Chapter 3. Affected Environment

Physical Environment

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 6 and 7 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 [Minerals Management Service (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, atmospheric transport and dispersion is inhibited by topography and re-circulating due to land/sea breeze effects. 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 ($\mu g/m^3$). 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 federal 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 (non-attainment) the NAAQS. A non-attainment designation means that a primary NAAQS has been exceeded more that three discontinuous times in 3 years in a given area. An area is in non-attainment if a CAAQS has been exceeded more than once in 3 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 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 VOCs interact in the presence of sunlight to form ozone.

Table 3-1 Ambient air quality standards

Pollutant	Averaging Time	California Standards	Federal Standards Primary	Federal Standards Secondary
Ozone (O_3)	1 hour 8 hour	0.09 ppm ---	0.12 ppm 0.08 ppm	same as primary same as primary
Carbon Monoxide	1 hour 8 hour	20.0 ppm 9.0 ppm	35.0 ppm 9.0 ppm	
Nitrogen Dioxide	1 hour annual average	0.25 ppm ---	--- 0.053 ppm	same as primary same as primary
Sulfur Dioxide	1 hour 3 hour 24 hour annual average	0.25 ppm --- 0.04 ppm ---	--- --- 0.14 ppm 0.03 ppm	--- 0.5 ppm --- ---
Lead	30 day average Calendar qtr	1.5 µg/m^3 ---	--- 1.5 µg/m^3	--- same as primary
Respirable Particulate Matter (PM_{10})	24 hour annual average	50 µg/m^3 ---	150 µg/m^3 50 µg/m^3	same as primary same as primary
Fine Particulate Matter ($PM_{2.5}$)	24 hour annual average	No separate Standard	65 µg/m^3 15 µg/m^3	same as primary same as primary
Sulfates	24 hour	25 µg/m^3	No Federal Standards	
Hydrogen Sulfide	1 hour	0.03 ppm	No Federal Standards	

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 (California State Lands Commission [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 a nonattainment area 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 is determined by measuring ambient concentrations of pollutants that are known to have deleterious effects. The degree of air quality degradation is then compared to health-based standards such as the CAAQS and the NAAQS.

Air quality can be affected by emissions from gas and diesel engines in commercial vessels engaged in the take of market squid. The calculation of emissions from commercial fishing vessels can be determined using the following emission factors for diesel fuel and gasoline:

Diesel
Carbon Monoxide (CO) = 110 lb/1000 gal fuel
Hydrocarbons (HC) = 50 lb/1000 gal fuel
Nitrogen Oxides (NO_x) = 270 lb/1000 gal fuel
Sulfur Oxides (SO_x) = 27 lb/1000 gal fuel

Gasoline
Carbon Monoxide (CO) = 1,822 lb/1000 gal fuel
Hydrocarbons (HC) = 11 lb/1000 gal fuel
Nitrogen Oxides (NO_x) = 96 lb/1000 gal fuel
Sulfur Oxides (SO_x) = 6 lb/1000 gal fuel

Pollution emissions released when vessels are underway are influenced by a variety of factors including power source, engine size, fuel use, operating speed, and load. Emission factors can only provide a rough approximation of daily emission rates. Most commercial vessels engaged in the take of market squid have diesel engines. Currently, two-cycle diesel engines are most common, but four-cycle engines, which are more efficient, are becoming more popular. Overall, fishing operations are responsible for less than 1 percent of the daily emissions from all sources (mobile and non-mobile) in California (CARB 1991, 1994), and do not have a significant effect on air quality in the nearshore environment (Table 3-2). However, they do add to the cumulative exposure effects on marine organisms.

Table 3-2 South Coast vessel emissions (tons per day) - 2001.

Pollutant	CPFV's	All fishing vessels	All marine vessels
CO	0	0.9	4.8
HC	0.1	0.3	3.3
NO_x	0.6	6.3	44.2
SO_x	0.1	1.1	26.7
PM_{10}	0	0.1	3.2

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

The quality of the water affects all fish species either directly or indirectly through the food chain, and the health of the ecosystem is largely determined by the constituents in the water, sediment, and air. The quantity and type of constituents entering the water column determine 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 outfalls 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.

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 outfalls 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 6 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 high-priority concerns in the changing bay ecosystems. For example, 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 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, 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. The potential and frequency 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 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 the MSFMP 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 provides 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 off the Santa Barbara coastline. The bioclastic, organic-rich Monterey Formation has been identified since the early 1900s as a prolific source rock for petroleum generation. 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 explorers 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 6 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 washed 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 MMS, the USGS has initiated a field study 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 the Boathouse (Vandenberg Air

Force Base) and Jalama Beach for repeated sampling of tarballs at 3-month intervals during the next 3 years. On the sandy beaches at the 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 leases in 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 1 January 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 occurs commonly 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 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 North 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; it 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 depth. Because of the variability of the coastline and offshore topography, the distance that the shelf extends from shore varies from approximately 1 nautical mile to 25 nautical miles. The continental slope extends from approximately 200 meter 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 meter depth, middle slope between 500-1,200 meter depth, and the lower slope between 1,200 and approximately 3,200 meter 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 is 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 down slope 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 identifies 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 meter 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 meters. 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 meters, where the slope flattens from 8 to 4 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 7 degrees Centigrade (°C) or greater in the winter and 15°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 meter 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, with a slow-moving (10 cm/sec) current which flows southward between late spring and early fall and northward during the winter and early spring (United States Fish and Wildlife Service 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 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 through out the year over the slope (bottom depths of 200 to 5,000 meters). 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 a 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 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 meters is typically low in salinity and high in oxygen content, which identifies the water mass as principally sub-arctic even though temperatures range between 9° and 18°C. The lower mass (below 300 meters) is consistently high in salinity and low in dissolved oxygen identifying it as equatorial Pacific with temperatures between 9° and 5° 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 kilometers and to a depth of 300 meters. The average speed is approximately 0.25 m/sec and occurs primarily during spring and summer. Nearer to the coast and within 150 kilometers, the surface current periodically reverses to a poleward direction and is then called the Coastal Countercurrent. This current is strongest during the fall and winter with its poleward flow reaching maximum speed typically within 50 kilometers offshore of the coast.

Below 200 meter depth, the poleward California Undercurrent exists throughout the year and is generally confined to within 100 kilometers of the coast along the continental slope. This current originates in the eastern equatorial Pacific and brings this 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 every 1 to 3 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 5 January through 26 January 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-gauging 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 fish in southern California.

Biological Environment

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, damming or stoppage of water courses, diverting water channels, placement of bank stabilization structures, modifying habitat from one type to another (e.g., removing wetlands for marina construction), and withdrawal of water for power plant 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, desiccation, water temperature, and light. The more important biological factors include competition and predation.

The rocky shore intertidal substrate form a stable platform to which macro algae 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. Adaptations 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 power 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 7 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 1 meter in height while high-relief are taller than 1 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 rarer. 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 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. California grunion utilize sandy beaches for spawning.

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 waterfowl. 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.

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, Steller 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 (plants, fish, birds, 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). 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 calmer portions of the coast south of Point Conception. Large kelp beds have been identified in waters up to 1 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 6 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 7 to 8 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, yellowtail, sheephead, opaleye, 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 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 meters 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 meters). The lower slope (1,200 to 3,200 meters) taxa include rattails, thornyheads, finescale codling and eelpouts. At depths lower than 1,500 meters, 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 meters) 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 meter depth, corresponding to the oxygen minimum zone, followed by 2) sharp density increases to approximately 1,800 meter 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 meters), mesopelagic (200 to 1,000 meters), and bathypelagic zone (1,000 meters to bottom). The epipelagic zone waters are typically well lit, 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 and salmon, utilize estuaries for a portion of their life cycle. Other commercial and recreational pelagic fish species include: market squid, northern anchovy, Pacific sardine, salmon, mackerel, and albacore tuna. Coastal pelagic species are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. Several species are managed by the PFMC CPSFMP. 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. Market squid inhabit the inshore and offshore waters of the Pacific Ocean from British Columbia down to Baja California, specifically within the California Current.

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, great 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: deepsea 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, pteropods, heteropods, cephalopods, and octopuses. Many of these species are either of commercial importance or are prey items for fish, sea turtles, seabirds, and marine mammals. Gelatinous invertebrates, such as jellyfish, salps, and tunicates, are the important prey items of some 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 meters) and night (generally near the surface).

Phytoplankton is generally limited in distribution from the sea surface to approximately 100 meters 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 nonupwelling events, dinoflagellates are dominant.

Zooplankton species are not limited to the photic zone and can occur from surface waters to depths of over 400 meters. 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 PFMC manages 90 species of fish under three Fishery Management Plans: 1) Coastal Pelagic Species 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." NOAA Fisheries 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 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 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.

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.

3.8.2 State Marine Managed Areas

California's State Marine Managed Areas (MMAs), such as refuges, reserves, preserves, areas of biological significance, and parks, are one of many tools for state resource managers to use for protecting, conserving, and managing the State's valuable marine resources. 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. 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.

Several State refuges, parks, and reserves are located throughout the nearshore areas. 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 the preserved. The Department 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 a network 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 kilometers 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.

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 3-3 for a list of all areas of special concern. Under the Marine Managed Areas Improvement Act (MMAIA) all ASBSs are now State Marine Water Quality Protection Areas.

California's current MMAs are the result of more than 50 years of designations on a case-by-case basis through legislative, administrative, and statewide ballot initiative actions which has led to 18 different classifications and subclassifications (PRC§ 36601). Many MMAs evolved without conforming to any plan ensuring the most representative or unique areas of the ocean and coastal habitat were included. Additionally, many MMAs do not encompass an organized system, as the individual sites are not designated, classified, or managed in a systematic manner and many designations lack a clearly defined purpose, effective management measures, and enforcement. Agencies are unable to meet management objectives, such as maintaining biodiversity, providing education and outreach, and protecting marine resources. To resolve these issues MMAIA, chaptered in 2000, formed an interagency committee to review all the existing MMA's and set criteria for considering and including additional areas into the MMA system. It also established a new classification system for designating managed areas in the marine and estuarine environment. The new classifications are; State Marine Reserve (no take), State Marine Park (limited recreational take), State Marine Conservation Area (limited commercial and/or recreational take), State Marine Water Quality Protection Areas (includes ASBSs), State Cultural Preservation Areas (e.g., shipwrecks), and State Recreational Management Areas.

The Marine Life Protection Act (MLPA), chaptered in October 1999, was designed to improve the array of Marine Protected Areas (MPAs), a subset of MMAs, existing in California waters through the adoption of a Marine Life Protection Program and a comprehensive master plan. MPAs provide for whole ecosystem protection, rather than focusing on single species or species groups. This ecosystem approach takes into consideration the interaction between different species and the importance of habitat. By using an ecosystem approach, biological diversity, reproductive potential, and resource sustainability are all increased. The Department is the lead agency charged with implementing the provisions of the MLPA. The MLPA requires that the Department develop a plan for establishing networks of MPAs in California waters to protect habitats and preserve ecosystem integrity, among other things. The MLPA states that "marine life reserves" (defined as no-take areas) are essential elements of an MPA system because they "protect habitat and ecosystems, conserve biological diversity, provide a sanctuary for fish and other sea life, enhance recreational and educational opportunities, provide a reference point against which scientists can measure changes elsewhere in the marine environment, and may help rebuild depleted fisheries." The MLPA further states that "it is necessary to modify the existing collection of MPAs to ensure that they are designed and managed according to clear, conservation-based goals and guidelines that take full advantage of the multiple benefits that can be derived from the establishment of marine life reserves. The Department will include MPAs with the classification of State Marine Reserve, State Marine Park, and State Marine Conservation Area in the recommended networks of MPAs. The final MLPA plan is due in December 2005.

