3 AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

The Channel Islands and surrounding ecosystems are unique and highly valued, as demonstrated by, for example, several national and international designations. In 1980 the United States designated both the Channel Islands National Marine Sanctuary, and the Channel Islands National Park. In addition, the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Man and the Biosphere Program designated the Sanctuary as a Biosphere Reserve in 1986. This area is characterized by a unique combination of features including: complex oceanography, varied bathymetry, diverse habitats, remarkable biodiversity, rich maritime heritage, remote yet accessible location, and relative lack of development. These features yield high existence values as well as human use values for research, education, recreation, and commerce.

This section defines the CINMS Management Plan Update Study Area, and describes the affected environment within that Study Area in five sub-sections:

- 3.1 Marine Ecosystems introduces the basic concept of a marine ecosystem, which provides context for the remaining four sub-sections;
- 3.2 Physical Environment describes the geology, oceanography, and meteorology within the Study Area;
- 3.3 Biological Environment describes the Study Area in terms of bioregions, biotic communities, coastal watersheds, and coastal processes, as well as select relevant regulatory information;
- 3.4 Maritime Heritage Resources describes the cultural and historic components of maritime heritage resources in the Sanctuary and Study Area;
- 3.5 Human Uses describes activities that occur within the Study Area, such as those pertaining to: oil and gas, fiber optic telecommunications cables, vessel traffic and harbors, contaminant sources, introduction of introduced species, fishing, marine bioprospecting, nonconsumptive recreation and tourism, Department of Defense activities, and research and education, along with select relevant regulatory information.

The Study Area, within which the current CINMS boundary lies, is shown in Figure 1.2-2. The Study Area begins on the coast north of Point Sal, at 33.00 degrees north (N) latitude, 120.64 degrees west (W) longitude. The Study Area then takes the following progression:

- West to 35.00 degrees N, 121.17 degrees W;
- South to 34.33 degrees N, 121.17 degrees W;
- East to 34.33 degrees N, 120.67 degrees W;
- South to 33.67 degrees N, 120.67 degrees W;
- East to 33.67 degrees N, 119.17 degrees W;
- South to 33.33 degrees N, 119.17 degrees W;

- East to 33.33 degrees N, 118.83 degrees W; and
- North to 34.02 degrees N, 118.83 degrees W.

Within the Study Area the Sanctuary consists of an area of approximately 1243 square nautical miles (NM) of coastal and ocean waters, and the submerged lands thereunder, off the southern coast of California. The Sanctuary boundary begins at the Mean High Water Line of and extends seaward to a distance of approximately six NM from the following islands and offshore rocks: San Miguel Island, Santa Cruz Island, Santa Rosa Island, Anacapa Island, Santa Barbara Island, Richardson Rock, and Castle Rock (the Islands). While the proposed regulatory changes pertain to the current CINMS boundary, outside influences within the Study Area are also discussed to provide the background necessary to understand the relationship between the dynamics of the marine environment and successful management of the CINMS.

Additional information about biological and maritime heritage resources can be found at Appendix C. Also, a comprehensive source of information about the physical environment, habitats, invertebrtates, marine plants, fish, seabirds, marine mammals, and other resources found within the CINMS is found in *Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary – Final Environmental Document* (2002), available on line at http://www.dfg.ca.gov/mrd/ci_ceqa/index.html.

3.1 MARINE ECOSYSTEMS

3.1.1 Introduction

The NMSA at 16 U.S.C. 1431(a)(3) states that "while the need to control the effects of particular activities has led to enactment of resource-specific legislation, these laws cannot in all cases provide a coordinated and comprehensive approach to the conservation and management of the marine environment". As a consequence, one of the management priorities for the CINMS is "to maintain the natural biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes" (16 U.S.C. 1431(b)(3)). This management priority requires a broad and comprehensive approach to resource protection. Such an approach brings a focus on large-scale, ecosystem level protection and management, which is unique *vis-à-vis* the various agencies and laws directed at managing single or limited numbers of species or specific human activities within the ocean.

An "ecosystem" is commonly defined as "a unit of land or water comprising populations or organisms considered together with their physical environment and the interacting processes between them" (U.S Navy 2000). Marine ecosystem management is sensitive to the spatial occurrence, form, dynamic nature, and extent of biophysical processes and human activities and uses that affect marine life. Overall, marine ecosystems include ecological links and relationships between oceanographic processes, such as currents and eddies, and biology and climate-related factors (McGinnis 2000).

3.2 PHYSICAL ENVIRONMENT

The CINMS and Study Area lie within the northern portion of the southern California bight (SCB). The SCB is formed by a physically defined transition in the California coastline wherein the north-south trending coast begins to trend east-west. The SCB extends from Point Conception, California, to Punta Banda, south of Ensenada, Baja California, Mexico (Dailey *et al.* 1993).

3.2.1 Geology/Oceanography

The geologic resources of an area consist of formational, depositional, and volcanic rocks and the soil derived from these sources. Geologic resources can also include unique landforms, tectonic features, and fossils. In coastal and marine settings, sediments are considered a part of the geologic resources of the area. These geologic features can have economic, scientific, and recreational value.

Figure 3.2-1 shows the geologic features of the Study Area. The four Northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) parallel the east-west trend of the coast and vary from about 13 to 25 miles offshore. Santa Barbara Island lies about 40 miles south of Point Mugu, California. These islands are all located within a unique oceanographic region known as the Continental Borderland (Norris and Webb 1990).

The Continental Borderland is the section of offshore California between Point Conception and Punta Banda in Baja California (Mexico). Continued large-scale overriding of the North American Plate by the Pacific Plate in southern California caused movement along the San Andreas Fault System (Dailey *et al.* 1993). The Continental Borderland, with its wide shelf and series of laterally shifted blocks, resulted from this movement. It extends seaward for up to 300 miles (Dailey *et al.* 1993). Unlike most wide continental shelves that consist of gently sloping platforms interrupted by low banks and occasional canyons, the Continental Borderland is a region of basins and elevated ridges. The Channel Islands are the portions of the ridges that rise above sea level. The highest point in the Channel Islands is Picacho Diablo on Santa Cruz Island, with an elevation of 2,450 feet (747 meters).

Basin and trough slopes account for 63 percent (19,210 square miles) of the borderlands area (Norris and Webb 1990). Basin and trough floors represent 17 percent of the total area (5,120 square miles), while the islands comprise only 1.1 percent of the total area (340 square miles). The Santa Barbara Basin, oriented east-west in parallel with the coastline and the islands, lies between the islands and the mainland, and is approximately 1,650 feet (500 meters) deep. The remaining basins trend northwest. The basins nearest the mainland are the shallowest and have the flattest floors and thickest sediment fill. The northwest-trending basins range in depth from 1,650 to 8,250 feet (500 to 2,500 meters). The seaward edge of the Continental Borderland is the Patton Escarpment, a true continental slope that descends 13,200 feet (4,000 meters) to the deep ocean floor (Norris and Webb 1990). Figure 3.2-1 shows the bathymetry of the Study Area.

There are at least 32 submarine canyons in the Continental Borderland. Along the mainland coast, there are six prominent canyons thought to be related to the modern shoreline. Other coastal canyons appear to be related to the shoreline and lower sea levels during the Ice Age that ended approximately 12,000 years ago (Norris and Webb 1990). There are also canyons cut into offshore basins in the region (Dailey *et al.* 1993).

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SOUNDINGS IN FATHOMS

18720 LORAN-C OVERPRINTED

UNITED STATES - WEST COAST
CALIFORNIA

POINT DUME TO PURISMA POINT

SOUNDINGS IN FATHOMS AT MEAN LOWER LOW WATER

LORAN LINEAR INTERPOLATOR

Not For Navigational Use

SANTA BARBARA CHANNEL

PACIFIC OCEAN

SOUNDINGS IN FATHOMS

(Point Dume to Purisima Point)

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CINMS EIS STUDY AREA
GEOLOGIC FEATURES AND
BATHYMETRY

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3.2.1.1 Sediment Transport

Sediments deposited in the offshore region include sand, silt, clay, and biogenic particulates (aggregates of planktonic origin) (Dailey *et al.* 1993). Sand, silt, and clay are discharged by rivers during the winter rainy season. Waves carry the sand in shallow suspension along the shore within the beach and inshore zone. Periodic strong storms produce long period swells and turbulence, which move the sand offshore to the inner and central shelf. Nearshore submarine canyons intercept much of the transported sand. Lack of turbulence in these deeper waters prevents these sediments from being re-suspended and silt and clay slowly settle out as the water circulates through a general pattern. The pattern of surface water circulation in the Channel Islands region tends to move fine suspended sediment into the Santa Barbara Basin from the California Current System to the west and through the Anacapa Passage to the southeast. As a result, the rate of silt and clay deposition in the Santa Barbara Basin is high (Dailey *et al.* 1993). Biogenic particulates represent 20 percent of the borderland sediments (Dailey *et al.* 1993). Unlike the sediments discharged seasonally by rivers, the biogenic particulates are produced continually, although seasonal blooms of algae increase their rate of production. Borderland sediments also include carbonate, opaline silica, and other organically derived matter (Dailey *et al.* 1993). A thick blanket of this sediment covers most of the borderland (Norris and Webb 1990).

The morphology of the SCB includes 12 major offshore basins. All of the basins are completely enclosed at some depth and semi-enclosed at shallower depths. Thus the region includes time-variable circulations characteristic of enclosed basins as well as fluctuating flows over the sills between the basins (Dailey *et al.* 1993).

The central bottom waters of the Santa Barbara Basin are anoxic, or oxygen depleted, meaning the concentration of dissolved oxygen in the water is less than 0.1 milliliter per liter (ml/L) (Dailey *et al.* 1993). The bottom waters entering the basin over the western sill (on the west end of the Santa Barbara Basin) also have a low oxygen content. In addition, organic carbon content increases with the increase of clay. As the organic material decays, it consumes oxygen faster than it can be replaced. Oxygen availability is the major factor controlling benthic communities in the Santa Barbara Basin. Anoxic central basin bottom waters are considered to be the source conditions for petroleum generation. In the geologic past, similar environments formed the oil-bearing black shales found extensively in both ocean floor and continental stratigraphies (Dailey *et al.* 1993).

3.2.1.2 Geologic Structure

The basins and ridges of the Continental Borderland are believed to have been formed by large-scale synclinal (strata bending upward away from the bed) and anticlinal (strata bending downward away from the crest) folding (Norris and Webb 1990). Some of the ridges, such as the Santa Rosa-Cortes Ridge, appear to be antiforms, or anticline-like structures in which the stratigraphic sequence is not known (Norris and Webb 1990). The four northern Channel Islands form an east-west mountain chain along the southwest border of the Transverse Ranges physiographic province (Weigand *et al.* 1994). The island chain appears to be a highly faulted, east-west trending anticlinorium (Weaver *et al.* 1969). The Transverse Ranges are unusual because of their topography, and the faults and folds that produce them, are oriented east-west. Within the last 17 million years, the Transverse Ranges rotated clockwise 90 degrees or more, to arrive in their unique orientation (Sorlien 1994). A thin sheet of upper-plate western Transverse Range crust separated from the northwest-southeast trending Peninsular Ranges that run from southern California south to Mexico, and was transported above sub-horizontal detachment faults (Sorlien 1994). Santa Rosa and Santa Cruz Islands are at the end of this rotating sheet, and were located west of San Diego before the rotation began. There is evidence that the rotation is still continuing (Sorlien 1994).

There are about 30 principal, east-west trending faults in the Channel Islands area (Norris and Webb 1990). Santa Cruz Island and Santa Rosa Island are both bisected by east-west trending faults that continue offshore. These two faults interconnect with the southern frontal faults of the western Transverse Ranges further east, such as the Dume, Malibu Coast, and Santa Monica faults, and form a part of a 200-kilometer-long fault system extending from Pasadena to San Miguel Island. The Channel Islands Fault Zone, a major fault system, lies beneath the Santa Barbara Channel north of Santa Cruz Island (Sorlien 1994).

3.2.1.3 Rocks

The oldest rocks in the region are metamorphic rocks of the Jurassic period (208 to 144 million years ago). These include the Santa Monica slate and the Santa Cruz Island schist. Rocks of the Franciscan subduction complex are also thought to underlie the Continental Borderland (Norris and Webb 1990). The late Jurassic to early Cretaceous Franciscan complex includes greenish-gray graywacke (sandstones), shales, chert, limestone, and fragments of ophiolite sequences. The basement rocks in the region are overlain by sedimentary Cretaceous and Cenozoic age rocks (Paleocene, Eocene, and Miocene). San Miguel Island has outcrops of late Cretaceous marine sandstone and shale. Paleocene marine sandstone occurs on Santa Cruz and San Miguel Islands. Eocene rocks are found on southwestern Santa Cruz Island, Santa Rosa Island, and San Miguel Island. The Miocene rocks are the youngest (23.5 to 5 million years old) rocks in the region and they are exposed on all four of the northern Channel Islands.

Miocene age rocks include the Monterey formation, the San Onofre breccia, and various volcanics. The Monterey formation is composed of deep-water, diatomaceous, dolomitic, and cherty shales, and often contains pockets of bituminous material. The Monterey formation is an important reservoir for gas and oil. The San Onofre breccia is a coarse-grained breccia and conglomerate with prominent clasts of blue glaucophane schist, green schist, gabbro, and limestone. Miocene volcanics include andesitic, diabasic, and basaltic flow, sills, and dikes, many of submarine origin (Norris and Webb 1990). Marine and non-marine terrace deposits of Pleistocene age (1.8 million to 10,000 years old) and younger overlie the Miocene rocks on the Channel Islands (Norris and Webb 1990). San Miguel and Santa Cruz Islands have locally thick marine terrace deposits.

3.2.1.4 Oil and Natural Gas

There are numerous naturally occurring oil and gas seeps in the Santa Barbara Channel (Norris and Webb 1990; Washburn and Clark 1998). The rate of oil seepage from the South Ellwood anticline, located about 3 kilometers offshore in the Santa Barbara Channel, is one of the highest in the world. The seeps are a major source of marine pollution because the oil they release accumulates in large slicks. Ongoing research conducted by the Minerals Management Service (MMS) suggests that 6 tons of oil and 24 tons of hydrocarbon gases are released per day from the South Ellwood anticline (Washburn and Clark 1998). This natural seep releases more hydrocarbon gases than all of the mobile sources (mostly automobiles) in Santa Barbara County. Plumes of dissolved hydrocarbons are transported westward with prevailing currents, including the California Current system, which carries them for hundreds of kilometers (Washburn and Clark 1998).

More than 20 oil fields and several natural gas fields lie beneath the Santa Barbara Channel. Most are close to the mainland, and several are accessed from offshore platforms (Norris and Webb 1990). The first offshore oil field developed in North America was the Summerland field, discovered in 1896. The Dos Cuadras field, a major field by American standards, lies only 1,000 feet (300 meters) below the sea floor southeast of the city of Santa Barbara (Norris and Webb 1990). This field was the source of the extensive Santa Barbara oil spill in 1969. Other oil fields beneath the channel include the Coal Oil Point,

Ellwood Offshore, and Hondo Offshore fields. Just north of Point Conception, the Point Arguello field was discovered in 1981. This major oil field may ultimately recover over 200 million barrels of oil.

The majority of oil and gas development in Southern California between the 1960s through the 1990s took place off the coast of Santa Barbara County. Much of that activity occurred in the Santa Barbara Channel (Norris and Webb 1990).

3.2.2 Meteorology

The Study Area has a Mediterranean climate characterized by mild winters, when most rainfall occurs, and warm, dry summers. The regional climate is dominated by a strong and persistent high pressure system that frequently lies off the Pacific coast (generally referred to as the Pacific High). The Pacific High shifts northward or southward in response to seasonal changes or the presence of cyclonic storms. In its usual position to the west of Santa Barbara County, the Pacific High produces an elevated temperature inversion. Coastal areas are characterized by early morning southeast winds, which generally shift to northwest later in the day. Transport of cool, humid marine air onshore by these northwest winds causes frequent fog and low clouds near the coast, particularly during night and morning hours in the late spring and early summer months.

The most important climatic and meteorological characteristics influencing air quality in the Study Area are the relatively consistent temperature, predominance of onshore winds, topography, and solar irradiance.

3.2.2.1 Wind and Topography

Topography plays a significant role in direction and speed of winds in the Study Area. During the day, the sea breeze (from sea to land) is dominant. The sea breeze is typically northwesterly throughout the year although local topography causes variations in this pattern. During summer months, these northwesterly winds are stronger and persist later into the night. Wind direction reverses in the evening as the air mass over land cools, becomes heavier, and flows down the coastal mountains and mountain valleys back toward the ocean as land breezes (from land to sea). This diurnal “sloshing” can aggravate pollution problems by continually moving the same air mass over pollution sources. This effect is more pronounced during periods when wind speeds and turbulent mixing are low.

The terrain around Point Conception, combined with the change in orientation of the coastline from north-south to east-west, can cause counterclockwise circulation (eddies) to form east of the point. These eddies fluctuate from time to time and place to place, leading to highly variable winds along the southern coastal strip. Point Conception also marks the change in the prevailing surface winds from northwesterly to southwesterly.

In addition to topography, several other factors also affect winds in the Study Area. During the fall and winter months, the region is subject to Santa Ana winds, which are warm, dry, strong, and gusty winds that blow northeasterly from the inland desert basins through the mountain valleys and out to sea. Wind speeds associated with Santa Ana conditions are generally 15 to 20 miles per hour (mph) although they can reach speeds in excess of 60 mph. "Sundowner" winds are a local phenomenon on the coastal strip below the canyons. Similar to Santa Ana conditions, warm, gusty winds blow sometimes with great intensity down canyons toward the sea. However, these winds are local and are caused by land-sea and diurnal temperature variations. Elevation may also affect wind patterns. The winds at 1,000 feet and 3,000 feet are generally from the north or northwest. Southerly and easterly winds occur frequently in winter and occasionally in the summer.

3.2.2.2 Sunlight

Fog occurs along the coast and in inland valleys from late spring to mid-summer and cloudy conditions occur during winter storms. Since sunlight is the driver of the photochemical reactions that produce ozone and other photochemicals, the prevalence of sunlight is yet another contributor to photochemical smog.

3.2.2.3 Air Quality

Atmospheric stability is a primary factor affecting air quality. Atmospheric stability regulates the amount of air exchange (referred to as mixing) both horizontally and vertically. Restricted mixing (that is, a high degree of stability) and low wind speeds are generally associated with higher pollutant concentrations. These conditions are typically related to temperature inversions that cap the pollutants emitted below or within them. An inversion is characterized by a layer of warmer air above the cooler air mass near the ground, preventing pollutants in the lower air mass from dispersing upward beyond the inversion "lid." This results in higher concentration of pollutants trapped below the inversion.

The airflow around the Study Area plays an important role in exacerbating the movement of pollutants. Wind speeds typical of the region are generally light, another factor that tends to cause higher levels of pollution, since low wind speeds minimize dispersion of pollutants.

During Santa Ana conditions, pollutants emitted in Santa Barbara, Ventura County, and the South Coast Air Basin (SCAB, which includes the Los Angeles region) are moved out to sea. These pollutants can then move back onshore to Santa Barbara County (via the Santa Barbara Channel) in what is called a "post Santa Ana condition." They may also become entrained in offshore winds and get transported farther south before coming onshore.

3.2.3 Physical Oceanography

The south-flowing California Current and the north-flowing Southern California Countercurrent (Figure 3.2-2) dominate the mean water circulation in the SCB (Dailey *et al.* 1993). In the Study Area, currents in the Santa Barbara Channel include patterns of warm water from the Southern California Countercurrent and cold water from the California Current. Upwelling often occurs where these currents meet, near the massive headlands of Point Arguello and Point Conception, as well as along much of the California coast, depending on the season. Oceanographic thermal fronts are abundant in the Santa Barbara Channel and form as a consequence of upwelling and of current shear between the two primary currents (Harms and Winant 1998). Near Point Conception, the continental shelf is broad and deflects the south-flowing California Current offshore of the SCB and along the shores of the northern Channel Islands (Brink and Muench 1986).

3.2.3.1 Offshore Ocean Currents

Offshore circulation in the Study Area is a dynamic system resulting from the interaction of large-scale ocean currents, local geography, and the unique basin and ridge topography of the ocean bottom in the SCB. The California Current is the major ocean current moving through the Study Area (Figure 3.2-2). Year-round, this current brings cold, fresh water from the Gulf of Alaska southward down the coast of California. At Point Conception, where the coastline turns east, the California Current moves further offshore as it continues its southward flow. Near the United States-Mexico border the California Current turns east and then north, and flows back up along the coast and into the Santa Barbara Channel. This directional shift creates a large eddy known as the Southern California Countercurrent or the Southern

California Eddy (Hickey 2000a). The Southern California Countercurrent moves warm water from southern California northwestward up the coast (Hickey 2000b) At the eastern end of the Channel Islands, the Southern California Countercurrent separates into two parts. One part flows northwestward through the Santa Barbara Channel. The other part flows westward south of the Channel Islands (Hickey Basin Exchange). The California Current and Southern California Countercurrent are both strongest in the summer (Hickey 1993). During the spring, the countercurrent disappears, and surface flow throughout the SCB tends to be southward (Hickey 1993).

Upwelling currents also influence circulation in the Study Area. These currents are the result of prevailing winds and the orientation of the coastline. Due to a process called Ekman transport, wind blowing over water in the northern hemisphere moves the surface water about 45 degrees to the right of the wind direction. Where the wind pushes surface water away from a coastline, deeper water moves up toward the surface to take its place, creating an upwelling current. Along the north-south oriented coast of California, winds blowing from the north move surface water westward, away from the coastline, and create upwelling currents that bring colder water to the surface (San Francisco State University 2000). At Point Conception, where the coastline makes an almost right-angle bend to the east, upwelling essentially ceases. Upwelling is rare along the mainland coast of the Santa Barbara Channel because the headlands at Point Conception shelter the east-west oriented channel from the strong northwesterly winds that generate upwelling (Love *et al.* 1999). Point Conception is the last major upwelling center on the west coast of the United States, and marks a transition zone between cool surface waters to the north and warm waters to the south (Love *et al.* 1999). However, upwelled water from regions north of the SCB appears to enter the western end of the Santa Barbara Channel and move eastward along its southern boundary (Hickey 2000a).

Within the Santa Barbara Channel, a localized cyclonic gyre exists year-round (Hendershott and Winant 1996) with seasonal variations in intensity. In general, cool water enters the Channel from the west and flows eastward along the Channel Islands while warm water enters the Channel from the east and flows westward along the coast. Winant and Harms (2000) identify six distinct patterns; Upwelling, Relaxation, Cyclonic, Propagating Cyclones, Flood East, and Flood West. In the Upwelling pattern, there is a strong south and southeastward flow of cool water from Point Conception and along the north sides of the Channel Islands; a weak warm water current flows toward the northwest along the mainland. In the Relaxation pattern, there is a strong northwestward flow of warm water into the Channel from the east, and a weak inflow of cold water from the west. The Cyclonic pattern is an elongated, closed pattern created when the central eddy is strongest, and there is little flow into the channel from either the west or the east. In the Propagating Cyclones pattern, small, tight circular flow cells form in the center of the Channel and drift toward the west. These four patterns form in spring, summer, and fall, but the cyclonicity is strongest in summer and weakest in winter. In the winter, directional flow patterns form. The winter Flood East pattern consists of a strong eastward flow into the Channel along the coastline, and lesser eastward inflow along the Channel Islands. The winter Flood West pattern has a strong northwestward flow along the coast, and a weaker northwest flow along the islands.

Two opposing forces generate the cyclonic flow patterns: a poleward pressure gradient and an equatorward wind stress (Nishimoto and Washburn 2002). In the warm waters of the SCB, sea level is higher than in the cold, upwelled waters north of Point Conception. This difference in sea level creates a poleward pressure gradient that draws water westward through the channel. Upwelling-favorable winds tend to drive strong eastward flow, opposing the westward pressure gradient. When the effect of wind equals that of the pressure gradient, the cyclonic flow patterns form. Imbalances in the two competing forces create the pattern variations described above.

