced Research Projects Agency 1994). More than 70 percent of all diving between Point Conception and Oregon occurs in this area (NOAA 1992). While some scuba and free diving do involve consumptive activities like spear fishing and the harvest of abalone, many scuba and skin divers engage solely in underwater photography and wildlife viewing. Commercial dive boats also operate out of Monterey Bay.

Recreational divers taking nearshore fish or invertebrates can have an impact on the environment. Recreational divers typically will enter nearshore waters either by boat or by shore entry. Divers entering the water from shore may trample organisms or become entangled in kelp, causing temporary damage to kelp beds. Intertidal populations susceptible to trampling include fleshy seaweeds, coralline algae, fragile tube forming polychaetes, bivalves such as mussels, barnacles, limpets, and grapsid crabs that seek refuge under loose rocks and seaweeds during low tide (Ghanzanshahi et al. 1983; Murray 1998). Divers may launch small boats from the shore, in which case they might trample intertidal organisms, and as they proceed to their dive location, may travel through kelp beds, damaging or cutting loose kelp fronds.

3.11.1 Cabezon, *Scorpaenichthys marmoratus*

The cabezon is the largest member of the cottid family. Populations range along the eastern Pacific coast from Point Abreojos, Baja California to Sitka, Alaska (Miller and Lea 1972). Cabezon normally occur nearshore, except as larvae, and their depth range extends from the intertidal to 335 feet. As fish get older and larger, they tend to migrate into deeper water. In shallow water they move in and out with the tide to feed. Usually solitary, juveniles and adults both are common on any rocky bottom area with dense algal growth. They are often found in the vicinity of kelp beds, jetties, isolated rocky reefs or pinnacles, and in shallow tide pools. All life stages are identified as having an estuarine composite EFH by PFMC (PFMC 1998). Most of their time is spent sitting in holes, on reefs, in pools, or on kelp blades beneath the canopy, but not actively swimming.

Cabezon have been aged, using whole otoliths and fin ray sections, to a maximum age of 17 years for males and 16 years for females (Lauth 1987). In California, spawning commences in late October, peaks in January, and continues until March (O'Connell 1953). Females spawn their eggs on intertidal and subtidal, algae-free, rocky surfaces, primarily in crevices and under rocks, but also on moderately exposed surfaces. Apparently the same nest sites are used from year to year. Fish are very protective of the nests for the two to three weeks it takes the eggs to develop and hatch. Individual cabezon larvae remain in that stage for three to four months; however, larvae may be found in the plankton anytime from November to March (Tenera Environmental Services 2000).

Their diet consists mainly of crustaceans, although large and small cabezon have different diets. Larval cabezon prey upon barnacle larvae, copepod nauplii, copepods, amphipods, decapod larvae, euphausiids, and larval fish (Barraclough et al. 1968). Small juveniles depend mainly on amphipods, shrimp, crabs, and other small crustaceans (Quast 1968). Adult fish eat crabs, small lobsters, mollusks (abalone, squid, octopus), other small fish (including rockfishes), and fish eggs. Juveniles are taken by rockfishes and larger cabezon, as well as by lingcod and other sculpins. Large cabezon may be taken by harbor seals or sea lions. In British Columbia, sea otters, pigeon guillemots, least terns, and Brandt's cormorants have been identified as predators of adult cabezon (Love 1996).

Limited information is available on population biology or changes in biomass over time. Recreational landings have declined concurrently with an increase in commercial fishing effort and reported commercial landings. Their habit of sitting makes them an easy target for recreational divers. In the 1980s, annual recreational landings ranged from approximately 150,000 to 300,000 lb and exceeded commercial landings by an order of magnitude. However, from 1993 to the present, that trend altered dramatically. By 1999 commercial landings were six times higher than recreational landings.

3.11.2 California Scorpionfish, *Scorpaena guttata*

California scorpionfish are found from Santa Cruz, California south along the Pacific coast of Baja California and into the Gulf of California (Miller and Lea 1972). Preferring warmer water, the species is common as far north as Santa Barbara. Scorpionfish live from tide-pool depths to about 600 feet, but are usually found between 20 and 450 feet (Miller and Lea 1972). They have been identified as utilizing the estuarine composite EFH for eggs and parturition (PFMC 1998). Scorpionfish tagging studies have shown they are a transient species, with individuals ranging as far as 217 miles (Love 1996). Some of these movements are related to annual spawning migrations, when most adults move to 12 to 360 feet depths, forming large spawning aggregations on or near the bottom.

Spawning occurs from April to September, peaking in June and July (Love 1996). The egg masses float near the surface and the eggs hatch within five days. Very young scorpionfish live in shallow water, hidden away in habitats with dense algae and bottom-encrusting organisms. Juveniles and adults are most abundant on hard bottom surfaces, such as rocky reefs, sewer pipes, and wrecks, over a wide depth range, but they are also found in kelp beds and on sandy or muddy substrates. Very young scorpionfish live in shallow water, hidden away in habitats with dense algae and bottom-encrusting organisms. Juveniles and adults are most abundant on hard bottom surfaces, such as rocky reefs, sewer pipes, and wrecks, over a wide depth range, but they are also found in kelp beds and on sandy or muddy substrates. California scorpionfish grow to 17 inches and some live at least 21 years (Love 1996).

Scorpionfish are a carnivorous, ambush predator (Allen 1982). Small crabs are probably the most important food of the scorpionfish, although other items such as small fishes, octopuses, crustaceans, such as shrimp, spiny lobster, and even pebbles are sometimes eaten.

No population estimates exist for California scorpionfish. However, data from trawl studies conducted by the Los Angeles County Sanitation Districts, Southern California Coastal Water Research Project, and the Orange County Sanitation District from 1974 to 1993 show that there are substantial short-term fluctuations in California scorpionfish abundance within the Southern California Bight (SCB) (Love 2001).

3.11.3 California Sheephead, *Semicossyphus pulchrum*

The California sheephead is a member of the mostly tropical, worldwide wrasse family. California sheephead range from Monterey Bay, California, south into the Gulf of California (Miller and Lea 1972). This species is not common north of Point Conception, Santa Barbara County. Sheephead are found intertidally to about 280 feet. They are considered a resident, solitary species and no systematic movements have been described. They inhabit nearshore rocky reefs, kelp beds, and surfgrass beds.

Sheephead seem to prefer areas of high- and low-relief hard bottom surfaces, but have also been observed foraging over sandy bottom habitat. Sheephead are resident on many artificial reefs in southern California. At night they often utilize rock crevices and holes to sleep.

Male sheephead have been aged to around 50 years and females have been aged to 30 years (Love 1996). As growth rates are higher and mortality lower at the northern end of the range, the sexual transformation occurs later there and the males are larger. Sheephead are protogynous hermaphrodites, which means they all begin life as females; then older, larger females develop into secondary males (Cowen 1990). Female sexual maturity may occur in three to six years, and fishes may remain female for as long as 15 years. The timing of the transformation to males involves the population sex ratio as well as the size of available males, and sometimes does not occur (Cowen 1990). The transformation occurs between spawning cycles. Sheephead are sometimes seen in large schools, perhaps associated with spawning aggregations. Larval drift ranges from 34 to 78 days with two settlement patterns: most larvae settle at about 37 days, but some slow their growth at this time and may continue as pelagic larvae for another month.

Sheephead feed by crushing their prey with their enlarged jaw teeth (Limbaugh 1955). They have a broad diet, with crabs, barnacles, mollusks, sea urchins, polychaetes and even bryozoa occasionally dominant. They also feed on ophiuroids and other echinoderms, mussels, gastropods, spiny lobster, squid, and fish eggs such as blacksmith eggs. Giant sea bass, moray eels, and harbor seals have been documented as predators of sheephead (Love 1996).

There has been no ongoing analysis of the status of the California sheephead. Long-term studies at two localities in Southern California (Palos Verdes Point and the King Harbor breakwater, both in Los Angeles County), have shown that the species was not abundant in the cool-water period of the early 1970s. The population increased at both sites with the onset of the weak El Niño of 1977 to 1978, but decreased through the end of the strong El Niño of 1982 to 1983, and remained low until the early 1990s when it again reached a large size (1994 and 1998). From 1990 to 1997 commercial landings tripled, and since then have declined.