In a process independent from the MLPA, the Department proposed MPAs within the Channel Islands National Marine Sanctuary. The Fish and Game Commission voted to adopt the Department's MPA plan and implementation occurred in April 2003. The Department's plan represents 19 percent of State waters within the Sanctuary and includes 132 square nautical miles in 10 no-take State Marine Reserves and 10 square nautical miles in 2 limited-take State Marine Conservation Areas.

3.8.3 National Marine Sanctuaries

Marine sanctuaries are areas that are legally defined and regulated by the 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.

Table 3-3 State Marine Managed Areas in or adjacent to the marine environment and the new designations for MPAs (where applicable).

AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE (STATE MARINE WATER QUALITY PROTECTION AREAS)
Redwoods National Park Head State Marine Water Quality Protection Area
Kelp Beds at Trinidad Head State Marine Water Quality Protection Area
Kings Range National Conservation Area State Marine Water Quality Protection Area
Pygmy Forest Ecological Staircase State Marine Water Quality Protection Area
Kelp Beds at Saunders Reef State Marine Water Quality Protection Area
Del Mar Landing Ecological Reserve State Marine Water Quality Protection Area
Gerstle Cove State Marine Water Quality Protection Area
Bodega Marine Life Refuge State Marine Water Quality Protection Area
Bird Rock State Marine Water Quality Protection Area
Pt. Reyes Headlands Reserve and Extension State Marine Water Quality Protection Area
Double Point State Marine Water Quality Protection Area
Duxbury Reef Reserve and Extension State Marine Water Quality Protection Area
Farallon Island State Marine Water Quality Protection Area
James V. Fitzgerald Marine Reserve State Marine Water Quality Protection Area
Ano Nuevo Point and Island State Marine Water Quality Protection Area
Pacific Grove Marine Gardens Fish Refuge State Marine Water Quality Protection Area
Hopkins Marine Life Refuge State Marine Water Quality Protection Area
Carmel Bay State Marine Water Quality Protection Area
Point Lobos Ecological Reserve State Marine Water Quality Protection Area
Julia Pfeiffer Burns Underwater Park State Marine Water Quality Protection Area
Ocean Area Surrounding the Mouth of Salmon Creek State Marine Water Quality Protection Area
San Miguel, Santa Rosa, Santa Cruz Islands State Marine Water Quality Protection Area
Santa Barbara and Anacapa Island State Marine Water Quality Protection Area
San Nicolas Island and Begg Rock State Marine Water Quality Protection Area
Mugu Lagoon to Latigo Point State Marine Water Quality Protection Area
Santa Catalina Island (4 subareas) State Marine Water Quality Protection Area
San Clemente Island State Marine Water Quality Protection Area
Newport Beach Marine Life Refuge State Marine Water Quality Protection Area
Irvine Coast Marine Life Refuge State Marine Water Quality Protection Area
Heisler Park Ecological Reserve State Marine Water Quality Protection Area
San Diego Marine Life Refuge State Marine Water Quality Protection Areas
San Diego-La Jolla Ecological Reserve State Marine Water Quality Protection Area

NATURAL PRESERVES
Existing Name
Big Lagoon (3 sub units)
Brush Creek/Lagoon Lake Wetland
Carmel River Lagoon and Wetland
Morro Estuary
Morro Rock
Pajaro River Mouth
Pescadero Marsh
Point Dume
Salinas River Mouth
Santa Clara Estuary

ECOLOGICAL RESERVES	
Existing Name	**New Designation Without Regulation Changes**
Tomales Bay Ecological Reserve	Tomales Bay State Marine Park
Fagan Marsh Ecological Reserve	Fagan Marsh State Marine Park
Peytonia Slough Ecological Reserve	Peytonia Slough State Marine Park
Bair Island Ecological Reserve	Bair Island State Marine Park
Albany Mudflats Ecological Reserve	Albany Mudflats State Marine Park
Del Mar Landing Ecological Reserve	Del Mar Landing State Marine Park
Corte Madera Marsh Ecological Reserve	Corte Madera State Marine Park
Marin Islands Ecological Reserve	Marin Islands State Marine Park
Redwood Shores Ecological Reserve	Redwood Shores State Marine Park
Point Lobos Ecological Reserve	Point Lobos State Marine Reserve
Elkhorn Slough Ecological Reserve	Elkhorn Slough State Marine Reserve
Farallon Islands Ecological Reserve	n/a
Moro Cojo Ecological Reserve	n/a
Watsonville Slough Ecological Reserve	n/a
Carmel Bay Ecological Reserve	Carmel Bay State Marine Conservation Area
Morro Rock Ecological Reserve	Morro Rock Ecological Reserve
San Miguel Island Ecological Reserve	San Miguel Island State Marine Conservation Area
Anacapa Island Ecological Reserve	Anacapa Island State Marine Conservation Area
Anacapa Island Ecological Reserve Natural Area	Anacapa Island State Marine Reserve
Santa Barbara Island Ecological Reserve	Santa Barbara Island State Marine Conservation Area
Goleta Slough Ecological Reserve	Goleta Slough State Marine Park
Abalone Cove Ecological Reserve	Abalone Cove State Marine Park
Farnsworth Bank Ecological Reserve	Farnsworth Bank State Marine Conservation Area
Bolsa Chica Ecological Reserve	Bolsa Chica State Marine Park
Upper Newport Bay Ecological Reserve	Upper Newport Bay State Marine Park
Heisler Park Ecological Reserve	Heisler Park State Marine Reserve
Buena Vista Lagoon Ecological Reserve	Buena Vista Lagoon State Marine Park
Batiquitos Lagoon Ecological Reserve	Batiquitos Lagoon State Marine park
San Dieguito Lagoon Ecological Reserve	San Dieguito Lagoon State Marine Park
San Elijo Lagoon Ecological Reserve	San Elijo Lagoon State Marine Park
San Diego-La Jolla Ecological Reserve	San Diego-La Jolla State Marine Conservation Area
Offshore Rocks and Pinnacles Ecological Reserve	n/a

MARINE RESOURCE PROTECTION ACT ECOLOGICAL RESERVES (MRPAER)	
Existing Name	**New Designation Without Regulation Changes**
King Range MRPAER	King Range State Marine Reserve
Big Creek MPRAER	Big Creek State Marine Reserve
Vandenberg MRPAER	Vandenberg State Marine Reserve
Big Sycamore Canyon MRPAER	Big Sycamore State Marine Reserve

CLAM REFUGES (PISMO CLAM PRESERVES)	
Existing Name	**New Designation Without Regulation Changes**
Pismo-Oceano Beach Clam Preserve	Pismo-Oceano State Marine Conservation Area
Atascadero Beach Pismo Clam Preserve	Atascadero Beach State Marine Conservation Area
Morro Beach Clam Preserve	Morro Beach State Marine Conservation Area

REFUGES	
Existing Name	**New Designation Without Regulation Changes**
Bodega Marine Life Refuge	Bodega State Marine Reserve
Farallon Islands Game Refuge	n/a
California Sea Otter Game Refuge	n/a
Pacific Grove Marine Gardens Fish Refuge	Pacific Grove State Marine Conservation Area
James V. Fitzgerald Marine Life Refuge	James V. Fitzgerald State Marine Conservation Area
Hopkins Marine Life Refuge	Hopkins State Marine Reserve
Point Fermin Marine Life Refuge	Point Fermin State Marine Conservation Area
Catalina Marine Science Center Marine Life Refuge	Catalina Marine Science Center State Marine Reserve
Newport Beach Marine Life Refuge	Newport Beach State Marine Conservation Area
Irvine Coast Marine Life Refuge	Irvine Coast State Marine Conservation Area
Laguna Beach Marine Life Refuge	Laguna Beach State Marine Conservation Area
Niguel Marine Life Refuge	Niguel State Marine Conservation Area
Doheny Beach Marine Life Refuge	Doheny Beach State Marine Conservation Area
Dana Point Marine Life Refuge	Dana Point State Marine Conservation Area
South Laguna Beach Marine Life Refuge	South Laguna Beach State Marine Conservation Area
City of Encinitas Marine Life Refuge	City of Encinitas State Marine Conservation Area
San Diego Marine Life Refuge	San Diego State Marine Conservation Area

RESERVES	
Existing MPA Name	**New Designation Without Regulation Changes**
Duxbury Reef Reserve	Duxbury Reef State Marine Conservation Area
Gerstle Cove Reserve	Gerstle Cove State Marine Conservation Area
Point Reyes Headlands Reserve	Point Reyes Headlands State Marine Conservation Area
Estero de Limantour Reserve	Estero de Limantour State Marine Reserve
Ano Nuevo Reserve	n/a
Point Lobos Reserve	n/a
Pismo Invertebrate Reserve	Pismo State Marine Conservation Area
Robert W. Crown Reserve	Robert W. Crown State Marine Conservation Area
Coal Oil Point Reserve	n/a
Carpinteria Salt Marsh Reserve	n/a
Santa Cruz Island Reserve	n/a
Lover’s Cove Reserve	Lovers Cove State Marine Conservation Area
Point Cabrillo Reserve	Point Cabrillo State Marine Conservation Area
Point Loma Reserve	Point Loma State Marine Conservation Area
Scripps Coastal Reserve	n/a

STATE ESTUARIES
Morro Bay State Estuary
San Diego Bay State Estuary

STATE PARKS AND BEACHES	
Existing MPA Name	**New Designation Without Regulation Changes**
MacKerricher State Park	MacKerricher State Marine Conservation Area
Russian Gulch State Park	Russian Gulch State Marine Conservation Area
Van Damme State Park	Van Damme State Marine Conservation Area
Manchester State Park	Manchester State Marine Conservation Area
Arena Rock Marine Natural Preserve (in Manchester State Park)	Arena Rock State Marine Conservation Area
Salt Point State Park	Salt Point State Marine Conservation Area
Fort Ross State Historic Park	Fort Ross State Marine Conservation Area
Sonoma Coast State Beach	Sonoma Coast State Marine Conservation Area
Julia Pfeiffer Burns State Park	Julia Pfeiffer Burns State Marine Conservation Area
Refugio State Beach	Refugio State Marine Conservation Area
Crystal Cove State Park	Crystal Cove State Marine Conservation Area
Cardiff and San Elijo State Beaches	Cardiff and San Elijo State Marine Conservation Area

MARINE PROTECTED AREAS
Anacapa Island State Marine Reserve
Santa Barbara Island State Marine Reserve
Harris Pt. State Marine Reserve
Judith Rock State Marine Reserve
Richardson Rock State Marine Reserve
Scorpion (Santa Cruz Island) State Marine Reserve
Gull Island (Santa Cruz Island) State Marine Reserve
Carrington Pt. (Santa Rosa Island) State Marine Reserve
Skunk Pt. (Santa Rosa Island) State Marine Reserve
South Point (Santa Rosa Island) State Marine Reserve
Anacapa Island State Marine Conservation Area
Painted Cave (Santa Cruz Island) State Marine Conservation Area

3.9 Threatened and Endangered Species

The USFWS and the NOAA Fisheries grant at-risk species and stocks protection under the federal Endangered Species Act of 1973 (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. 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 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.

NOAA Fisheries is charged with the implementation of the ESA for marine and anadromous species, while the USFWS implements programs and regulations for terrestrial and freshwater species. Section 7 of the ESA 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. The ESA requires NOAA Fisheries and the USFWS 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 provides for the conservation of threatened and endangered species (FGC §2062, 2067, 2068) under the CESA. Like the ESA, CESA policy is to conserve, protect, restore, and enhance any endangered or threatened species and its habitat. Additionally, the FGC designates several marine mammal (§4700) and bird species (§3511) as “fully protected” meaning there is no issuance of permits under FGC §2081 to take such species.