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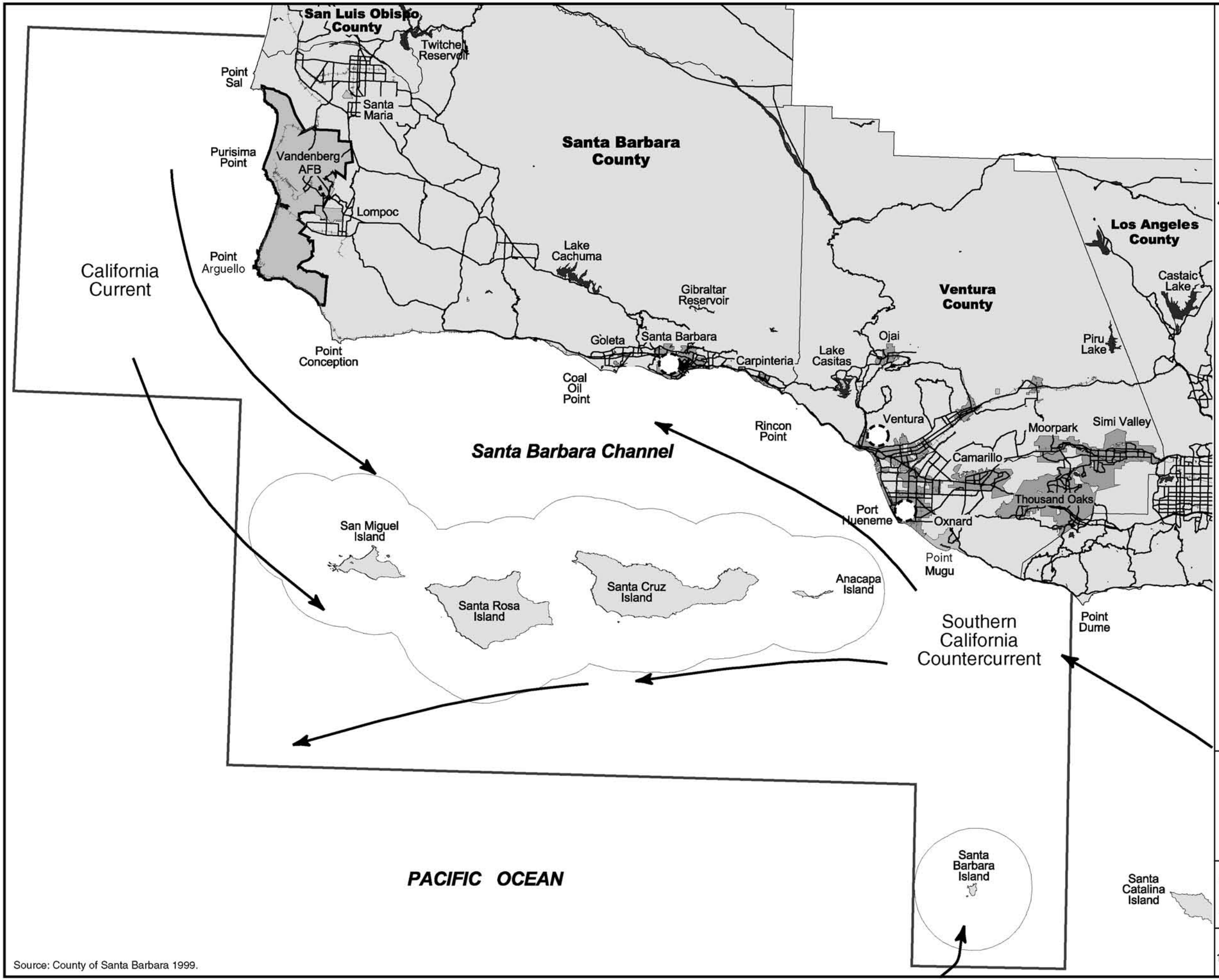

Source: County of Santa Barbara 1999.

CINMS EIS STUDY AREA
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Nishimoto and Washburn (2002) found that the eddy circulation in the Santa Barbara Channel extended to depths of at least 650 feet (200 meters), or nearly half the total channel depth, and suggest that persistent cyclonic eddies play an important role in maintaining marine populations through climate changes. Cold water uplifted in the center of the eddy may provide an additional source of nutrients during a shift to a warm-water regime, increasing primary productivity and the amount of food available for fish. Nishimoto and Washburn (2002) found large aggregations of juvenile fishes concentrated in an eddy in the Santa Barbara Channel. The researchers suggest that high food availability and feeding success contributed to faster growth and higher survivorship of these fishes. Nishimoto and Washburn (2002) note that the fishes were entrained in the eddy current in their larval stages and remained there until they passed the juvenile stage, when they grew strong enough to escape the circulating current.

Hickey (2000a) found that the sediments in ocean basins of the SCB are near anoxic to anoxic, and that the anoxic area is increasing. Expansion of the anoxic areas reduces the ability of the basin sediments to support marine life. The high ridges between the basins essentially prevent influx of oxygen-bearing water into the basins, which is important for maintaining oxygen levels within the basins. The events that bring oxygen to the basins are associated with processes in the upper water column above the basin. Strong upwelling and southeastward flow from the Santa Barbara Channel into the Santa Monica Basin appear to drive cold, denser water over the ridges into the basins, where it mixes with the ambient water confined within the basins. Influxes of oxygen-bearing cold water to the basins occur only for a few days at a time, after intervals of several years (Hickey 2000a). An intense coastal upwelling event off Point Conception can cause rapid renewal of the water in this basin. Within the last 40 years, water in the Santa Barbara Channel has overturned several times (Hickey 1993).

3.2.3.2 Waves

Waves in the Santa Barbara Channel are produced by seasonal swells crossing the open ocean, the sheltering effect of Point Conception and the Channel Islands, the variable wind fields arising from the mountainous coastal and island topography, and the complex shallow water bathymetry within the Channel (O'Reilly *et al.* 2000).

Deep water swells from winter storms typically enter the channel from the west or west-southwest, for the most part unbroken by the Channel Islands. West swells produce high waves along the south-facing coastline just south of Point Conception and at the eastern end of the Channel south of Ventura. A massive fan of sediment deposited on the shelf by the Ventura and Santa Clara rivers concentrates much of the wave energy traveling eastward down the channel onto a narrow section of coastline near the Santa Clara River mouth (O'Reilly *et al.* 2000). When the deep water swell originates more from the west-southwest, this focusing zone shifts directly northward into the Ventura area. West swells can also produce large waves at Rincon Point west of Ventura. Wave heights increase along portions of the Channel Islands that border the south side of the Channel (O'Reilly *et al.* 2000). On the north side of Santa Cruz Island, the large extent of sheer coastal cliffs that drop straight into water depths of 33 feet (10 meters) or more are a good wave reflector.

In the summer, deep water swells originate in the south Pacific, and encounter the Channel Islands as they move north toward California. The islands shelter most of the channel and the south-facing coast from summer swells, significantly limiting wave heights. South swells from storms near New Zealand enter the western end of the channel while those originating further east near South America are almost entirely obstructed. South swells travel past Anacapa Island and reach the coast near Ventura and Rincon Point. Rare swells originating from the southeast can reach the coast at Santa Barbara (O'Reilly *et al.* 2000).

3.2.3.3 Water Temperature

Much of the uniqueness of the SCB and the adjacent marine environment north to Point Sal is due to the mixing of water masses from the south-flowing cold California Current and the north-flowing warm Southern California Countercurrent. These complex water movements result in differential temperature, nutrient, and larval recruitment conditions among the islands and along the coast north and south of Point Conception. In addition, prevailing winds periodically push surface water offshore from the Point Conception area, causing upwelling of cold, nutrient-rich water that bathes the northwestern islands, but rarely reaches the southeastern islands. It is difficult to separate the effects of temperature, nutrients, and larval drift on the distribution and abundance of marine life in the Study Area. Because the oceanographic influences typically vary, temperature is the easiest parameter to measure, and temperature clearly has major effects on marine life; it has become the standard means for characterizing northern (Oregonian) versus southern (Californian) biotic assemblages.

Broad-scale sea surface temperatures (SST) obtained from satellite infrared photographs (with ground truth from oceanographic data buoys) provide the best long-term records of concurrent temperature regimes throughout the Study Area. Depending on the depth, season, and particular location, surface temperatures may differ considerably from subsurface values, yet SST do reflect reasonably consistent general temperature relationships (Bernstein *et al.* 1977; List and Koh 1976). Water temperature regimes for nearshore habitats are not completely known. Specific data are available for particular locations, depths, and times. For example, CINP, the Tatman Foundation Channel Islands Research Program, and the University of California, Santa Barbara's Partnership for Interdisciplinary Study of Coastal Oceans (PISCO) Program have had intertidal and subtidal thermisters in place at specific locations in recent years. However, deepwater temperature data are primarily available from periodic California Cooperative Oceanic Fisheries Investigation (CalCOFI) cruises.

Mean monthly SST for each of the Channel Islands, as well as at Point Conception and Los Coronados Islands (near San Diego), for the 18-year period from 1982 to 1999 reveal characteristic trends that confirm the transitional nature of this special biogeographic region (Figure 3.2-3). All ten locations show a generally similar pattern of seasonal fluctuations, with lowest SST from January to March (except for Santa Rosa and San Miguel Islands and Point Conception, where upwelled water flowing southeast from Point Conception causes low SST also in April and May) and highest SST from July to October. Except for the Santa Catalina/San Clemente and San Nicolas/Anacapa island pairs, the locations have consistently separate temperature regimes. North/south SST differences are greatest in August (5.0 degrees Celsius [C]) and least in January (1.6 degrees C). Overall, there is a clear southeast to northwest trend of decreasing surface water temperatures for the 10 representative locations that correlates well with differences in species assemblages (Engle 1994; Murray *et al.* 1980; Murray and Bray 1993; Seapy and Littler 1980; Thompson *et al.* 1993). The warmest areas are Los Coronados (San Diego), Santa Catalina, San Clemente, and Santa Barbara Islands. San Nicolas, Anacapa, and Santa Cruz Islands are intermediate. The coldest regions are Santa Rosa, San Miguel, and Point Conception. If areas north of Point Conception were plotted, they would show incrementally colder temperatures.

The extent to which cold water enters the Santa Barbara Channel is variable (Harms and Winant 1998). In general, while the cold-water mass surrounds the north shores of San Miguel and Santa Rosa Islands, the north shore of Santa Cruz Island is alternately surrounded by the cold-water and warm-water masses. If upwelling is intense, the cold-water mass can reach the north side of Santa Cruz Island and will intrude into the pass between Santa Rosa and Santa Cruz Islands.

Temperature-related oceanographic phenomena influencing marine life at the islands vary considerably over time scales ranging from minutes to decades or more. Many organisms are adapted to withstand

typical short-term fluctuations; however, seasonal or longer trends may kill sensitive species or enhance survival of tolerant species, resulting in profound community effects (Tegner and Dayton 1987; Dayton *et al.* 1992). For long-term perspective, daily surface water temperature records taken at the Scripps Institution of Oceanography pier (La Jolla) since 1920 (the longest consistent data available) reveal remarkable long-term trends that likely occurred in similar fashion in the Study Area (Figure 3.2-4). Notably, the 32-year period from 1944 to 1975 was characterized by cooler than average temperatures, except for the 1957 to 1959 El Niño years. In contrast, the 23-year period from 1976 to 1998 has been warmer than the 78-year mean, with a few minor exceptions. This recent multi-decade, warm-water trend helps explain key community changes documented at the Channel Islands during the 1980s and 1990s, including increased numbers of southern species at the northwestern islands, "disease" epidemics, other die-offs, and sea urchin overgrazing phenomena. The peak 1997–1998 El Niño was immediately followed by cold La Niña conditions in 1999. Only time will tell if this marks the start of a cold-water cycle or is just an aberration in the long warm-water period. El Niño, La Niña and temperature regime shifts are discussed next.

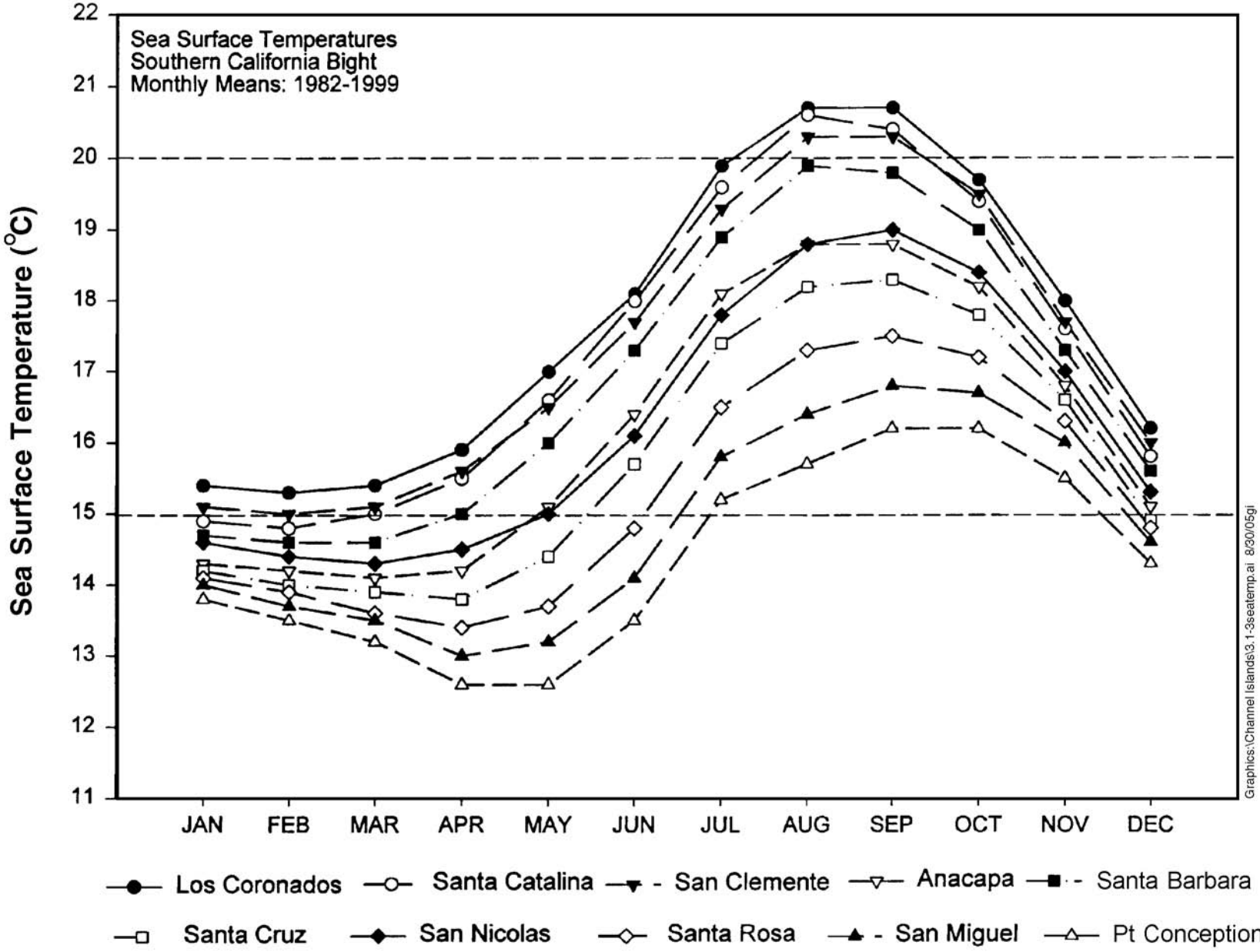

Figure 3.2-3

CINMS STUDY AREA EIS
MONTHLY MEAN SEA SURFACE TEMPERATURE IN THE SOUTHERN CALIFORNIA BIGHT

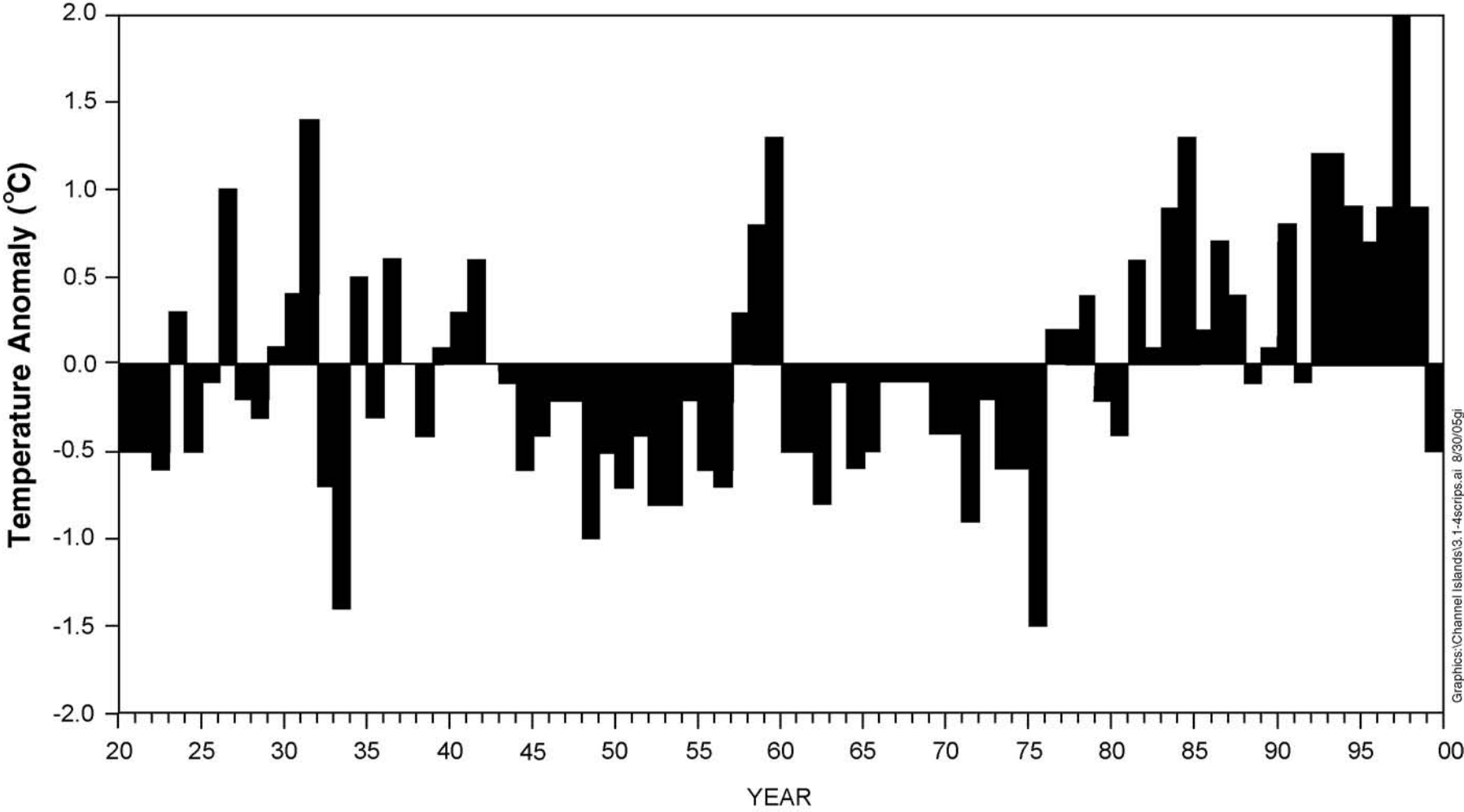

Figure 3.2-4

SCRIPPS PIER SEA SURFACE TEMPERATURE ANOMALIES
(1920 - 1999)

3.2.3.4 El Niño/La Niña

Environmental fluctuation is an important factor influencing the distribution and abundance of marine life of the northern Channel Islands. In the SCB, El Niño and La Niña contribute to environmental fluctuation. El Niño is characterized by a large-scale weakening of the trade winds and warming of the surface layers in the eastern and central equatorial Pacific Ocean. El Niño events occur irregularly at intervals of 2 to 7 years, although the average is about once every 3 to 4 years. They typically last 12 to 18 months and are accompanied by swings in the Southern Oscillation (SO), an interannual see-saw in tropical sea level pressure between the eastern and western hemispheres. During El Niño, unusually high atmospheric sea level pressures develop in the western tropical Pacific and Indian Ocean regions, and unusually low sea level pressures develop in the southeastern tropical Pacific. SO tendencies for unusually low pressures west of the date line and high pressures east of the date line have also been linked to periods of anomalously cold equatorial Pacific SSTs sometimes referred to as La Niña.

Strong El Niño influences, which begin off South America, can eventually influence the climate, resources, and biodiversity of California's marine and coastal environment (Norton *et al*. 1985). A "California El Niño" is characterized by warm sea surface temperatures, a deeper surface mixed layer, a depressed thermocline, nutrient-poor water, greater poleward flow, and an anomalous high sea level (Barber and Chavez 1983; Dayton and Tegner 1990; North *et al*. 1993; Tegner and Dayton 1987). El Niño impacts forests of giant kelp in California in a variety of ways that result in little or no canopy being produced, depending upon the severity of the event. Such impacts also affect kelp forest population dynamics, succession, and competitive interactions among kelp forest species (Tegner *et al*. 1997).

The impact in California depends on the strength of the event. Mild El Niños, which slowed kelp growth, were felt along the coast of California during 1977–1978 and 1992–1993. Especially strong events impacted kelp resources and stopped commercial kelp harvesting off California in 1941, 1957–1959, and 1982–1984. The 1982–1984 El Niño was the largest ever recorded off South America and California (Rasmusson 1984).

Storms associated with the 1982–1984 El Niño also devastated kelp beds throughout California. The effects of this El Niño on giant kelp in southern California were studied by Gerard (1982), Dayton *et al.* (1984), Zimmerman and Robertson (1985), Dean and Deysher (1983), Tegner and Dayton (1987, 1991), and North *et al*. (1993).

Zimmerman and Robertson studied the giant kelp forest at Santa Catalina Island during the 1982–1984 El Niño. They found that deepened isotherms associated with the El Niño resulted in severe nutrient limitation and very low kelp productivity. Frond growth rates were so low that terminal blades formed before the frond reached the surface, eliminating canopy formation. Frond initiation rates were extremely low and resulted in significant reductions in mean plant size. Plants growing above 33 feet were more severely affected by the nutrient limitation than plants growing at 66 feet. These results suggested that nutrient pulses associated with internal waves were critical for survival of giant kelp in nutritionally marginal habitats in southern California (Zimmerman and Robertson 1985).

The relative growth rates of juvenile giant kelp in southern California were substantially reduced during the 1982–1984 El Niño (Dean and Deysher 1983). The lower growth rates were correlated with increased temperature and decreased nitrogen availability. Fertilization of juvenile plants with slow-release nitrogen-phosphorus fertilizer increased their growth rate to levels previously observed when the temperature was low and nutrient levels were high (Dean and Deysher 1983). The limitation in growth of juvenile giant kelp by levels of available nutrients during the El Niño was in contrast to the usual limitation in growth by irradiance during non–El Niño years. There was a shift in the relative importance

of factors controlling growth of juvenile *Macrocystis pyrifera* during the El Niño (Dean and Deysher 1983).

Large-scale, low frequency oceanographic phenomena, such as El Niño or La Niña, play a very important role in kelp forest successional processes, population dynamics, and competitive interactions with understory kelps (Tegner *et. al.* 1997). El Niño can drastically reduce the standing crop and canopies of giant kelp in California, resulting in a cessation or reduction of kelp harvesting for many months. Aquaculture, algin, and herring roe-on-kelp industries can all be severely impacted by significant El Niño events in California.

Environmental variations are important contributors to the unexplained distribution of many kinds of fish and shellfish. Consequently, the fishing of and reproductive success of some species are affected by environmental conditions, one of which is water temperature (Radovich 1961).

The effects of water temperature on California's marine flora and fauna can be both beneficial and detrimental. Ocean temperature directly affects the metabolism and survival of adult fish, and the abundance and type of food available. El Niño events have had dramatic effects on the flow patterns of the SCB (Chelton *et al*. 1982). Changes in the flow patterns as well as the resultant changes in rain and weather patterns associated with El Niño have been shown to have a number of biological impacts:

- Population shifts in commercially harvested species, such as squid, rockfish, and lobster;
- Transport of enormous volumes of sediments and suspended materials from the mainland to coastal and offshore waters; and
- Disturbance to critical marine habitats, notably storm and water temperature damage to kelp forests.

El Niño events cause proportional reductions in the growth and reproductive success of organisms within coastal ecosystems. Warm waters and the intrusion of a different water mass associated with El Niño events may change the abundance, species composition, and temporal dynamics of the prey community in local species assemblages. Depending on the nature of an organism's diet and patterns of energy storage and mobilization for reproduction, adult condition and spawning efforts may be adversely affected. Starvation and thermal stress may have direct physiological effects on fecundity, timing of spawning, and egg viability in both fishes and invertebrates, especially if they are sedentary or limited-range species (Bailey and Incze 1985; Barber and Chavez 1983).

It is important to note that marine organisms of the CINMS Study Area adapt within this ecosystem and have developed strategies which allow them to recover under natural conditions (Tegner and Dayton 1987). Some stocks, such as herring, are adapted to living in an environmentally variable coastal zone (Bailey and Incze 1985). Birds and pinnipeds are known to abandon their young so that the adults may use available food for their own survival (Barber and Chavez 1983).

However, the ability of a particular species to recover may be reduced if the El Niño event is particularly severe or prolonged. Early life history stages of organisms are especially vulnerable to the effects of warm waters, altered food production, and changes in transport regimes (Bailey and Incze 1985).

Overexploitation of a particular species may further hamper or prevent recovery (Cushing 1982). Overfishing may cause recruitment failure by either reducing the abundance of certain key species within an ecosystem, or by reducing the adult population size. Consecutive years of poor recruitment increases the likelihood of a total population collapse (CINMS 2001).