3.11.4 Kelp Greenling *Hexagrammos decagrammus*

The kelp greenling is in the family Hexagrammidae and shares this taxonomic relationship with lingcod. The kelp greenling is one of the most conspicuous fishes in rocky nearshore habitats, occurring often in and around kelp beds. Populations range along the eastern Pacific coast from La Jolla, California to the Aleutian Islands in Alaska (Miller and Lea 1972). However, this species is infrequently observed south of Point Conception. Kelp greenling are not known to migrate and adults are often territorial, particularly during the spawning season. They are documented to utilize the estuarine composite EFH for all life stages (PFMC 1998).

Kelp greenling grow faster than most nearshore fishes during their first three years. Kelp greenling have been aged, using whole otoliths, to a maximum of 8 years for males, 13 years for females, and 14 years for unsexed fish (Barker 1979). In California, the spawning season for kelp greenling occurs from September through December

(Rothrock 1973). Females spawn their eggs subtidally on rock (particularly crevices) and biological substrate, including encrusting epifauna, empty barnacle valves, hydrocoral branches, and algae (Gorbunova 1970). Kelp greenling egg nests have been observed at depths of 16 to 56 feet. Hatching occurs from December through February in northern California and gets progressively earlier to the north. Larvae remain as planktonic organisms up to a total length of 2.0 to 2.7 inches. Kelp greenling larvae prey on a wide variety of planktonic organisms, including fish larvae and eggs, copepods, amphipods, euphausiids, ostracods, isopods, larvaceae, and larvae of brachyurans, barnacles, and bryozoans (Barraclough 1967a). After they settle in the nearshore environment, juveniles and adults continue to have flexible food habits. During most of the year, they consume a variety of prey that is consistently available in the habitat, including crabs, shrimp, amphipods, snails, chiton, abalone, octopus, brittle stars, urchin eggs, polychaetes, ascidians, fish, fish eggs, and algae (Long 1996). There are brief periods when organisms such as juvenile fishes or herring spawn become exceptionally abundant, and kelp greenling shift their food habits to take advantage of these opportunities.

There are no estimates of abundance for kelp greenling in California. The yearly recreational catch remained relatively constant during the first 10 years it was surveyed (1980 to 1989), but has declined steadily from 1993 to 1999. Kelp greenling are more frequently taken in the recreational fishery by private boat anglers and divers, as opposed to anglers on CPFVs, beaches, banks, and piers. Spear fishermen could overfish local populations because they can select individual targets, and greenling are particularly vulnerable to spears when guarding their nests. Prior to 1990, the commercial catch was traditionally lower than the recreational catch. In recent years, however, the increased fishing pressure by nearshore commercial fisheries has reversed this trend. Reported annual commercial landings in California between 1991 and 1999 have ranged from approximately 5,000 to 32,000 lb, with the maximum occurring in 1999. These landings now occur primarily from port areas north of Point Conception. The most recent estimate of the recreational catch comes from the Pacific States Marine Fisheries Commission (PSMFC) website (www.psmfc.org/recfin). The total catch estimate for northern California for 1999, from all recreational fishing modes, was 13,000 fish, or 13,000 lb total weight.

3.11.5 Rock Greenling *Hexagrammos lagocephalus*

The rock greenling is in the family Hexagrammidae and is closely related to the kelp greenling, both taxonomically and morphologically. The rock greenling ranges from the Bering Sea to Point Conception, but also occurs in the western Pacific Ocean south to Japan (Miller and Lea 1972). In California, this species is infrequently observed south of San Francisco. Rock greenling range in depth from the intertidal to approximately 1,950 feet, but are more common at depths less than 300 feet. Juveniles and adults frequent subtidal habitats in or around rocky reef areas and under kelp beds. Adults are territorial, similar to kelp greenling. Rock greenling have been aged, using hypurals (bones in the tail), to a maximum of 8 years for males and 11 years for females (Gorbunova 1970). Female rock greenling may spawn a large number of egg batches which adhere to rocks or algal holdfasts in areas of strong currents and in relatively shallow depths of 15 to 35 feet. Larvae are pelagic up to a total length of 2.6 inches. Juvenile and adult rock greenling prey on a wide variety of organisms including euphausiids, amphipods, isopods, mysids, shrimp, crab, mollusks, gastropods, octopus, squid, clams, worms, fish, fish eggs, and algae (Barraclough et al. 1968). In northern California, rock greenling occur in recreational and commercial fishery catches at a lower rate than kelp greenling, and are a minor component of both fisheries.

3.11.6 Monkeyface Prickleback (monkeyface-eel) *Cebidichthys violaceus*

The monkeyface-eel is not a true eel, and, in the late 1980s, it was reclassified to the prickleback family, Stichaeidae (American Fisheries Society 1991). Populations range along the eastern Pacific coast from San Quintin Bay, Baja California to southern Oregon, but are rarely encountered south of Point Conception, Santa Barbara County (Miller and Lea 1972). Monkeyface pricklebacks normally occur nearshore and their depth range extends from the intertidal to 80 feet. They are considered to be a residential species, exhibiting only small movements from under rocks to foraging sites and have the ability to home to specific under-rock refuges (Helm 1990). They have been aged to a maximum of 18 years using otoliths and opercula (Tenera Environmental Services 2000). Females spawn their eggs on subtidal, rocky surfaces. Nest-guarding behavior has been observed, but it is unclear if males, females, or both sexes guard eggs (Tenera Environmental Services 2000). Larval length at hatching is unknown, and larvae begin to settle out of the plankton at 0.7 to 0.9 inches (Setran and Behrens 1993).

The eating behavior of monkeyface pricklebacks varies from carnivorous to omnivorous to herbivorous, depending on life history stage and time of year. Prey items for early juveniles are predominantly zooplankton above the substrate and include copepods, amphipods, isopods, mysids, and polychaetes (Montgomery 1977). They switch to larger, substrate-dwelling prey as body size and mouth gape increase, and the diet gradually shifts to primarily red and green algal species as well as crustaceans (Fitch and Lavenberg 1971). Adults prefer annual red and green algae species as opposed to perennial reds. Predators of monkeyface pricklebacks include piscivorous (fish-eating) birds such as great egrets and red-breasted mergansers, and fishes such as cabezon and grass rockfish (Helm 1990).

Typical habitat for monkeyface pricklebacks includes rocky areas with ample crevices, including high and low intertidal tide pools, jetties and breakwaters, and relatively shallow subtidal areas, particularly kelp beds (Norris 1963). Juveniles are particularly adapted for the high intertidal area (Horn and Riegle 1981), and this species has air-breathing capabilities (Martin 1993).

No information is available on the status of stocks of monkeyface pricklebacks. The primary source of fishing mortality results from recreational anglers fishing from shore. The most recent estimate of the recreational catch comes from the PSMFC website www.psmfc.org/recfin. Total catch estimate of monkeyface prickleback for northern California for 1999 from all recreational fishing modes was 2,000 fish.

3.11.7 Black Rockfish *Sebastes melanops*

Black rockfish are a minor to moderate component of nearshore commercial and recreational fisheries, with increasing importance from the San Francisco area northward. Black rockfish range from Amchitka Island, Alaska to Santa Monica Bay, Los Angeles County, in southern California (Love 1996), but are uncommon south of Santa Cruz. They frequently occur in loose schools 10 to 20 feet above shallow (less than 120 feet), rocky reefs; but individuals may also be observed resting on rocky bottom or schooling midwater over deeper (120 to 1200 feet) reefs (Eschmeyer and Herald 1983). They have been documented to utilize the estuarine composite EFH for adult and juvenile life stages (PFMC 1998). Black rockfish occur with blue and olive rockfishes in the water column and with black-and-yellow rockfish near and on the bottom (Houk 1992a). Records for black rockfish show or describe a range of movement/migratory patterns from residential to transient (Lea et al. 1999). Between 1978 and 1985, 89 black rockfish were tagged in central California. Four tags were returned from fish that had been at liberty from 18 to 552 days; all fish were recaptured in the same areas where they were released (Lea et al. 1999).