3.9.1 Protected or Listed 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. Six whale species occurring in California waters are listed as endangered under ESA, while the central coast harbor porpoise is listed as a strategic stock by NOAA Fisheries. The Steller sea lion (eastern stock), Guadalupe fur seal, and the southern sea otter are listed as threatened under ESA. There are no candidate ESA marine mammal species found in California waters. The Guadalupe fur seal is listed under CESA as threatened. The southern sea otter, Guadalupe fur seal and northern elephant seal are also fully protected under FGC §4700. In addition to those species listed under the ESA, all marine mammals are protected under the Marine Mammal Protection Act of 1972, amended 1994, (MMPA) administered by the NOAA Fisheries and the USFWS.

3.9.1.1 Marine Mammal Protection Act and Current Fishery Categories

In addition to the ESA, the federal 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). Additionally, the MMPA 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, NOAA Fisheries develops estimates of PBR's for each marine mammal stock in U.S. waters.

Under section 118 of the MMPA, NOAA Fisheries 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. 2003). The classifications are listed in the List of Fisheries (LOF) which is updated and published annually in the Federal Register. 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 1 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 1 percent of the PBR level. Category III fisheries have a remote likelihood of marine mammal interaction or no known serious injuries or mortalities with marine mammals. Only participants in Category I or II are required to be registered under the MMPA (NMFS,NOAA,OPR 2003).

NOAA Fisheries issues permits through the Marine Mammal Authorization Program 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 NOAA Fisheries 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 2003). NOAA Fisheries may also issue permits for the incidental, but not intentional, taking of marine mammals listed as T&E under ESA, (those species under NOAA Fisheries jurisdiction), if NOAA Fisheries 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 2003). 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.

In California, the thresher shark/swordfish drift gill-net and the large mesh (>3.5inches) set gill-net fishery are classified as Category I fisheries, while the California anchovy, mackerel and tuna purse seine, squid purse seine, and the California long-line are classified as Category II California fisheries. Class III California fisheries include: small mesh (<3.5 inches) set and drift gill-net; herring purse seine; sardine purse seine; squid dip net; salmon troll; shark/ bonito long-line/set line; groundfish, bottomfish long-line/set line; groundfish trawl; shrimp trawl, lobster, prawn, shrimp, rock crab and fish pot; hagfish pot; crab pot; sablefish pot; swordfish harpoon; bait pens; abalone, sea urchin; kelp; sea urchin, clam, octopus, oyster, sea cucumber, scallop, ghost shrimp hand dive or mechanical collection; Commercial Passenger Fishing Vessel; and finfish and shellfish live-trap/hook-and-line (NMFS/NOAA/OPR 2002 LOF). There is no Category classification for recreational angling. Proposed changes for 2003 concerning California fisheries include reclassifying the California/Oregon thresher shark/swordfish drift gill-net fishery from Category I to Category II, adding the California angel shark/halibut set gill-net fishery (mesh size>3.5 inches and < 14 inches) as a Category I fishery and adding the California yellowtail, barracuda, white seabass and tuna drift gill-net fishery (mesh size>3.5 inches and < 14 inches) as a Category II fishery to the LOF.

Table 3-4 lists marine mammal species and their current listing/designation status and PBR (Forney et al. 2000, Carretta et al. 2001) level (note the “stock” designations for harbor porpoise, bottlenose dolphin, Steller sea lion, and northern fur seal). Following are brief descriptions of listed and state fully protected marine mammal species. Non-listed marine mammals with documented or suspected fishery interactions are further discussed in Section 3.10.1.

Table 3-4 Marine mammal species found in California waters
(from Forney et al. 2000 and Carretta et al. 2001)

Species	Status	PBR
Humpback whale (*Megaptera novaeangliae*)	FE, SS, DEP	1.9
Northern right whale (*Eubalaena glacialis*)	FE, SS, DEP	N/D
Sperm whale (*Physeter macrocephalus*)	FE, SS, DEP	2.1
Sei whale (*Balaenoptera borealis*)	FE, SS, DEP	N/D
Fin whale (*Balaenoptera physalus*)	FE, SS, DEP	3.2
Blue whale (*Balaenoptera musculus*)	FE, SS, DEP	1.7
Gray whale (*Eschrichtius robustus*)		575
Harbor porpoise (*Phocoena phocoena*) (Central CA Stock)	SS	56
Bryde's whale (*Balaenoptera edeni*)		N/D
Minke whale (*Balaenoptera acutorostrata*)		4.4
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*)		3.1
Short-finned pilot whale (*Globicephala macrorhynchus*)		5.7
Northern right whale dolphin (*Lissodelphis borealis*)		97
Long-beaked common dolphin (*Delphinus capensis*)		250
Short-beaked common dolphin (*Delphinus delphis*)		3,188
Bottlenose dolphin (*Tursiops truncatus*) (Offshore Stock)		8.5
Bottlenose dolphin (*Tursiops truncatus*) (Coastal Stock)		1.9
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, SS, DEP	1,368
Northern fur seal (*Callorhinus ursinus*)		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 ne*reis)	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

3.9.1.2 Humpback Whale, *Megaptera novaeangliae*

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). The best estimate of abundance is 1,024 humpback whales in the stock ranging from Mexico to Washington state (Calambokidis 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 (Forney et al. 2000). 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 NOAA Fisheries, 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).

3.9.1.3 Northern Right Whale, *Eubalaena glacialis*

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.

3.9.1.4 Sperm Whale, *Physeter macrocephalus*

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 also are 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 2000). Sperm whales are deep water divers; males have been known to dive to depths of 3,936 feet. Surveys conducted in 1993, and 1996 by Barlow and Taylor (2001), estimated 1,407 sperm whales off the coast of California Oregon and Washington.

NOAA Fisheries 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.

3.9.1.5 Sei Whale, *Balaenoptera borealis*

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 NOAA-Fisheries'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.

3.9.1.6 Fin Whale, *Balaenoptera physalus*

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. Barlow and Taylor (2001) estimated 1,851 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, NOAA-Fisheries reported the mortality of a fin whale in the California shark swordfish offshore drift gill-net fishery (NMFS, NOAA, SWRO, 2003). 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).

3.9.1.7 Blue Whale, *Balaenoptera musculus*

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 2000). NOAA-Fisheries 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.

3.9.1.8 Harbor Porpoise, *Phocoena phocoena*

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 (Gearin et al. 1994, Wynne and Folkens 1992). Based on aerial surveys, it is estimated that there are approximately 7,579 harbor porpoise in central California (Caretta et al. 2001).

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 data indicate an average of 79 harbor porpoise were killed annually from 1996 to 1999 in the fishery (Caretta et al. 2001). In April 2002, the Department's Director ordered a prohibition of 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.

3.9.1.9 Steller (Northern) Sea Lion, *Eumetopias jubatus*

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 Steller sea lions includes the major rookeries around Ano Nuevo Island, Southeast Farallon Island, Sugarloaf Island and Cape Mendocino (NOAA, NMFS, AK Regional Office 2003). In southern and central California, Steller sea lion numbers have declined while in northern California they are stable. During 1996, NOAA Fisheries 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

3.9.1.10 Guadalupe Fur Seal, *Arctocephalus townsendi*

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. According to NOAA Fisheries, individuals have been sighted in the southern California Channel Islands, including two males who established territories on San Nicolas Island (NOAA/NMFS/OPR 2003). 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, stranding 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. 1997).

3.9.1.11 Northern Elephant Seal, *Mirounga angustirostris*

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). Northern elephant seals may 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). California stranding data from 1995 to 1998 attributed 1 boat collision injury, 5 deaths from car collisions at Piedras Blancas (recent measures have been taken to prevent further car collision deaths), and 3 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).

3.9.1.12 Southern Sea Otter, *Enhydra lutris*

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). 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). Since April 2002, the Department has prohibited 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. Southern sea otters are primarily found in water depths less than 100 feet.

3.9.2 Listed Marine and Coastal Birds in California Waters (Seabirds)

For bird species, the federal ESA is administered by the USFWS. 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 USC Section 7030). This federal law is incorporated into state law through FGC §3513. As mentioned in Section 3.9, CESA also provides for the conservation of threatened and endangered species. The Department also designates taxa as "species of special concern” or 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. Finally, the FGC §3511 designates two marine seabirds as "fully protected," meaning there is no issuance of permits under FGC §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 3-5 lists seabird species likely to be in California state waters and their current listing and/or designation status. The bald eagle is included because it is a listed species found seasonally along the coast and offshore islands, and the osprey is a SSC found along the coast. Non-listed species are discussed in detail in Section 3.10.2 if they are documented to be involved in squid fishery interactions and/or consume squid as part of their diet.

Table 3-5 The federal and state status of seabirds in California waters*****

Species	Status**
Red-throated Loon (*Gavia stellata*)	
Pacific Loon *(G. pacifica*)	
Arctic Loon (*G. arctica*)	
Common Loon (*G. immer*)	SSC
Horned Grebe (*Podiceps auritus*)	
Red-necked Grebe (*P. grisegena*)	
Eared Grebe (*P. nigricollis*)	
Western Grebe (*Aechmophorus occidentalis*)	
Clark's Grebe *(A. clarkii*)	
Black-footed Albatross *(Phoebastria nigripes*)	
Northern Fulmar *(Fulmarus glacialis*)	
Pink-footed Shearwater *(Puffinus creatopus*)	
Buller's Shearwater (*P. bulleri*)	
Sooty Shearwater *(P. griseus*)	
Short-tailed Shearwater (*P. tenuirostris*)	
Black-vented Shearwater *(P. opisthomelas*)	
Fork-tailed Storm-Petrel *(Oceanodroma furcata)*	SSC
Leach's Storm-Petrel *(O. leucorhoa*)	
Ashy Storm-Petrel *(O. homochroa*)	FSC, SSC
Black Storm-Petrel *(O. melania*)	SSC
Least Storm-Petrel (*O. microsoma*)	
California Brown Pelican *(Pelecanus occidentalis californicus*)	FE, SE, FPO
Brandt's Cormorant *(Phalacrocorax penicillatus*)	
Double-crested Cormorant *(P. auritus*)	SSC
Pelagic Cormorant *(P. pelagicus*)	
Black Scoter *(Melanitta nigra*)	
White-winged Scoter *(M. fusca*)	
Surf Scoter *(M. perspicillata*)	
Western Snowy Plover (*Charadrius alexandrinus nivosus*)	FT, SSC
Black Oystercatcher (*Haematopus bachmani*)	
Red Phalarope *(Phalaropus fulicaria)*	
Red-necked Phalarope *(P. lobatus*)	
South Polar Skua (*Stercorarius maccormicki*)	
Pomarine Jaeger *(S. pomarinus*)	
Parasitic Jaeger (*S. parasiticus*)	
Bonaparte's Gull (*Larus philadelphia*)	
Heermann's Gull (*L. heermanni*)	
Mew Gull (*L. canus*)	
Ring-billed Gull *(L. delawarensis*)	
California Gull (*L. californicus*)	SSC
Herring Gull (*L. argentatus*)	
Thayer's Gull (*L. thayeri*)	
Western Gull *(L. occidentalis*)	
Glacous-winged Gull (*L. glaucescens*)	
Sabine's Gull (*Xema sabini*)	
Black-legged Kittiwake *(Rissa tridactyla*)	
Caspian Tern *(Sterna caspia*)	