Highly migratory or mobile species may be able to avoid the warm El Niño conditions by either migrating further north or into deeper waters. However, bioenergetic costs associated with migration may pre-empt somatic growth and/or gonadal development. Fecundity, timing of spawning, and egg viability may be adversely affected by the weakened condition of adults (Bailey and Incze 1985).

Migration to cooler waters may present opportunities to expand a species' range by colonizing new areas. Successful colonization will depend upon the species' ability to cope with local dynamics like the timing of plankton blooms and current patterns, new interspecific interactions, such as competition and predator-prey relationships, and local conditions once the El Niño conditions subside (Bailey and Incze 1985).

Species more commonly found in tropical waters may migrate to, or be advected into, temperate waters during El Niño events (Squire 1983). For example, red crabs (*Pleuroncodes planipes*), pelagic tunicates, and fishes such as albacore, barracuda, dorado, yellowfin tuna, marlin, and triggerfish have been noted to occur far to the north of their usual range. In general, highly migratory species like yellowtail and some pelagic species such as barracuda and sardines thrive during warm water events. In the case of barracuda and yellowtail, these fish move north into Californian waters in response to the movement of warm water from the south. Sardines spawn when the water temperature is above 55.4 degrees Fahrenheit (13 degrees C). Higher water temperatures probably enhance the reproductive success of sardines. The arrival of new species may introduce new interspecific reactions that may alter the local community structure (Bailey and Incze 1985).

The displacement of species during El Niño events is reflected in depressed commercial catches of temperate-water species such as salmon, northern anchovy, lingcod, sablefish, rockfishes, dungeness crab, market squid, and shrimp (Smith 1985). During El Niño events, cold water species such as anchovy and salmon suffer declines. For anchovies, a warm water event merely signals the lack of preferred food such as plankton. Salmon, however, cannot metabolically withstand substantial increases in water temperature. Thus they will move away from areas of warm water. For those species at or near the bottom of the food chain, such as algae and lower invertebrates, the cessation of upwelling can be fatal. The dependence of these species on the nutrients found in cool upwelled water is well documented (Barber *et al*. 1985; Smith 1985). When the nutrients are depleted, the resulting mortalities and their effects can be felt all along the food chain (Barber *et al*. 1985).

Strong El Niño events are highly correlated with severe storms (Tegner and Dayton 1987). The community structure of kelp forests and other benthic habitats may be significantly altered following storm-induced disturbances. Recovery of plants damaged by storms may be hindered by the warm, nutrient-poor water associated with El Niño events.

3.2.3.5 Temperature Regime Shift

Recent data from extracted cores from the Santa Barbara Channel includes high quality information that can be tracked in increments of close to 50 years. The cores show rapid and extreme shifts in water temperatures during the last 60,000 years (Cannariato and Kennett 1999). These extreme shifts in water temperature are one indication of regime shifts in the marine ecosystems of the CINMS and the SCB. As described earlier, climatic changes from natural and human causes are likely to produce major marine ecosystem disruptions or regime shifts. Regime shifts reflect significant changes in water temperature and in the currents of marine ecosystems (Steele 1998). Changes in water temperature can contribute to changes in the abundance and distribution of marine life and the general spatio-temporal character of marine habitats (McGowan *et al*. 1998).

Marine scientific evidence points to a large-scale persistent biological response to the climate regime shift in the California Current. CalCOFI investigators and others show that large-scale changes, or what is referred to as a regime shift, in the physical and biological processes can lead to change in the distribution and abundance of some marine species. Each regime shift changes the basic nature of marine ecology for several decades at a time (or on the order of several human generations). McGowan *et al.* (1998) state that the last regime shift occurred in 1977. General characteristics of regime disturbance, along with the current low-nutrient regime of the SCB, are described further below in Section 3.2, Biological Environment. It is important to note that despite regime shifts, Cannariato *et al.* (1999) show there has been no extinction of benthic species in the Santa Barbara Channel. This is an important finding given that a number of benthic species have recently declined to the point of being listed as threatened under the federal Endangered Species Act.

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Bioregions

The confluence of the California Current and the Southern California Countercurrent has been shown to affect the abundance and distribution of marine species (Dailey *et al.* 1993). Murray and Littler (1981) define five distinct biogeographical provinces or biogregions (areas characterized by distinct patterns of species abundance and distribution) across the SCB based on analyses of 21 sites. The Study Area coincides with three biogeographical provinces: (1) the colder Oregonian Province, (2) the warmer California Province, and (3) the transition zone between the two. Point Conception is often identified as marking the transition between the Oregonian and Californian Provinces (Horn and Allen 1978; Murray and Bray 1993; Murray and Littler 1981). However, changes in the province boundaries are influenced by hydrographic conditions of the SCB and climate perturbation (Murray and Bray 1993; Murray and Littler 1981; Seapy and Littler 1980). Depending on the season, the Channel Islands and the CINMS are embedded in one or more of the three biogeographical provinces identified above. San Miguel Island typically lies in the colder waters of the Oregonian Province while Anacapa and Santa Barbara Islands are typically in the warmer Californian Province. The eastern side of Santa Rosa Island and Santa Cruz Island are generally in the transition zone (Horn and Allen 1978).

Numerous studies support the distinctions between these biogeographical provinces. Murray and Littler (1981) show that the marine flora of the island sites near the California Current (San Miguel and Santa Rosa Islands) had much greater likeness to flora north of Point Conception than did the flora bathed principally by the Southern California Countercurrent or those of mixed waters. Other studies of species distribution patterns also suggest the presence of two primary faunal regimes. California fish fauna assemblages may be classified into two groups: those associated with cold-water masses and those associated with warm-water masses (Horn and Allen 1978). Earlier studies by Fitch (1967) of Pleistocene fossil fishes in southern California support the premise that these faunal regimes were consistent through time. Studies of the distribution patterns of shallow water benthic mollusks (Valentine 1966), rocky intertidal assemblages (Kanter 1980; Littler 1980; Murray *et al.* 1980), kelp-bed fishes off the Santa Barbara coast (Ebeling *et al.* 1980), and sandy beaches of the region, including the mainland (Dugan *et al.* 1999), show distinct but interrelated biogeographical provinces. For example, because most nearshore fishes, invertebrates, and macroalgae have planktonic phases in their life histories, the spatial and temporal variability of their recruitment is linked to physical oceanographic processes, such as currents, eddies, and upwelling (Roughgarden *et al.* 1988).

3.3.2 Biotic Communities

3.3.2.1 Introduction

A biotic community is defined by the species occupying a particular locality and the interactions between those species. In turn, a biotic community coupled with its associated physical environment is considered an ecosystem. A fundamental way biological communities organize themselves is by food webs. A food web must have primary producers to capture energy from the sun (algae, phytoplankton, vascular plants), a means of energy transfer by feeding, and nutrient cycling between biotic and abiotic environment by excretion, bacteria, fungi, and detritus to provide nutrients back to primary producers. The different habitats of the CINMS are linked by these nutrient cycles and food webs (Dailey *et al*. 1993). Figure 3.3-1 depicts a simplified food web showing linkages between sea lions and other marine life, including fishes, in the CINMS.

As tides and currents move water among the habitats, dissolved and particulate organic matter and nutrients also flow among the diverse habitat areas. Marine organisms from fish and invertebrates to seabirds and marine mammals also move among different habitat areas.

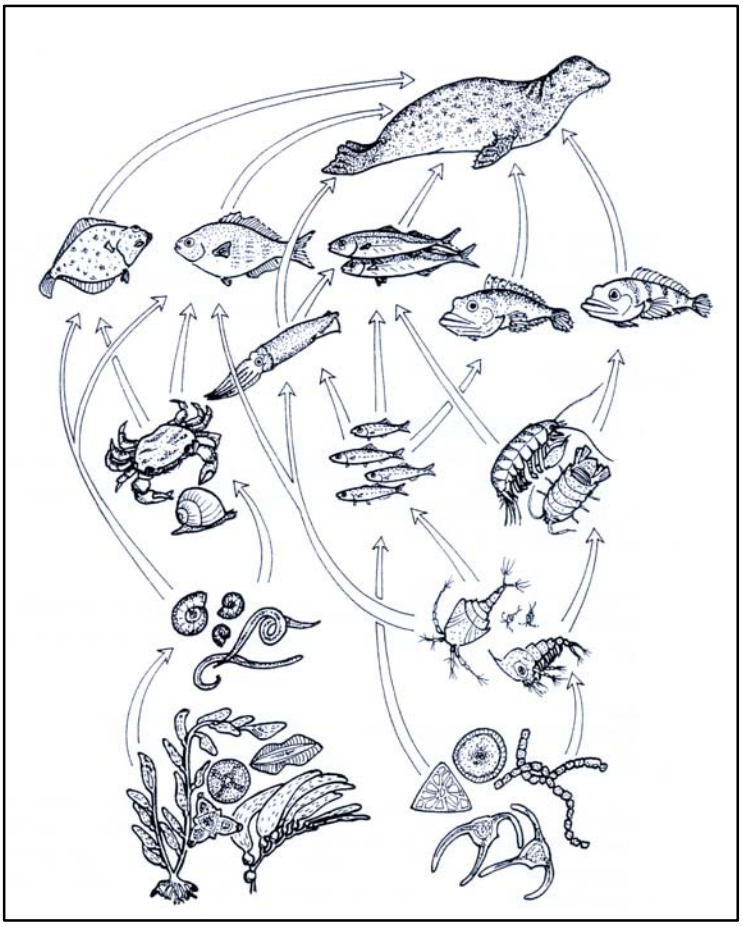

Figure 3.3-1 Simplified Food Web
Source: U.S. Navy 2000.

3.3.2.2 Habitats Within the Study Area

The Sanctuary contains many important and varied physical and geological features including a complex of plateaus, continental slope, gyres, banks, subsea canyons and rocky reefs. The diversity of accentuated bottom relief, abrupt change in depth, and varied substrate provide a spectrum of marine habitats. In summary, the primary habitats found within the study area include kelp forests, surfgrass and eelgrass beds, rocky and sandy intertidal, rocky and sandy nearshore subtidal, deep-water benthic, and pelagic habitats. A detailed discussion of study area habitats is provided in Appendix C, section 1.1, of this DEIS.

Kelp Forests Kelp forests in the Sanctuary are highly productive habitats that provide food, attachment sites, and shelter for myriad invertebrates and fishes. Locations supporting kelp generally have been consistent through time, but the extent of these beds has varied considerably based on environmental conditions such as water temperature and natural predation.

Surfgrass and Eelgrass Surfgrass and eelgrass beds are also highly productive and complex

microhabitats that support a wide variety of marine species. The largest beds of eelgrass in the Sanctuary occur at Smugglers Cove, Canada del Agua, and Prisoners Harbor on Santa Cruz Island and at Bechers Bay on Santa Rosa Island.

Intertidal The intertidal zone comprises a variety of coastal habitats periodically covered and uncovered by waves and tides. Intertidal habitat within the Sanctuary is composed of approximately 94.5 miles of rocky coastline interspersed with approximately 47 miles of sandy beaches (California Resources Agency, CDFG 2002). A wide variety of sedentary invertebrates, including barnacles, limpets, and mussels compete for space with the plants in the intertidal zone which also provides important habitat for fish, seabirds, seal and sea lions.

Nearshore Subtidal Nearshore subtidal habitats include mud, sand, gravel, cobble, and bedrock substrates. Nearshore subtidal rocky habitats at the Islands are widespread, especially high relief volcanic reefs with walls, ledges, caves, and pinnacles. Typical shallow subtidal areas in the Sanctuary contain assemblages of plants, invertebrates, and fishes, with giant kelp dominating. However, many shallow reefs grazed by sea urchins have less giant kelp and greatly reduced species diversity. Many sandy nearshore habitats in the Sanctuary have relatively steep slopes composed of coarse shelly debris. Stable sand habitats with fine grain sediments are generally limited to sheltered coves at canyon mouths, such as those found around Santa Cruz Island.

Deep-Water Benthic Beyond nearshore subtidal depths are deep-water habitats extending from 99 to greater than 660 feet deep. Well over 90 percent of deep-water benthic habitats in the Sanctuary consist of fine sands in shallower portions, grading into silt and clay-dominated sediments in deeper portions (Science Applications International Corporation 1986; Thompson et al. 1993). In addition, deep rock bottoms are often located offshore from major headlands and Islands, and on the highest parts of undersea ridges, banks, and pinnacles. High relief pinnacles and ridges occur in some areas, such as off the northwest end of San Miguel Island.

Pelagic Habitats Water column, or pelagic, habitats consist of discrete portions of ocean waters categorized by variation among multiple factors, such as light penetration, temperature, oxygen concentration, and density. Water column habitats within the majority of the Sanctuary do not extend deeper than the mesopelagic zone (from approximately 660 to 3,300 feet), though the southern reaches of the Sanctuary boundary near the mouth of Santa Cruz Canyon (a submarine canyon between and offshore from southeastern Santa Rosa Island and southwestern Santa Cruz Island) approach bathypelagic depths (from approximately 3,300 to 11,500 feet).

3.3.2.3 Floral and Faunal Assemblages in the Study Area

The Sanctuary's oceanographic and physical features support a great diversity of marine species, many of which are extremely rare and afforded special protection by federal and state law. A detailed description of floral and faunal assemblages in the Study Area is provided in Appendix C, Section 1.2, of this DEIS.

Plankton Plankton, single celled pelagic marine plants (phytoplankton) and animals (zooplankton), form the base of the food web. Many species of plankton inhabit the Sanctuary and marine life is highly dependent on their growth and productivity. Their numbers, biomass, and production vary greatly both spatially and temporally.

Marine Plants Marine plants of the Sanctuary are made up of algae and seagrasses. Diversity of marine plants is greater in the SCB and the Channel Islands than along coastal central California. In the SCB,

there are at least 492 species of algae and 4 species of seagrasses known to occur of the 673 species described for California (Abbott and Hollenberg 1976; Murray and Bray 1993). Giant kelp, surfgrass and eelgrass are marine plants that provide important habitat to numerous other species within the Study Area. In particular giant kelp forests are conspicuous features of the Sanctuary and important not only ecologically, but also recreationally and commercially.

Invertebrates The Channel Islands support a wide variety of invertebrates due to their transitional location between cold and warm biogeographic provinces and diversity of substrates. The total number of species may well be in excess of 5,000, not including microinvertebrates (Smith and Carlton 1975: Straughan and Klink 1980). Marine invertebrates may be benthic (bottom-dwellers) or pelagic, and may range in size from little known microscopic forms (micro-invertebrates) to the more common larger organisms (macro-invertebrates). Select invertebrates in the Sanctuary include multiple species of corals, prawns, spiny lobster, crabs, sea urchins, sea cucumbers, sea star, abalone, nudibranchs, scallops, mussels, squid, clams, barnacles, snails, salps, tunicates, jellyfish, sea slugs, and anemones. White abalone is protected by the ESA. Within the Sanctuary highly valuable commercial fisheries for squid, sea urchin, and lobster occur.

Fish About 481 species of fish inhabit the Southern California Bight (Cross and Allen 1993). The great diversity of species in the area occurs for three principal reasons: 1) the ranges of many temperate and tropical species extend into and terminate in the SCB; 2) the area has complex bottom topography and a complex physical oceanographic regime that includes several water masses and a changeable marine climate (Cross and Allen 1993; Horn and Allen 1978); and 3) the islands and nearshore areas provide a diversity of habitats including soft bottom, rock reefs, extensive kelp beds, and estuaries, bays, and lagoons. Select fishes commonly found in the Sanctuary include: albacore, anchovy (northern), bass (various species), cabezon, California sheephead, California halibut, garibaldi, rockfish (various species), salmon (king), sardine (Pacific), shark (various species), surfperch (various species), swordfish, and white sea bass.

Sea Turtles Four species of sea turtles have been reported in the offshore southern California region: green, loggerhead, olive Ridley, and leatherback (Cordaro 2003). Most information on sea turtle distribution in southern California is based on stranding data. This stranding data indicates that for the Channel Islands area all four species of sea turtle may be found within the Sanctuary at any time of year (Cordaro 2003). All sea turtles are protected by the Endangered Species Act (ESA).

Seabirds Over 195 species of birds use open water, shore, or island habitats in the Southern California Bight (Baird 1990). The Channel Islands region is located along the Pacific Flyway, a major migratory route for birds, and acts as a stopover during both north (April through May) and south (September through December) migrations. The months of June and July are peak months for transient shorebirds (Lehman 1994). The diversity of habitats provided both on- and offshore also contributes to the high species diversity in the region. Sandy beaches provide foraging and resting habitat for a number of shorebirds including Black-Bellied Plover, Willet, Whimbrel, Long-billed Curlew, gulls, and sanderlings. The upland portions of the beach provide kelp deposits that attract invertebrates where Black and Ruddy Turnstones, dowitchers, and other shorebird species forage. Several bird species within Sanctuary region have special status (of concern, threatened or endangered) under federal or state law. The Sanctuary provides important habitat for eight seabirds that have special status under Federal or state law: Ashy storm-petrel, Black storm-petrel, California brown pelican, California least tern, Double-crested cormorant, Rhinoceros auklet, Western snowy plover, Xantus's murrelet.

Marine Mammals There are three marine mammal groups in the Sanctuary: 1) whales, dolphins and

porpoises (cetaceans); 2) seals and sea lions (pinnipeds); and 3) the southern sea otter. All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA). In addition, some marine mammals are protected under the federal and state ESA. Species with special protected status are listed in Section 1.2.7.3 of Appendix C within this DEIS. At least 33 species of cetaceans have been reported in the Sanctuary region (Leatherwood et al. 1982; Leatherwood et al. 1987). Common species found in the Sanctuary include: long-beaked common dolphin, short-beaked common dolphin, Bottlenose dolphin, Pacific white-sided dolphin, Northern right whale dolphin, Risso's dolphin, California gray whale, Blue whale, and Humpback whale. Historically seven species of pinnipeds have been found throughout or in part of the Sanctuary: the California sea lion (common), northern fur seal (uncommon), northern elephant seal (common), Pacific harbor seal (common), Guadalupe fur seal (rare), Steller sea lions (extremely rare), and ribbon seal (extremely rare). The productive waters and relatively undisturbed environment of the Sanctuary provides vital habitat for these pinniped species, offering important feeding areas, breeding sites, and haul outs. Finally, sea otters were common in the Channel Islands until prolonged periods of hunting led to local extinction at the Islands and severe depletion along the mainland California coast. From 1987 to 1990, the USFWS, which has primary jurisdiction over sea otters, translocated 139 otters to San Nicolas Island, though as of 2003 only 33 animals were reported (Sanders 2003). Following the translocation rare sightings of sea otters in the Sanctuary have been reported.

3.3.2.4 Status of Biotic Communities in the Study Area

Communities and ecosystems do not have a preset optimal level to which they invariably return (Noss 1995). These composite biological structures are different from homeostatic systems. When a limit of tolerance, for example, in a marine ecosystem is reached, the ecosystem does not die. Instead, the system reaches a different state with different operating conditions, processes, and ecological structures. The ecosystem's response to ecological disturbance refers to the capacity of an ecosystem to withstand stress and environmental fluctuation. The system possesses integrity if it retains the ability to continue its ongoing change and productive development (Noss 1995).

Scientific evidence shows that ecosystems in the Sanctuary and Study Area are disturbed (CDFG 2002). Based on an analysis of CalCOFI data, Roemmich and McGowan (1995a,b) document large-scale changes in primary and secondary productivity throughout the SCB between 1951 and 1993. Note that this long-term trend in the decline in ecological productivity pre-dates the 1977 warm-water and low-nutrient regime change (discussed above in 3.2.3.5). This evidence suggests that the maintenance of community structure and patterns of native species diversity has changed in accordance with hydrographic perturbations and climate-ocean variability (Hayward *et al*. 1996; McGowan *et al*. 1998).

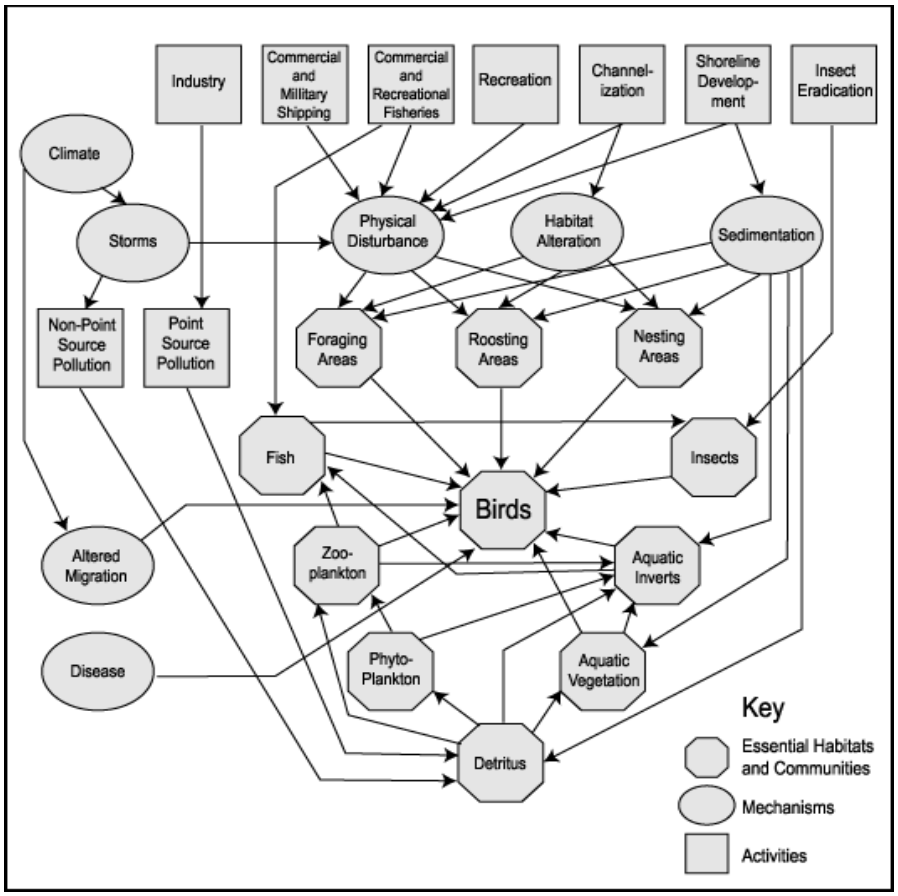

Figure 3.3-2 Activities, Mechanisms, Habitats, and Communities Affecting Coastal Birds
Source: U.S. Navy 2000

Figure 3.3-2 illustrates an example of ecosystem relationships and the complexity of physical, ecological, and human interactions that influence the abundance and distribution of birds, which are indicator species of the health and integrity of coastal marine ecosystems.

A summary of large-scale changes in the SCB as described by marine scientists follows (CDFG 2002; McGinnis 2000):

The Photic Zone *(upper zone of sunlight of the sea, less than 120 meters thick).* Smith and Kaufmann (1994) show a long-term deficit in the supply of food necessary to meet the metabolic demands of the sediment community. The long-term increase in sea surface and upper water column temperatures and physical stratification in the system has resulted in a lower rate of supply of nutrients to the photic zone. This has lead to a decrease in productivity and a general decline of zooplankton and other species (e.g., larval fish production, seabirds, kelp production, and a shift in benthic, intertidal community structure). Despite this decline in food supply, the food demand of the deep-benthic sea community remains constant. With the demand on food constant, and the supply diminishing, a net deficit in available food occurs (CDFG 2002).

Macrozooplankton. Since the late 1970s, macrozooplankton volume in the California Current has declined over 70 percent, in concert with increasing sea surface temperatures (McGowan *et al.* 1998;

Roemmich and McGowan 1995a,b). Reduced macrozooplankton has a major impact at higher trophic levels by changing the nature of the food supply.

Fishes and Invertebrates. CDFG data show decreases in landings for several categories of groundfish, sea urchin, swordfish and selected shark species, Pacific mackerel, Pacific herring, California halibut, and market squid (for the period 1997–1998), among others (CDFG 2002). Dugan and Davis (1993) document the general decline in long-term productivity in 19 species of nearshore fishes and invertebrates in California from 1947 to 1986. A study by Love *et al*. (1999) of long-term trends in the SCB commercial rockfish fishery shows a substantial decline from 1980 to 1996, with extremely low catches from 1993 to 1996. In addition, the estimated abundance in streams south of Point Conception for southern steelhead (*Oncorhynchus mykiss*) are probably only on the order of 100 to 300 adults (Pacific Fishery Management Council [PFMC] 1996).

Oceanic Birds. Ecological theory predicts that in a stable ecosystem those species occupying high trophic levels maintain native species diversity and community structure (Paine 1966). Upper trophic level animals such as pelagic birds are indicators of the health of the marine environment (Veit *et al*. 1996). Evidence suggests the abundance of oceanic birds in the region and the SCB has declined steadily since 1988 (Veit *et al*. 1996, 1997). For example, numbers of the sooty shearwater, the most abundant bird in the SCB, have declined by 90 percent. Veit *et al.* (1996) show that the decline in bird biomass reflects considerable biological change within the California Current system. Veit *et al*. (1996, 1997) indicate that ocean warming and climatic events change pelagic bird abundance within the California Current system.