Otoliths from black rockfish along the coasts of Washington, Oregon, and California have been aged to 48 years for males, and 35 years for females. As with all members of the genus *Sebastes*, fertilization and development of embryos is internal. Black rockfish mating generally occurs between September and November. Females are ovoviviparous producing eggs that hatch within the body, which are not highly developed, and store the sperm internally until their eggs mature in December or January, at which time the eggs are fertilized. The larvae develop within 30 days. Larvae are planktonic for three to six months, where they are dispersed by currents and upwelling. They begin to reappear as young-of-the-year fish in shallow, nearshore waters by May, but the major recruitment event usually occurs from July to August.

Mortality estimates have been calculated for black rockfish along the Pacific coast. The instantaneous rate of natural mortality (M) varies between 0.2 and 0.4 for unsexed fish along the Pacific coast (STAR 1999; Dorn 2000), and from 0.249 to 0.381 in Puget Sound, Washington (Barker 1979). In addition, M varies between 0.10 and 0.409 for males, and between 0.12 and 0.704 for females in areas of Washington and Oregon (Wallace et al. 1999).

Larval black rockfish are pelagic. Young-of-the-year settle nearshore, generally in the shallower portions of the kelp beds (15 to 40 feet) , where they frequent the sand-rock interface, sea grass beds, kelp canopy, midwater column, and high-relief rock. As larvae, black rockfish feed on nauplii, invertebrate eggs, and copepods. Juveniles feed on crustaceans such as carangids, mysids, barnacle cypriots, fish larvae, and juvenile polychaetes. Adults inhabit the midwater and surface areas over high-relief rocky reefs. They are found in and around kelp beds, boulder fields, and artificial reefs. As adults, they remain primarily planktivorous, feeding on small fishes (including juvenile blue and other rockfishes) as well as crustaceans, polychaetes, cephalopods, chaetognaths, and jellyfish (Lea et al. 1999). Adults are subject to predation by large rockfish, lingcod, sharks, salmon, dolphin, pinnipeds, marine birds, and possibly river otters (Bloeser 1999).

Long-term monitoring of the recreational private boat fishery in the Eureka/Crescent City area showed black rockfish as the most frequently taken species every year in the 1990s. South of the Eureka area, black rockfish gradually decrease in relative abundance in the recreational catch and are infrequently observed south of

Santa Cruz. During the 1990s the annual estimated take of black rockfish in the recreational fishery was fairly similar to that of the commercial fishery.

The Eureka area accounts for 80 to 90 percent of all commercial landings in the “black rockfish” market category (which may contain other species, most commonly blue rockfish). Annual statewide landings in the 1990s ranged from 189,000 to 277,000 lb, except in 1993, when only 86,000 lb were landed. Landings from port areas south of San Francisco have never comprised more than 10 percent of total landings in the market category. In the San Francisco port area, “black rockfish” landings increased fifteen-fold from 1989 to 1992. The majority of black rockfish in commercial fisheries are landed dead, but a small portion are now landed live in the recently expanded live-fish fishery, primarily from Morro Bay, San Luis Obispo County, north to Fort Bragg, Mendocino County. They are also taken incidentally in the commercial salmon troll fishery.

3.11.8 Black-and-Yellow Rockfish *Sebastes chrysomelas*

Black-and-yellow rockfish are distributed from Eureka, Monterey County, to Isla Natividad, central Baja California, but they are less common south of San Diego, California (Love 1996). They are demersal, usually in water less than 60 feet deep, although they have also been found at depths down to 120 feet. They are a residential species with homing ability, and they inhabit kelp beds and rocky reefs. After establishing residence, the adults are highly territorial and travel no more than one mile from their home range (Lea et al. 1999).

Whole otoliths have been used to age this species to a maximum of 20 to 22 years (Tenera Environmental Services 2000). Spawning occurs off California from February through the end of July, with peak spawning in February and March (Chen 1971). Female black-and-yellow rockfish may be carrying fertilized eggs anytime between October and the end of February. The newly spawned larvae settle out of the plankton after one to two months. In central California, June is the primary month of first appearance of young-of-the-year in kelp bed areas, and they are usually first observed in the kelp canopy (VenTresca et al. 1996).

Larvae and young juveniles are pelagic, but the juveniles will eventually become demersal and settle among nearshore rocky areas or kelp forests. Prey items for larval black-and-yellow rockfish include nauplii eggs, invertebrate eggs, and copepods. Both juveniles and adults consume crustaceans, but the adults also eat mollusks and fish. The adults are nocturnal feeders, ambushing their prey between dusk and dawn. Predators of the adult black-and-yellow rockfish include sharks, dolphins, and seals, while juveniles are prey of birds, porpoises, and fishes, including rockfishes, lingcod, cabezon, and salmon.

No formal stock assessments have been made for this species. Off California, black-and-yellow rockfish are mainly taken by commercial hook-and-line, particularly in Monterey and Morro Bay area ports. In 1999, they comprised 11 percent of the total catch by weight in the Morro Bay, San Luis Obispo County area, ranking fourth behind cabezon, brown rockfish, and gopher rockfish. In 1999, they comprised 8.1 percent of the commercial nearshore fishery component in the Monterey Bay area (Sport Fish

Restoration Act 2000b). They are also a minor component of the private boat and CPFV recreational fishery and are occasionally landed by rocky shore anglers (Love 1996).

3.11.9 Blue Rockfish, *Sebastes mystinus*

The blue rockfish is a medium-sized, mid-water rockfish important in both the recreational and commercial catches in California, and it is the most abundant rockfish in central California kelp beds. They range from the Bering Sea to Punta Baja, Baja California, and from surface waters to a maximum depth of 1,800 feet. They are less common south of the northern Channel Islands and north of Eureka. Adults inhabit the midwater and surface areas around high-relief rocky reefs, within and around the kelp canopy, and around artificial reefs. In kelp beds they form both loose and compact aggregations.

Movement and migration studies of blue rockfish have determined them to be residential and most authors report movement of less than six miles, although there is one report of movement as high as 16 miles. A population study using freeze branding as a marking technique resulted in more than 80,000 recently-settled blue rockfish being marked in a five-week period. These fish showed very little movement from an isolated reef 100 x 150 feet and showed very little movement from one part of the reef to another. In addition, tagging studies of adult blue rockfish indicate they do not migrate laterally along the coast. Between 1978 and 1985, over 1,500 blue rockfish were tagged and released in central California waters by Department biologists (Lea et al. 1999). Eighteen tags were subsequently returned from fish at liberty between 11 and 502 days; all were recaptured at the same locations they were tagged. While these studies show adult blue rockfish populations are more or less discreet at each fishing port, it is not known how much larval drift occurs between fishing areas.

Laidig et al. (in prep.) report ages 44 years for males and 41 years for females. Rockfishes in general are considered to be slow-growing fishes. The instantaneous rate of natural mortality (M) has been reported as averaging 0.006, with a range of 0.001 to 0.008, using catch curve analysis (Adams and Howard 1996, Tenera Environmental Services 2000). Tenera Environmental Services (2000) reports M=0.14. Blue rockfish are thought to spawn once a year; however, Tenera Environmental Services (2000) report that spawning may occur multiple times a year. Larvae are planktonic for four to five months, and young-of-the-year blue rockfish begin to appear in the kelp canopy and shallow rocky areas by late April or early May. As larvae, blue rockfish are planktivorous and are known to feed on nauplii and invertebrate eggs and copepods. Juveniles feed on larvaceans, crustaceans such as harpacticoids and barnacle cypriots, hydroids, jellyfish, polychaetes, and tunicates. As adults they remain primarily planktivorous and are considered to be omnivorous/zooplanktivorous feeding on jellyfish, tunicates, algae, ctenophores, hydrozoans, gastropods, polychaetes, small crustaceans (like mysids), small fish, and chaetognaths.

The blue rockfish is one of the most important recreational species in California, and for anglers fishing from private boats and CPFVs, is usually the most frequently caught rockfish north of Point Conception, Santa Barbara County (Karpov et al. 1995). It is believed that the last exceptionally strong year-class of blue rockfish in central California occurred in 1988 (VenTresca pers. comm.). Five years later, when the majority of these individuals had become available to recreational anglers, mean lengths in the sampled catch declined substantially in central California due to this influx of small fish. Commercial and recreational fishery sampling seems to suggest that while blue rockfish have withstood considerable fishing pressure over the last four decades, the stock continues to be healthy. The total number of blue rockfish caught in recreational fisheries increased substantially from the late 1950s to the mid 1980s, concurrent with increased effort (Karpov et al. 1995). In every complete year sampled by the Department from 1988 through 1998, blue rockfish has been among the three most frequently observed species caught on CPFVs in every major port area from Morro Bay north to Fort Bragg (Wilson-Vandenberg pers. comm.). Based on Department onboard observations and CPFV log book summaries, estimated annual take of blue rockfish by CPFV anglers ranged from 199,000 to 546,000 fish during 1988 to 1995, and averaged 335,000 fish.