Table 3-5 The federal and state status of seabirds in California waters*	
Royal Tern *(S. maxima)*	
Elegant Tern *(S. elegans)*	FSC, SSC
Common Tern *(S. hirundo)*	
Arctic Tern *(S. paradisaea)*	
Forster's Tern *(S. forsteri)*	
California Least Tern (*S. antillarum browni*)	FE, SE, FPO
Black Tern *(Chlidonias niger)*	FSC, SSC
Black Skimmer (*Rynchops niger*)	SSC
Common Murre *(Uria aalge)*	RE
Pigeon Guillemot *(Cepphus columba)*	
Marbled Murrelet *(Brachyramphus marmoratus)*	FT, SE
Xantus's Murrelet *(Synthliboramphus hypoleucus)*	FSC, SSC,*ST
Craveri's Murrelet (*S. craveri*)	
Ancient Murrelet (*S. antiquus*)	
Cassin's Auklet *(Ptychoramphus aleuticus)*	
Rhinoceros Auklet *(Cerorhinca monocerata)*	SSC
Tufted Puffin (*Fratercula cirrhata*)	SSC
Osprey (*Pandion haliaetus*)	SSC
Bald Eagle (*Haliaeetus leucocephalus*)	FT, SE, FPD

FE Federally listed as endangered under ESA
FT Federally listed as threatened under ESA
FPL Petitioned for federal listing under ESA
SE State listed as endangered under CESA
ST State listed as threatened under CESA
*ST In process of being State listed as threatened under CESA
CAN State Candidate Species under CESA
FSC Federal species of concern
SSC State species of special concern
DFGFP Fully protected under FGC §3511
FPD Federally proposed for delisting

3.9.2.1 California Brown Pelican, *Pelecanus occidentalis californicus*

The California brown pelican was listed as an endangered species under the ESA in 1970 and by the Commission under CESA in 1971 because of decreased population numbers and extensive reproductive failures. These resulted from the effects of dichlorodiphenyltrichloroethane or "DDT" in the late 1960s. Additionally, they are a fully protected species under FGC §3511. California brown pelicans are found in estuarine, marine subtidal, and pelagic waters along the California coast. They breed in the southern California Bight (SCB) at West Anacapa and Santa Barbara islands, and at several islands off Baja California, Mexico. During the non-breeding season, these birds disperse along the coast as far north as Vancouver, British Columbia and south to El Salvador. California brown pelicans are colonial nesters and require nesting grounds free from human disturbance and mammalian predators, and 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 plunge-diving birds that feed almost exclusively on fish and dive from distances of 6 to12 meters (6.6-13.2 feet) in the air (Johnsgard 1993). The main prey items in California are northern anchovies, Pacific sardines, and Pacific mackerel. After the collapse of the sardine fishery in the 1950s, 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 since the early 1992 are common items in the California brown pelican diet.

The California brown pelican may be affected by nearshore fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, seal bombs, whistles, etc.) near known rookeries and roosting sites. The recovery plan for the California brown pelican (Gress and Anderson 1983) describes the negative effects of disturbance. Although they are large seabirds, California brown pelicans are nonetheless disturbed by events which are out of the ordinary (Anderson and Keith 1980, Anderson 1988). This includes not only direct human disturbance, but loud noises as well. This conclusion is bolstered by additional work on disturbance effects upon wintering California brown pelicans (Jaques and Anderson 1988). They found that not only are pelicans sensitive to subtle movements by researchers, they are also 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 USFWS that this decline was attributed to the presence of vessels fishing for market squid 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.

3.9.2.2 California Least Tern, *Sterna antillarum browni*

The California least tern is both state and federally listed as endangered, and is a fully protected species under FGC §3511. 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 3 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. In the CPFV fishery, terns may get hooked in the mouth or other body parts when they go after bait. Terns also may be taken on long-lines. 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, seal bombs, whistles, etc.) near rookeries and roosting sites.

3.9.2.3 Marbled Murrelets, *Brachyramphus marmoratus*

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 coastal 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 1990). 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 (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. 1995a). 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. 1995a).

3.9.2.4 Bald Eagle, *Haliaeetus leucocephalus*

The bald eagle is federally (although petitioned for delisting) and state listed as endangered, and is a fully protected species under FGC §3511. 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 scavenge dead fish, water birds, mammals, and possible squid found at the water surface. Bald eagles also pursue live fish, but do not dive underwater nor rest on the water (as seabirds do); thus, interactions with fishermen are possible but not likely.

Formally a resident breeding species on all of the Channel Islands, the bald eagle disappeared from the islands by the early 1960s (Kiff 1998). More than 30 eagles have been released and breeding has been reestablished at Santa Catalina Island, Los Angeles County, and some live on the mainland in Santa Barbara County. A recovery plan for the bald eagle is currently in place that establishes geographical goals for population enhancement.

As part of the Montrose Settlements Restoration Program (the Department is a representative of this Trustee Council), about 12 juvenile bald eagles are proposed to be released on Santa Cruz Island in the summer of 2003. This is part of a feasibility study to determine if the program will attempt to reintroduce bald eagles to the northern Channel Islands. There is no information available to determine if bald eagles would be impacted by the squid fishery in the northern Channel Islands, however, squid fishing does occur off Santa Catalina Island and bald eagle breeding has been reestablished there. It is possible that artificial lighting from squid vessels could enable bald eagles, which are normally a diurnal feeder, to forage at night and possibly prey on seabird species. To ensure successful reintroduction of bald eagles to the northern Channel Islands, the Council should monitor potential release sites and the availability of prey for eagles prior to release. If the Council believes that eagles may be impacted by the market squid fishery or may result in impacts to other listed or sensitive species, they should coordinate activities with the Department to identify appropriate areas for release that will minimize impacts.

3.9.2.5 Xantus's Murrelets, *Synthliboramphus hypoleucus*

On February 5, 2004, the Commission determined that the Xantus's murrelet should be designated as a threatened species under the CESA and a formal rulemaking process is underway to add Xantus's murrelet to the list of species designated as threatened in CCR Title 14. The process is expected to be complete during July/August 2004. The Department recommended the listing after conducting a year-long review of the status of the species. Prior to their listing, Xantus's murrelets were considered a SSC by the Department. They are also a globally rare seabird species (one of the ten rarest seabird species in the North Pacific). A petition was filed for both state and federal 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. In October 2002, the Commission designated the Xantus's murrelet as a threatened species candidate under the CESA. At the same time, the Commission also adopted emergency regulations governing incidental take of the murrelet during the candidacy period. The emergency regulations are intended to reduce night-time disturbance near breeding colonies. During the candidacy period (and until they are designated as threatened under CCR Title 14), Xantus's murrelets receive the same protection under CESA as species that are officially listed as threatened or endangered. The emergency regulations adopted by the Commission authorize incidental take of

Xantus's murrelets during the night-time (dusk to dawn) vessel operations from 1 February to 15 July, within 1 nautical mile of Santa Barbara and Anacapa islands, if vessels comply with the following conditions:

- 1) vessels are not engaged in night fishing or night diving;
- 2) external loud speakers on the vessels are not in use;
- 3) vessels are within a designated anchorage or safe harbor during the night, except when transiting through the specified areas; and
- 4) lighting on the vessels is limited to navigational lighting necessary for safe operations.

Take is authorized during night-time vessel operations from 16 July to 31 January, and at any time beyond the specified areas around Santa Barbara and Anacapa islands.

Xantus's murrelets are small birds (in the Alcid family) 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 only breeds from the Channel Islands south to Central Baja California. Eighty percent of the United States breeding population and 33.5 percent of the world's breeding population nest in the Channel Islands, primarily at Santa Barbara Island (also found at San Miguel, Santa Cruz, and Anacapa islands). They usually return to the nesting islands in February and disperse from the islands by mid-July, although they may visit the breeding sites starting in January. 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). Chicks depart to the sea with their parents at night at two days of age and are dependent on their parents for an extended period of time (Gaston and Jones 1998). Chicks that get lost or separated from their parents at night, or those who leave the nest during the day, are often fed upon by predators (e.g., western gulls).

Population numbers of Xantus's murrelets have been declining for the past 20 years. Because they spend a substantial amount of time in the water, Xantus's murrelets are vulnerable to oil spills, contamination by marine pollution, and entanglement in fishing gear (Carter et al. 2000). Predators include peregrine falcons, western gulls, barn owls, deer mice, and introduced predators such as feral cats and black rats. No direct studies on sensitivity to humans have been conducted on Xantus's 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 disturbances are another cumulative impact for these specialized birds that evolved on island or offshore rock environments, far from human disturbance. Murrelets are known to be attracted to bright light sources, particularly on dark, foggy nights (Whitworth et al. 1997, Carter et al. 1999). Disorientation from lights can cause parent-chick separation (which will result in increased mortality of young-of-the-year) and has been observed in the Channel Islands (Keitt, Kelly, Naughton, McChesney, Zeidberg pers. comm.).

As with other alcids, Xantus's murrelets may be affected by ancillary fishing activities (e.g., presence of vessels, motor noise, generators, lights, radios, gunshots, seal bombs, whistles, etc.) near rookeries and roosting sites. Nesting sites can be disturbed by boats, low-flying aircraft, and intruding humans (Reimer and Brown 1997; Parker et al. 2000, 2001; 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 colonies of common murres at Hurricane/Castle Rock, Monterey County, and Point Reyes, Marin County (Parker et al. 2000, 2001; Rojek and Parker 2000). 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 alcid colonies.

Artificial night-lighting can be a problem for alcids which are nocturnal in colony or foraging habits. When flying in total darkness, alcids may become disoriented by and attracted to bright artificial lights (Verheijen 1958, Reed et al. 1985, Telfer et al. 1987). This may cause birds to crash into lighted boats, which can result in direct mortality or birds falling stunned and/or injured into the water or landing on deck (Dick and Donaldson 1978, Zeidberg pers. comm.). Injured birds become easy targets for predation after daylight. In worst cases, the adult birds may avoid the colony and not return to their nests, as nocturnal seabird species are known to reduce levels of colony attendance during lighted or full moonlight conditions, likely to avoid predation (Manuwal 1974; Watanuki 1980; Story and Grimmer 1986; Keitt, in review). In addition, for several species, including Xantus's murrelets, fledglings depart the colony at night. They may become attracted and disoriented by lights and collide with vessels, increasing the normal mortality rates of young-of-the year. This has been documented for fledging petrels and storm-petrels in Hawaii and is a major concern for the survival of these species (Byrd et al. 1978, Reed et al. 1985, Reed 1987, Telfer et al. 1987, Harrison 1990).

The concern over the potential impacts of artificial lights on seabirds in the Channel Islands arose in 1999 when large increases in artificial light intensity levels associated with nighttime squid fishery boat activity extended into the seabird breeding season. The use of bright lights (current regulation of 30,000 watts maximum per vessel) is thought to increase the mortality of Xantus's murrelets, and likely other alcid species, nesting in the Channel Islands. In 1999, increased mortality rates of Xantus's murrelets due to predation by barn owls were recorded (Channel Islands National Park, unpublished data). Additionally, western gulls, predators of Xantus's murrelet which are normally diurnal, were noted by researchers as more active at night when squid lights were on, and predation rates likely increased over normal levels (Channel Island National Park, unpublished data).

3.9.2.6 Rhinoceros Auklets, *Cerorhinca monocerata*

Rhinoceros auklets are considered an SSC by the Department due to small population numbers in the state. Rhinoceros auklets feed on small fish, crustaceans, and cephalopods (including market squid) by diving and pursuing their prey underwater (Cogswell 1977). A study on the winter diet of Rhinoceros auklets in Monterey Bay found market squid to be the predominant prey item (Baltz and Morejohn 1977). Rhinoceros auklets are colonial, monogamous nesters that breed along the coasts of the north Pacific Ocean (Harrison 1983). In California, approximately 1,800 birds nest in burrows and crevices 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 on the Farallon Islands in central California. Rhinoceros auklets are nocturnal at nesting colonies 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 1 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 at nesting colonies, rhinoceros auklets are accustomed to flying in total darkness and may become disoriented in bright lights.