Southern California Kelp. Tegner *et al*. (1997) show a two-thirds reduction in standing biomass since 1957 in southern California kelp forests. Moreover, Tegner *et al*. (1996, 1997), Tegner and Dayton (1991), and Dayton *et al*. (1992) show that kelp forests have suffered great damage since the 1970s.

Global Climate Change. Another large-scale change lies in the increasing frequency of climatic events (McGowan *et al*. 1998).

Marine ecosystem disturbance affects the abundance and distribution of native marine species associated with the Study Area. Further, several species listed as threatened or endangered depend on Sanctuary ecosystems. Many of these species are indicators of ecosystem health. A detailed description of the major biological resources of the CINMS marine ecosystems (specific habitat types and species descriptions, including special-status species) is included as Appendix C of this DEIS and also found in *Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary – Final Environmental Document* (2002), available on line at http://www.dfg.ca.gov/mrd/ci_ceqa/index.html.

3.3.3 Coastal Watersheds

There are 24 major drainage systems within the 32,000 square km of the SCB (Saint *et al.* 1996). Of these, 53 percent of the drainage area is controlled by major water retention structures, such as dams and reservoirs.

Freshwater input to the majority of the Study Area is derived from the streams and rivers draining the Transverse Ranges. Two rivers, the Santa Clara River and the Ventura River, drain the eastern portion of the range and provide the majority of the sedimentary input along the southern coastline (Dailey *et al* 1993; Norris and Webb 1990). The Santa Clara River drains most of southern and central Ventura County and is the largest drainage system in the Transverse Ranges (Norris and Webb 1990). The Santa Clara River extends approximately 75 miles and has been extensively used for urban and agricultural

water supplies (Norris and Webb 1990). The Santa Ynez and Santa Maria Rivers provide major drainages north of Point Conception. The 60-mile-long Santa Ynez River drains the north-facing slopes of the Santa Ynez Mountains and the southernmost Coast Ranges. The Santa Maria River System, which includes the Cuyama and Sisquoc Rivers, drains the San Rafael and Sierra Madre Mountains of northern Santa Barbara County. Table 3.3-1 describes the major watersheds in the Study Area.

Table 3.3-1
Major Watersheds of CINMS Study Area[1]

Watershed Name	Counties in Watershed	Watershed Area in Square Miles	Watershed Land Use (in order of decreasing areal extent)[1]	Annual Mean Discharge in acre - feet (recording period)
Santa Maria River System (includes Cuyama and Sisquoc Rivers)	San Luis Obispo Santa Barbara Ventura	1,826[3]	National forest/wilderness Agriculture Urban	133,500 (1944-1994)[3]
San Antonio Creek	Santa Barbara	135[2]	Military reservation Agriculture Urban	4,420[2] (1956-1996)
Santa Ynez River	Santa Barbara	789[2]	National forest Agriculture Military reservation Urban	80,700[2] (1952-1996)
Santa Barbara Coastal (41 creeks)	Santa Barbara Ventura	375[4]	National forest Agriculture Urban	Not available
Ventura River	Santa Barbara Ventura	188[2]	National forest/wilderness Agriculture Urban	47,670[2] (1960-1996)
Santa Clara River	Santa Barbara Ventura Los Angeles	1,577[2]	National forest/wilderness Agriculture Urban	121,200[2] (1928-1996)

Data Sources:

1 McGinnis (2001).

2 Watershed area and annual mean discharge obtained from U.S. Geological Survey 1996 California Hydrologic Data Report (http://water.wr.usgs.gov/data/96), for the farthest downstream gauging station recorded on each watershed. Note that the recording period is not the same for all stations. No data was available in the 1996 report for the Santa Maria River or the Santa Barbara Coastal watersheds.

3 Watershed area and discharge data for Santa Maria River System obtained from Bateni and Turner, State of California Department of Water Resources Draft Natural Flow, Santa Maria River 1997.

4 Watershed areas obtained from California Rivers Assessment (CARA) 1997. http://endeavor.des.ucdavis.edu.

The coastal mainland of the Study Area also includes the San Antonio Creek watershed and 34 small coastal watersheds draining the south side of the Santa Ynez Mountains (NPS 2003). The creeks of these watersheds provide important nutrients to the marine environment but can also carry pollution from agricultural and urban runoff.

3.3.4 Coastal Processes

In the SCB, coastal processes physically link watersheds to wetlands via the delivery of water, sediment, and nutrients to the wetland from the watershed (Dailey *et al.* 1993; NPS 2003). A characterization of coastal ecosystems of southern California is depicted in *Making the Watershed Connection: Wetlands, Watersheds and Regional Planning Efforts of the South Coast* (McGinnis 2001) and by the California Coastal Conservancy (2001).

Within a particular geologic context, water, sediment, and nutrients from the watershed define the type of coastal wetland that emerges (Ferren *et al.* 1995). Wetlands in southern California occur in various ecosystem contexts (e.g., lagoons, rivers, lakes, ponds), but have origins related to several major physical

processes. Wetlands that develop as a result of fluvial processes occur in riparian corridors, such as along the Santa Clara River. Here, riverine and palustrine wetlands occur in proximity to estuarine and marine wetlands when a river reaches the coast, and tidally influenced water regimes bearing ocean-derived salts meet waters and habitats of continental origin.

Several special-status species are found in the CINMS that also depend on the wetlands of the coastal mainland, such as Mugu Lagoon (California Coastal Conservancy 2001). The coastal area between Coal Oil Point and Point Sal comprises only 15 percent of southern California's coast yet holds approximately 50 percent of its remaining rural and natural coastline (NPS 2003). These coastal wetlands are recognized as a "significant biological resource" (Zedler 1982) and "environmentally sensitive habitat" (Santa Barbara County Coastal Plan 1982).

The wetland at Skunk Point, located on Santa Rosa Island is considered to be one of the healthiest remaining in Southern California (Davis 2000).

3.3.5 Regulatory Setting

3.3.5.1 Federal

U.S. Fish and Wildlife Service

There are several laws utilized by the U.S. Fish and Wildlife Service (USFWS) in managing marine and coastal resources. The U.S. Fish and Wildlife Coordination Act gives the USFWS the power to review and comment on federal actions that affect many habitat-related issues, including wetlands and waters protected under the Federal Water Pollution Control Act and Rivers and Harbors Act.

The federal Endangered Species Act (ESA) allows the USFWS to regulate, monitor, and implement programs for protecting the ecosystems upon which fishes, wildlife, and habitat of listed species depend. The ESA also helps enforcement of international treaties and conventions related to species facing extinction.

The federal Migratory Bird Treat Act (MBTA) allows the agency to enforce the prohibition against the taking of migratory birds, their eggs, or their nests. The USFWS has sole authority for coordinating and supervising all federal migratory bird management activities, including enforcement of federal migratory bird statutes regulating the taking of federally protected species (game and non-game) by individuals and federal agencies. The MBTA provides the USFWS opportunity to comment on projects potentially affecting bird species, and their habitats that are not protected under the ESA.

USFWS also has authority to enforce portions of the Marine Mammal Protection Act that deal with sea otters, as well as species not found in the Study Area including walrus and polar bears.

NMFS

The Magnuson-Stevens Fishery Conservation and Management Act authorizes the National Marine Fisheries Service (NMFS) to maintain and conserve fisheries and rebuild overfished stocks. NMFS is also responsible for determining whether projects or activities may adversely impact Essential Fish Habitat zones (those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity) and consulting with project or activity proponents to mitigate for or minimize adverse impacts.

The NMFS Office of Protected Resources (OPR) is charged with the implementation of the MMPA, ESA, and the Fur Seal Act with respect to marine mammal species under NMFS' jurisdiction, including whales, dolphins, porpoises, seals, and sea lions. As part of the MMPA mandate, OPR works in collaboration with the Protected Resources Divisions of the NMFS Regional Offices and Science Centers to develop and implement a variety of programs for the protection, conservation, and recovery of marine mammals. OPR also establishes cooperative agreements with states and Alaska Natives regarding marine mammal resources, identifies important research needs to collect appropriate information for management decisions, and administers the activities of the Marine Mammal Health and Stranding Response Program.

In addition, OPR serves as the principal liaison for NMFS with the Marine Mammal Commission, environmental organizations, industry, other federal and state agencies (including USFWS and the Animal and Plant Health Inspection Service), the academic community, public display institutions, and environmental and animal welfare organizations to meet its mandates under the MMPA. The OPR also administers the national program for display of captive whales, dolphins, porpoises, seals, and sea lions, coordinates with the USFWS on issues concerning the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and administers various exemptions to the take prohibition under the MMPA for the activities below:

- Scientific research;
- Enhancing the survival or recovery of a marine mammal species or stock;
- Commercial and educational photography;
- First-time import for public display;
- Capture of wild marine mammals for public display;
- Incidental take during commercial fishery activities; and
- Incidental take during non-fishery activities.

NMFS OPR is also responsible for implementing the ESA, generally managing endangered and threatened marine species, including anadromous salmonids. NMFS and USFWS share joint responsibility for managing sea turtles. In the Pacific Ocean, NMFS manages 5 species of sea turtles, over 25 evolutionarily significant units of salmon and steelhead, including their critical habitat, white abalone, 7 large whales and several species of pinnipeds. In coordination with the regional offices and science centers, OPR develops policies and regulations to implement the provisions of the ESA with the goal of protecting and recovering endangered and threatened marine and anadromous species and their habitat.

3.3.5.2 State

California Department of Fish and Game

The CDFG administers the California Endangered Species Act and manages sport and commercial fish, wildlife, and aquaculture.

The CDFG regulates the "take" or "possession" of species protected under the California Endangered Species Act and other species under the California Fish and Game Code (e.g., for fishing and hunting).

Seabirds taken in Department-managed hunting programs, for example, include various species of sea ducks. CDFG also continues to be actively involved in restoration and recovery of some native seabird species and other species on the islands.

An established state (CDFG) and federally (USFWS and NMFS) coordinated permit system ensures compliance with numerous applicable state and federal laws affecting the take and possession of other seabirds. Under the provisions of a Memorandum of Understanding with the USFWS, the CDFG may issue scientific collecting permits for various scientific endeavors that advance the conservation interest of seabird resources. In addition, numerous other activities involving the taking or possessing of marine mammals, sea turtles, and seabirds are currently allowed under the California Fish and Game Code, including collection of carcasses for wildlife disease studies, studies of the effects of fishing (bycatch), food habit studies, pollution studies, museum collections, and others. Permitted individuals include agency personnel and designated agents of the agencies, including volunteers.

Recent legislation and plans require that the CDFG develop and implement networks of marine protected areas, or MPAs, in California waters to protect habitats and preserve ecosystem integrity, among other things. Assembly Bill 993 (Shelley), the Marine Life Protection Act (MLPA), was introduced in February 1999 and chaptered in October 1999. The language is now included in Chapter 10.5 of the California Fish and Game Code, Sections 2850–2863. Sponsored by the Natural Resources Defense Council, the bill was supported by conservation, diving, scientific, and educational groups. The purpose of the MLPA is to improve the array of MPAs existing in California waters through the adoption of a Marine Life Protection Program and a comprehensive master plan. 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 master plan requires that recommendations be made for a preferred alternative network of MPAs with "an improved marine life reserve component." 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 CDFG is the lead agency charged with implementing the provisions of the MLPA.

A second state law, the Marine Life Management Act (MLMA), enacted on January 1, 1999, establishes a fisheries management system and establishes fisheries management goals for CDFG. With respect to meeting the MLMA's primary goal of sustainability, the CDFG Commission adopted a Nearshore Fishery Management Plan (NFMP), which aims at preventing overfishing, rebuilding depressed stocks, ensuring conservation, and promoting habitat protection and restoration.

State Lands Commission

The California State Lands Commission has responsibility for managing state-owned sovereign lands for the benefit of all people of California for the public trust purposes of waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space, among others. In that regard, the State Lands Commission is supportive of public trust uses consistent with and protective of the fragile resources of the state-owned sovereign lands.

The California State Lands Commission manages and protects the sovereign lands of the state pursuant to section 6301 of the California Public Resources Code. These lands include the beds of California's

naturally navigable rivers, lakes, and streams, as well as the state's tide and submerged lands along California's more than 1,100 miles of coastline extending from the mean high tide line out to 3 NM offshore. The State Lands Commission's policies for managing the state's lands and natural resources are based upon the highest standards of environmental protection, finanancial responsibility, and the Public Trust Doctrine, which imposes a duty to preserve the public's lands for the use and enjoyment of future generations. The State Lands Commission was created by the California legislature as an independent body, composed of three members: the Lieutenant Governor and State Controller, both statewide elected officials, and the Director of the Department of Finance, a cabinet level officer appointed by the Governor.

3.4 MARITIME HERITAGE RESOURCES

The Sanctuary and Study Area contain a wealth of maritime heritage resources (MHRs) representing as much as 13,000 years of human history. MHRs consist of shipwrecks; aircraft wrecks; material associated with wharves, piers, and landings; prehistoric archaeological sites and their associated artifacts; and paleontological remains. For the purposes of this EIS, this material is divided into two categories: *cultural,* consisting of Native American artifacts, and *historical,* consisting of artifacts from non-Native American cultures. Historic resources span the period from Juan Rodriguez Cabrillo's voyage of discovery (1542 to 1543) to the present. In addition, recently discovered paleontological remains have also contributed to the rich record of the area. In 1994, for example, a relatively complete pygmy mammoth was discovered on a coastal bluff on the north shore of Santa Rosa Island. This discovery represents the most complete pygmy mammoth discovered in the world to date. The discovery suggests a high probability of the existence of submerged paleontological remains within the Sanctuary. Collectively, MHRs of the Sanctuary represent a remarkable cross-section of our regional and national heritage. The following text provides an overview of cultural and historical resources in the Sanctuary and Study Area. A detailed characterization of these resources is provided in Appendix C of this DEIS.

3.4.1 Cultural Resources

Cultural resources found in the Sanctuary represent Chumash Native American cultures and date back to the end of the Pleistocene, approximately 13,000 years before present (B.P.). This is the date associated with the early human remains of a woman ("Arlington Springs Woman") discovered at Arlington Canyon on Santa Rosa Island. These are the oldest human remains yet discovered in North America (Johnson 2000).

The Chumash Indian homeland consisted of villages along the California coast from the present day sites of Malibu to Paso Robles, and in the northern Channel Islands. The Chumash people spoke different but related languages in different parts of the region. The marine component of the Chumash diet consisted of over 150 types of marine fishes (Miller 1988), as well as a variety of shellfish including crabs, lobsters, mussels, abalone, clams, oysters, chitons, and other gastropods (Erlandson 1994). Shellfish were also important to the Chumash economy and material culture. In fact, the Chumash produced the majority of shell bead money used by peoples throughout southern California (Miller 1988).

The abundance of prehistoric Native American Chumash artifacts found in the Santa Barbara Channel has helped archaeologists piece together important Chumash trade networks, fishing practices, and submerged village sites. In addition, archaeological information obtained from middens may help to determine the relative effects of subsistence and environmental fluctuation on prehistoric faunal assemblages in the Santa Barbara Channel (Raab *et al*. 1995). Archaeologists suggest that the Sanctuary may have once been the site of Chumash villages, now submerged by changes in sea level (Howorth and Hudson 1993; Hudson 1976; Hudson and Howorth 1985). During the period when Arlington Springs Woman lived, the

sea level was at least 150 feet lower than it is today, and the northern Channel Islands were joined as one island (Johnson 2000). Further, some submerged artifacts may have been deliberately deposited in the water during religious ceremonies, washed to the sea from shore, or deposited in the water through cliff erosion (Howorth and Hudson 1993; Hudson 1976 and 1979; Hudson and Howorth 1985). Descendants of the Chumash consider the CINMS a special place, still occasionally paddling these waters in tomols (seaworthy wood plank canoes used for crossing the Santa Barbara Channel and for offshore fishing). For more detailed information on historical resources in the CINMS, see App. C, sec. 2.4.

3.4.2 Historical Resources

The historic period in the Study Area dates from early European exploration, starting with Juan Rodriguez Cabrillo's voyage of discovery (1542 to 1543). For hundreds of years, mariners transiting this region have been faced with prevailing winds, extreme weather conditions and natural hazards. An important trade route, the Manila galleon trade, transited this coastline from 1565 to 1815. Sailing east from the Philippines, these galleons would make landfall near Cape Mendocino, California, before sailing southward to Acapulco, Mexico (Wilcox 1991). The small settlement of Santa Barbara became an established coastal trading port during the Spanish (1769–1821) and Mexican occupations (1822–1846). Regional commerce included the hide and tallow trade. Alaskan Aleut Indians, working for the Russian and American fur companies, hunted seals and sea otters for their pelts in the Channel Islands from 1803 to the 1840s (Terrell 1995).

Shortly after American occupation, the 1849 Gold Rush gave rise to the single largest migration of people to California (Delgado 1990). A substantial increase in both steam and sailing ship activity passed through the Santa Barbara Channel during the Gold Rush.

United States Coast Survey teams (renamed the U.S. Coast and Geodetic Survey in 1878) were sent out from the east to the Channel Islands and along the California coast to chart safe anchorages and navigational hazards (Davidson 1858). California ports became a center for international trade, with Western and Eastern economies exploiting natural resources such as seals and whales. Chinese immigrants, working from California-built junks, established some of the earliest commercial fisheries in the Santa Barbara region (Bentz and Schwemmer 2000). From the twentieth century to present, commercial fisheries, commercial freight, military, recreational boating, and oil exploration dominated maritime activities.

Between 1853 and 1980, an inventory of over 140 shipwrecks and aircraft wrecks was documented in the area now encompassed by the CINMS. To date, about 20 of these sites have been located. Shipwrecks in the study area reveal the diverse range of activities and nationalities traversing the Santa Barbara Channel. They include California-built Chinese junks, American coastal traders, vessels engaged in island commerce, and Gold-Rush-era side-wheel steamers. Some examples in the CINMS include the *Comet* (a three-masted coastal lumber schooner that was run aground on San Miguel in 1911 after striking Wilson Rock) and the *Winfield Scott* (a Pacific Mail Steamship Company passenger steamer, which, at full speed, ran aground on Anacapa Island in 1853 with over 400 passengers onboard). The area's American and European shipwrecks depict a remarkable diversity in sail and steam propulsion.

Sanctuary staff have a very active shipwreck reconnaissance program working in partnership with the CINP and Coastal Maritime Archaeology Resources (CMAR) avocational group. Several of the submerged sites have been recorded through the development of underwater maps.

In addition, the Study Area includes a number of land-associated underwater historical sites, both along the mainland shore and offshore islands, including submerged historic remains of landings and wharves.

Submerged artifacts associated with vessel activities, spilled cargoes, and the pioneer oil industry may also exist. Documented settlements include Chute Landing 1880 (Point Sal Landing), Lompoc Landing (Purisima Point), Meherin Wharf (Surf), Wrecker's Wharf (Honda Creek), Sudden Wharf-Rancho Espada (Point Arguello), Lifeboat Station (Point Arguello), shore whaling site (Cojo), Gaviota Wharf, More's Landing (Goleta), Chapala Street Wharf and Stearns Wharf (Santa Barbara), Ventura Wharf, Carpinteria Wharf, and Hueneme Wharf. The offshore island sites include Prisoners Harbor Pier, Scorpion Ranch Pier (Santa Cruz Island), Anacapa Island Landing, Bechers Bay Pier, East Island Pier and Johnson's Lee Pier (Santa Rosa Island), and Cuyler Harbor Pier (San Miguel Island) (Lima 1994).

3.4.3 Regulatory Setting

Within the Study Area, state and federal agencies are mandated to protect historical resources. These agencies have various jurisdictional boundaries. As stated previously, the Sanctuary consists of an area of approximately 1243 square nautical miles (NM) off the southern coast of California. The Sanctuary boundary begins at the Mean High Water Line of and extends seaward to a distance of approximately six NM from the following islands and offshore rocks: San Miguel Island, Santa Cruz Island, Santa Rosa Island, Anacapa Island, Santa Barbara Island, Richardson Rock, and Castle Rock (the Islands).. The boundaries of Channel Islands National Park include San Miguel and Prince Islands, Santa Rosa, Santa Cruz, Anacapa and Santa Barbara Islands, including the rocks, islets, submerged lands, and waters within one nautical mile of each island (16 U.S.C. sec. 410(ff)). The state's jurisdiction extends 3 NM off the California coast and islands. Also, several state ecological reserves exist within the Study Area; resources within these reserves have additional protection. In addition, the MMS has guidelines to protect historic resources during offshore oil exploration in federal waters.

The protection of historical resources is provided through the following regulations, laws, and orders:

- CINMS regulations (15 CFR Part 922, Subpart G);
- The National Marine Sanctuaries Act (16 U.S.C. 1431 *et seq.*);
- CINP regulations (36 CFR Parts 2 and 7, Resource Protection, Public Use and Recreation, and Special Regulations);
- Archaeological Resources Protection Act (16 U.S.C. 470aa *et seq.*);
- National Historic Preservation Act (16 U.S.C. 470 *et seq.*);
- Abandoned Shipwreck Act of 1987 (43 U.S.C. 2101 *et seq.*);
- Executive Order 11593 (1971);
- California Penal Code Section 622.5: Objects of Archaeological or Historical Interest;
- California Administration Code, Title 14, Section 630(a)(1), General Regulations for Ecological Reserves;
- California Public Law 100-298, implementing federal Abandoned Shipwreck Act; and
- California Native American Resource Protection Act of 2003, Chapter 1.76, Public Resources Code, Section 5097.993-5097.996

The current CINMS regulations prohibit removing or damaging any historical or cultural resource. The NMSP is required to adhere to the Federal Archaeology Program, as established by the NHPA. Federal agencies with land management responsibilities for public lands (including NOAA) must inventory their holdings (Section 110) and ensure mitigation of any federally funded activities that threaten historical and cultural resources on their holdings (Section 106). In 1971, Executive Order 11593 required that all federal agencies create programs to facilitate the protection of cultural resources on their lands. To accomplish such tasks, agencies must have staff trained in archaeological methods and cultural resource management (Terrell 1995). The NPS also has a special provision under Part 7, Resource Protection, Public Use and Recreation for the Channel Islands, 36 CFR 7.84 stating "(b) Wrecks. No person shall destroy, molest, remove, deface, displace, or tamper with wrecked and abandoned water or airborne craft or any cargo pertaining thereto."

The California Native American Resource Protection Act of 2003 states that it is a misdemeanor for any person to illegally excavate, destroy, injure, or deface a Native American historic, cultural, or sacred site, including any historic or prehistoric ruins, any burial ground, any archaeological or historic site, any inscriptions made by Native Americans at such a site, any archaeological or historic Native American rock art, or any archaeological or historic feature of a Native American historic, cultural, or sacred site. California has title to older abandoned shipwrecks in state waters through the Abandoned Shipwreck Act of 1987. In the case of modern shipwrecks, either the insurance underwriter, in the case of a total loss, or the registered owner has title to the wreck.

3.5 HUMAN USES

The focus of this section is to describe consumptive and non-consumptive human uses that relate to the regulatory changes presented in the Proposed Action and/or Alternative 1, described in Chapter 2.0. Human behavior and activity on land and at sea can dramatically impact coastal marine ecosystems and associated species diversity. A great variety of human uses occurs in the Study Area. For example, the Channel Islands are close to harbors in Santa Barbara, Ventura, and Port Hueneme, as well as Channel Islands harbor in Oxnard. These harbors facilitate visitation to the Islands for numerous recreational and commercial activities. Human use of the Sanctuary is not limited to residents of the Santa Barbara Channel region. Almost 20 percent of those who use California's coastal areas for recreation, for instance, are interstate or international visitors (California Resources Agency 1997).

3.5.1 Oil and Gas

A comprehensive history of offshore oil and gas development in the Study Area is found in work produced by the University of California, Santa Barbara's Ocean and Coastal Policy Center (Lima 1994; Molotch 1999a, b, c). These studies show that offshore oil and gas development is typically dependent on onshore facilities. Current onshore facilities prepare crude oil for shipment to refining centers and process natural gas. A characterization of onshore facilities for offshore oil and gas activities is found in *Final California Offshore Oil and Gas Resources Study* (MMS 2000).

This section describes offshore oil and gas activities and their corresponding potential environmental impacts in four phases: (1) exploration, (2) development and production, (3) transfer of oil and/or gas to shore, and (4) platform decommissioning.

3.5.1.1 Offshore Oil Exploration

When an area of the ocean has been identified as having potential oil and gas reserves, geophysical surveys (primarily through the use of seismic technology) are carried out to "type" the geological

formations beneath the seabed. If a seismic survey reveals oil or gas, then exploratory (or "delineation") drilling is carried out to test the limits or capacity of the field.