Increased commercial fishing in the nearshore area during the same period has put additional stress on blue rockfish populations. Although only a small portion of blue rockfish landings derives from the commercial fishery, those landings have increased in the past decade. During 1987 to 1989, landings in the "blue rockfish" market category averaged 25,670 lb; in 1998 landings were approximately 92,000 lb. Blue rockfish have become a minor component of the live-fish commercial fishery which developed during the 1990s in California.

It is also an important species for skindivers and scuba divers using spears, and occasionally is caught by shore anglers fishing in rocky subtidal areas. In a diver survey conducted in 1972 in northern and central California, blue rockfish ranked second in importance (to lingcod), representing 10.5 percent of all fish landed, and was the most common rockfish taken, comprising 29.6 percent of all rockfishes (Miller et al. 1974).

3.11.10 Brown Rockfish, *Sebastes auriculatus*

The brown rockfish is a common nearshore rockfish species in California. Brown rockfish are found along the Pacific coast of North America from southeast Alaska to Hipolito Bay, central Baja California (Miller and Lea 1972). They live in shallow waters and bays, and have been found as deep as 420 feet, although they are primarily found in waters less than 175 feet. Brown rockfish are typically found associated with sand-rock interfaces and rocky bottoms of artificial and natural reefs over a fairly wide depth range, and in eelgrass beds. In shallow waters, they are associated with rocky areas and kelp beds, while in deeper waters they stay near the rocky bottom. They have been documented to utilize the estuarine composite EFH for all life stages (PFMC 1998). Sub-adult and adult brown rockfish are residential, though they migrate into deeper water in the winter. Brown rockfish have a home range, and tagging studies generally show either no movement or movements of less than 1.2 miles within that range, although one tag study showed a brown rockfish moving more than 31 miles.

Brown rockfish live less than 25 years, which is a relatively short life span compared to other members of the genus (Bloeser 1999). A natural mortality rate of M=0.112 has been calculated for brown rockfish from Puget Sound, Washington (Gowen 1983). Larvae are released from the female into the pelagic environment in December and January, and may also be released in May and June (Adams 1992a). They live in the upper zooplankton layer for a month and then metamorphose into pelagic juveniles. The pelagic juveniles spend three to six months in the water column as plankton. As they grow older, they settle in shallow, nearshore water and then migrate to deeper water. As juveniles, they feed on small crustaceans, amphipods, and copepods, but at approximately five inches, shift to crabs and small fish (Gaines and Roughgarden 1987). Young-of-the-year fish commonly migrate into bays and estuaries as nursery habitat. They may remain in the bay around rocks, piers, and other structures in areas of higher salinity for one to two years before returning to the open coast (Ashcraft 2001). San Francisco Bay appears to be an important habitat for juvenile brown rockfish (Kendall and Lenarz 1986). Adult brown rockfish will feed on larger fish, shrimp, crabs and other crustaceans, and polychaetes

Brown rockfish have long been a major component of the marine recreational fishery and a relatively minor but important component of the nearshore commercial fishery in California, especially north of Pt. Conception in Santa Barbara County. Throughout the1990s, this species ranked among the 10 most frequently taken species by CPFV anglers in the port areas of Bodega Bay, San Francisco, and Morro Bay (Reilly et al. 1993, 1998).

3.11.11 Calico Rockfish, *Sebastes dallii*

Calico rockfish range from Sebastian Viscaino Bay, Baja California to San Francisco (Miller and Lea 1972) and they inhabit a depth range of 60 to 840 feet. They have been documented to utilize the estuarine composite EFH for adult and juvenile life stages (PFMC 1998). They have been aged to 11 to 12 years. They are a residential, non-schooling species (Tenera Environmental Services 2000).

Spawning occurs in southern California between January and May, with peak spawning occurring in February (Love 1996). Fertilized eggs are present in November and December. The calico rockfish larval stage lasts from less than four weeks to two months (Moser 1996). Juvenile calico rockfish feed on zooplankton such as copepods, barnacle cypriots, and larval fish (Gaines and Roughgarden 1987). Juvenile calico rockfish are found in areas of soft sand-silt sediment, and on artificial reefs over a wide depth range. Adult calico rockfish inhabit rocky shelf areas where there is a mud-rock or sand-mud interface with fine sediments. They are associated with areas of high- and low-relief, including artificial reefs. Adults feed on larger crustaceans such as euphausiids, fishes, and cephalopods (Casillas et al. 1998).

Because of the relatively small size of adult calico rockfish, they are not usually targeted by either recreational or commercial fishermen, but are caught incidentally when other finfish species are targeted. Calico rockfish frequently appear as a by catch in prawn trawls in southern California, and are caught by recreational anglers on CPFVs and private boats while they are fishing for other, larger benthic species.

3.11.12 China Rockfish, *Sebastes nebulosus*

China rockfish occur from Kachemak Bay, northern Gulf of Alaska to Redondo Beach and San Miguel Island in southern California, but they are most abundant from southeastern Alaska to Sonoma County, California (Love 1996). They are found at depths down to 420 feet (Miller and Lea 1972), but are most common between 30 to 300 feet. The juveniles are pelagic but the adults are sedentary, associated with rocky reefs or cobble. They are residential, traveling less than three feet from their home range, and generally are found resting on the bottom or hiding in crevices (Love 1996).

China rockfish have been aged to a maximum age of 26 years using whole otoliths (Lea et al. 1999). Spawning occurs off central and northern California between January and July, with peak spawning in January (Burge and Schultz 1973). Individual China rockfish spawn once a year, but estimates of fecundity and the number of larvae released have not been determined. Larvae settle out of the plankton between one and two months after release (Moser 1996). China rockfish larvae are planktivores eating nauplii eggs, invertebrate eggs, and copepods as their primary prey. Juveniles eat crustaceans such as barnacle cypriots (Love et al. 1991), while the adults eat crustaceans, ophiuroids, mollusks, and fish. Juveniles are prey of birds, porpoises, and fishes; including rockfishes, lingcod, cabezon, and salmon. Predators of adult China rockfish include sharks, dolphins, seals, lingcod, and possibly river otters.

China rockfish are valuable in nearshore commercial fisheries from northern California to southeastern Alaska, taken mainly by hook-and-line. China rockfish are also moderately important recreational species taken by private boats, CPFVs, spear fishermen, and rocky shore anglers (Love 1996). During recreational creel surveys from 1980 to 1986, the spear-fishing mode was the only one in which this species ranked among the 15 most frequently observed species (Karpov et al. 1995). However, in a subsequent onboard survey of CPFV anglers from 1988 to 1991, China rockfish ranked eleventh in species observed in the San Francisco area (Reilly et al. 1993).

3.11.13 Copper Rockfish, *Sebastes caurinus*

Copper rockfish are sold as fillets by the market names rockfish or red rockfish, and often whole as red rockcod. The copper rockfish is broadly distributed geographically, known from the northern Gulf of Alaska to central Baja California, Mexico (Love 1996). It also has a broad depth distribution known to occur from the shallow subtidal area to 600 feet. They have been documented to utilize the estuarine composite EFH for adult, egg, parturition, and juvenile life stages (PFMC 1998). Tagging studies indicate that copper rockfish show little movement once they have settled to the bottom. Movement of up to one mile has been noted, but the majority of tagged and recaptured copper rockfish are from the locality where they were originally taken. This characteristic of high site-fidelity makes this species susceptible to local depletion.