3.9.2.7 Ashy, Black, and Fork-tailed Storm-Petrels; *Oceanodroma homochroa, O. melania, O. furcata*

Storm-petrels are small, highly pelagic seabirds that prey on small invertebrates (young squid, euphausiids, crab larvae) and small fish while they flutter along at the ocean's surface. They only come to land for nesting, otherwise they remain over the open sea. Four species breed in California on offshore islands nesting in burrows or rock crevices (Carter et al. 1992). Storm-petrels are monogamous, lay a single egg, and both parents participate in raising the nidicolous young. The adults are nocturnal in their nesting colony activities, which is thought to reduce predation by gulls that are normally diurnal (Ainley et al. 1974, Watanuki 1980, Storey and Grimmer 1986). Parents 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 or 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 at sea once their flight feathers are completed developed.

Three species of storm-petrels, ashy, black, and fork-tailed, are considered SSCs by the Department, and the ashy is a globally rare seabird species (one of the ten rarest seabird species in the North Pacific). Ashy storm-petrels are restricted to the north-east Pacific Ocean, breeding on islands from central to southern California (with a few small colonies in Baja California and northern California). Approximately half of the world's population, estimated at less than 10,000 individuals, nest at the Farallon Islands, and half at the Channel Islands, primarily at San Miguel, Santa Barbara, and Santa Cruz islands (Carter et al. 1992). The breeding period is from April through November, although birds may visit their nesting colonies year-round. Dispersal in the non-breeding season is thought to be limited. 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. 1998a, 1998b) (long-term trends are not available for the Channel Islands population). Factors in their decline include habitat loss from invasive non-native plants; introduction of feral cats, house mice, and other nonnative animals; decline in zooplankton in the SCB; and predation by house mice, western gulls, burrowing owls, and other owl species (Sydeman et al. 1998, Nur et al. 1999). Ashy storm-petrels are also known to be sensitive to human disturbance, oil pollution, and marine pollution.

Black storm-petrels are found in the northeast Pacific Ocean. They primarily breed on islands off the coast of Baja California and in the Gulf of California (Harrison 1983). A small population, estimated at 274 individuals, breeds from April to October on Santa Barbara Island in Santa Barbara County (Carter et al. 1992). After breeding, birds generally move south towards northern South America, however, in warm-water years large numbers move as far north as Monterey 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). In California, the estimated breeding population of 410 birds breeds on six small islets off Del Norte and Humboldt counties from March to September (Carter et al. 1992). Individuals are observed as far south as southern California in the non-breeding season.

Storm-petrels are not likely to become entangled in fishing gear because of their feeding methods. However, they may be affected by ancillary fishing activities (e.g., vessel proximity, motor noise, generators, gunshots, seal bombs, lights, radios, etc.) near roosting and breeding sites. Because of their nocturnal colony 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 birds to crash into lit boats, which can result in direct mortality or result in birds either falling stunned and/or injured into the water or landing on deck (Dick and Donaldson 1978). Injured birds become easy targets for predation after daylight. In worst cases, the adult birds may avoid the colony and not return to their nests, as nocturnal seabird species are known to reduce levels of colony attendance during lighted or full moonlight conditions, likely to avoid predation (Manuwal 1974; Watanuki 1980; Story and Grimmer 1986; Keitt 2000). In addition, storm-petrel fledglings depart the colony on their own at night. They may become attracted and disoriented by lights and collide with vessels, increasing the normal mortality rates of young-of-the-year. This is documented for fledging petrels and storm-petrels in Hawaii and is a major concern for survival of these species (Byrd et al 1978, Reed et al. 1985, Reed 1987, Telfer et al. 1987, Harrison 1990).

Storm-petrels (and related petrels and shearwaters) are known to be attracted to and strike lit long-line vessels, as well as other lit vessels, fishing at night in the southern hemisphere (Reid pers. comm., Weimerskirch et al. 2000), lit vessels at night in Alaska (Canez, Trapp, and Williams pers. comm.) and Newfoundland (Chardine pers. comm.), and artificial night-lighting in Hawaii (Reed et al. 1985, Telfer 1987). There are documented interactions of inflight strikes of storm-petrels with lit fishing vessels and other lighted vessels in the Channel Islands (McChesney, Naughton, Zeidberg, pers. comm.). The concern over the potential impacts of artificial lights on seabirds in the Channel Islands arose in 1999 when large increases in artificial light intensity levels associated with night-time squid fishery boat activity extended into the seabird breeding season. The use of bright lights (current regulation of 30,000 watts maximum per vessel) is thought to increase the mortality of ashy storm-petrel and equally likely the black storm-petrel nesting in the Channel Islands. In 1999, western gulls, which are normally diurnal and a predator of storm-petrels, were noted by researchers as more active at night when squid lights were on, and predation rates likely increased over normal levels (Channel Island National Park, unpublished data).

3.9.2.8 Double-Crested Cormorant, *Phalacrocorax auritus*

Double-crested cormorants are year-long residents along the entire coastline of California. They feed mainly on mid-water to bottom-dwelling fish, diving from the surface to pursue prey underwater. 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 is usually March to August or 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. Roosting sites on offshore rocks, islands, cliffs, wharfs, and jetties are important habitat for all cormorants year-round because, unlike other seabirds, their feathers are not completely waterproof and they need to dry them daily (Johnsgard 1993).

The double-crested cormorant is considered a SSC by the Department. This species is found over most of North America, with an estimated breeding population of 10,000 individuals in California (Carter et al. 1995b). The subspecies found along the California coast breeds mainly in marine and estuarine habitats, with some nesting inland (Harrison 1983). Population declines occurred throughout the 1900s and continue in some colonies due to habitat loss, marine pollution, human disturbance, and introduced predators (Carter et al. 1995b). In the Channel Islands, breeding numbers of double-crested cormorants, as well as Brandt's cormorants, have declined since 1991, probably due mostly to the El Niños in 1992-93 and 1997-98 (McChesney et al. 2000).

Cormorants can be affected by ancillary fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, seal bombs, 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, 2001; Rojek and Parker 2000). 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). Similarly, continual disturbance of roosting sites could compromise the cormorant's abilities to waterproof its feathers and effect thermoregulation.

3.9.2.9 Black Skimmer, *Rynchops niger*

Black skimmers are considered a SSC by the Department. The black skimmer is a migratory colonial nesting seabird that arrives at breeding sites along the California coast in Orange and San Diego counties (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 has increased along the coast, most likely due to colony protection and use of artificial nesting sites (Carter et al. 2001a). 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 near 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 are dependent upon their parents until a month after they are ready to fly (Erwin 1977). Preferred nesting habitats are beaches and sand bars, which makes them vulnerable to human disturbance.

3.9.2.10 Elegant Tern, *Sterna elegans*

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.

3.9.2.11 Black Tern, *Chlidonias niger*

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).

3.9.2.12 California Gull, *Larus californicu*s

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. 2001a) 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 introduction of predators (Rigney 1990, Carter et al. 1992). Gulls are not capable of deep dives, thus they are surface feeders and many may include squid species in their diets. Market squid is known to be consumed by wintering California, mew, glaucous-wing, and Heermann's gulls and black-legged kittiwakes (Baltz and Morejohn 1977, Morejohn et al. 1978).

Behavior patterns of gulls may be influenced by fishery activities. They are attracted to fishery operations where they feed on bait or on scavenged or discarded targeted species or bycatch. For example, gulls, which are normally diurnal, are known to forage at night near squid fishing boats where they are attracted by the activity and bright lights. Artificial lighting may increase foraging abilities of gulls on colonies, resulting in increased levels of predation on nocturnally nesting seabirds. In 1999, western gulls were noted by researchers as more active at night when squid lights were on in the Channel Islands (Channel Island National Park, unpublished data). Gulls and terns also may be affected by ancillary marine fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, seal bombs, whistles, etc.) near rookeries and roosting sites.

3.9.2.13 Tufted Puffin, *Fratercula cirrhata*

Tufted puffins are considered an SSC by the Department. While colonies are found along the coasts of the northern Pacific Ocean, only a small number, estimated at 276 birds, breeds in California (Carter et al. 1992). They nest on offshore islands in northern California, at the Farallon Islands and Point Reyes in central California, and have recently recolonized southern California at the Channel Islands, where they had not been seen since the early 1900s (Carter et al. 2001a). Tufted puffins feed on medium-sized fish, crustaceans, and squid by diving and pursuing their prey underwater (Cogswell 1977). Diet studies in the Gulf of the Farallones found market squid to be a predominate prey item, along with anchovies and rockfish (Ainley et al. 1990). Tufted puffins are colonial nesters who burrow on island cliffs or grassy island slopes and may visit the nest burrow in daylight hours. Tufted puffins lay one egg which is incubated for about 45 days. The semiprecocial young is tended by both parents and remains in the burrow for close to 2 months. Fledglings depart for the sea alone, at night (Gaston and Jones 1998), and may become attracted and disoriented by lights and collide with vessels, increasing the normal mortality rates of young-of-the-year.

3.9.2.14 Common Loon, *Gavia artica*

The common loon is considered an SSC by the Department. The common loon is a fairly common transient in nearshore habitats along the coast of California during their wintering season, approximately September through May (Granholm 1990). It does not nest 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. Other loons that are found along the

California coast in the winter include Arctic, red-throated and Pacific loons. The Arctic loon is documented to consume market squid in Monterey Bay (Baltz and Morejohn 1977, Morejohn et al. 1978).

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. Loons also may be taken on long-lines. 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.

3.9.2.15 Western Snowy Plover *Charadrius alexandrinus nivosus*

The Pacific coast population of the western snowy plover is federally listed as threatened and is a SSC. A draft recovery plan was written by the USFWS (Federal Register 14 Aug 2001). This small shorebird breeds above the mean high tide line on coastal beaches, dunes, estuaries, and lagoons from Washington to Baja, California (USFWS 2001). The U.S. pacific coast population is estimated at 2,000 or less individuals. The nesting season extends from March through September. Plovers lay between two and six eggs, which are incubated for about 24 days. The precocial young fledge between 29 and 47 days of age.

In winter, western snowy plovers range from southern Washington to central America in coastal areas, although some breeding groups in California remain on their breeding grounds year-round. Snowy plovers primarily fed on terrestrial and marine invertebrates.

Population declines have been attributed to habitat degradation, human disturbance, and predator expansion (including gulls, ravens, coyotes, foxes, and skunks) into nesting areas (Powell 2002). Declines have been particularly apparent in southern California and the CINPS has documented declines in breeding numbers in the Channel Islands since 1991 (Martin and Sydeman 1998). Breeding has not occurred on San Miguel Island since 1999, and numbers have been declining at Santa Rosa Island (only 23 birds in 2001) (Paige Martin, pers. comm.). The National Park Service prohibits access to the nesting area on the east side of Santa Rosa Island during the breeding season, from 1 March to 15 September. No studies have been conducted to determine if the bright lights and noise associated with the squid fishery has a negative impact on the breeding activity of western snowy plovers in the Channel Islands and along the coast in central and southern California. Increased light levels can alter the behavior of diurnal species and result in nest abandonment (Avery 2000, Bower 2000). Additionally, diurnal predators, such as western gulls, have been noted by researchers as more active at night when squid lights are on (Channel Island National Park, unpublished data). Thus, predation rates of plover adults, eggs, and/or chicks by diurnal predators could be increased over normal levels. Therefore, it is possible that the fishery could have impacts to nesting plovers if fishing occurs close to breeding colonies during the breeding season.

3.9.3 Listed Marine (Sea) 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. They are well adapted to life in the marine environment possessing streamlined bodies, flipper-like limbs, and the ability to navigate across the oceans. Sea turtles often travel long distances from their feeding grounds to their nesting beaches. All six species of sea turtles in the U.S. are protected under the ESA. Although sea turtles do not nest on the U.S. west coast, four species, green, leatherback, loggerhead, and olive ridley, are occasionally present in State waters. Because sea turtles nest on land, responsibility for their conservation is shared between NOAA Fisheries and the USFWS. 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 fishing activities would constitute a take under the ESA and is prohibited. Table 3-6 lists sea turtle species likely to be found in California state waters and their current designation status.