Environmental effects of exploratory drilling typically occur over 60 to 90 days (Klee 1999). Although exploratory drilling tends to be short-term, noise and pressure from seismic surveys may still affect the behavioral traits of various marine organisms, such as feeding, mating and avoiding predators. These effects tend to be more pronounced when drilling occurs during natural phenomena such as fish spawning or whale migrations (Klee 1999). A typical marine seismic survey consists of an airgun array, which generates the seismic pulses and hydrophones spaced along a streamer cable just below the surface of the water, which receive the reflected energy from the subsurface formations and transmit data to the vessel, where the data is collected (NOAA 1999a). Underwater sounds produced by seismic operations may be detectable some distance away from the activity. Typical behavior changes in marine mammals that can result from seismic activities include alterations in the surface-dive-respiration cycles, changes in activity or aerial displays, movement away from the sound source, or complete avoidance of the area (NOAA 1999a).

Offshore oil and gas exploration is currently prohibited within the CINMS under the existing regulations, except for leases executed prior to March 30, 1981. Existing leases within CINMS are discussed below in Section 3.5.1.2.

Since 1995, several seismic surveys have been conducted off the Southern California coast. In 1995 Exxon completed a high-energy seismic survey that encompassed 16 leases and covered 117 square miles offshore of Santa Barbara County (County of Santa Barbara Energy Division 2003). This was the first high-energy survey to be completed offshore of Santa Barbara County since 1988.

3.5.1.2 Offshore Oil Development and Production

Federal Activities

Except for the majority of waters within the CINMS (and other National Marine Sanctuaries), no portion of the federal Outer Continental Shelf (OCS) has a permanent moratorium on oil and gas leasing and development (California Coastal Commission 1999). Temporary moratoria have been in place since 1982 (California Coastal Commission 1999). In addition to Congressional moratoria, the Bush (George H.W.) and Clinton administrations issued directives under the OCS Lands Act to restrict leasing of new offshore areas. In 1990, President Bush directed that all areas protected by Congressional moratoria be deferred for leasing consideration until after the year 2002. This deferral included the federal OCS offshore of California. In June 1998, President Clinton also issued a directive under the OCS Lands Act preventing the leasing of any area currently under moratorium for oil and gas exploration and development prior to June 30, 2012. These OCS "presidential deferrals" can be reversed by subsequent administrations.

Offshore oil and gas development has occurred in leased tracts in California waters from the mean high tide line to 3 miles offshore, and in federal waters from 3 to 11 miles offshore. Table 3.5-1 depicts federal offshore oil and gas fields, operators, platforms, installation dates, and platform depths. Figure 3.5-1 depicts the federal offshore oil and gas leases within the Study Area.

Twenty platforms, one island (Rincon Island), and approximately 180 miles of associated pipelines are located in the Study Area. A total of 19 platforms are in federal waters; 1 platform (Platform Holly) and Rincon Island are in state waters (MMS 2000). These structures were installed prior to the passage of NEPA and the Coastal Zone Management Act of 1972. Federal OCS leases within the Study Area yield

approximately 93,205 barrels (one barrel equals 42 gallons) of oil per day and 112,318 million cubic feet of gas per day (County of Santa Barbara Energy Division 2001).

Three pre-existing federal oil and gas leases exist within the CINMS; very small portions of the Port Hueneme Field, the Santa Clara Field, and the Cavern Point Field overlap with the CINMS boundary; however, there are no platforms within the CINMS boundary.

Table 3.5-1
Federal Offshore Oil and Gas Fields, Operators, Platforms, Installation Date, and Platform Depth

Field	Operator	Platform(s)	Installation Date	Platform Depth (feet)
Port Hueneme	Nuevo	Gina	1980	95
Santa Clara	Nuevo	Gilda	1981	205
	Venoco	Grace	1979	318
Dos Cuadras	Nuevo	Hillhouse	1969	190
	Nuevo	A	1968	188
	Nuevo	B	1968	190
	Nuevo	C	1977	192
Carpinteria	Nuevo	Henry	1979	173
	POOI	Hogan	1967	154
	POOI	Houchin	1968	163
Sockeye	Venoco	Gail	1987	739
Pitas Point	Nuevo	Habitat	1981	290
Hondo	Exxon	Hondo	1976	842
	Exxon	Harmony	1989	1,198
Pescado	Exxon	Heritage	1989	1,075
Point Arguello	Arguello Inc.	Hermosa	1985	603
	Arguello Inc.	Harvest	1985	675
	Arguello Inc.	Hidalgo	1986	430
Point Pedernales	Torch	Irene	1985	242

Source: California Coastal Commission 1999; MMS 2000; POOI-Pacific Operators Offshore Inc.

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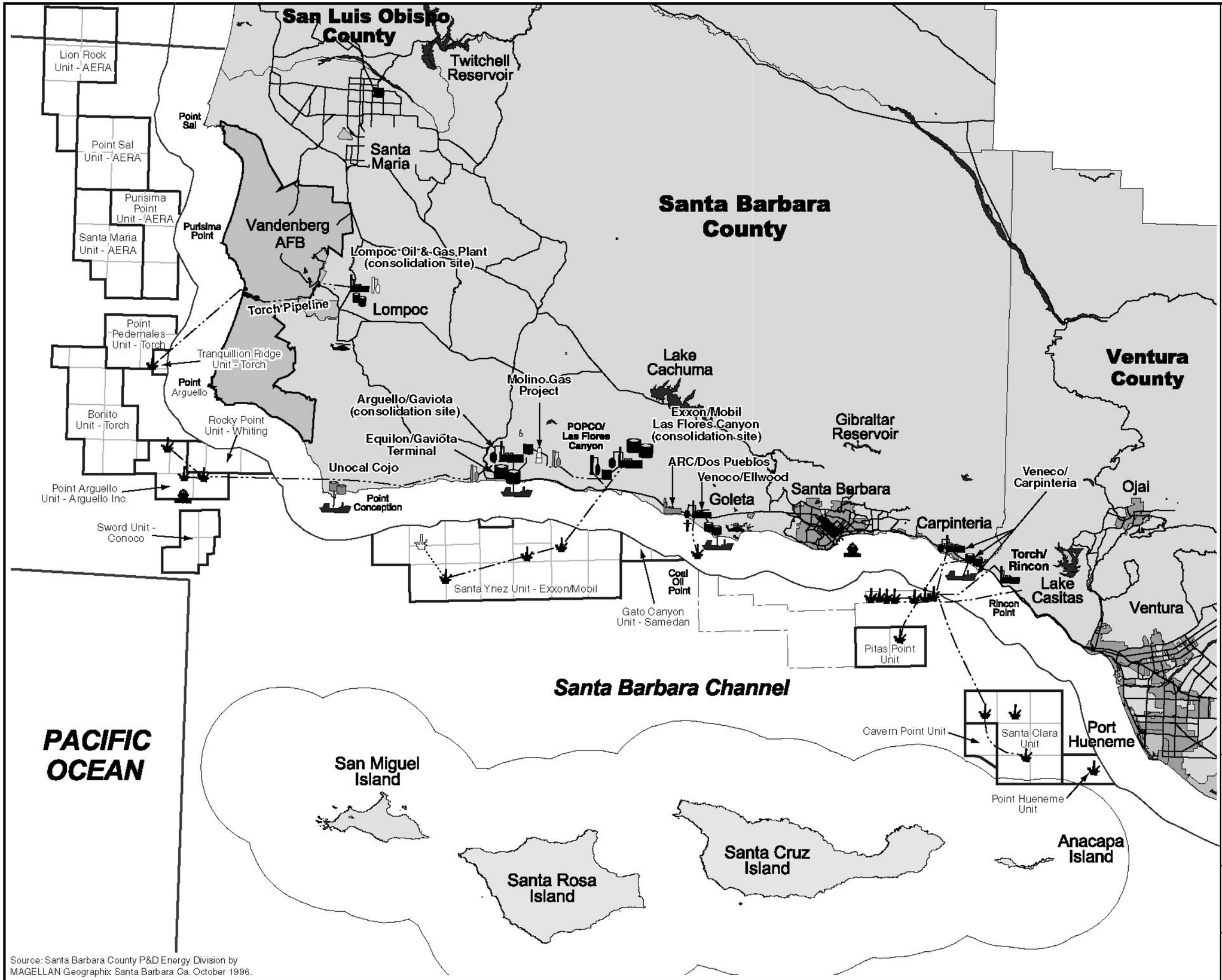

Source: Santa Barbara County P&D Energy Division by MAGELLAN Geographix Santa Barbara Ca. October 1996.

CINMS EIS STUDY AREA
FEDERAL OIL AND GAS LEASES

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TC#	DATE	DRAWN BY	FILENAME	FIGURE NO.
10871-01	8/30/05	IGE	GRAPHIC\ CHANNEL ISLAND\ 3.4-1oilgaslenew.ai	3.5-1

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A brief characterization of each developed oil and gas field follows:

- The Hueneme Field is located in the eastern Santa Barbara Basin approximately 4 miles southwest of Port Hueneme. The field is produced from Platform Gina, which is located approximately 6 miles from shore. This field is in a mature stage of development and production is declining.

- The Santa Clara Field is located in the eastern Santa Barbara Basin approximately 7 miles west of Oxnard. The field is produced from Platforms Gilda and Grace. Gilda is located approximately 10 miles from shore. Grace is located in the eastern Santa Barbara Basin, and is approximately 10 miles north of Anacapa Island. As of August 1998, the MMS indicated that the operator has shut in or plugged and abandoned all the production wells at Platform Grace. The Santa Clara Field is in a mature development stage and total production is declining.

- The majority of the West Montalvo Field is located onshore. The field extends offshore into the California state submerged lands. The field is produced from onshore wells, some of which are directionally drilled under the ocean. There are no platforms or drilling islands used to produce from these offshore reserves; the onshore wells produce from state leases.

- The Dos Cuadros Field is located in the eastern Santa Barbara Basin, approximately 6 miles southwest of Carpinteria. The field is produced from four platforms: Platform Hillhouse, A, B, and C. All platforms are located 6 miles from shore. The field has reached a mature stage and production at most wells is declining.

- The Carpinteria Offshore Field is located in the eastern Santa Barbara Basin, approximately 4 miles south of Carpinteria. The field is developed from both state and federal leases. Platforms Hope and Heidi, which were removed in early 1996, produced from the state leases. Platforms Hogan, Houchin, and Henry produce from federal leases. This field is mature and in an advanced stage of depletion.

- The Sockeye Field is produced from Platform Gail, approximately 11 miles west of Port Hueneme. This field has reached a mature development stage.

- The Pitas Point Field is a gas field and is produced from Platform Habitat, approximately 8 miles from shore. The field is in decline and has a limited future productive life.

- The Hondo Field is produced from Platforms Hondo and Harmony, both of which are in federal waters, approximately 6 miles from shore.

- The Pescado Field is produced from Platform Heritage, approximately 8 miles from Gaviota.

- The Point Arguello Field is located in the southern part of the Santa Maria Basin, approximately 6 miles from shore. Platforms Hermosa, Harvest, and Hidalgo are used to produce the field's oil.

- The Point Pedernales Field is located in the southern Santa Maria Basin, approximately 6 miles west of Point Pedernales. The field is produced from Platform Irene.

State Activities

Commencing in the 1920s, the California state legislature placed most of the California coast off limits to oil and gas leasing and development through a variety of oil and gas "sanctuary" statutes. However, large areas of the coast and submerged lands (0 to 3 miles offshore) remained unprotected. By 1989, the State Lands Commission filled in the remaining gaps in California "sanctuary statutes" and administratively foreclosed the possibility of new oil and gas leasing in state coastal waters, with few exceptions. This administrative sanctuary was later incorporated by the legislature in its comprehensive ban on new oil and gas leasing, through the California Coastal Sanctuary Act of 1994 (California Coastal Commission 1999). Pursuant to this California statute, all state coastal waters, except those under lease on January 1, 1995, are permanently protected from development.

State tide and submerged lands include the area from the mean high tide line seaward to the 3 NM boundary with the federal OCS. State leases in the Study Area yield 1,466 barrels (one barrel equals 42 gallons) of oil per day and 1,249 million cubic feet of gas per day (County of Santa Barbara Energy Division 2001). Figure 3.5-2 depicts the state oil and gas leases in the Study Area. The following describes these oil leases:

- The West Montalvo Field is located at the eastern end of the Study Area. The majority of the West Montalvo Field is located onshore; however, the field extends offshore into the California state tide and submerged lands. The majority of the production in the offshore portion comes from the Colonia Zone of the Sespe formation. The West Montalvo Field is produced from onshore wells, some of which are directionally drilled under the ocean ("offshore" wells). No platforms or drilling islands are used to produce offshore reserves.

  The offshore wells produce from state lease PRC-375 and the onshore wells (i.e., those producing from the onshore portion of the field) produce from state lease 3314 (MMS 2000).

- The Rincon Field is located in state waters and is composed of state leases PRC-145, PRC-410, PRC-427, PRC-429, and PRC-1466. Production is from the Pico formation and has essentially no sulfur or hydrogen sulfide in the crude or gas.

  As of August 1997, the field was being produced from two locations: a man-made drilling island located approximately 0.6 miles from shore in 45 feet of water on lease PRC-1466 and eight onshore wells drilled into state waters in leases PRC-145 and PRC-410. Rincon Island is a man-made drilling island that was constructed in 1958 and began production in 1960. The island has its own oil/water/gas processing capability and is connected to the mainland by an elevated causeway. The onshore facility that processes the production from the onshore "offshore" wells is located approximately 1.2 miles south of the point where the causeway reaches shore.

  Since 1995, the site has changed ownership and the current owner is evaluating methods for increasing production from the field including reworking and redrilling existing wells (MMS 2000). The initiated, proposed, and planned improvements (as of August 1997), may result in production higher than originally projected. However, given the relatively

small level of production from the facility, it is unlikely that the resulting production will have significant impacts on the operation of the facility or the subregion as a whole.

- The Carpinteria Field is located in the eastern Santa Barbara Basin about four miles south of Carpinteria and extends across the 3-mile limit separating the state and federal jurisdictions. The field covers portions of state leases PRC-3150 and PRC-4000 and federal leases OCS-P0166 and OCS-P0240. All production is from reservoirs in the Repetto Formation and is free of sulfur and hydrogen sulfide.

  The state leases were produced by the removed Platforms Hope and Heidi, which were both in lease PRC-3150. Platforms Heidi and Hope were removed in early 1996. The federal leases are being produced from Platforms Hogan and Houchin located in lease OCS-P0166 and by Platform Henry located in lease OCS-P0240. Oil and gas produced from these platforms is transported to the La Conchita Facility via pipelines from Platform Hogan with a landfall in Ventura County in the La Conchita area.

  The Carpinteria Field is a mature, fully developed oil field in an advanced stage of depletion (MMS 2000).

- The South Ellwood Field is located in state waters near Goleta and includes lease PRC-208, PRC-3120, PRC-3243, PRC-308, and PRC-309. Projected production is from the Rincon and Monterey formation.

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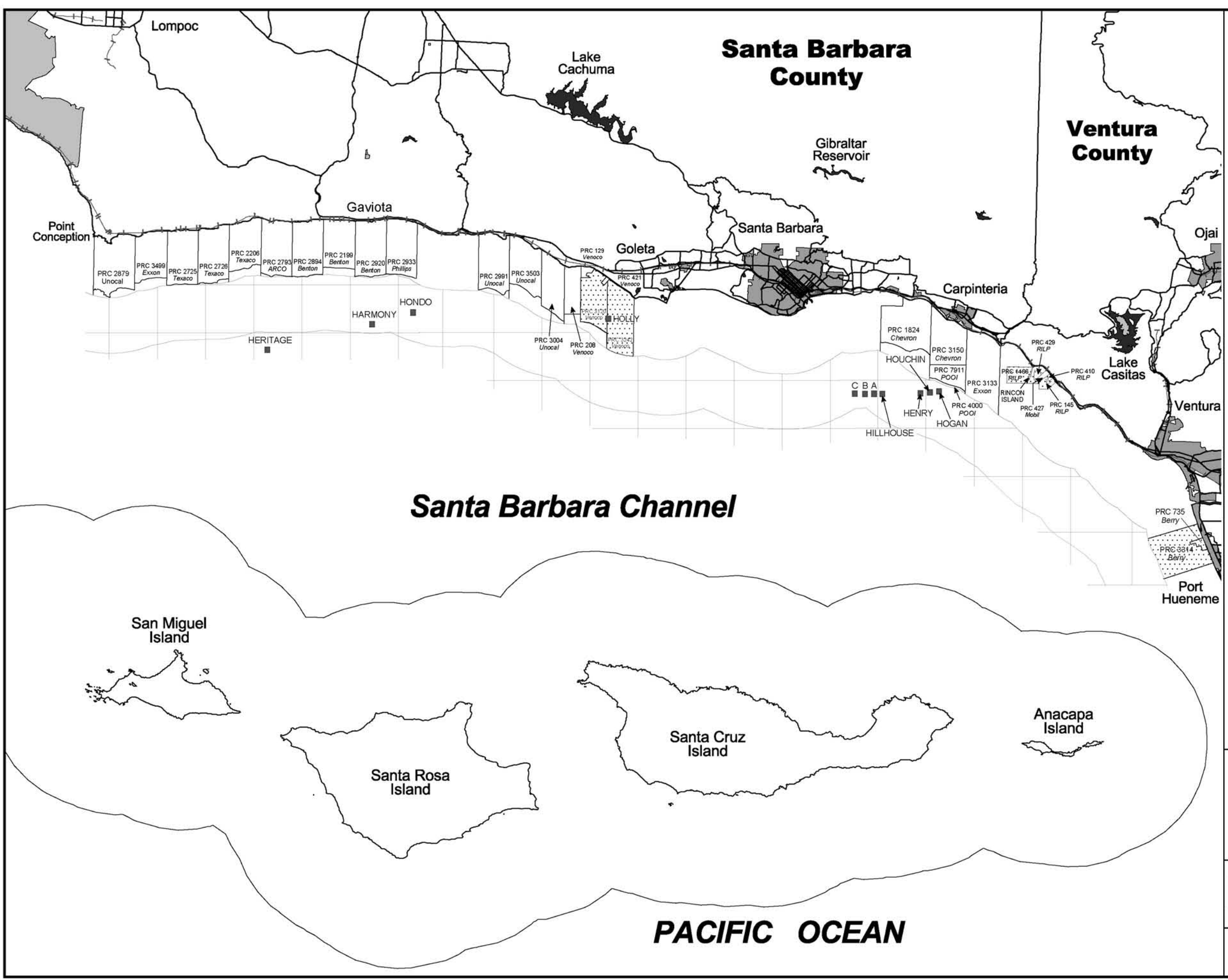

LEGEND

- ROADS
- STUDY AREA BOUNDARY
- RAILROAD
- LAKES
- LANDMARKS
- PLACES
- SANTA BARBARA CHANNEL ISLANDS
- COUNTIES
- LEASES CURRENTLY PRODUCING
- EXISTING CINMS BOUNDARY
- STATE OIL AND GAS LEASES
- OIL PLATFORMS

SCALE IN MILES
0 6 12

CINMS EIS STUDY AREA STATE OIL AND GAS LEASES

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Santa Barbara, CA 93110-2847

TC#	DATE	DRAWN BY	FILENAME	FIGURE NO.
10871-01	8/30/05	RANDALL	GRAPHIC:\ CHANNEL ISLAND\ 3.4-2O&Gleasenew.ai	3.5-2

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The South Ellwood Field is produced from Platform Holly, which is located in 211 feet of water on lease PRC-3242 approximately 2 miles from shore in California state waters. Platform Holly was installed in 1965 and production began in 1966.

In addition to the platform, a seep containment tent was installed in 1983 to collect gas from natural seeps and the gas is sent to the Ellwood Oil & Gas Processing Facility by pipeline. The South Ellwood Field is apparently in a mature level of development. The South Ellwood Field, Platform Holly and the associated infrastructure were sold to a new operator (Venoco) in August 1997 (MMS 2000).

Future Production

The MMS projected offshore oil and gas production from 1995 to the end of 2015 is shown in Table 3.5-2. OCS oil and gas production is projected to decline in the Study Area by the year 2015 (MMS 2000).

Table 3.5-2
Oil and Gas Production and Projections on the OCS

Year	Oil (MMSTB)	Gas (BCF)
1995	73.99	57.69
2000	48.65	83.15
2015	4.38	35.00

Notes: BCF - billion cubic feet
MMSTB - million stock tank barrels
OCS – Outer Continental Shelf
Source: MMS 2000.

The MMS (2000) notes that several platforms would likely be decommissioned within the next 25 years because they are nearing the end of their economic production.

Undeveloped Leases

The existing Congressional moratoria and Presidential leasing deferrals do not restrict development of federally leased areas. Thirty-six federal leases remain in a "non-producing" status. These 36 tracts were leased between 1968 and 1984 and are in the Santa Barbara Channel or the Santa Maria Basin. This means there are several undeveloped leases not producing natural gas and/or oil, although some of these leases have been explored.

The MMS may grant lease suspensions or extensions upon lessees' requests or directed suspension by the MMS Regional Director. When MMS receives a request for suspension, its options are to either approve or deny the request based upon the criteria in the MMS regulations. For a comprehensive review and summary of this issue, see California Coastal Commission (1999), *California Offshore Oil and Gas Leasing and Development Status Report.*

Table 3.5-3 depicts the federal leases that may be developable from existing or new platforms. If a federal lease does not have an existing platform nearby, there may be a need for a new offshore oil rig or platform to develop the lease.

Table 3.5-3
Federal Leases Developable from Existing or New Platforms

Unit Name	36 Undeveloped Federal Leases	Owner	Closest Existing Platform
Cavern Point	210, 527	Venoco	Gail and Grace
Gato Canyon	460, 464	Samedan	N/A
Sword	319, 320, 322, 323A	Conoco	Hermosa
Rocky Point	452, 453	Arguello Inc.	Harvest, Hermosa, and Hidalgo
Bonito	443, 445, 446, 449, 499, 500	Nuevo	N/A
Santa Maria	425, 430, 431, 433, 434	AERA	N/A
Purisma Point	426, 427, 432, 435	AERA	N/A
Point Sal	415, 416, 421, 422	AERA	N/A
Lion Rock	396, 397, 402, 403, 408, 414	AERA	N/A
(Non-Utilized)	409	AERA	N/A

Sources: California Coastal Commission 1999; Mayerson 2000.

3.5.1.3 Liquefied Natural Gas

There is a growing demand for natural gas in the United States, including California. The North American supply of natural gas is maturing, which means the United States will have to rely more on imported supplies. Natural gas is often imported in the form of liquefied natural gas, which is much more compact than the gaseous form, and therefore much easier to transport. In fact, one carrier load of liquefied natural gas is equal to 600 times the volume of natural gas shipped via pipeline (BHP Billiton 2003). In order to convert natural gas to its liquid form, it is cooled to minus 260 degrees Fahrenheit. During this cooling process the gas is purified, eliminating compounds like nitrogen, carbon dioxide, and hydrogen sulfides. The elimination of these compounds and other impurities enhances the clean-burning properties of the gas. Warming is required in order to convert liquefied natural gas back to its gaseous form.

Currently there are four liquefied natural gas receiving and regasification terminals in the United States, but no terminal is located on the West Coast (Marks 2003). Recently, several companies have proposed to locate liquefied natural gas import facilities in California (Marks 2003). Although there are no liquefied natural gas facilities within the CINMS, a couple of these facilities are proposed in adjacent locations within the Study Area.

In the 1970s, California's gas utilities were planning to build a liquefied natural gas import facility. They identified the Port of Los Angeles, Oxnard, and Point Conception as possible sites, all of which were outside the CINMS (Marks 2003). However, the three agencies involved in site approval could not agree on a preferred site. To address the conflict, at least at the state level, the project proponents turned to the legislature, which enacted the Liquefied Natural Gas Terminal Siting Act of 1977. Under this act the California Public Utilities Commission, with input from the California Coastal Commission and California Energy Commission, could approve one site. The California Public Utilities Commission chose Point Conception because of its remote location, but the proponents cancelled the project when liquefied natural gas became uneconomical. In 1987, the legislature repealed the Liquefied Natural Gas Terminal Siting Act, and no company has attempted to site a liquefied natural gas import facility on the

West Coast until recently. The current process for siting such facilities is unclear as a result of that repeal (Marks 2003).

BHP Billiton has proposed a liquefied natural gas facility named Cabrillo Port to be located 21.5 miles offshore of the City of Oxnard (BHP Billiton 2003), outside of the CINMS. This facility would consist of a floating storage and re-gasification unit (FSRU), which would be the receiving point for shipments of liquefied natural gas from ocean carriers. An FSRU is a floating vessel permanently moored offshore. Cabrillo Port would receive and store liquefied natural gas from ocean tankers. A process called re-gasification would then be used to convert the liquefied natural gas into its gaseous form, which would be transferred to the mainland via new pipelines that would connect to existing pipelines of the Southern California Gas Company at the Ormond Beach facility. Another type of liquefied natural gas facility involves the conversion of an offshore oil platform to accommodate liquefied natural gas storage and re-gasification. In March 2003, Crystal Energy signed a long-term lease agreement to use Platform Grace, located 11 miles offshore of Ventura County, as a liquefied natural gas facility (Crystal Energy 2003). This facility would receive liquefied natural gas from ocean carriers, store it, and convert it to a gaseous form before shipping it to land via existing pipeline corridors.