Copper rockfish have been aged to 41 years (Yamanaka and Kronlund 1997). Off central California, copper rockfish have been aged to 28 years. Calculations of natural mortality (M) have been made from populations in Puget Sound, Washington. Barker (1979) found M=0.1127 using tag/recapture method on fish 5 to 34 year old. Gowen (1983) found M=0.131 using Hencke survivorship/ration/age frequency method with fish between 9 and 18 year old. Mating occurs in the fall. In California, larvae are released during winter months (January to April) with a peak in February, with larval duration found to be one to two months (Moser 1996). Young-of-the-year copper rockfish recruit into the nearshore environment at about 0.8 to 1.0 inches during April and May off central California (VenTresca et al. 1996). Newly recruited copper rockfish initially associate with surface-forming kelp such as *Macrocystis* sp., *Cystoseira* sp., and

Nereocystis sp. After several months, the juveniles settle to the bottom on rocky reefs as well as sandy areas, and are referred to as benthic juveniles. Juvenile copper rockfish feed primarily on planktonic crustaceans. Larger crustaceans form a major part of their diet as they grow; these include *Cancer* sp. crabs, kelp crabs, and shrimps. Squid of the genus *Loligo* and octopuses are also important food items. Adults are commonly found in kelp bed areas but also frequent deeper rocky reefs. As adults, this species normally occurs slightly above the substrate, which is often high-relief rocky shelf and rock-sand interface. As juveniles and adults, copper rockfish are preyed upon by a variety of fishes including other rockfishes, lingcod, cabezon, and salmon, several species of birds, and marine mammals.

Copper rockfish are taken in the commercial live-fish fishery. Copper rockfish have been a major component of the recreational catch in both private boat and CPFV fisheries, especially off central and northern California. They are generally among the 10 most frequently observed species taken by CPFV anglers in the port areas of Fort Bragg, San Francisco, and occasionally Morro Bay (Reilly et al. 1993). Due to its relatively large size, copper rockfish has been considered one of the premium species in the recreational angler's catch and a prime target for the recreational diver.

3.11.14 Gopher Rockfish, *Sebastes carnatus*

Gopher rockfish range from Eureka, Humboldt County, to San Roque, central Baja California (Miller and Lea 1972), but they are most common from about Mendocino County to Santa Monica Bay, Los Angeles County. Larvae and young juveniles are pelagic, but as the juveniles mature, they will settle on rocky reefs or into the kelp canopy. Adults are residential and demersal, associated with kelp beds or rocky reefs, from the intertidal to about 264 feet, most commonly between 30 and 120 feet.

Off California, spawning takes place between January and July, peaking in February, March, and May. Females will spawn hatched larvae once a year. It may take up to 90 days before the larvae settle out of the plankton (Tenera Environmental Services 2000). In central California, June has been observed to be the primary month for recruitment of larvae to nearshore areas (VenTresca et al. 1996). Gopher rockfish larvae are diurnal planktivores, their prey items include nauplii eggs, invertebrate eggs, and copepods. Juveniles are also daytime feeders, and eat crustaceans such as calanoid copepods, shrimp, brachyurans, including *Cancer* sp., and barnacle cypriots. Their predators include fishes such as rockfish, lingcod, cabezon, and salmon, as well as birds and porpoises. Adult gopher rockfish are nighttime predators that ambush their prey including: crustaceans (particularly *Cancer* sp. crabs, caridean shrimp, anomurans), fish (especially juvenile rockfish), and mollusks.

No formal stock assessments have been done for gopher rockfish. This species is a valuable component of recreational and commercial fisheries in California. It comprises 7 to 11 percent of the recreational fishery catch in California from Mendocino County south, with the largest catches off San Luis Obispo County (Karpov et al. 1995, Love 1996). Gopher rockfish are usually among the five most frequently observed species in the CPFV fishery in the Morro Bay, San Luis Obispo County, area (Reilly et al. 1993). In the 1999 commercial hook-and-line fishery, gopher rockfish were the most commonly landed nearshore species in the Monterey Bay area ports, making up 20 percent of the landings, and were the third most common nearshore species landed in Morro Bay, San Luis Obispo County, area ports (Sport Fish Restoration Act 2000).

3.11.15 Grass Rockfish, *Sebastes rastrelliger*

Grass rockfish are found from Yaquina Bay, Oregon to Bahia Playa Maria, central Baja California, although they are most common south of Oregon (Miller and Lea 1972). This is a shallow-water species, commonly found from the intertidal to 20 feet (usually only the juveniles are found in tide pools), but they have been found to depths of 150 feet. As juveniles they are pelagic, but as they mature they are found in vegetated areas, particularly kelp beds, and around reef structures where the adults may be found hiding in crevices. However, juveniles may recruit to shallow sandy areas and reefs. This species is considered residential, moving less than three feet from their home range (Miller and Geibel 1973).

Grass rockfish have been aged, using whole and sectioned otoliths, to a maximum of 23 years (Bloeser 1999). In California waters, spawning takes place between November and March, with peak spawning in January and February (Moreno 1993). The larvae settle out of the plankton, about 1.1 inches, eating nauplii eggs, invertebrate eggs, and copepods. Young-of-the-year first appear in shallow waters between spring and summer (Love 1996). Juveniles and adults prey upon crustaceans, but the adults also eat other fish (such as juvenile surfperches and midshipmen), cephalopods, and gastropods (Love et al. 1996). The adults are nighttime feeders (Holbrook and Schmitt 1988).

No formal stock assessment has been done for this species. Grass rockfish are taken in substantial numbers by finfish traps and commercial hook-and-line, particularly in central California. In 1999, they made up nearly 10 percent of the nearshore commercial hook-and-line fishery in the Morro Bay and Monterey Bay area ports (Sport Fish Restoration Act 2000). Grass rockfish are also taken in large numbers by spear fishermen, and are also common for shore, pier, and small vessel recreational fishermen (Love 1996). Grass rockfish are relatively more important to anglers fishing from shore than to those fishing from boats (Karpov et al. 1995).

3.11.16 Kelp Rockfish, *Sebastes atrovirens*

Kelp rockfish live in kelp beds and on rocky reefs, ranging from Timber Cove, Sonoma County, to Punta San Pablo, central Baja California (Miller and Lea 1972). They are, however, most abundant between northern Baja and central California. This species is known to occur at depths down to 150 feet, but are most common between 15 and 50 feet. They have been documented to utilize the estuarine composite EFH for the juvenile life stage (PFMC 1998). Kelp rockfish are residential species, making no migrations except possibly into deeper water during winter storms (Love 1996). They spend their days drifting within kelp blades, sometimes upside down or resting on them. They are more active at night, leaving the kelp beds to search out or chase prey.

Kelp rockfish have been aged, using whole otoliths, to a maximum of 20 years (Larson 1991, Tenera Environmental Services 2000). Off central California, spawning takes place between December and June, with peak spawning in May, and fertilized eggs are present between December and January. The planktonic larvae will settle into the kelp canopy after one to two months, or 50 to 75 days (Krigsman 2000). Kelp rockfish larvae are zooplanktivores, preying on nauplii and invertebrate eggs as well as copepods. As juveniles, they will settle out of their pelagic phase and first appear in the kelp beds between April and August (earlier in the southern extent of their range). Recruitment to the nearshore area in central California generally occurs during June and July (VenTresca et al. 1996). Prominent prey for adults and juveniles include crustaceans such as shrimp and amphipods, and small fish, particularly juvenile blue rockfish.

Local abundances have been studied for the kelp rockfish. However, there is no comprehensive stock assessment throughout their range. This species is often taken in recreational fisheries such as spear fishing, but they are also taken in small numbers by commercial hook-and-line and traps. In 1999, they comprised 0.5 percent of the nearshore commercial trap fishery and 2.5 percent of the hook-and-line fishery in Morro Bay and Monterey Bay (Sport Fish Restoration Act 2000a).

3.11.17 Olive Rockfish, *Sebastes serranoides*

Olive rockfish are one of several nearshore *Sebastes* spp. associated primarily with the mid-water region of kelp forests of the California coast. Olive rockfish occur from northern California to Islas San Benitos (central Baja California), from surface waters to 570 feet. They are common from about Cape Mendocino to Santa Barbara and around the northern Channel Islands from surface waters to about 396 feet (Love 1996). Olive rockfish appear to be very rare off much of both southern California and Baja California. Tagging studies have found that olive rockfish move relatively little, ranging from less than one mile to less than 6.5 miles (Hartmann 1987), and are commonly found in and around kelp beds, oil platforms, surfgrass, and other structures at depths as shallow as 10 feet. This species has been variously described as transient or residential. It has been documented that the abundance of olive rockfish decreases as beds of *Macrocystis* are removed (Bodkin 1988).