Table 3-6 The federal status of sea turtles found in California waters

Species	Status**
Green Turtle *Chelonia mydas*	FE
Leatherback Turtle *Dermochelys coriacea*	FE
Loggerhead Turtle *Caretta caretta*	FT
Olive ridley Turtle *Lepidochelys olivacea*	FE

**Status Codes
FE- Federally listed as Endangered under FESA
FT - Federally listed as Threatened under FESA

The following information on the distribution and threats to sea turtles, was derived from the corresponding Federal Turtle Recovery plans (NMFS/USFWS 1998a,1998b, 1998c, 1998d) and the 2000 NOAA Fisheries biological opinion for the California/Oregon drift gill-net fishery. Impacts to sea turtles in the California marine environment includes ingestion of marine debris, effects of pesticides, heavy metals, and PCB's, dredging activities, ship and boat strikes, marina and dock development, loss of foraging and refuge habitat, risk of oil spills, entrapment in saltwater intake systems of coastal power plants, commercial fishing interactions, and entanglement in discarded fishing gear. The discharge of garbage can be harmful as sea turtles have been known to ingest plastic bags, beverage six-pack rings, styrofoam, and other items commonly found aboard fishing vessels. Chemical contamination of the marine environment due to sewage, pesticides, agricultural runoff, solvents and industrial discharges is widespread along the coastal waters of California. 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. Direct poisoning as well as blockage of the gastrointestinal tract by ingested tar balls has been reported. Both the entanglement in, and ingestion of, synthetic debris have been documented by NOAA Fisheries. Oil spills can result in death to sea turtles as oil affects respiration, skin, blood chemistry and salt gland functions. Indirect consequences of an oil spill include destruction of foraging habitat. Sea turtles are vulnerable to collisions with vessels and can be killed or injured when struck. The development of marinas in inshore waters can negatively impact sea turtles by destruction or degradation of their foraging habitat. Additionally, marina development leads to increased boat traffic. Dredging activities may directly injure and kill sea turtles or dredging may indirectly harm sea turtles by destroying their forage habitat. In San Diego Bay, juvenile and adult turtles spend most of their time motionless on the floor of dredge channels (Stinson 1984, McDonald and Dutton1992). Periodic dredging may injure or kill these turtles (NMFS/USFWS 1998a). The entrainment and entrapment of juvenile and sub-adult sea turtles in the saltwater cooling intake systems of coastal power plants has been documented in southern California at the NRG power plant in Carlsbad, as well as the Southern California Edison Nuclear Generating Station at San Onofre (NMFS/USFWS/1998a,b,c,d) and PG&E's Diablo Canyon power plant. Some of these turtles are released unharmed.

Fishing activities also impact sea turtles. Sea turtles may become entangled in abandoned fishing gear resulting in death or injury by drowning or loss of a limb. Commercial fishing operations result in thousands of incidental sea turtle deaths nationwide per year although exact numbers are not available for all fisheries. Fisheries known to take sea turtles include shrimp trawlers, gill net fisheries, hook-and-line, long line, trap (entanglement in fishery lines) and purse seine for anchovy, sardines and tuna (NMFS 2000 Biological Opinion). In California waters, NOAA Fisheries observer programs, conducted from 1990 to 2001, have documented loggerhead, green, leatherback, olive ridley, and "unidentified" sea turtles interacting with drift gill-nets off California. The California set gill-net fishery for halibut and angel shark, has been observed to take loggerhead, green, leatherback, and "unidentified" sea turtles (Julian and Beeson 1998, NOAA/NMFS/SWR 1999, Carretta, 2000, 2001). Long-line fishing gear is another documented gear type affecting sea turtles in California through entanglement and hooking (NMFS Southwest Fisheries Science Center). Turtles are known to be taken incidentally by the California-based pelagic long-line fleet (PFMC 2001). Table 3-7 lists the yearly number of sea turtles that have been stranded in California from1990 to 2000.

Table 3-7 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	1	10	2		3	1	4	9	2	8	11	**51**
Loggerhead	2		3	1	2	1	2	5	3		4	**23**
Olive Ridley	7	1	1	2	2		1	1	1	1	2	**19**
Unidentified	1			1						2	5	**9**
Total	**23**	**17**	**9**	**11**	**12**	**5**	**11**	**15**	**14**	**13**	**32**	**162**

Source: NOAA Fisheries, 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, and3.

3.9.3.1 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, as 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 primary threats to green sea turtles in U.S. waters include incidental capture by coastal fisheries, vessel impacts and water pollution (NMFS/USFWS 1998c). The only green turtle taken by the drift gill-net fishery (through 2000) 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).

3.9.3.2 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/NOAA 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. 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 (Starbird et al. 1993), 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 3-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, making leatherbacks the most common turtle. The “Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle” (NMFS/USFWS 1998a) states that the leatherback is the most common sea turtle in U.S. waters north of Mexico.

Foraging, for jellyfish in nearshore and oceanic areas, occurs throughout the northeastern Pacific. Leatherbacks feed mainly on open ocean soft-bodied invertebrates such as jellyfish and tunicates, but the diet may also include squid, fish, crustaceans, algae, and floating seaweed. 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 NOAA Fisheries. 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. The primary threat to this species in U.S. waters is incidental take in fisheries. All of the leatherback turtles observed taken by the drift gill-net fishery (1990 to 2000) were located north of point Conception from September through January, and the majority of them were found in areas of coastal upwelling.

3.9.3.3 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). 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 loggerheads are know to occur within these waters. There is limited information on mortality of loggerheads on the U.S. west coast. Primary threats include natural disasters and incidental take in fisheries. El Niño events, may cause loggerheads to migrate north where they "cold stun" once they encounter colder water. Occasional cold strandings occur in Washington and Oregon. El Niño events can cause reduced food production for some turtle species which can reduce growth and fecundity. During 1983 to 1991, two loggerhead turtles were entrained and both of these were released alive. From 1990 to 2000, 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 1 KHz. Sensitivity declined rapidly above 1 KHz and was highest at 250 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 turtles 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 sea turtle (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. Major threats on the U.S. west coast include incidental take in fisheries and vessel collisions. Olive ridleys have been incidentally killed in the California drift gill-net fishery and cold-stunning has occurred in Oregon and Washington (NMFS/USFWS 1998d).

3.9.4 Listed Fish in California Waters

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. 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 was listed as endangered under the ESA in 1994. 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, 2-inch long, bottom-dwelling fish which is nearly transparent (Federal Register Vol 65 No. 224 page 69693-69717). Historically the northern population ranged from Del Norte County to Los Angeles County while the southern population ranged from Aliso Creek in Orange County to Agua Hedionda Lagoon in northern San Diego County. Since 1994, the northern populations have nearly doubled. Since the 1900s tidewater gobies have disappeared from nearly 50 percent of the coastal lagoons within their historic range, including 74 percent of the lagoons south of Morro Bay in central California (USFWS 2001). Critical habitat was designated in Orange and San Diego Counties in November 2000 for the southern population (Federal Register Vol 65 No. 224 page 69693-69717).

Gobies are often found in low salinity waters (10 ppt) but can tolerate higher salinities when moving between coastal streams in the ocean. They live approximately 3 years and feed on crustaceans and aquatic insects. Coastal development, loss of saltmarsh habitat, and alterations of upstream flow are the major reasons for the gobies decline.

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. 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 1 year for chinook salmon and up to 6 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 1 to 3 years feeding. Submarine canyons and other regions of pronounced upwelling are 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 Maria 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 federally 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-Northern California is a State candidate for listing and federally listed as threatened.

3.10 Non-listed Species

3.10.1 Non-listed Marine Mammals (MMPA Protected)

3.10.1.1 Short-finned Pilot Whale *Globicephala macrorhynchus*

Short-finned pilot whales were commonly seen off California and a resident population was documented around Santa Catalina Island (Dohl et al. 1980, Miller et al. 1983). However, since the 1982 to1983 El Niño event, sightings of pilot whales have been rare (Shane 1995, Forney et al. 2000). In 1993, six groups of pilot whales were seen off California (Carretta et al. 1995, Barlow and Gerrodette 1996), but according to NOAA Fisheries, sightings remain rare. Short-finned pilot whales are gregarious, living in herds of a few to several hundred, often occurring with bottlenose dolphins (Leatherwood et al. 1988). Short-finned pilot whales predominantly consume squid and occasionally small fish (Seagars and Henderson, 1985). Their seasonal abundance appears to be correlated with the seasonal abundance of spawning squid (Bernard and Reilly 1990, Miller et al. 1983). NOAA Fisheries estimates the California, Oregon, and Washington population of pilot whales at 970 animals (Barlow 1997).

There is documented mortality of short-finned pilot whales in squid purse seine fishery operations off southern California (Miller et al. 1983, Heyning et al. 1994, Seagars and Henderson 1985, Carretta et al 2001). Pilot whales are attracted to spawning aggregations of squid, their main food prey. Near Santa Catalina they were noted to move inshore as the squid spawning season began (Miller et al. 1983, Dohl et al. 1980). Interactions between the squid fishery and pilot whales at Santa Catalina were observed in January through March, 1980 (Miller et al. 1983). Pilot whales were seen wrapped in purse seine nets where they drowned or had their flukes severed as they were brought aboard by power blocks. Additionally, there were observations of dead pilot whales with severed flukes and squid in their stomachs, indicating capture in squid nets. From aerial surveys of pilot whales in the vicinity, Miller et al. (1983) estimated at least 30 pilot whales were killed annually in the squid fishery at this one location. Some pilot whale mortality was likely intentional rather than incidental with fishermen shooting and killing the animals to protect gear and catch. From interviews and observations Miller found that fishermen viewed pilot whales as competitors as the animals would scare squid from the lights. In addition to the round haul vessels, Miller also describes dip net squid fishermen shooting at pilot whales. Heyning et al. (1994) records 14 short-finned pilot whale mortalities in southern California (1975 to 1988) with evidence of squid purse seine fishery interaction.

However, 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. According to NOAA Fisheries, pilot whale sightings have been extremely rare during their surveys and the areas where pilot whales used to be regularly seen, primarily Santa Catalina and San Clemente islands, no longer provide sightings (K. Forney, NOAA Fisheries, pers. comm.). There have been, however, anecdotal reports of pilot whales near squid fishing operations in southern California in the 1998 to 1997 fishing season (Carretta et al. 2001). Mortality also could be unreported because the fishery is not being observed for marine mammal mortality. The only other fishery to document short-finned pilot whale mortality is the shark-swordfish drift gill-net fishery.

3.10.1.2 Risso's Dolphin *Grampus griseu*s

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 (SCB) and in the slope and offshore waters (Forney et al. 2000). Highest densities tend to occur along the shelf break. Risso's dolphins were rarely seen in the SCB in the 1950s but numbers have increased since the 1982 to1983 El Niño, particularly around Santa Catalina Island (Kruse et al. 1990, Shane 1995), where it is thought that Risso's dolphins replaced pilot whales after the 1982 to 1983 El Niño event (Shane 1995). Risso's dolphins are common in Monterey Bay. Risso's dolphins are gregarious, and schools may include several hundred animals, but the average group consists of 30 individuals (Kruse et al. 1990). Risso's dolphins consume cephalopods and occasionally fish (Kruse et al. 1990, Leatherwood et al. 1988). Studies at Santa Catalina Island concluded that Risso's are nocturnal feeders (Shane 1995). NOAA Fisheries estimates that there are approximately 16,500 Risso’s dolphins in California, Oregon, and Washington (Barlow 1997).