Potential impacts generated by a liquefied natural gas facility include impacts to air quality, the marine environment, visual resources, and traffic. Diesel-fired generators are the primary source of air emissions associated with liquefied natural gas facilities (Marks 2003). Diesel-fired generators are typically operated only during an emergency, therefore, under normal operating conditions, air emissions from the facility would be minimal. However, the U.S. Coast Guard (USCG) requires that vessels transporting liquefied natural gas generate their own electricity while they are in port. As a result, docked vessels transporting liquefied natural gas would generate air emissions from their diesel generators. Tugboats required to bring the vessels into port would also generate air emissions. However, in the case of an offshore liquefied natural gas facility, these impacts may not be generated, since vessels carrying liquefied natural gas would not be required to enter a port.

Liquefied natural gas facilities do not consume significant amounts of water or produce significant amounts of waste (Marks 2003). However, cold-water discharges are required in order to operate the heat-exchanger regasifications systems. These cold-water discharges could generate significant impacts to marine life. If dredging and filling activities were required to accommodate large tankers carrying liquefied natural gas, impacts to the marine environment could also be significant. Visual impacts and traffic impacts may also be generated by a liquefied natural gas facility.

Liquefied natural gas is a hazardous material; the primary safety concerns are the potential consequences of a liquefied natural gas spill (Marks 2003). Liquefied natural gas hazards result from three of its properties:

- Cryogenic temperatures;
- Flammability characteristics; and
- Dispersion characteristics.

The extreme cold of liquefied natural gas can directly cause injury to humans and, on contact with metals, such as ship decks, can cause immediate cracking. Exposure to the vapor cloud can cause asphyxiation due to the absence of oxygen. An ignited liquefied natural gas vapor cloud can cause extensive damage to life and property as well (Marks 2003). Spilled liquefied natural gas would disperse faster on the ocean than on land and vaporizes more quickly on water (Marks 2003).

3.5.1.4 Transfer of Oil and/or Gas to Shore

Pipelines

Although oil and locally produced gas may be processed on a platform, in most cases they are processed at an onshore facility. In the Study Area, most offshore oil and locally produced gas are transferred to either the Unocal Santa Maria Refinery in San Luis Obispo County or to the Chevron oil and gas plant at Gaviota in Santa Barbara County. Transfer takes place through either the 180 miles of pipeline or by vessel. New liquefied natural gas storage and re-gasification units would require new pipelines to the mainland.

Lightering

Lightering is a method of delivering foreign crude oil to United States refineries and importing petroleum products (NRC 1998). Lightering, per the NMSP program-wide regulations at 15 CFR sec. 922.3, means "at-sea transfer of petroleum-based products, materials, or other matter from vessel to vessel." Although no lightering currently occurs in or near the CINMS, the regulatory change under Alternative 1 (described in Chapter 2.0) would preclude this permanently; therefore, a discussion of this process is included in the following text.

Lightering becomes necessary when very large tankers, which are often used to move cargo from the Arabian Gulf and other distant sources of oil, are too wide and too deep to enter most United States ports. Transferring part or all of the cargo to smaller vessels for delivery to terminals is less expensive than moving all of the cargo the entire distance in a larger number of smaller vessels.

Lightering safety became a topic of national interest several years ago because of public concerns about oil spills in general (NRC 1998). The Coast Guard Authorization Act of 1996 requires that the USCG coordinate with the Marine Board of the NRC to conduct studies on the risks of oil spills from lightering off the United States coasts. Accordingly, an 11-member committee was assembled by the NRC, under the auspices of the Marine Board, to evaluate current lightering practices and trends, analyze the safety record, assess the regulatory and standards-setting framework, analyze accident prevention and risk reduction measures, and recommend technical and institutional improvements. The highlights of the one-year study and the committee's 16 recommendations are summarized below.

More than 25 percent of the 7.5 million barrels of crude oil imported into the United States each day is lightered (NRC 1998). Small amounts of refined products are also lightered. Approximately 95 percent of offshore lightering (i.e., between 12 and 200 NM off the United States coast), by volume, takes place in the Gulf of Mexico, according to government data. Additional offshore lightering takes place off Long Island, near the New Jersey and Virginia capes, off San Diego in California, and near the Bahamas. More than two-thirds of inshore lightering (i.e., within 12 NM of the coast), by volume, takes place on the East Coast, primarily in the Delaware Bay and River and Long Island Sound. The rest of the inshore lightering takes place on the West Coast, in San Francisco Bay. No known lightering takes place in the Santa Barbara Channel. The committee's estimates of the volume of oil involved in inshore lightering, combined with government data on offshore lightering, provide the most complete picture of United States lightering activity available to date. Although the projected increase of United States oil imports may lead to an increase in lightering, the committee expects that increases in the near term will be small and that current lightering patterns and volumes will remain fairly steady.

The vessel from which the cargo is removed is referred to as the ship to be lightered (STBL), and the receiving vessel is referred to as the service vessel. The STBLs and service vessels may either be owned

by an oil company or chartered on a long-term basis or for a specific voyage. The STBLs are typically large tankers. A number of United States companies are engaged solely in the lightering business and operate service vessels. Service vessels may be all-purpose tankers, tankers equipped specifically for lightering, integrated tug-barge units equipped specifically for lightering, or standard all-purpose tug-barge units.

The USCG data on lightering safety for 1984 to 1996 indicate that few spills occurred during lightering on United States coasts and, when a spill did occur, the average volume was only 26 barrels (1,095 gallons) (NRC 1998). Recurring causes of spills that appear to be directly related to lightering include valve failures, tank overflows, and hose ruptures. From 1993 to 1997, no spills were reported on the East or West coasts of the United States, and only seven spills (accounting for less than 0.003 percent of the total volume lightered) were reported in the Gulf of Mexico.

In an emergency, lightering may be needed within or adjacent to the CINMS. In accordance with the Oil Pollution Act of 1990 and 33 CFR Part 155, owners and operators of tank vessels are required to submit vessel response plans to the USCG for review and approval (U.S. Coast Guard 2003). These plans describe the preparedness arrangements made by the owners and operators for each Captain of the Port zone in which their tank vessel operates. These plans must include arrangements for a "qualified individual," a spill management team, and contracted response resources. Contracted response resources include designations of emergency lightering companies, oil spill removal organizations, and salvage and firefighting companies (U.S. Coast Guard 2003).

3.5.1.5 Decommissioning of Offshore Oil and Gas Platforms

To date, seven relatively small offshore oil structures have been removed from state waters of the Santa Barbara Channel. The most recent project occurred in 1996 when Chevron removed Platforms Hope, Heidi, Hilda, and Hazel. These platforms were in water depths ranging from 100 to 140 feet. One hundred and thirty-four wells were plugged and abandoned on these platforms. In order to remove the rigs and bring them ashore for recycling and disposal, explosives and heavy machinery were used to tear the rigs from their foundations. The biomass that accumulated around these OCS oil and gas structures was destroyed during the platform removal (MMS 1997). Shell mounds remain on the bottom of the sea floor from these structures.

Comprehensive reviews of the ecological, economic, and regulatory requirements associated with decommissioning are found in McGinnis *et al*. (2001) and Carr *et al*. (2003). Impacts from the removal of oil and gas platforms depend primarily on the methods and extent to which the structure is removed. Removal may lead to issues such as:

- Destruction of the biomass that has accumulated on and around a structure;
- Destruction of benthic habitat and re-suspension of sediments;
- Noise impacts on living resources from explosives;
- Interference with filter feeding functions of marine organisms;
- Loss of food sources;
- Disruptions in populations and migratory patterns of fish, invertebrates and marine mammals; and

- Lowered photosynthesis and oxygen levels.

3.5.1.6 Regulatory Setting

A complete characterization of the regulatory setting for OCS oil and gas activities is found in California Resources Agency (1997), *California's Ocean Resources: An Agenda for the Future*.

Federal OCS Oil and Gas Exploration, Development, and Production

The MMS leases the federal OCS as well as conducts environmental review, permit processes, and ongoing monitoring for specific proposals to explore for, or produce oil and gas resources.

The NMFS protects marine species that could be affected by oil and gas development, including most marine mammals and anadromous fishes, and conducts a consultation with the applicant to determine if the development would threaten the continued existence of any protected species pursuant to the federal ESA.

The U.S. Army Corps of Engineers (USACE) requires permits to locate any surface structures in navigable waters.

The USCG implements provisions of the Oil Pollution Act of 1990 and requires adequate provisions to prevent and respond to oil spills that could occur from these facilities.

The U.S. Environmental Protection Agency (U.S. EPA) regulates operational discharge requirements under the Federal Water Pollution Control Act (usually concerning the discharge of drill muds and cuttings) and air quality impacts under the Clean Air Act.

The USFWS protects certain species that could be affected by offshore oil and gas operations, such as southern sea otters, and conducts consultation with applicants to determine if the development would threaten the continued existence of protected species pursuant to the federal ESA.

State OCS Oil and Gas Exploration, Development, and Production

The California Coastal Commission conducts federal consistency review of federal permits or any federal activity that may "affect" the coastal zone, and issues coastal development permits for activities in state tidelands and within land portions of the coastal zone, if local governments have not assumed the land permitting role under the California Coastal Act.

The Division of Oil and Gas (Department of Conservation) provides technical assistance to the California Coastal Commission for federal consistency review of projects on the OCS and has direct regulatory authority over specified oil and gas operations in state tidelands or onshore.

The CDFG provides technical assistance to the California Coastal Commission for federal consistency review of projects on the OCS and has direct jurisdiction for protecting and managing the state's wildlife resources that could be affected by proposed projects.

The CDFG's Oil Spill Prevention and Response (OSPR) provides technical assistance to the California Coastal Commission for federal consistency review of projects on the OCS, works with the USCG and other federal agencies to improve oil spill prevention and response in federal waters, and is responsible

for the review and approval of oil spill prevention and contingency plans for marine facilities in California.

The State Lands Commission provides technical assistance to the California Coastal Commission on federal consistency reviews for projects on the OCS, leases state tidelands, administers lease agreements for oil and gas production activities on land, and, in the case of a production facility located in federal waters, would issue a right-of-way lease for any portion of the pipeline which crosses state tidelands.

The State Water Resources Control Board and Regional Water Quality Control Boards provide technical assistance to the California Coastal Commission on federal consistency reviews for projects on the OCS that include discharges into the water column, and administer the NPDES and Waste Discharge Requirements for discharges from facilities in state tidelands.

The Air Pollution Control Distrtict and local Air Quality Management Districts administer approved state implementation plans for air emission discharges from onshore oil and gas facilities within their jurisdiction and from facilities on the OCS if delegated such authority by the U.S. EPA.

Local Agency OCS Oil and Gas Exploration, Development, and Production

County Land Use and Environmental Quality Reviews maintain regulatory authority over all onshore facilities used to support offshore oil and gas developments, including zoning, building permits, coastal development permits in areas with approved local coastal plans and all other applicable permits.

While state and federal governments have direct management jurisdiction over their respective offshore jurisdictions, local governments have jurisdiction over the permitting of onshore production facilities associated with OCS oil and gas activities (e.g., processing plants, pipelines, supply bases, and marine terminals). Development in unincorporated county areas is regulated by a county's comprehensive general plan, local coastal program, and zoning ordinances. Although all the elements of the general plan apply to development within the coastal zone, the Local Coastal Program (LCP) (which includes the coastal plan, coastal zoning ordinance, coastal zoning district maps, and other implementing actions) addresses specific policies that supercede other general plan policies. The LCP identifies acceptable development in the coastal zone and clarifies local policies and requirements that implement the requirements of the California Coastal Act. Local governments with a certified LCP have coastal development permit authority in the onshore coastal zone area. Locally issued coastal development permits for major energy facilities can be appealed to the California Coastal Commission. Local resource management or planning agencies typically act as the lead agency for projects involving offshore facilities, even when these projects also involve components on state tide and submerged lands (MMS 2000).

Because offshore oil production is often dependent on onshore support facilities, county governments are active participants in the planning and permitting process. Although most county agencies only have jurisdiction for the onshore components of the project, revisions to the OCS Lands Act and the Clean Air Act delegate regulatory review responsibilities to Air Pollution Control Districts. Under some circumstances, local residents are also formal participants in the planning process because county-wide initiatives have been passed that require the vote of citizens to approve onshore support facilities (MMS 2000).

Liquefied Natural Gas

Federal, state, and local government permits would be required in order to build a liquefied natural gas receiving and regasification terminal in California. Based on recent power plant licensing experience, the California Energy Commission staff believe approximately 100 permits could be required for a liquefied natural gas facility in California (Marks 2003).

Federal Undeveloped Leases

In 2003, the U.S. Department of the Interior decided not to appeal a court decision that supported the state's earlier lawsuit against the federal government, and the dispute over whether the California Coastal Commission has jurisdiction to review consistency certifications for requests for suspensions of exploration, development, and production or operation of 36 undeveloped offshore oil and gas leases within the Study Area (California Coastal Commission 2003a). The Ninth Circuit Court of Appeals upheld the authority of the state of California to review the re-issuance of federal offshore oil and gas leases for consistency with the state's coastal management plan (Californa Coastal Commision 2003b). The future of the federal undeveloped leases remains unknown.

State Undeveloped Leases

Development of oil and gas resources on existing state leases in the Study Area is subject to the regulatory authority of the State Lands Commission. Development of resources on state tide and submerged lands involving facilities at onshore locations is subject to local agency authority, including local agency administration of the California Environmental Quality Act (CEQA) requirements and other land use controls. As the California lead agency for administration of the CEQA process, the State Lands Commission is responsible for coordinating with other regulatory agencies and the public through the CEQA environmental review process. The California Coastal Commission is another key commission involved in the review of development on state tide and submerged lands (MMS 2000).

Transfer of Oil and/or Gas to Shore (Lightering)

Various controls have been imposed on lightering (and tanker operators in general) by international agreements and U.S. laws and regulations (NRC 1998). The USCG oversees lightering operations outside port areas through six general mechanisms: vessel design requirements, operational procedures, personnel qualifications, oil spill contingency planning and equipment requirements, vessel inspection, and monitoring. Three separate sets of regulations have been promulgated by the USCG regarding lightering activities. One set applies to lightering in inshore waters. For this purpose, inshore waters means all waters inside of 12 NM from the coast, including all internal waters (i.e., lakes, bays, sounds, and rivers). The second set of regulations applies to lightering in all offshore waters, except for designated lightering zones. Offshore, for this purpose, means between 12 and 200 NM off the coast. The third, and most comprehensive, set of regulations applies in designated lightering zones more than 60 NM off the coast. The USCG does not regulate lightering in foreign waters or outside the U.S. EEZ. Technically, lightering in offshore waters is subject to regulation by the USCG only when the cargo is bound for a United States port. As a practical matter, though, all oil lightered in United States waters is bound for the United States. Under the comprehensive national lightering regulations, four areas are designated lightering zones (offshore) in the Gulf of Mexico.

In general, lightering is performed with the local USCG captain of the port exercising regulatory authority (NRC 1998). The regulatory regime for lightering is widely regarded as adequate, with one notable exception. Vessels sometimes have to maneuver excessively or separate prematurely to comply with a

legal provision that requires certain vessels to remain within designated lightering zones in the Gulf of Mexico except in emergencies.

Industry guidelines for lightering have been established by at least two industry groups, and most individual companies have developed their own internal guidelines (NRC 1998). A set of comprehensive minimum standards for offshore lightering, now in its third edition, has been developed by the Oil Companies International Marine Forum (OCIMF), an international group of vessel owners and charters. The guidelines contain advice on lightering procedures and arrangements, as well as specifications for mooring, fenders, and cargo transfer hoses. In the United States, a supplement to the OCIMF guidelines was developed by the Industry Taskforce on Offshore Lightering, a cooperative organization that promotes industry self-policing and, in partnership with the USCG, continuous improvement in lightering in the Gulf of Mexico. The OCIMF guidelines are also widely used for U.S. inshore lightering (NRC 1998). General standards for inland shipping have been established by the American Waterways Operators, but no separate lightering standards have been established for inland trade despite its unique characteristics, such as the extensive use of barges and the frequent transport of specialized refined products.

Decommissioning of Offshore Oil and Gas Platforms

As of 2003, international, federal, and state law requires the complete removal of California OCS oil and gas structures (McGinnis 1998, 2003; McGinnis *et al.* 2001). A brief overview of the regulatory compliance requirements follows:

- *MMS* is responsible for implementing Federal law (30 CFR 250) which requires the plugging and abandonment of wells; full removal of well conductors and platform jackets to 15 feet below the mudline; decommissioning and full removal of platform decks; decommissioning and removal of pipelines and power cables as appropriate; and site clearance.

- *California Department of Conservation, Division of Oil, Gas and Geothermal Resources* is responsible for establishing the basic plugging requirements found in the California Code of Regulations Title 14 Division 2, Chapter 4, Section 1745.

- *State Lands Commission* is also responsible for establishing the basic plugging requirements found in the California Code of Regulations Title 2 Section 2128(q).

There are also lease and permit requirements that must be met during decommissioning of offshore oil and gas structures. The CDFG, the agency with oversight over the state's artificial reef program, has policy guidelines in place for artificial reefs with a preference for those structures that provide "good" habitat.

The framework of the National Fishing Enhancement Act of 1984 (33 U.S.C. 2101 *et seq*.), as amended, provided broad discretionary authority to states to develop rigs-to-reefs programs. This act created the National Artificial Reef Plan, which identifies OCS oil and gas structures as potential materials for development of offshore artificial reefs. Gulf of Mexico states have developed rigs-to-reefs programs in accordance with the act (Carr and McGinnis 2003; McGinnis *et al*. 2001; McGinnis 2003). However, it is important to note that the ecology and socioeconomic characteristics of Gulf states are very different from those off southern California (McGinnis 2003). Since the late 1990s, several California Senate bills have proposed the use of a rigs-to-reefs option for offshore oil rigs (McGinnis *et al*. 2001).

Provisions of MMS regulations provide the flexibility to allow MMS to consider and approve methods of rig decommissioning other than complete removal, as evidenced in the Gulf of Mexico. MMS may waive the removal requirement under special circumstances, including the following: (1) proper permits from the U.S. Army Corps of Engineers, (2) siting meets USCG requirements, and (3) the state accepts liability and holds the permit for the structure under its artificial reef program. MMS's stated policy towards the rigs-to-reefs alternative is as follows, "The MMS supports and encourages the reuse of obsolete offshore petroleum structures as artificial reefs in United States waters" (McGinnis *et al.* 2001).

3.5.2 Fiber Optic Telecommunication Cables

Fiber optic telecommunications cables are increasingly used to meet the growing demand for better productivity and quality in telephone, internet, and data transmissions. As a result, the number of project proposals and specific permit requests for laying cables in marine and coastal environments has been increasing at a tremendous rate (U.S. EPA 2003). Currently, no fiber optic telecommunication cables occur or have been proposed in the CINMS.

The NMSP has issued two special use permits to allow telecommunications companies to maintain fiber optic cables beneath the seafloor within the Olympic Coast National Marine Sanctuary (two cables permitted in November of 1999) and Stellwagen Bank National Marine Sanctuary (one cable permitted in June of 2000) (Department of Commerce 2003). An additional fiber optic cable is present within the Olympic Coast Sanctuary; however, this project was completed before the NMSP had examined the issue of fiber optic cable placement within sanctuaries (NOAA 2003).

There is evidence that the seafloor topography and rocky substrates offshore of California can preclude complete burial of fiber optic cables. No fiber optic cable projects that the California Coastal Commission has reviewed and approved have been 100 percent buriable (California Coastal Commission 2003c). Cable burial is important because it prevents potential entanglement of bottom-feeding whales, and prevents loss or damage to fishing gear.

3.5.2.1 Regulatory Setting

There currently are no specific regulations on installation of fiber optic cables in marine and coastal environments; however, each proposed project for installation of a fiber optic cable must undergo NEPA and/or CEQA review. In addition, each project must be approved by the various trust agencies of the land which the cable must pass. Finally, a Coastal Consistency Certification must be prepared and approved by the California Coastal Commission to ensure the project's consistency with an area's coastal plans and policies.

3.5.3 Vessel Traffic and Harbors

3.5.3.1 Vessel Traffic

The expansion of the global economy has resulted in a substantial increase in international vessel traffic through the Santa Barbara Channel. The CINMS is located about 70 miles northwest of the Port of Long Beach-Los Angeles. The Port of Long Beach-Los Angeles (Port) is the busiest container port in North America (Port of Long Beach 2003). The containerized trade at the port has grown 150 percent since 1990, and the Santa Barbara Channel is a main thoroughfare. An assessment of shipping patterns from January 1 through August 31, 2000 indicates that a majority of vessels that entered California ports were container vessels. Nearly 45 percent of the vessel calls identify a last port of call as Far East ports such as Japan, China and Korea, while 20 percent of the vessel calls originated from Pacific North American

ports in Canada and Mexico and 13 percent called at a South American port prior to arriving in California (California State Lands Commission 2000). Approximately 75 percent of the departing vessel traffic leaves northbound and 65 percent of arriving vessel traffic comes southbound, passing through the Study Area (this accounts for an average of 6,500 cargo vessels that travel through the Santa Barbara Channel each year).

According to the *Port of Long Beach Master Plan*, the Los Angeles Port Authority plans to expand capacity of the harbor, which will increase both the number and size of the vessels that use the Santa Barbara Channel (Port of Long Beach 2003). The Los Angeles Port Authority plans to increase capacity by 100 percent by the year 2020. The size of the commercial vessels that use the Santa Barbara Channel is expected to increase, with the 4,000 to 4,999 twenty-foot equivalent units (TEU) class being the predominant size class by 2020 (USACE 1984). The expected tonnage carried by commercial vessels is also expected to increase from 75 million tons in 1980 to 202 million tons by the year 2020 (Temple *et al.* 1988; USACE 1984).

Port Hueneme, the only deep-water international port in the Study Area, also generates vessel traffic. In 2000, 391 cargo vessels arrived or departed from Port Hueneme (Oxnard Harbor District 2002). Each year, approximately 158 supply vessel trips are made each year to regional oil and gas facilities (Oxnard Harbor District 2002). Total commercial vessel traffic is approximately 8,000 vessels per year, or an average of 21 vessels per day.

To help direct offshore vessel traffic in the Santa Barbara Channel, a Vessel Traffic Separation Scheme (VTSS) was designated in the Study Area to separate opposing flows of vessel traffic into lanes, including a zone between lanes where traffic is to be avoided. Vessels are not required to use any designated VTSS, but failure to use one would be a major factor for determining liability in the event of a collision.

The VTSS for the Santa Barbara Channel is depicted in Figure 3.5-3. CINMS is one of only two internationally accepted "areas to be avoided" (ATBAs) for oil tankers on the Eastern Pacific. As a result, oil tankers often voluntarily reroute to the outer Santa Barbara Channel. This reduces the number of oil tankers in the Santa Barbara Channel to insignificant levels, but these vessels still travel in the Study Area. In addition, many other hazardous materials are transported through the Channel.

Data from the CDFG's OSPR suggest routing vessel traffic 50 miles offshore significantly reduces the chance of oil impacting the coast. Although the USCG has no proposal for vessel routing off central California, the Western States Petroleum Association (WSPA) has volunteered to route all tankers carrying crude oil 50 miles offshore. A survey by the WSPA found almost 90 percent of tankers were 25 miles off the coast and nearly 50 percent were 50 miles or farther from the coast. This voluntary agreement does not apply to all carriers of hazardous materials.

Vessel Accidents

Potential accidents involving commercial vessels passing through the Study Area include collisions between vessels or between a vessel and an offshore oil/gas facility, groundings, and structural or operational difficulties taking place on a vessel with hazardous cargo (County of Santa Barbara Energy Division 1989). The northern extent of the Santa Barbara Channel VTSS ends at Point Conception, where vessels must depart from or merge into the VTSS as they change course with limited visibility around the point (County of Santa Barbara Energy Division 1989). The VTSS continues to the south, but it turns at the eastern end of the channel where visibility is again limited by offshore facilities and the Channel Islands (County of Santa Barbara Energy Division 1989). Three areas within the Santa Barbara Channel present the greatest risk of collisions between ships: the western end of the VTSS, the eastern

turn of the VTSS, and the intersection of the VTSS and the access lane to the Exxon Terminal (County of Santa Barbara Energy Division 1989). There are also three areas within the channel where groundings are considered most likely to occur: at Point Conception, landward of the Exxon Consolidated Marine Terminal, and eastern Anacapa Island (County of Santa Barbara Energy Division 1989). The coastline north of Point Conception has caused many groundings as well. According to the County of Santa Barbara Energy Division (1989), the risk of collisions is greater than the risk of groundings, which is considered quite low. The potential for collisions with oil facilities is greatest near Anacapa Island, where there is one platform within one mile and several platforms within 4 miles of the north lane of the VTSS. Statistically, smaller vessels have higher accident rates than the large supertankers.