Ageing of otoliths has shown that olive rockfish live at least 25 years (Love 1978). Mating occurs in the fall, and females release larvae once a year in the winter from December through March, peaking in January (MacGregor 1970). Larvae are planktonic for three to six months; then settle out of the plankton from April to September as young-of-the-year. Larval olive rockfish are planktivorous and are known to feed on nauplii, invertebrate eggs, and copepods. Juveniles feed on crustaceans such as calanoid copepods, zoea larvae, and barnacle cypriots, juvenile fishes, polychaetes, octopuses, and squid. Adult olive rockfish feed on fish (especially juvenile rockfishes like blue rockfish), small crustaceans, polychaetes, cephalopods, and tunicates. Juvenile olive rockfish become more active at night near or on the bottom, sheltering under algae or among rocks. Young olive rockfish also are found under drifting kelp mats. Subadults and adults live over high-relief reefs, as well as around the midwaters of oil platforms.

There has been no stock assessment of this species. However, there is clear evidence from recreational fish catch records that olive rockfish have declined in abundance south of Pt. Conception, Santa Barbara County (Ally et al. 1991; Love et al. 1998). As late as the 1980s, olive rockfish were a very commonly caught recreational species throughout much of southern California. However, a combination of overfishing and poor juvenile survival brought about by adverse changes in oceanographic conditions led to a steep decline (83.0 percent) in southern California CPFV catches between 1980 and 1996. Olive rockfish form a minor part of the commercial fishery in central and southern California, where they are primarily taken by hook-and-line. A relatively small number find their way into the live-fish fishery.

3.11.18 Quillback Rockfish, *Sebastes maliger*

The quillback rockfish is a component of central and northern California's nearshore benthic community. Quillback rockfish are known from the Gulf of Alaska to Anacapa Passage in southern California (Love and Lea 1997). They are considered common between southeast Alaska and northern California. Qiillback are considered a shallow to moderate-depth species, although they rarely occur to a depth of 900 feet. They have been documented to utilize the estuarine composite EFH for all life stages (PFMC 1998). Like other rockfish of shallow, benthic habitat, individual quillback rockfish are not known to range far. Tagging studies in central California and Washington have shown quillback to be residential or to show movement of less than six miles. They have also demonstrated homing ability and specific diurnal movement patterns (Borton 1982).

In California, quillback rockfish have been aged to 15 years, but have been aged to 76 years in Canada (Yamanaka and Kronlund 1997). Natural mortality (M) values have been calculated for quillback rockfish stocks in Washington. Barker (1979) found M=0.1253 via tag and recapture methods, and Gowan (1983) calculated M=0.115 via Hencke survivorship/age frequency curve. In California, mating takes place in the late winter/early spring, and larvae are released from April through July, with a peak in May and June (Wyllie Echeverria 1987). Larval drift is a likely mechanism for transport of cold-temperate rockfish species such as quillback, black, and China from central and perhaps northern California to the Santa Barbara Channel Islands and the SCB (Love and Lea 1997). After roughly one to two months in the plankton, they begin to settle near shore. In Washington, young-of-the-year quillbacks are found among relatively shallow, low-relief rocky substrate and shallow, vegetated habitats such as kelp and eelgrass beds (West et al. 1994). After they settle in the shallow, nearshore areas, they remain zooplanktivorous and feed on crustaceans such as barnacle cypriots, shrimp, and calanoid copepods. As adults their habitat is more benthic, and they are known to feed on a variety of prey such as crustaceans, small fish including rockfishes and flatfishes, bivalves, polychaetes, and fish eggs such as those from lingcod. Adults have also been noted to retreat to eelgrass beds at night (Borton 1982). Quillback rockfish are also associated with the rock-sand interface, but are rarely seen in the open away from suitable cover.

No stock assessment has been done for this species. Quillback rockfish are a minor component of the California nearshore recreational fishery with decreasing occurrence south of northern California. They are also a component of the nearshore commercial fishery. Between the late 1980s and mid-1990s, quillback rockfish experienced increased take by the commercial fishery as the market demand for premium, live fish increased. Beginning in 1999, catch restrictions aimed at this fishery went into effect, and fishing pressure has relaxed somewhat.

3.11.19 Treefish, *Sebastes serriceps*

Treefish are nearshore rockfish that inhabit shallow, rocky habitat. Treefish range from Cedros Island, Baja California to San Francisco (Love et al. 1996). The depth range they inhabit is shallow to 150 feet. Adult treefish are found on shallow rocky reefs, frequently in caves and crevices. Treefish are a residential species with a limited home range; they do not exhibit migrational activity and are solitary and highly territorial.

Treefish are thought to spawn once annually in late winter (Love 1996). Treefish are ambush predators that feed nocturnally on benthic invertebrates, including mollusks, crustaceans, and small fish. Larval treefish are fed upon by chaetognaths and siphonophores (Yoklavich et al. 1996). Juveniles are fed upon by rockfishes, lingcod, cabezon, salmon, birds, porpoise, and least terns. Juvenile treefish are found in drifting mats of kelp, in areas of high rocky relief, and on artificial reefs. Adults are preyed upon by sharks, dolphins, and seals (Morejohn et al. 1978, Antonelis and Fiscus 1980).

There are no estimates of abundance for treefish in California. In southern California treefish are an important species in both the nearshore recreational fishery and in the commercial fishery for live fish. They are observed infrequently in the central California CPFV fishery in the Morro Bay area (Reilly et al. 1993). They are a minor component of the commercial nearshore hook-and-line fishery in the same area (Sport Fish Restoration Act 2000).

3.12 Land Use and Existing Infrastructure

Coastal population growth includes both a movement toward the shore and the expansion of a large population base. Population increases between 2000 and 2010 are projected to be about 9 percent (12 to 13 million people) in each decade. Compared with other areas of the nation, the largest coastal population increases between 1994 and 2015 are expected to be in southern California, Florida, Texas, and Washington. Ten counties account for almost one-third of all anticipated coastal population growth in the nation, with the largest population increases projected for Los Angeles (1.6 million) and San Diego (1.3 million) counties in California. However, Del Norte, Humboldt, and Mendocino counties have the lowest population density of the coastal counties - approximately one percent (MMS 1987).

The dominant industries of northern California are currently tourism and commercial fishing and historically lumber harvesting and processing. Land use is mainly open space principally in support of the tourist and timber industry. Native American land use in the coastal zone of Humboldt County is 67 percent and 89.6 percent in Mendocino County (MMS 1987). Shoreland ownership can be divided into federal, public, and private. For the three northern counties, 32.9 percent is the average amount of public ownership, 77 percent in private ownership, and 10.6 federal (MMS 1987). Local coastal plans were adopted by the California Coastal Commission in the mid 1980s.

The majority of land use in central California is undeveloped forest and range land, although large areas are used for agriculture (NOAA 1992). Commercial agriculture occurring in watersheds that drain to the nearshore zone include: artichokes (90 percent of U.S. production), broccoli (60 percent of U.S. production), celery (25 percent of U.S. production), and lettuce (80 percent of U.S. production). The total market value of agricultural production in Monterey County was almost 2.3 billion dollars in 1998. Central

California coastal population changes were highest in 1980 to 1990 (18 percent increase), but have decreased in recent years due to lack of housing and infrastructure.

Land use in southern California historically was dominated by agriculture and the petroleum industry (MMS 2001). Conversion of agricultural land, open space, or other land uses will be required to house, educate, and employ the projected population increases. Land use now has shifted towards a more urbanized population away from an agricultural one. This shift caused an increase in population and increased pressure on public facilities and services such as water supply, sewage treatment, housing, and schools. Property taxes generated by the value of petroleum deposits and onshore oil and gas infrastructure were an important source of property tax revenue. More details on employment and population statistics, housing, and infrastructure, for San Luis Obispo, Santa Barbara, and Ventura counties, can be found in the Draft Environmental Impact Statement: "Delineation Drilling Activities Offshore Santa Barbara County MMS 2001" and is incorporated by reference.