Risso’s dolphins have been observed in the vicinity of commercial squid boats (Shane 1995) and there is documented mortality of unknown extent for Risso's dolphins in the squid purse seine fishery off southern California (Heyning et al. 1994). Some of the 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. However, mortality of Risso’s dolphins is likely unreported because the fishery is not being observed for marine mammal mortality. There is documented mortality of Risso’s dolphins in the shark-swordfish drift gillnet fishery (Forney et al. 2000).

3.10.1.3 Bottlenose Dolphin *Tursiops truncatu*s

Bottlenose dolphins are distributed worldwide in tropical and temperate waters. In California, NOAA Fisheries 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. Bottlenose dolphins are social animals usually found in groups of 2 to 15 (Wells and Scott 1999). Offshore bottlenose dolphins consume predominantly squid, while coastal bottlenose dolphins eat a variety of fish, squid, and crustaceans (Drumm 2000). NOAA Fisheries estimates that there are approximately 956 offshore bottlenose dolphins in California, Oregon, and Washington, and 206 coastal dolphins in California waters (Caretta et al. 2001).

Coastal bottlenose dolphins have documented mortality in the California large mesh set gill-net fishery while offshore bottlenose dolphins have documented interactions with the California shark-swordfish drift gill-net fishery, as well as the anchovy, mackerel, and tuna purse seine fisheries (Forney et al. 2000; FR Vol. 68 No. 7 2003). Offshore bottlenose dolphins are often associated with Risso’s dolphins and short-finned pilot whales, thus, they also may experience some mortality in the squid fishery as well (Heyning et al. 1994). However, the fishery is not being observed for marine mammal mortality so this is unknown. 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 the highest levels of pollutants in their system, especially DDT, of any cetacean examined (O’Shea et al. 1980, Schafer et al. 1984).

3.10.1.4 Pacific White-sided Dolphin *Lagenorhynchus obliquiden*s

Pacific white-sided dolphins are primarily found in shelf and slope waters off the west coast. 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 forming groups of several hundred or less and seek out other marine mammals (Leatherwood and Reeves 1983). Pacific white-sided dolphins feed on a variety of small schooling fish and squid, primarily at night (Wynne and

Folkens 1992, Leatherwood and Reeves 1983). They have taken hake (depths of greater than 400 ft), cephalopods, and anchovies (400 to 650 foot depth), and white seaperch. NOAA Fisheries estimates that there are approximately 25,000 animals in California, Oregon, and Washington (Barlow 1997).

There is documented mortality and injury in the shark-swordfish drift gill-net fishery and the domestic groundfish trawl fishery.

3.10.1.5 Short-beaked Common Dolphin *Delphinus delphis*

Short-beaked common dolphins are the most abundant cetacean off California. Historically, they were only reported south of Pt. Conception but on recent NOAA Fisheries surveys they were commonly sighted as far north as the Oregon border (Forney et al. 2002). Their distribution extends south into Mexican waters. Off southern California, they tend to occur along sea mounts and escarpments (Leatherwood and Reeves 1983). Common dolphins are known to feed on small schooling fish and squid at night and are among the most gregarious of dolphins (Leatherwood and Reeves 1983, Leatherwood et al.1988). Based on three ship surveys, NOAA Fisheries estimates the population for California, Oregon and Washington waters at 373,573 animals (Barlow 1997).

In California waters there is documented mortality of short-beaked common dolphins primarily in the shark-swordfish drift gill-net fishery although some have been taken in the large mesh (>3.5 inches) set gill-net fishery. One stranding report reported a common dolphin with a hook and line in its mouth (Forney et al. 2002), while another reported a common dolphin with severed flukes (Heyning et al. 1994).

3.10.1.6 Long-beaked Common Dolphin (*Delphinus capensis*)

Long-beaked common dolphins occur from Baja California to central California (Forney et al. 2001). Only recently have they been recognized as a distinct species having previously been included with the short-beaked common dolphin. Off southern California, they tend to occur along sea mounts and escarpments feeding at night on small schooling fish and squid (Leatherwood and Reeves 1983, Leatherwood et al.1988). Based on three ship surveys, NOAA Fisheries estimates the population for California, Oregon and Washington waters at 32,239 animals (Barlow 1997).

In California waters, there is documented mortality of long-beaked common dolphins primarily in the shark-swordfish drift gill net fishery although some have been taken in the large mesh (>3.5 inches) set gill net fishery (Forney et al. 2001). Heyning et al. (1994) reports seven long-beaked common dolphin strandings with severed flukes due to fishery interactions.

3.10.1.7 California Sea Lion, *Zalophus californianus californianus*

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 anchovy, sardine, salmon, rockfish, flatfish, and lamprey among other species. Market squid is one of the most important prey of sea lions in southern California (Lowry and Caretta 1999).

California sea lions are incidentally killed in the set and drift gill-net fisheries. Mortality also occurs in the salmon troll and in the round haul fisheries for herring, anchovy, mackerel, sardine, tuna, squid, the CPFV fishery, and the California groundfish trawl (Miller et al. 1983, NMFS 1995, NMFS,NOAA,OPR. 2002). Although illegal, the mortality associated with the round haul fisheries is likely intentional with fishermen killing the animals to protect gear and catch (Miller et al. 1983). In addition to the round haul vessels, Miller describes dip net squid fishermen also shooting at sea lions. From interviews with fishermen and observations, Miller et al. (1983) found that squid fishermen viewed sea lions as competitors as the animals would scare squid from the lights.

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 California sea lions along the central California coast (Scholin et al. 2000).

3.10.2 Non-listed Marine and Coastal Birds (Seabirds)

3.10.2.1 Common Murre *Uria aalge*

The common murre is a large alcid which breeds in both the north Pacific and north Atlantic oceans. In California, they are year-round residents off the coast of northern and central California, with small numbers observed in southern California. (Cogswell 1977). They are diurnal feeders that prey on fish by pursuing them underwater. Prey items include cephalopods (including squid), crustaceans, and a variety of small fish (e.g., juvenile rockfish, sand lance, Pacific herring, sardines, and anchovies) (Baltz and Morejohn 1977, Morejohn et al 1978, Ainley et al. 1990). Diet studies in the Gulf of the Farallones point to market squid as a principal prey item (Ainley et al. 1990). 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 central Monterey County. The largest colonies are found on offshore rocks in Del Norte and Humboldt counties and at the Farallon Islands in San Francisco County. 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 1 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 2 months (Gaston and Jones 1998).

Central California common murre numbers declined an estimated 52.6 percent between 1980 and 1986 due to mortality in gill nets and oil spills and low breeding success during a severe El Niño-Southern Oscillation event (Takekawa et al. 1990, Carter et al. 2001b). Population numbers have increased in the 1990s but are still substantially lower than historical levels (Carter et al. 2001b). Oil spills and entanglement in fishing gear are still threats to the viability of local colonies. Human disturbance, such as by aircraft and boats, also can impact nesting success at colonies depending on proximity to colony, timing, frequency, and duration of disturbances (Thayer et al. 1999, Parker et al. 2000, 2001, Rojek and Parker 2000). Common murres have been targeted by Trustee Agencies (California Department of Parks and Recreation California State Lands Commission, DFG, NOAA, and USFWS) for restoration actions in recent oil spill damage assessments because of the tenuous status of the Central California population and the fact that they are the most common victims of oil spills in California. Much of the millions of dollars in natural resource damages collected by DFG in the past few years have been based on injuries to, and compensatory restoration for, common murres (Page and Carter 1987, Page et al. 1990).

Large mesh set gill-nets are known to take alcids incidentally and have previously taken common murres in central California (Carter et al. 1995a, 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 Gull, *Larus occidentalis*

The western gull breeds along the Pacific coast from British Columbia to central Baja California (Carter et al. 1992). The largest breeding numbers (estimated at about 61,800 birds) occur in California. The Farallon Islands in central California harbor the largest colony in the world, and large numbers are 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 (including market squid), euphausiids, offal, and birds and eggs (including adult and chicks of auklets and petrels, gull chicks, and eggs). Off the Farallon Islands, breeding birds are known to primarily feed in surface waters on live prey (Ainley et al. 1990). Western gull 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).

Behavior patterns of gulls may be influenced by fishery activities. They are attracted to fishery operations where they feed on bait or on scavenged or discarded targeted species or bycatch. For example, gulls, which are normally diurnal, are known to forage at night near 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 colonies, resulting in increased levels of predation on nocturnally nesting seabirds. In 1999, western gulls were noted by researchers as more active at night when squid lights were on in the Channel Islands (Channel Island National Park, unpublished data). Gulls and terns also may be affected by ancillary marine fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, seal bombs, whistles, etc.) near rookeries and roosting sites.

3.10.2.3 Heermann's Gull *Larus heermanni*

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). Market squid is known to be consumed by wintering California, mew, glaucous-wing, and Heermann's gulls and black-legged kittiwakes (Baltz and Morejohn 1977, Morejohn et al. 1978). Market squid and northern anchovy were the most important prey items for glaucous-wing and Heermann's gulls in Monterey Bay (Baltz and Morejohn 1977). Gull behavior is detailed in the western gull section above.

3.10.2.4 Brandt's and Pelagic Cormorants; *Phalacrocorax penicillatus*, *P. pelagicus*

Brandt's and pelagic cormorants are year-long residents along the entire coastline of California. Both species feed mainly on mid-water to bottom-dwelling fish, diving from the surface to pursue prey underwater. Brandt's cormorants are known to forage on market squid (Baltz and Morejohn 1977, Morejohn et al. 1978, Ainley et al. 1990). They forage principally in nearshore waters less than 50 meters in depth and at short distances from nesting or roosting sites (Ainley et al. 1981, Hebshi 1998). 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 for all species. Cormorants are monogamous colonial nesters with clutch sizes ranging from 2 to 7 eggs. Incubation is performed by both parents and the young are altricial. Predators on eggs and young include crows, ravens, and western gulls. Roosting sites on offshore rocks, islands, cliffs, wharfs, and jetties are important habitat for all cormorants year-round because, unlike other seabirds, their feathers are not completely waterproof and they need to dry them daily (Johnsgard 1993).

Cormorants can be affected by ancillary fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, seal bombs, 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, 2001; Rojek and Parker 2000). 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). Similarly, continual disturbance of roosting sites could compromise the cormorant's abilities to waterproof its feathers and effect thermoregulation.

Large mesh (> 3.5 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. 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 long-line vessels near the Farallon Islands.

Cormorants also may be affected by ancillary fishing activities (e.g., vessel proximity, motor noise, generators, lights, radios, gunshots, seal bombs, 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).

3.10.3 Non-listed Fish and Incidentally-taken Species

Fish generally are classified into inhabiting coastal, benthic, or pelagic habitats. Complex relationships exist between marine plant and animal communities. Many fish species are highly dependent upon particular types of habitat and may show little large-scale movement after they recruit to these areas. Localized removals of large portions of the 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.

Fish species may be incidentally taken by the squid fishery. Through the Department's port sampling program, 2,402 samples were collected between October 1998 and October 2003 in California, with 886 observed landings containing incidentally caught fish and invertebrates. This represents a 37% occurrence by frequency of bycatch (Table 3-8). Two or more species were observed as bycatch in 47% of landings with bycatch. Most of this bycatch was other coastal pelagic species, including Pacific sardine, Pacific mackerel, northern anchovy and jack mackerel. Approximately 3.2% of sampled landings contained squid egg cases. Previous drafts of this MSFMP reported that incidental catch of squid eggs was 2%. In addition, if examined by port area, squid eggs occurred in 8.3% of the Monterey samples. This higher level of observed egg cases is most likely due to the shallower nature of the northern fishery and is a source of concern. Under the proposed management strategy, the fishery is monitored by evaluating escapement of squid eggs from the fishery. If the fishery damages squid spawning beds, and this damage is a significant source of egg mortaility, the monitoring program will be biased unless this additional source of mortaility is accounted for. Less than 2 percent of the landings contained species that are prohibited from being landed using seine gear (e.g., barracuda, yellowtail). In terms of species of concern, there have been 7 observations of Chinook (King) salmon representing 1.6% of observed landings in Monterey as well as one observation of salmon (species unknown). In addition, bocaccio was observed in 1.2% of the Monterey landings.