The primary mechanism for damage to marine ecosystems with vessel accidents is spilled oil, which is carried on all vessels in varying amounts as fuel, cargo, or both (County of Santa Barbara Energy Division 1989). Non-tanker vessels, such as large cargo vessels, carry large volumes of bunker fuel used for propulsion. Bunker fuel is an extremely heavy oil, very similar to crude oil. Vessel fuel capacity ranges from 10,000 to 1.2 million gallons (NOAA 1998). The most common oil spills are those involving fewer than 50 barrels (County of Santa Barbara Energy Division 1989). Oil spill statistics for California and the United States confirm that the probability of a large oil spill is low in comparison to the amount of oil shipped. Although the probability of a large spill is low, the impact could be catastrophic due to the potential size of a spill (NOAA 1998). A corollary hazard to marine accidents is the potential for the spilled oil to ignite, creating thick smoke and soot, and hampering spill cleanup activities (County of Santa Barbara Energy Division 1989).

SOUNDINGS IN FATHOMS

18720
LORAN-C OVERPRINTED

NORTHBOUND COASTWISE TRAFFIC LANE

SEPARATION ZONE

SOUTHBOUND COASTWISE TRAFFIC LANE

UNITED STATES - WEST COAST
CALIFORNIA

POINT DUME TO PURISIMA POINT

SOUNDINGS IN FATHOMS AT MEAN LOWER LOW WATER

LORAN LINEAR INTERPOLATOR

Not For Navigational Use

SOUNDINGS IN FATHOMS

(Point Dume to Purisima Point)

18720
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CINMS EIS STUDY AREA
VESSEL TRAFFIC SEPARATION SCHEME

Tetra Tech, Inc.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TC#	DATE	DRAWN BY	FILENAME	FIGURE NO.
10871-01	8/30/05	IGE	GRAPHIC:\ CHANNEL ISLAND\ 3.4-3vesseltrafnew.ai	3.5-3

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Oil released during a vessel accident may include fuel oil used to power the vessel and/or cargo oil. These oils behave and affect the environment in different ways. Heavier petroleum products, crude oil, and bunker fuel last longer but are less toxic. Heavy crude oil tends to be very sticky, adhering to fur, feathers, and skin of mammals and birds, and harming the environment with its physical properties. In contrast, light petroleum products typically evaporate quickly but are more toxic. Volatile compounds in oil can burn eye, nose, and mouth membranes of various marine animals. Lighter hydrocarbons (benzene, propane, and toluene) enter the bloodstream and damage red blood cells, immune system, liver, kidneys, spleen, and the reproductive organs.

Oil, however, is not the only type of hazardous cargo transported through the study area. A recent example of a toxic, non-oil accident in the Study Area was the cargo vessel *Pacbaroness*, which collided with the car carrier *Atlantic Wing* off Point Conception in 1987. A relatively small amount of fuel entered the environment, but of greater concern was the cargo of 23,233 tons of powdered copper ore, which is toxic to marine organisms.

Initial surveys of the *Pacbaroness* shipwreck were completed in 1987 and 1988. The shipwreck was not revisited until 2002, when the site was visited as part of NOAA's exploration cruise known as *Sanctuary Quest: West Coast Expedition 2002*. During the 2002 survey, abundant marine life was found around the shipwreck, indicating the presence of a diverse marine life community (CINMS 2003). Bottom sediment was observed to have built up around the shipwreck, possibly encapsulating the spilled cargo. Sediment samples were collected around the shipwreck in order to determine the extent of the copper contamination and are being analyzed (CINMS 2003).

Vessel Strikes with Wildlife

A direct result of vessel traffic is the possibility of collision with marine mammals. Although NMFS maintains records of ship strikes, many such incidents go unreported, as evidenced by the number of stranded cetaceans, pinnipeds and sea otters with obvious propeller slashes or blunt force trauma suspected to have been caused by ship strikes. Even though reporting such incidents is required in U.S. waters, few ship strike reports are actually received.

West coast stranding records have revealed ship strikes involving the following species (Caretta *et al.* 2002; Laist *et al.* 2001; NMFS 2003a; Rugh *et al.* 1999; Scarff 1986):

- Sperm whales;
- Northern right whales;
- Gray whales;
- Blue whales;
- Fin whales;
- Minke whales;
- Humpback whales;
- California sea lions;

- Pacific harbor seals;
- Northern elephant seals;
- Southern sea otters;
- Leatherback sea turtles; and,
- Green sea turtles.

According to Caretta *et al* (2002), stranding records are a gross underestimate of injury and mortality. Not only do many ship strikes go unreported, but also many animals wash ashore in which ship strikes are suspected because of blunt force trauma, yet this cannot be proven. In addition, many species of whales are observed with apparent propeller slashes and other wounds consistent with ship strike, but these cannot be proven, either. In many cases, ship strikes are reported, but the species of marine mammal is not known. It is probable that ship strikes have occurred involving other species. Data from 58 well-documented ship strikes used in the first worldwide survey indicate significant impacts from ship strikes (Laist *et al*. 2001).

According to Laist *et al.* (2001), eleven species of whales have been documented worldwide as victims of ship strikes. Fin whales are hit most frequently, with right whales, humpback whales, sperm whales, and gray whales the other most common victims. Most ship strikes occur in coastal waters off the continental shelf, in areas with high concentrations of vessel traffic and whale populations. Although all types of vessels can hit whales, size and speed are the most important variables in assessing the potential for a fatal collision, according to Laist *et al.* (2001). Most lethal or severe ship strikes occurred with vessels over 80 meters in length. Of lethal or severe ship strikes, 89 percent were caused by ferries traveling at speeds over 12 knots, cargo ships over 14 knots, or cruise ships over 29 knots.

The majority of in-transit cargo vessels travel through the Santa Barbara Channel at speeds greater than 14 knots. During their migrations, many gray whales cross the shipping lanes, potentially needing to navigate around large commercial vessels each day. During the late summer and fall months, the Santa Rosa and San Miguel escarpment, just south of the shipping lanes, is heavily populated by blue and humpback whales. Finally, the region between the northern and southern Channel Islands is frequented by gray, blue, humpback, and fin whales. This concentration of whales and ships makes the potential for collisions between the two high throughout much of the Study Area.

NOAA Fisheries data indicate that ten suspected incidents of vessel collisions with whales were reported between January 1983 and May 1998 within or in close proximity to the Santa Barbara Channel (California Marine Mammal Stranding Network Database). While in most cases it is almost impossible to determine the actual location of a collision, these incidents are thought to have occurred within or in close proximity to the Santa Barbara Channel. Involved in these collisions were three species of whales including: gray (4), fin (3), blue (1) and unidentified (2). (There have been no records of ship strikes with northern right whales in the CINMS or in California.) The collisions resulted from various vessels types including: three Navy vessels, three freighters, and one whale-watching vessel. The remaining three incidents were stranded whales that bore propeller lacerations that were assumed to have been a consequence of collisions with unidentified vessels. Whales with definite propeller slashes have stranded along the mainland coast of Santa Barbara, Ventura, and Los Angeles counties, along with whales showing massive blunt force trauma. In addition, ships have arrived in the port of Los Angeles-Long Beach with dead rorquals draped over their bows. The bulbous protuberance common to modern vessels, which juts forward underwater from the bow, apparently traps some animals as they are struck. The

bulbous bow also drastically reduces the bow wake generated from such vessels, providing much less warning of a vessel's approach.

Most vessel strikes involving pinnipeds and sea otters appear to involve small, fast boats. Propeller slashes on such animals have been proportionately small, and collision reports have come from small vessels (NMFS 2003a). Also, such animals are often concentrated in shallow coastal waters where small craft abound.

There has been direct evidence of vessel strikes with sea turtles. Stranding records show evidence of vessel strikes with leatherback and green sea turtles primarily. (NMFS 2003(a)).

Vessel Air Emissions

Vessel traffic also plays a significant role in influencing air quality in the Study Area and throughout all of coastal Southern California. Emission inventory data are divided into two geographic regions in the Study Area, Santa Barbara County and the OCS. The Santa Barbara County emission inventory includes all onshore sources of air pollution in Santa Barbara County and in the state tidelands (within 3 miles of the shoreline) and is part of the South Coast Central Coast Air Basin. This basin also includes San Luis Obispo and Ventura counties. The OCS is its own air basin, and includes pollution from sources offshore of Santa Barbara County beyond the 3 mile state tideland boundary (Santa Barbara County Air Pollution Control District [SBCAPCD] 2003a).

The SBCAPCD is responsible for "implementing state and federal air pollution control laws in order to attain all ambient air quality standards and to minimize public exposure to airborne toxins and nuisance odors" (SBCAPCD 2003c). In order to accomplish this goal, the SBCAPCD issues clean air plans, adopts rules and issues permits to limit air pollution, inspects businesses to ensure compliance, monitors the County's air quality, reviews and implements new technologies to help clean the air, works with other government agencies to ensure their actions and decisions do not degrade air quality, responds to complaints and inquiries, provides information to the public, educates the public, and helps both businesses and individuals understand and comply with federal, state, and local air pollution laws (SBCAPCD 2003c).

Effective August 8, 2003, Santa Barbara County was reclassified by the U.S. EPA to attainment status for the federal one-hour ozone standard (SBCAPCD 2003b). The County had violated the federal one-hour ozone standard since 1970, when the SBCAPCD first began monitoring air quality. Since the Clean Air Act Amendments of 1977, the County has been classified in nonattainment of the federal one-hour ozone standard (SBCAPCD 2003b). In addition, the County was reclassified from a "moderate" ozone nonattainment area to a "serious" ozone nonattainment area in 1997, because although the air quality was improving, it was not improving quickly enough. Although Santa Barbara County was reclassified to attainment status for the federal one-hour ozone standard, it is still in violation of the state ozone standard, which is stricter than the federal standard. The SBCAPCD has released a clean air "Maintenance" Plan, which shows how the County will continue to be in attainment of the federal standard, and work towards attaining the state ozone standard (SBCAPCD 2003b).

The 1999 Annual Emission Inventory for the OCS estimates that 3,033 tons per year of reactive organic gases (ROG) and 10,612 tons per year of nitrogen oxides (NO_x) were emitted (ROG and NO_x are precursors of ozone). Of the 1999 ROG emissions, 12 percent (377 tons) was from stationary sources (oil and gas production), 22 percent (651 tons) was from mobile sources (marine offshore vessels), and 66 percent (2,004 tons) was from natural sources (gas and oil seeps) (SBCAPCD 2003). Of the 1999 NO_x emissions, 2 percent (255 tons) was from stationary sources (natural gas turbine engines involved in oil

and gas production) and 98 percent (10,356 tons) was from mobile sources (marine offshore vessels) (SBCAPCD 2003). More recent data for emissions from offshore marine vessels are also available. In 2000, marine vessels emitted 782 tons of ROG and 12,267 tons of NO_x (Petrini 2003). In 2001, marine vessels emitted 373 tons of ROG and 11,972 tons of NO_x (Petrini 2003). Although these data show a decrease in marine vessel emissions between 2000 and 2001, differences in data collection methodology likely account for these differences (Petrini 2003). The emissions data are summarized in Table 3.5-4.

Table 3.5-4
Summary of OCS Annual Emissions Generated by Marine Offshore Vessels

Year	ROG (tons/year)	NO_x (tons/year)
1999	651	10,356
2000	782	12,267
2001	373	11,972

Note: The decrease in emissions between 2000 and 2001 is likely due to differences in data collection methodology (Petrini 2003).
Sources: Petrini 2003; SBCAPCD 2003.

As evidenced by the annual emission inventory data, offshore marine vessels generate a significant amount of air pollution in the Study Area. Engine exhaust from vessels generates ROG and NO_x, but also carbon monoxide, sulfur, and particulate matter. Cruise ships, ferries, and naval vessels also routinely incinerate non-hazardous waste such as paper and plastics (NRC 1996). Few data are available regarding shipboard incinerator emissions. Analysis of emissions from incinerators on a 2,000-passenger ferry and a 3,500-passenger cruise ship indicate that such incinerators are sources of carbon monoxide, carbon dioxide, hydrogen chloride gas, NO_x, sulfur oxides, lead, and other metals (NRC 1996). The majority of heavy metal pollutants (cadmium, copper, lead, zinc, and iron) that enter the marine ecosystem come from airborne sources (Group of Experts on the Scientific Aspects of Marine Pollution 1990); some of these heavy metals may build up in the food chain, reaching toxic levels in predators.

MARPOL Annex VI on air emissions (which entered into force on May 19, 2005) addresses shipboard incineration, but the US has not ratified it. The Coast Guard has promulgated regulations on shipboard incineration that follow International Maritime Organization guidance, but are not as stringent as MARPOL Annex VI. California State Assembly Bill 471 was signed on June 4, 2003, to prohibit cruise ships from using onboard incinerators within 90 miles of the California coast and require the vessels to burn only California highway diesel within 25 miles of the California coast. The bill was approved by the Governor on September 23, 2004 and is now part of California Health and Safety code (Division 26, Part 2, Chapter 3.3, commencing with Section 39630).

Emissions from marine vessels may remain concentrated because air does not mix as well over water as over land (NRC 1996). This is because the heat flux over water is weak compared with that over land. The depth of mixing over water is relatively low, about 1,600 feet (500 meters) above low-latitude oceans. A mixing depth of about 300 feet (100 meters) was reported in studies designed to test offshore and coastal dispersion (NRC 1996). Shallow mixing depths can trap emission plumes and lead to high local concentrations of pollutants (NRC 1996).

Vessel Noise

Considerable low-frequency noise (sound below 1,000 hertz) is generated by human activities, and ships are the principal source of low-frequency anthropogenic noise in the Study Area. Some marine mammals vocalize and/or hear at lower frequencies, particularly mysticetes (whales) and pinnipeds (seals and sea

lions). Most odontocetes (beaked whales) vocalize at predominately higher frequencies; however, some species may vocalize or hear at lower frequencies as well. Shipping noise is transitory in intensity, slowly building as a vessel approaches, and fading after it passes. Considering this, it is extremely unlikely that a marine mammal could suffer injury or death from such noise, since it is improbable that a marine mammal, given adequate warning, would or could remain close enough to a transitory noise to cause damage. Sudden impulse power noises, such as those generated by geophysical airguns, underwater detonations, mid- and low-frequency sonar, and pile-driving activities, can cause injury or death if the sound is sufficiently loud.

Vessel noise can affect marine animals in subtle ways, however. All marine mammals rely on sound for communication and for detecting predators and prey. In the case of odontocetes, sound is also used for echolocation. Sounds that mask communications and make it difficult to hear predators and prey can adversely impact marine mammals. Several mysticetes emit low-frequency sounds that can be heard hundreds of miles away. Pervasive low-frequency sounds generated by shipping activities can mask such communications. At closer ranges, shipping noise can be sufficiently loud to drown out higher frequency signals. Also, the frequency spectrum of shipping noise is broader near the source, meaning higher frequency sounds can be emitted as well. Small craft generally have faster turning propellers and generate sounds in higher frequencies that can mask the echolocation sounds of odontocetes at closer ranges.

Another danger from shipping noise is habituation. When animals become habituated to the incessant drone of passing ships, they no longer perceive such sounds as threats. This may explain why ship strikes occur when they would appear avoidable. Moreover, the bulbous underwater bow section of modern ships was designed to minimize the bow wake of such vessels. The smaller the bow wake, the more swiftly and efficiently a vessel can move through the water. But the smaller the bow wake, the less noise such a vessel makes. Modern ships can stretch some 400 meters in length. If the bow wake is silenced, especially when whitecaps and other natural sounds mask the sound of the bow wake, the danger may not be perceived in time. The propeller is the loudest noise source on a ship, and it can be 400 meters from the bow.

Other effects include masking of important predator-prey cues, altering migration patterns or abandonment of important habitats, and negative effects on energy and physiology (Ketten 1998; Scheifele 2000). Fish and invertebrates may experience damage to eggs, reduced reproduction rates, and physiological or morphological damage from noise impacts (Lagardère 1982; Myerberg 1990; Hastings 1991).

Vessel Discharge

Although generally no type of pollutant discharge or dumping is permitted in CINMS waters, pollutant activities that occur legally farther offshore may still negatively impact the marine ecosystems of the CINMS. The International Convention for the Prevention of Pollution from Ships (MARPOL) was created in 1973 to regulate marine debris including oil, chemicals, harmful substances in package form, and sewage and garbage, that enter the marine environment from either accidental or operational causes. Routine and often legal oil discharge is a significant marine source of oil contamination in the ocean, as much as five times greater than catastrophic, accidental oil spills. The mandatory regulations for hazardous liquid are less stringent than oil. The MARPOL annex on sewage has not been ratified, so although there is no legal discharge of untreated sewage inside CINMS, there are no restrictions on sewage discharge outside the CINMS more than 3 NM from shore. While effects of dumping raw or under-treated sewage in smaller, closed ecosystems are better understood, the effects on large-scale ocean processes are unknown.

Disposal of food waste into CINMS waters beyond 3 NM from land is currently allowed as long as the waste is ground up to pieces smaller than 1 inch under the Act to Prevent Pollution from Ships; this act implements MARPOL.

Two California State Assembly Bills were recently signed on September 24, 2003, Assembly Bill 906 and Assembly Bill 121, to prohibit cruise ships from dumping graywater and hazardous wastes into state waters and prohibit cruise ships from discharging raw sewage or treated sewage, sewage sludge, oily bilge, and ballast water into state waters, respectively.

Ballast Water Exchange and Other Management

Ballast water from ships is a major source of the introduction of non-native species. Over 80 percent of the world's commodities are transported via ships, resulting in an annual transfer of an estimated 10 to 12 billion tons of ballast water across the globe (Global Ballast Water Programme 2003). The World Resources Institute estimates that every day, 3,000 aquatic species are transported around the globe in the ballast water of ships (World Resources Institute 2003). It is estimated that between 5,000 and 50,000 exotic species have been introduced into the United States with approximately 15 percent of these species becoming established (National Invasive Species Council 2001).

Nearly 4.6 million metric tons of ballast water were discharged into California ports between January 1 and August 31, 2000. Nearly 50 percent of those vessels discharging ballast in California originated from Pacific Rim ports (e.g., Japan, China, North and South Korea), while 30 percent came from Mexican ports (California State Lands Commission 2000).

Ballast water can contain four kinds of organisms: (1) plankton (2) nekton (3) benthos, and (4) fouling organisms. Many of these organisms are transported in their larval stages. Viruses and bacteria have also been detected in ballast water. All major and most minor phyla have been found in ballast water, averaging over 7,000 species relocating every day (Carlton 2001). Non-native species may become a new form of predator, competitor, disturber, parasite, or disease that can have devastating effects upon ecosystems. Changes in species interactions lead to disrupted nutrient cycles and altered energy flows that ripple with unpredictable results through the entire ecosystem. Section 3.5.5 describes in more detail issues associated with the introduction of exotic species in the CINMS.

The current technique for managing ballast water is an at-sea exchange of ballast water wherein coastal water taken at a port is replaced with less biologically productive open oceanic water. This process is not 100% effective, and can allow exotic species to survive until discharge in a foreign port or coastal area. It may also be dangerous to vessels because of loss of stability during reballasting, and should be attempted only during calm weather and oceanic conditions. Additional techniques that have been suggested include minimal or non-release of ballast water in foreign ports, and discharge to onshore reception and treatment facilities. The inadequacy of existing treatment facilities in most areas along the West coast is considered one of the main reasons this alternative is not being used by port authorities (Kimball 2001).

3.5.3.2 Harbors

Santa Barbara Harbor

Santa Barbara Harbor, built in 1926, is a 1,133-slip harbor used primarily by fishing, commercial, and recreational vessels. It is a popular destination for recreational boaters, fishermen, and tourists. The harbor offers a number of boating services including maintenance, hull cleaning, repairs, and towing (Santa Monica Bay Restoration Project [SMBRP] 2000).

Santa Barbara Harbor Patrol officers provide security and law enforcement services to the waterfront area. Using boats, patrol vehicles, and foot patrols, they monitor all areas several times each day. The Harbor Patrol enforces the California Boating Law. This law addresses the equipment and operation of boats. The Harbor Patrol also assists other agencies within the waterfront area with the enforcement of laws including camping, parking, drinking, and drug laws. Security of the harbor and marinas is maintained by regular foot, vehicle, and boat patrols over the entire area, which consists of 84 acres of water and 40 acres of land.

Vessels providing routine services to the offshore oil and gas industry typically do not use Santa Barbara harbor to load or unload personnel, supplies, or equipment, but they may refuel there. Vessels belonging to the Clean Seas Oil Spill Response Cooperative are anchored east of Stearns Wharf at the Santa Barbara Harbor (MMS 1999).

Ventura Harbor

Ventura Harbor is located approximately 65 miles northwest of Los Angeles. Since its opening in 1963, the harbor has increased in size so that it now encompasses 152 acres of land, 122 acres of water, and contains 1,375 slips. This small harbor is used primarily by small recreational and commercial vessels and provides several services and outdoor activities. Its proximity to the Channel Islands makes it an excellent point of origin for day or extended trips (SMBRP 2000). Although it is used primarily by recreational and commercial fishing vessels, Ventura Harbor does offer berths for some supply and work vessels that service offshore platforms (MMS 1999).

Channel Islands Harbor

Channel Islands Harbor is located in Oxnard, halfway between Ventura Harbor and Port Hueneme. With nine marinas and four yacht clubs, the harbor is home to more than 2,800 recreational and commercial vessels. Channel Islands Harbor is the closest harbor to the Channel Islands, making it a convenient location for day or extended trips. Public facilities and services include laundry rooms, restrooms and showers, picnic areas, marine supplies, and maintenance and repair shops (SMBRP 2000). Vessels associated with the offshore oil and gas industry typically do not use Channel Islands Harbor (MMS 1999).

Port Hueneme

Port Hueneme, the only deep water port between Los Angeles and San Francisco, is used by commercial ships to load and unload goods. It is also used by supply and crew vessels that service offshore platforms (MMS 1999).

Commodities shipped through the port include bananas and other fruit, automobiles, oil products, lumber, fish, livestock, wood pulp, liquid fertilizer, and other agricultural products. The Port of Hueneme is the import center for Mazda automobiles in Southern California. Mercedes Benz, BMW, Jaguar, Range Rover, and Mitsubishi Corporations also import stock through the port. Oil products, which are available for ship operation from the port, come in through barges at least quarterly (Ortiz 1999). The Port of Hueneme serves as the principal staging area for supplies, equipment, and crews for the oil platforms located in the Santa Barbara Channel. The port also handles a small amount of fuel oil for Southern California Edison Company. The newest commodity to be imported through the port is liquid fertilizer, which comes in bulk tankers (Ortiz 1999).

3.5.3.3 Regulatory Setting

Ballast Water Exchange and Other Management

There are a number of international, national and state regulations in place with respect to ballast water exchange.

The International Maritime Organization (IMO) was created by the United Nations in 1958 as a central clearinghouse for maritime issues. The IMO's Resolution A.868(20), adopted in 1997, and entitled *Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens* suggests a number of policies to prevent the release of ballast water and discharge of exotic species in ports. These guidelines, however, are not legally binding.

The National Invasive Species Act of 1996, 16 U.S.C. 4701 *et seq*., which was amended by the Non-Indigenous Aquatic Nuisance Prevention and Control Act (1999), supports a ballast water management program that aims to prevent the introduction and spread of exotic species into the EEZ by introducing preventive strategies and management techniques. Section 1101(c)(1) (16 U.S.C. 4711(c)(1)) of this act establishes voluntary guidelines to prevent exotic species introductions. Section 1101(c)(2)(D) (16 U.S.C. 4711 (c)(2)(D)) directs any vessel carrying ballast water into the EEZ of the United States to exchange ballast water outside the EEZ or to other waters where the exchange will not pose a threat of infestation to United States waters or apply sound alternative ballast water management methods.

The U.S. EPA Ballast Water Report (U.S. EPA 2002) summarizes the results of a study on aquatic nuisance species in ballast water discharges, and recommends actions to address the issue. The report suggests that the greatest barrier to effectively preventing the threats posed by exotic species is the lack of effective and affordable technologies for treating ballast water (U.S. EPA 2002).

In addition, the U.S. District Court for the Northern District of California on March 30, 2005 held that discharge of ballast water within three miles from shore is discharge of a pollutant and therefore requires a National Pollutant Discharge Elimination System (NPDES) permit. The court ordered EPA to repeal its regulation exempting ballast water from its NPDES permit program (Northwest Environmental Advocates et al v. EPA, 35 Envtl. L. Rep. 20,075).

The State Lands Commission is collaborating with the State of Washington to develop an interstate approach for ballast water treatment systems for the shipping industry. The following California Resource Agency regulations address issues associated with ballast water management:

- Fish and Game Code; Section 6430-6433; Ballast Water Management Program.
- Harbors and Navigation Code; Section 132: Ballast Water.
- Public Resources Code; Section 30260-30265.5: Ballast water from tankers.
- Public Resources Code; Section 30707: Ballast water from tankers.
- Public Resources Code; Section 71200-71202: Ballast water.
- Public Resources Code; Section 71203-71207: Ballast water management practices.
- Public Resources Code; Section 71210-71213: Ballast water.

- Public Resources Code; Section 71215: Exotic species control fund.

- Public Resources Code; Section 71216: Ballast water reporting violations.