For many in this country, coastal areas define a way of life and a sense of place. Historically, the beauty and economic prosperity of coastal areas have drawn people to the nation's shores. In California, approximately 80 percent of the state's residents live in the 14 coastal counties. Coastal waters constitute a unique natural resource with significant economic, social, and ecological values. Approximately 95 percent of the more than 17,000 heavily polluted surface waters surveyed nationally are polluted by urban runoff (California Coastal Commission 1996). More than one-half of the nation's coastal wetlands and nine percent of California's historic wetlands have been destroyed, and many of the remaining wetlands suffer from chronic disturbance and degradation.

Coastal states issued over 8,000 ocean and bay beach closing or advisories over a 6-year period because of poor water quality. In 1992, beaches nationwide were closed or advisories against swimming were issued on almost 3,000 occasions. The California Beach Closure Report states urban or storm runoff (from land areas) caused or contributed to at least 11 beach closures for a total of approximately 260 days in 1993 (California Coastal Commission 1996). The State Water Resources Control Board (SWRCB) and the California Coastal Commission recognize that nonpoint source pollution from land activities is the most significant cause of coastal water quality degradation. The SWRCB (1998) has determined that surface runoff is the major source of pollution to the State's impacted streams, rivers, groundwater basins, wetlands, estuaries, harbors, bays, and ocean waters.

Coastal resources are highly vulnerable to human intervention in the watershed. Land use practices or implementation of development plans can result in increased runoff within a watershed and thus, individually or cumulatively, affect the water and sediment quality. For example, land use practices can change natural geomorphic features through grading, removing natural vegetation, or creating impervious surfaces, all of which increase the transfer of pollutants to the marine environment. Land use activities introduce a wide range of pollutants to coastal waters and the underlying sediments.

There are two principal impacts that typically result from urbanization. First, the hydrology of the area is changed. The change typically consists of increased runoff volumes, flows, and velocities, accompanied by reduced groundwater recharge. Second, the increase in human activities within a watershed creates pollutants. These pollutants are transported in runoff and subsequently discharged into the marine ecosystem. Urban activities that contribute to marine ecosystem degradation range from automobile use to complex chemical processing and power generation. The predominant continuing sources of organochlorine pesticides are runoff and atmospheric deposition from past applications on agricultural land. Other practices such as liberation of inorganic mercury from fuel burning and other incineration operations continue, as do urban runoff and atmospheric deposition of metals and polynuclear aromatic hydrocarbons. Sources of polychlorinated biphenyls to the atmosphere include municipal and hazardous waste landfills, refuse and sewage sludge incinerators, and occasional leakage from electrical transformers and capacitors. Increasingly higher percentages of urban land use in watersheds correlates with steadily increasing contamination from most chemical classes including the urban-type pesticides (e.g., diazinon) (EPA 1997).

3.13 Transportation

Federal regulations concerning marine navigation are codified in 33 CFR Parts 1 through 399 and are implemented by the U.S. Coast Guard and the U.S. Army Corps of Engineers. Federal regulations for marine vessel shipping are codified in 46 CFR Parts 1 through 599 and are implemented by the Coast Guard, Maritime Administration, and Federal Maritime Commission. California laws concerning marine navigation are codified in the Harbors and Navigation Code and are implemented by local city and county governments.

Types of transportation in the nearshore area include: commercial ships (e.g. tankers, container ships, bulk carriers, military vessels), commercial fishing vessels, research vessels, and recreational boating. The major ports along California are San Francisco Bay, Los Angeles and Long Beach, and the Port of San Diego. Most of the commercial shipping along the California coast follows customary north-south shipping lanes. Within these shipping lanes, approximately 27 percent of commercial vessel traffic travels within 0 to 5 nautical miles of the coast, 36 percent within 5 to 10 nautical miles and 20 percent over 15 nautical miles off the coast (Advanced Research Projects Agency 1994). Between San Francisco Bay and the ports of Los Angeles and Long Beach, vessel traffic totals an estimated 4,000 coastal transits per year by large vessels. About 20 percent of these transits are crude oil tankers. The majority of the remainder are large commercial vessels greater than 300 gross tons, including container ships and bulk carriers (SLC 1999).

Baleen whales have been observed to travel several kilometers from their original position in response t a straight-line pass by a vessel (MMS 2001). Although large cetaceans have occasionally been struck by freighters or tankers, and sometimes by small recreational boats, no such incidents have been reported with crew or supply boats to oil platforms off California. However, the single documented instance of a collision between a marine mammal and support vessel involved an adult male elephant seal struck in the Santa Barbara Channel in June 1999 (MMS 2001). In the Santa Barbara Channel and Santa Maria Basin, approximately 90 to 140 crew boat and 10 to 12 supply boat trips are made each week. In addition, 25 crew boat trips are made each week to State Platform Holly (MMS 2001).

Members of the Western States Petroleum Association, whose tankers carry crude oil from Alaska, agreed in 1990 to voluntarily keep laden vessels a minimum of 50 nautical miles from shore along the central coast of California. Southbound tankers loaded with oil from Alaska bound for Los Angeles, pass about 85 nautical miles offshore of Point Sur before turning eastward to enter the Santa Barbara Channel. The quantity of oil transported along the San Francisco Bay to Long Beach route was estimated to be 292.3 million barrels per year. For the trans-Pacific route, it was estimated that 5.8 million barrels of oil per year are transported (MMS 2001). Farther north they pass approximately 45 nautical miles offshore of Cape Mendocino. Other ports of call for Alaskan oil are Seattle, Washington and San Francisco, California. Slower-going ocean tank barges transit the central coast of California approximately 15 to 25 nautical miles from shore to minimize interaction with the oil tankers further out and the speedier container ships closer in.

In 1991, annual movements of all types of vessels transiting in, out, and solely within San Francisco Bay exceeded 86,000 trips, of which approximately 56,000 were ferries, 13,000 were tugs with tows, and 6,000 were commercial vessels (Advanced Research Projects Agency 1994). The remaining 11,000 trips were split between tankers, military vessels, dredges, and several smaller categories. Over 80 percent of these movements were by small vessels (ferries, tugs, dredge barges) primarily involved transits with in the Bay. Movements through the Golden Gate accounted for less than 10 percent (8,600) of all vessel traffic, although they represent a large percentage of the commercial cargo, Coast Guard, Navy, tanker, and other large vessel movements. Approximately 38 percent of vessels arriving and departing San Francisco Bay use the northern traffic lane, 20 percent the western lane, and 42 percent the southern lane. The Coast Guard estimates that the volume of recreational and small vessels traffic, such as fishing vessels, is 25 to 50 times the number of large commercial and military movements (Advanced Research Projects Agency 1994). Offshore of the southern entrance to San Francisco Bay is the Navy submarine operating area. This are is fished by trawlers and a submarine has been caught in a trawl net (R. Leos pers. comm).

3.14 Noise

Ambient noise levels can vary dramatically, depending upon proximity to major metropolitan areas, shipping traffic lanes, commercial fishing operations, and offshore oil and gas activities, as well as ambient oceanographic conditions and seafloor composition and topography. In busy port regions, shipping activities can contribute to ambient nosie levels, although such sources are transitory. In addition, commercial vessels and tankers moving up and down the west coast also contribute nosie to the marine environment. Shipping traffic is most significant at frequencies from 20 to 300 Hertz (Hz). Fishing vessels produce high frequency sound peaking at 300 Hz, whereas larger cargo vessels produce lower frequency sounds (MMS 2001). Marine mammals also produce underwater sounds which can travel up to 185 km for fin whale vocalizations (MMS 2001). Humpback whales produce sounds between 20 to 2,000 Hz and gray whales sounds are from less than 100 Hz to 2 kHz.

Sources of human-caused noise affecting marine organisms include commercial shipping activities, military operations, fishing and recreational vessels, and machinery associated with dredging and other forms of coastal construction. Many of these noises are produced at the same frequency used by marine mammals for communication. In addition, sound waves travel farther in water than in air, and therefore marine mammals are able to detect and react to noises at long distances from their source (15 to 18 miles for some). This reaction is responsible for some of the success of "pingers" on fishing nets designed to deter entanglements with marine mammals and turtles.