Currently, the type of net used to fish for squid is unregulated, although purse seines used for squid typically do not hang as deep as purse seines used for other species, so contact with the bottom is reduced. Incidental catches of squid eggs and other species increase in the squid fishery when the nets are set in shallower water (less than 22 fathoms), where bottom contact may occur (Lutz and Pendleton 2001). Damage to the substrate, and thus, mortality of squid eggs associated with purse seining for squid has not been quantified.

Along with anchovy and sardine, market squid are important as forage to a long list of fish and they serve as an important food source for many larger pelagic fish that are commercially and recreationally important, such as white seabass, California yellowtail, kelp bass, barred sand bass, California barracuda, California halibut, and other nearshore species. In Monterey Bay, 19 species of fish were found to feed upon market squid, including many commercially important species such as Pacific bonito, salmon, halibut, and tuna (Fields 1965; Morejohn, Harvey, and Krasnov 1978). It is not currently possible to estimate the total amount of CPS used as forage by finfish in the California Current ecosystem or the size of the CPS populations necessary to sustain predator populations. However, the CPSFMP along with the MSFMP contain the goal of providing adequate forage for dependent species and is implemented by harvest policies that reserve a portion of the biomass as forage for dependent species.

Table 3-8. Percent frequency of occurrence of observed market squid incidental catch by port area. A total of 2,402 port samples were taken between October 1998 and October 2003. Source: CDFG Port Sampling Data.

Common Name	**Total All Ports**	**Monterey Moss Landing**	**Santa Barbara Ventura**	**San Pedro Terminal Is.**
PACIFIC SARDINE	18.5	9.5	18.9	21.5
PACIFIC MACKEREL	6.9	2.3	6.0	9.7
NORTHERN ANCHOVY	5.0	3.9	4.0	6.2
JACK MACKEREL	4.0	6.7	0.1	6.6
MARKET SQUID EGGS	**3.2**	**8.3**	**1.7**	**2.3**
PACIFIC BUTTERFISH	2.0	4.4	1.8	1.0
BAT RAY	1.9	1.4	2.3	1.6
JACKSMELT	1.3	6.7	0.1	0.1
CALIFORNIA BARRACUDA	**0.9**		**1.0**	**1.1**
PACIFIC ELECTRIC RAY	0.9	4.9		
PELAGIC RED CRAB	0.9		2.0	0.1
DUNGENESS CRAB	0.7	3.9		
SANDDAB	0.6	2.1	0.4	0.2
SEA STAR	0.6	0.9	0.1	0.9
SCULPIN	0.6			1.4
HORN SHARK	0.4			0.9
TURBOT	0.4	1.9		
SOLE	0.4		0.6	0.3
CABEZON	0.3	0.2	0.1	0.6
ROCK CRAB	0.3		0.5	0.3
CHINOOK (KING) SALMON	**0.3**	**1.6**		
MEXICAN POMPANO	0.3		0.6	0.1
CALIFORNIA HALIBUT	0.3	0.5	0.1	0.4
RAY	0.3	0.2		0.6
MIDSHIPMAN	0.2	0.2		0.5
PACIFIC SANDDAB	0.2	0.7		0.3
BOCACCIO	**0.2**	**1.2**		
QUEENFISH	0.2		0.2	0.2
SMELT	0.2			0.4
WHITE CROAKER	0.2			0.4
PACIFIC SAURY	0.2	0.9		
FLYINGFISH	0.2		0.1	0.3
ROCKFISH	0.2	0.5	0.1	0.1
PACIFIC HERRING	0.2	0.9		
ENGLISH SOLE	0.2	0.7		0.1
MISCELLANEOUS FISH	0.2			0.4
CURLFIN TURBOT	0.1	0.5		0.1
MACKEREL UNCLASSIFIED	0.1	0.5	0.1	
OCTOPUS	0.1		0.2	0.1
SALEMA	0.1	0.7		
BLUE SHARK	0.1		0.2	
HORNYHEAD TURBOT	0.1			0.2

Table 3-8. Percent frequency of occurrence of observed market squid incidental catch by port area. A total of 2,402 port samples were taken between October 1998 and October 2003. Source: CDFG Port Sampling Data.

Common Name	Total All Ports	Monterey Moss Landing	Santa Barbara Ventura	San Pedro Terminal Is.
SPECKLED SANDDAB	0.1	0.2		0.1
SURFPERCH	0.1	0.5		
SEA URCHIN	0.1		0.2	
CALIFORNIA LIZARDFISH	0.1			0.2
SAND SOLE	0.1	0.5		
DIAMOND TURBOT	0.1			0.2
BARRED SAND BASS	0.1			0.2
BIGMOUTH SOLE	0.1			0.2
CALIFORNIA SPINY LOBSTER	0.0		0.1	
BLACKSMITH	0.0			0.1
GREENSPOTTED ROCKFISH	0.0		0.1	
BIG SKATE	0.0	0.2		
WAHOO	0.0			0.1
BLUE ROCKFISH	0.0	0.2		
YELLOWTAIL	**0.0**			**0.1**
SKATE	0.0		0.1	
SHRIMP UNCLASSIFIED	0.0			0.1
SHOVELNOSE GUITARFISH	0.0			0.1
SALMON	**0.0**	0.2		
Total Port Samples Taken	**2,402**	**415**	**988**	**999**

3.10.4 Market Squid *Loligo opalescens*

Market squid, *Loligo opalescens*, belong to the family Loliginidae. These squid are less than 1/8 inch at hatching and grow to have a mantle length of approximately 6 inches at the time of spawning. Squid use their fins for swimming and the funnel for extremely rapid "jet" propulsion forward or backward. The squid's capacity for sustained swimming allows it to migrate long distances as well as to move vertically through hundreds of meters of water in its daily feeding. This species is a terminal spawner; spawning occurs at the end of their lifespan, when spawning adults are targeted by commercial fisheries. Recent age and growth information suggests that maximum age is less than 1 year, and the average age of squid taken in the fishery is approximately 6 to 7 months. Refer to Section 1, Chapter 2 in the MSFMP for a more detailed description of market squid.

Market squid are the focus of the largest commercial fishery in California and are harvested commercially by targeting of spawning aggregations primarily off southern California and Monterey Bay, although some catch occurs throughout their range in other non-directed fisheries. Peak catches occur off southern California during the fall and winter and off central California during the late spring and summer. Though market squid are harvested near the surface and generally considered pelagic, they are actually found over the continental shelf from the surface to depths of at least 2,600 feet. They prefer oceanic salinities (Jefferts 1983). Adults and juveniles are most abundant between temperatures of 10°C and 16°C (Roper and Sweeney 1984). The California squid fishery accounts for most of the coast-wide landings; minor amounts of market squid are landed in Canada, Washington, and Oregon. The size of the Mexican fishery is unknown but is thought to be minor.

Genetic analyses have had limited success in distinguishing stocks within a fishery. Gilly et al. (2001) investigated genetic differences between the northern and southern squid fisheries. No temporal or spatial genetic differences for market squid were found within the southern California Bight. No temporal differences occurred between stocks in the Monterey area. Only slightly significant differences were observed between the Southern California and Monterey stocks, suggesting that market squid does not have 100 percent identity between the two fisheries. Additional genetic research is taking place, focusing on genetic differences at the extremes of the market squid range (Alaska and Baja California) before looking for differences within the range (Monterey and the Channel Islands). Thus, the number of market squid stocks or subpopulations along the Pacific Coast is unknown at this time.

Spawning market squid tend to congregate in dense schools, usually over sandy habitats where they deposit extensive egg masses. In central California, spawning activity starts around April and ends around October, while in southern California, spawning activity starts around October and ends in April or May. During some years, however, reproductive activity and landings may occur throughout most of the year. Year-round spawning in several areas statewide at different times of year likely reduces the effects of poor local conditions on survival of eggs or hatchlings, and suggests that stock abundance is not solely dependent on availability of squid in a single spawning area. Females attach each egg capsule individually to the bottom. As spawning continues, mounds of egg capsules covering more than 100 square meters may be formed, appearing to carpet the sandy substrate. It is well established that market squid die after completing their first and only spawning period (McGowan 1954, Fields 1965) but the duration of the spawning period is unknown.

The best information available indicates that squid endure very high natural mortality rates and the adult population is composed almost entirely of new recruits. No spawner-recruit relationship has been demonstrated. These observations suggest that the entire stock is replaced annually, even in the absence of fishing. Thus, the stock is entirely dependent on successful spawning each year coupled with good survival of recruits to adulthood. Full recruitment of market squid into the fishery occurs at an average age of 6 months.

Market squid are an integral part of the food web to many marine vertebrates. Fish, sea turtles, seabirds, and marine mammals all utilize the availability of squid as a prey item. In Monterey Bay, 19 species of fish were found to feed upon market squid, including many commercially important species such as Pacific bonito, salmon, halibut, and tuna (Fields 1965; Morejohn, Harvey, and Krasnov 1978). Market squid are used as bait in some of these commercial fisheries – they are the primary invertebrate bait for commercial and recreational fishermen of adult white seabass in California west coast waters (WSFMP 2002). Seabirds such as the sooty shearwater, rhinoceros auklet, short-tailed shearwater, common murre, and the kittiwake all feed on market squid, and it is the primary prey item in the diet of harbor porpoises in Monterey Bay (Lowry and Caretta 1999). Squid also factors into the diets of the sea otter, elephant seal, northern fur seal, California sea lion (Lowry and Caretta 1999), Dall's porpoise, Pacific striped dolphin, short-finned pilot whale (Hacker 1992), Risso's dolphin (Kruse et al. 1990), offshore bottlenose dolphins (Drumm 2000), Pacific white-sided and common dolphins (Leatherwood and Reeves 1983), and the sperm whale and bottlenose whale (Fields 1965).

Just as availability of prey affects squid foraging, the changing abundance of squid affects potential predators. Short-finned pilot whales, blue sharks, and Pacific bonito all increase their consumption of market squid during spawning season. When short-finned pilot whales were common in the SCB near Santa Catalina Island they moved inshore as spawning season began (Miller et al. 1983, Dohl et al. 1980). Blue sharks near Santa Catalina Island (Tricas 1978) may move inshore as spawning season begins, while Pacific bonito consumption of squid is influenced by the shoaling behavior of squid spawning in nearshore waters of southern California (Oliphant 1971).

Socioeconomic Environment

3.11 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 2020 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. However, Del Norte, Humboldt, and Mendocino counties have the lowest population density of the coastal counties - approximately 1 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 industries. Native American land use is 67 percent in the coastal zone of Humboldt County and 89.6 percent in Mendocino County (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 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 away from agriculture, resulting in a more urbanized population. 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".

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 9 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).

3.12 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 boats. The major ports in 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 to 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 vessel 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.

3.13 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 noise levels, although such sources are transitory. In addition, commercial vessels and tankers moving up and down the west coast also contribute noise 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. 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 4 minutes before passing, for 38 seconds at 3 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, seal bombs, 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).

3.14 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 SWRCB 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.

3.15 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 5 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 CSLC 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 which sank off Crescent City and the Persephone which sank off Point Arguello. The MMS baseline study for northern California, Oregon, and Washington identified a total of 3,850 shipwrecks from Morro Bay north to the Canadian border. The baseline study for southern California identified a total of 916 shipwrecks 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 en route 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 activity, 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).