Response of animals to acoustic stimuli has generally shown alterations in behavior and physiological effects, depending on the species studied, characteristics of the stimuli (e.g., amplitude, frequency, pulsed or non-pulsed), season, ambient noise, previous exposure of the animal, physiological or reproductive state of the animal, and other factors. Possible adverse effects from loud sounds include discomfort, masking of other sounds, and behavioral responses resulting in avoidance of the noise source (MMS 1987). Whales have been documented altering their migration routes in response to noise. These behavior changes range from startle to avoidance responses. Sperm whales have been observed to dive immediately in response to a Twin Otter airplane passing 150 to 230 meters overhead (MMS 2001).

For vessels used in the offshore oil and gas production field, the approximate size of crew and supply boats, tones dominate up to about 50 Hz. Broadband components may extend up to 100 kHz, but they peak much lower at 50 to 150 Hz. Richardson et al. (1995 MMS2001) gave estimates of source levels of 156 decibels (dB) for a 16 meter crew boat (with a 90 Hz dominant tone) and a 159 dB for a 34 meter twin diesel (630 Hz). Broadband source levels for small, supply boat-sized ships (55 to 85 meters) are about 170 to 180 dB. Most of the sound energy produced by vessels of this size is at frequencies below 500 Hz. Many of the larger commercial fishing vessels that operate off southern California fall into this class. Oil platforms also are serviced by helicopters. An estimated source level for a Bell 212 helicopter, is about 150 dB at altitudes of 150 to 600 meters, with the dominant frequency at 22 Hz tone with harmonics. Broadband helicopter noise is approximately 165 dB at frequencies of 45 to 7 KHz. A Bell 214 was audible in air for four minutes before passing, for 38 seconds at three meters depth, and for 11 seconds at 18 meters.

Very little data on the effects of sound on fish, larvae, and eggs have been collected. There are some data showing that sound can cause some damage to sensory cells of the ears of fishes, but not to the lateral line or cristae of the semicircular canals (vestibular receptor). Some behavioral studies of fish suggest that human-generated sounds affect a fish's ability to detect biologically meaningful environmental sounds (Gisiner 1998). This is significant since croakers are known to produce sounds which may be used to communicate with one another (Moyle and Cech 1996). Strong sound waves (e.g. blasting, air guns for oil and gas exploration) have resulted in the death of fish due to bursting of their swim bladders.

Research has shown that many seabird species are disturbed by human activities, including boat noise, close to and within breeding colonies and at roosting sites (Manuwal 1978, Anderson and Keith 1980, Carney and Sydeman 1999). Boating noise would include noise from motors, generators, radios, whistles, and gunshots. High-speed boating approaches are known to increase the level of disturbances (Carney and Sydeman 1999). Possible side effects from loud sounds include disruption of normal nesting and roosting activities, increased predation of eggs and chicks as result of flushing of birds from nests, and nest abandonment. Changes in hormone production can also occur with repeated disturbances, which can also result in altered behavior and nest abandonment (Avery 2000, Bower 2000).

3.15 Utilities

Many different types of utilities exist in the nearshore area. They can generally be classified into three groups: offshore cables, offshore oil and gas pipelines, and service pipelines. Communication cables, both offshore and onshore, are regulated by the Federal Communications Commission and the California Public Utilities Commission. Offshore pipelines fall under the regulatory jurisdiction of a number of federal and State agencies. In federal waters the Federal Energy Regulatory Commission, MMS, and the U.S. Department of Transportation are responsible for regulating various aspects of oil and gas pipelines. In State waters, the State Lands Commission (SLC), the State Fire Marshal's Office of Pipeline Safety, and the Department of Conservation's Division of Oil, Gas, and Geothermal Resources regulate those pipelines. Service pipelines, such as sewage treatment plant outfalls, are regulated by the State Water Resources Control Board through their issuance of National Pollution Discharge Elimination System permits. The location of many undersea cables and sewage outfalls constructed before 1984 are located on NOAA's nautical charts. However, the various location of the U.S. Navy undersea communication cables is generally classified information and their location is not revealed.

3.16 Archaeology/Paleontology

Cultural resources include prehistoric and historic archaeological sites, districts, and objects; standing historic structures, buildings, districts, and objects; and locations of important historic events, or sites of traditional/cultural importance. Cultural resources are primarily found on land, but submerged resources such as shipwrecks and prehistoric and historic sites and artifacts are known to occur in the waters off California. The analysis of cultural resources can provide valuable information on the cultural heritage of both local and regional populations.

Archaeological resources are any material remains (sites) of human life or activities that are at least 50 years of age and that are of archaeological interest. Material remains include physical evidence of human habitation, occupation, use or activity including the site, location, or context in which such evidence is situated. Prehistoric archaeological sites consist of various forms of evidence of human activities that spanned time from approximately 13,000 years ago until the time of European contact in 1542 of California. Sites may be submerged and include intact sites buried beneath the seabed, isolated artifacts deposited on the seafloor from erosion of an upland site, or remnants of aboriginal watercraft.

MMS has conducted two archaeological baseline studies that cover the entire Pacific Region. These studies include the California, Oregon, and Washington Archaeological Resource Study which ran from Morro Bay north to the Canadian border, and the Archaeological Resource Study from the Mexican Border to Morro Bay (MMS

2001). The baseline study for northern California, Washington, and Oregon compiled information on 2,762 known prehistoric archaeological sites within a narrow strip of land along the coast (3,135 recorded in Del Norte, Humboldt, and Mendocino counties MMS 1987). The baseline study for southern California documented 1,681 known prehistoric archaeological sites from Morro Bay to the Mexican border. A total of 4,443 prehistoric archaeological sites along the Pacific coast represents only those sites that have been recorded to date and it is likely that there are thousands of additional undocumented sites.

Archaeological evidence from the Channel Islands indicates that prehistoric populations may have settled in the area and traversed coastal areas by water as early as 13,000 years ago (MMS 2001). Although sea levels were much lower than today, the Channel Islands still were separated from the mainland by a minimum of five miles. The presence of archaeological sites dating to the late Pleistocene/Early Holocene era, approximately 12,000 to 8,000 Before Present (BP) suggests that maritime travel occurred between the mainland and the islands and that aboriginal populations may have exploited littoral and nearshore resources (MMS 2001). However, along the Monterey county coastline, very little use of the area occurred prior to 5,500 BP with high increases in coastal usage between 5,500 to 1,000 years BP.

The California State Lands Commission has compiled a database of shipwrecks off California. The information can be viewed at http://shipwrecks.slc.ca.gov and is incorporated by reference. Data includes information on such wrecks as the Brother Jonathan that sank off Crescent City to the Presephone off Point Arguello. The MMS baseline study for northern California, Oregon, and Washington identified a total of 3,850 shipwrecks for the area from Morro Bay north to the Canadian border. The baseline study for southern California identified a total of 916 shipwrecks for the area from Morro Bay south to the Mexican border. The total of 4,766 shipwrecks recorded for the Pacific Region represents only those shipwrecks that have been documented through literature searches (MMS 2001).

The first European exploration of the southern and central California coast occurred in 1542 from vessels under the command of Juan Rodriquez Cabrillo. During the exploration, Cabrillo died and, according to some sources, is buried on one of the offshore Channel Islands (MMS 2001). For the next 267 years, until permanent Spanish colonization started in 1769, the area was largely ignored except for an occasional voyage of exploration and discovery. Vessels of commerce, the Manila galleons, sailed down the California coast enroute to Acapulco from Asia. Some of the galleons were lost along the California coast and reports of a galleon lost in the Channel Islands can not be completely dismissed (MMS 2001).

During the American period (1846 to present), coastwise shipping increased. Prior to completion of the Southern Pacific railroad, coastal communities, most lacking natural harbors, constructed piers as a means of accessing maritime trade for shipment of agricultural products. A thriving lumber trade between ports in the Pacific Northwest and the coastal communities developed and continued into the 1920s. In the 20th century, as coastwise trade decreased, it was replaced by trans-Pacific trade, commercial fishing, military, petroleum exploration and development, and leisure as sources of widespread maritime activity. The California coast contains the remains of the various vessels that came to grief while engaged in each of these activities. Shipwrecks tend to be concentrated around sites that focus maritime traffic. The earliest reported shipwreck along the Monterey county coastline was in 1831 and in San Luis Obispo 1852 (MMS 2001).