In addition, the West Coast Regional Applied Ballast Water Management Research and Demonstration Project is currently involved in research on ballast water issues. The following recent state laws regulate ballast water exchange:

- Assembly Bill 703 (1999) requires reporting and open ocean exchange for ships that discharge ballast water into California waters after operating outside of the EEZ. Starting January 1, 2000, the Ballast Water Management for Control of Nonindigenous Species Act of 1999 established a statewide, multi-agency program to prevent or reduce the introduction and spread of exotic aquatic species into the state waters under the direction of the State Lands Commission in consultation with other state and federal agencies. This program includes an inspection and monitoring program, biological surveys to determine the extent of exotic species introduction in state waters (conducted by the CDFG), and evaluation of alternatives for mid-ocean exchange, conducted by the State Water Resources Control Board. The law applies to all United States or foreign vessels that enter California waters after operating outside the U.S. EEZ. Moreover, vessels must either conduct a mid-ocean exchange of ballast water or retain all ballast water on board the vessel. The law also requires that the State Lands Commission develop and implement a ballast water inspection and monitoring program, and evaluate the effectiveness of the act. Under section 71205(a) of the act, ship agents and operators are responsible for submitting a ballast water reporting form for each voyage prior to the vessel leaving the first port of call in California;

- Assembly Bill 1334 (2001) bans the sale, possession and transport of the genus of *Caulerpa* throughout California;

- Senate Bill 1573 (2002) establishes the Interagency Aquatic Invasive Species Council to establish a plan to address the threats posed by aquatic invasive species in California by January 1, 2004; and

- Assembly Bill 1059 (2002) allows state officials to close Agua Hedionda Lagoon, or any other state waterway, to all recreational boating activities to control the spread of *Caulerpa taxifolia*.

The State Lands Commission (2000) reports that during the first three months of the new state program (noted above) compliance for reporting requirements was less than 60 percent statewide, and several large ship agents had compliance rates less than 50 percent. However, the State Lands Commission notes that compliance has improved since the early development and implementation of the state program.

Other Vessel Discharges

The regulatory setting for other vessel discharges is discussed above in Section 3.5.3.1.

3.5.4 Contaminant Sources

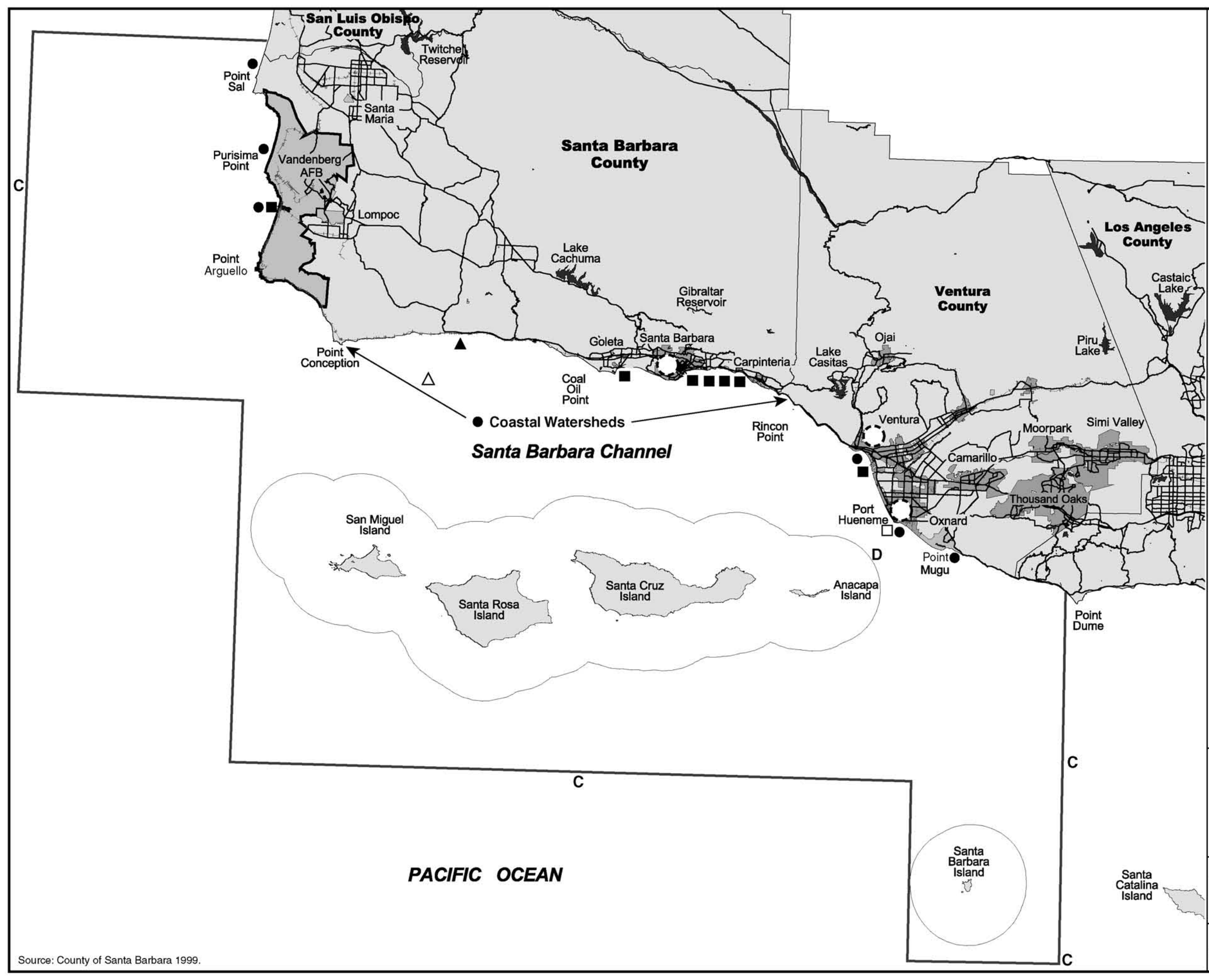
Water and sediment quality has been identified as one of the most important management issues affecting the general health and integrity of coastal marine ecosystems (California Coastal Conservancy 2001;

Ferren *et al.* 1997; Page 1999). During intense winter storms, millions of tons of material from coastal watersheds and urban areas are transported into the SCB, and can reach the northern Channel Islands. The "Plumes and Blooms" research program and partnership with the CINMS has shown that river discharge plumes distribute pollution throughout a large portion of the marine area; the Santa Clara and Ventura Rivers produce a plume that can enter the Santa Barbara Channel and extend as far as 37 miles westward. Plumes have been shown to cover areas from 38 to 580 square miles, although a 1,158 square mile plume was identified after an extreme storm event.

During winter storms, the four large rivers that discharge into the northern SCB (Santa Clara, Ventura, Santa Maria, and Santa Ynez Rivers) are capable of producing large discharge plumes that can affect the Santa Barbara Channel (Hickey 2000b). The discharge from a single major storm event can be much larger than the average annual discharge. During the upwelling conditions that follow major floods, the plume from the Santa Clara and Ventura Rivers can surround Anacapa Island (Hickey 2000b). Upwelling conditions also form a plume from the discharges of the Santa Maria and Santa Ynez Rivers that extends southward past Point Conception and enters that channel from the west (Hickey 2000b). The upwelling that follows major storms is very effective at moving fine sediments away from coastal river mouths and out toward the Channel Islands (Hickey 2000b). This material is derived from mainland river watersheds, which include agricultural lands and urban areas. Pollutants can be rapidly transferred from their point of origin to coastal marshes or the ocean (Hickey 2000b), at times reaching the CINMS.

This section focuses on water and sediment quality impacts associated with point and non-point source pollutants on the marine ecosystems of the Study Area, as well as pollution associated with natural oil seeps in the Santa Barbara Channel. Non-point source pollution, or polluted runoff, most often comes from a more ambiguous source, or a broader area, usually in the form of runoff from a variety of land uses such as agriculture, urban, and industrial operations. Point source pollution can be traced to a clearly discernible source, usually municipal or industrial facilities such as wastewater treatment plants, and oil refineries or power plants. The location of major contaminant inputs to the SCB is depicted in Figure 3.5-4.

Two state Areas of Special Biological Significance (ASBSs)/State Water Quality Protection Areas (SWQPAs) are located within the boundaries of the CINMS. ASBS/SWQPA 17 is located in state waters surrounding San Miguel, Santa Rosa, and Santa Cruz Islands seaward to a distance of 1 NM, and ASBS/SWQPA 22 is located in state waters surrounding Santa Barbara and Anacapa Island seaward to a distance of 1 NM.



LEGEND

- ROADS
- STUDY AREA BOUNDARY
- RAILROAD
- LAKES
- LANDMARKS
- PLACES
- SANTA BARBARA CHANNEL ISLANDS
- COUNTIES
- VAFB BOUNDARY
- POPULATION CENTER
- INDUSTRIAL EFFLUENTS
- OIL PLATFORM EFFLUENT
- POWER PLANTS
- SURFACE RUNOFF
- PUBLICLY OWNED TREATMENT WORKS

DUMP SITES

- **C** CHEMICALS
- **D** DREDGED MATERIALS

SCALE IN MILES

0 12 24

Source: County of Santa Barbara 1999.

CINMS EIS STUDY AREA
POINT SOURCE CONTAMINANT INPUTS

Tetra Tech, Inc.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

TC#	DATE	DRAWN BY	FILENAME	FIGURE NO.
10871-01	8/30/05	IGE	GRAPHIC:\ CHANNEL ISLAND\ 3.4-4contam.ai	3.5-4

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3.5.4.1 Natural Oil Seeps

Natural oil seeps are found offshore in the SCB from Point Conception to Huntington Beach. The largest concentration of seeps is in the Santa Barbara Channel area, adjacent to the CINMS (Wilkinson 1972). In the area of Coal Oil Point, seepage has been estimated to occur at a rate of 50 to 70 barrels of oil per day (Wilkinson 1972). These seeps produce continuous oil slicks on the surface of the water and even visible tar mounds on the bottom within kelp beds (Spies and Davis 1979). The natural seeps appear to cause no visible damage to nearby giant kelp beds, since extensive canopies regularly develop in these beds when oceanographic conditions are good for growth. In general, the oil released from seeps is moved by currents and wind to the shoreline, either on the mainland coast or the Channel Islands.

3.5.4.2 Point Source Discharges

Point sources of pollution to marine ecosystems include oil platforms, ocean dumping, municipal wastewater outfalls including storm water outfalls, and industrial outfalls including power plant cooling flows. Each of these point sources is discussed in more detail below.

Anderson *et al.* (1993) identified 178 discrete sources of contaminant and nutrient input to the SCB from Point Conception to the Mexican border. A total of 26 discrete input sources are located in the area from Point Conception to Point Dume (Table 3.5-5).

Table 3.5-5
Summary of Inputs from Discrete Sources of Contaminants to the Study Area

Location	Class	Flow (million m^3/yr)	Number of Sources
Santa Barbara and Ventura Counties	Municipal waste (sewage)	52.9	8
	Power plant effluent	2,543	2
	Other industrial effluent	1.7	6
	Surface runoff	59.4	10

Source: Anderson *et al.* 1993.

Oil Platforms

Details on the number and type of oil and gas facilities within the Study Area are described in Section 3.5.1. The following text discusses potential point sources stemming from these facilities.

Effluent discharge is only permitted from oil and gas platforms located in federal waters; no discharges are permitted from facilities located in state waters. A total of 10 of the 16 platforms discharge produced water, while all platforms discharge deck drainage, treated sewage, well completion and workover fluids, and other effluents (MMS 2001). While all platforms have the potential to discharge drilling muds and cuttings, only Exxon's Platform Heritage (which is not within or adjacent to the CINMS) is conducting a drilling program and at present is using both water- and oil-based drilling muds for these extended reach wells.

A project conducted by the Southern California Coastal Water Research Project (SCCWRP) found that although offshore oil production in the region increased by a factor of six from 1935 to 1991, oil platforms operating in federal waters in 1990 were a relatively minor source of contaminants to the

coastal ocean. The mass emissions of drilling wastes were 9 percent of the mass emissions of suspended solids discharged from the four largest municipal wastewater treatment facilities in southern California. The mass emissions of contaminants from produced water from oil platforms were less than one percent of the combined emissions for the same constituents from the four largest municipal facilities. The total mass emissions from the offshore platforms were low because most drilling and sanitary wastes generated at offshore platforms in 1990 were sent to onshore facilities for processing.

There are, however, threats of offshore oil well blowouts, pipeline leaks, oil tanker spills, and leaks associated with decommissioning of platforms. The effects of large oil spills on giant kelp beds (*Macrocystis pyrifera*) have been documented twice along the western Pacific coast; once during 1957 when a small tanker, the *Tampico*, spilled a load of mineral oil in a cove along Baja California; the other during the 1969 offshore well blow-out and spill in the Santa Barbara Channel (Foster and Schiel 1985). North *et al*. (1964) studied the *Tampico* spill and noted that there was massive mortality of invertebrates, including sea urchins, in the cove. Damage to giant kelp was not obvious and within five months of the spill, vegetation in the cove was increasing and juvenile giant kelp began to develop. Presumably, the diesel oil had killed sea urchins that had been maintaining the bottom. Once the urchins were killed, giant kelp and other species of algae began to develop (North *et al*. 1964). Giant kelp plants that recruited following the loss of sea urchins produced canopy in the cove, approximately 18 months after the spill.

Crude oil from the 1969 Santa Barbara spill polluted a large portion of the mainland coast, and many of the Channel Islands (Foster *et al*. 1971). Assessment of the effects of the spill was complicated by record storms and rainfall that occurred at the same time as the spill. There was little damage to the giant kelp beds, even though considerable quantities of crude oil fouled the surface canopies (Foster *et al*. 1971). The partially weathered crude oil appeared to stay on the surface of the water and did not stick to the fronds of the giant kelp. In addition to the direct effects from oil spills on giant kelp, there are documented negative effects on kelp from substances used in oil spill cleanup operations. The surfactant-based oil dispersant Corexit 9554 has been shown to have acutely toxic effects on the early life stages of giant kelp (Singer *et al*. 1995).

Surfgrass and eelgrass beds can be particularly sensitive to oil pollution, but the impacts of oil on these marine plants is not well understood (Foster *et al.* 1988). Unlike slime-producing algae that can slough off oil, eelgrass has non-mucilaginous leaves to which oil quickly adheres (CDFG 2002).

Oil spills and chemical dispersants used in oil spill cleanup can have significant effects on wildlife as well. Animals exposed to oil may be affected by both internal and external impacts. Exposure of fish embryos to low levels of oil has been shown to cause physical deformities, damage to genetic material, and mortality (Carls 1999). Seabirds that have ingested oil have been found to suffer from petroleum toxicosis and damage to the liver, kidney, pancreas, lungs, and intestine, and external exposure to oil fouls waterproofing capabilities of birds (Newman *et al.* 2003). Long-term effects of oil exposure on seabirds have also been documented after rehabilitation of oiled seabirds, including behavioral abnormalities in California Brown Pelicans, and higher mortality rates in American Coots due to problems associated with inflammation, iron utilization, or metabolism (Newman *et al.* 2003). Sea otters, a species especially vulnerable to oil spills, may suffer impacts arising from oil ingestion (during grooming), inhalation and damage to pelage and ingestion of oil-contaminated prey (Bodkin *et al.* 2002; Ridoux *et al.* 2004). In a study of long-term effects of the 1989 *Exxon Valdez* oil spill in Prince Williams Sound, Bodkin *et al.* (2002) found that the area of the Sound most heavily impacted by the oil spill showed no evidence of sea otter population growth as of 2000, likely due to elevated mortality in and emigration away from this heavily impacted area. Bodkin *et al.* (2002) also found evidence that residual oil has persisted and been transferred through the nearshore food web for up to a decade after the oil spill. In general, oil impacts on marine mammals include: getting stuck in the oil, becoming stained with oil, decreasing foraging

performance, modification of prey availability, hydrocarbon absorption by prey species (lethal in high concentrations), and bioaccumulation of oil-specific trace elements (Ridoux *et al.* 2004). Affects of oil on several invertebrate species found within the Channel Islands has been observed, though little is known about these impacts and impacts on numerous other invertebrate species have not been studied. California mussels (*Mytilus californianus*) are adversely affected by oil spills (Chan 1973; Foster *et al.* 1971). Little is know about oil impacts on black abalone, but North *et al.* (1964) reported black abalone mortality following a spill in Baja California. Owl limpets (*Lottia gigantea*) are common in high and middle intertidal zones of exposed rocky shores from Washington south to Baja California. The limpets and their feeding territories are vulnerable to oiling, but oil impacts are unclear. For example, limpets of this species were not obviously affected by the 1971 San Francisco oil spill (Chan 1973). Oil impacts on invertebrates such as limpets and abalone may be exacerbated due to their low recruitment and slow growth rates, so recovery from any major disturbance likely would be lengthy.

Due to variability among petroleum products, environmental conditions, and affected taxa, once oil spills occur there is no simple solution to address them. While dispersants are known to have negative effects on marine organisms, in a recent study of comparative toxicity of oil, dispersant, and oil plus dispersant, Fuller *et al.* (2004) concluded that dispersant (Corexit 9500) toxicity in field applications would be negligible compared to oil toxicity. Fuller *et al.* (2004) also concluded that while all three scenarios (oil, dispersant, and oil plus dispersant) demonstrated that declining exposures were less toxic than continuos exposures, but only significantly so in the oil plus dispersant scenario. Following the 2001 *Jessica* oil spill in the Galapagos Islands Gelin *et al.* (2003) studied the effects of the spill on intertidal macroinvertebrate communities. While Gelin *et al.* (2003) did not have pre-spill baseline data for comparison, based on their analyses they concluded that there were no impacts on high-intertidal invertebrate communities at oiled sites 4 to 11 months after the spill. Based on these findings, Gelin *et al.* (2004) concluded that extensive shoreline cleanup operations were not warranted in response to this spill, and that the trampling, mechanical abrasion, and use of dispersants associated with such a cleanup would likely have generated more impact than the oil spill itself. There is no scientific agreement as to whether oil spill response and cleanup enhances or hinders ecosystem recovery following oil spill events. Oil spill prevention is the most effective means to avoid potential direct and indirect oil spills impacts.

Cold-water discharges would be a potential point source discharge from proposed liquefied natural gas storage and re-gasification units (see Section 3.5.1.3).

Marine Debris and Ocean Dumping

Another SCCWRP study found that manmade debris occurred on approximately 14 percent of the mainland shelf of the SCB (Moore and Allen 2000). Manmade debris was most common in the central (urbanized) region on the outer shelf, and in areas near municipal sanitary sewer system outlets. The most common type of manmade debris found in the central region and the outer shelf was fishing gear, while glass bottles and plastic were most common near the sewer outlets. Natural debris, primarily vegetation from onshore sources and marine vegetation from nearshore reefs, was more common close to shore in the inner shelf zone (Moore and Allen 2000). Because the manmade debris (fishing gear and plastic) was found farther from shore than natural debris, the primary source of manmade debris in the marine environment was believed to be fishing activity rather than storm water runoff (Moore and Allen 2000).

There are no active ocean disposal or dumping sites within the Study Area and discharge and disposal of most matter within the CINMS is specifically prohibited under existing regulations. Dredge spoils, low-level radioactive waste, and military munitions and/or explosives have historically been disposed of in the SCB. The majority of dredging and filling operations currently occur within port facilities (Resources

Agency of California 1997). There are inactive chemical dump sites located in the vicinity of Santa Lucia Bank and south of Santa Cruz Island. These sites were formerly used or designated for United States chemical munitions dumping. An additional area southeast of Santa Barbara Island is charted as a disused explosives dumping area. In addition, 3,100 containers of low-level radioactive waste were dumped off Port Hueneme at a depth of 4,570 meters (U.S. EPA 1983).

The following active ocean disposal sites are also close to the boundaries of the Study Area:

- Name: Los Angeles/Long Beach, California (LA-2)
  Location: 33 degrees 37.10' North Latitude by 118 degrees 17.40' West Longitude (North American Datum from 1983), with a radius of 3,000 feet (910 meters).
  Size: 0.77 square NM.
  Depth: 380 to 1060 feet (110 to 320 meters).
  Primary Use: Ocean dredged material disposal.
  Period of Use: Continuing use, subject to submission of a revised Consistency Determination to the California Coastal Commission after 5 years of site management and monitoring.
  Restrictions: Disposal shall be limited to dredged sediments that comply with the U.S. Environmental Protection Agency's Ocean Dumping Regulations.

- According to nautical charts, an active dredged material disposal site is located at the base of Hueneme canyon (NOAA 1992).

Ocean dumping in or near the Study Area may lead to transport of material to the CINMS. Impacts of ocean dumping are not well understood and are highly dependent on such factors as ocean currents and distribution of contaminants, chemical interactions of dumped materials in water and associated degradation time, and short-term and long-term biological impacts on living marine resources such as invertebrates, marine mammals, and fishes. Marine debris can also injure or kill marine mammals, seabirds, and sea turtles through ingestion and entanglement.

Municipal Wastewater Outfalls

Most water used for domestic and industrial purposes enters municipal treatment plants and eventually empties into the ocean. Section 402(p) of the Federal Water Pollution Control Act (FWPCA) also requires that storm water outfalls (e.g., surface runoff) be considered point sources. Surface runoff is composed of storm and dry weather flows that differ in contaminant concentrations, time, and duration. Surface runoff is approximately one-third the volume of municipal wastewater discharge.

Pursuant to the FWPCA, municipalities are required to provide secondary treatment (physical and biological treatment) of discharges to treat disease-causing bacteria, excess nutrients, and hazardous substances such as heavy metals and polychlorinated biphenyls (PCBs). However, Section 301(h) of the FWCPA provides for a waiver of the full secondary sewage treatment requirement if certain conditions are met demonstrating equivalent treatment.

Ocean discharge of treated sewage is common throughout the region. Sewage outfalls, with varying levels of sewage treatment, discharge into the Santa Barbara Channel (Table 3.5-6). Treatment facilities for point source pollution are categorized as primary (physical treatment), advanced primary (physical and some chemical treatment), secondary (physical and biological treatment), and tertiary (additional control measures beyond secondary treatment to remedy specific pollution problems). There are no

municipal wastewater outfalls within the CINMS. The wastewater treatment plant at Oxnard is the largest point source discharging into the Santa Barbara Channel.

Industrial Outfalls

Anderson *et al*. (1993) show that power plants discharge 10 times more volume than municipal wastewater treatment plants in the region. Other industrial inputs to the coastal waters in the region are small compared to other point sources. There are no industrial wastewater outfalls within the CINMS, but there are a few in the Study Area.

Untreated industrial effluent can include toxic organic chemicals (detergents, oil, industrial solvents) and toxic metals (mercury, lead), or elevated temperatures, which can affect marine organisms at several levels including metabolic impairment or damage at the cellular level, physiological or behavioral changes at the organism level, changes in mortality or biomass at the population level, and changes in species distribution or altered trophic interactions at the community level (Klee 1999). Discharges from industrial outfalls can also increase sediment input to the marine ecosystem that can destroy benthic biota or interfere with the filter feeding and respiratory functions of marine organisms. Industrial outfalls can also cause impingement of marine organisms on cooling water intake screens or entrainment through cooling water systems (U.S. EPA 2004).

The following power plants currently discharge into the Study Area:

- The Ocean Vista Power Generation Company (Ocean Vista) operates the Ocean Vista Generating Station (formerly the Mandalay Generating Station), a plant with a design capacity of 560 megawatts, in Oxnard, California, under a National Pollutant Discharge Elimination System (NPDES) Self-Monitoring Program. Ocean Vista may discharge up to 255.3 million gallons per day of wastes consisting of once-through cooling water from two steam electric generating units (four condenser halves), metal cleaning wastes, fireside and air preheater washes, and low volume wastes into the Pacific Ocean. The combined effluent is discharged through a concrete and rock-revetted structure (Discharge Serial No. 001) located at a point directly across the Mandalay Beach, west of the plant.

  Ocean Vista monitors chemical constituents in their effluent. Ocean Vista also monitors receiving water column parameters twice a year at five shoreline stations and at twelve inshore stations. Seafloor sediments are monitored annually at five stations for general sediment quality and trace elements. Benthic invertebrate communities are monitored annually at five stations. Biological communities (monitored by trawl) are performed twice a year at four stations. Bioaccumulation in fish and invertebrates is not monitored.

- Southern California Edison operates the Ormond Beach Generating Station (Ormond), a 1,500 megawatt plant, in Oxnard, California, under a NPDES Self-Monitoring Program. Ormond may discharge up to 688.2 million gallons per day of wastes consisting of once-through cooling water from two steam electric generating units, metal cleaning wastes, and low volume wastes into the Pacific Ocean. The combined effluent is discharged through an ocean outfall (Discharge Serial No. 001) located approximately 1,790 feet offshore of Ormond Beach at a depth of 20 feet.

  Ormond monitors chemical constituents and toxicity in its effluent. Receiving water column parameters are monitored twice a year at nine stations. Seafloor sediment are

monitored annually at six stations for general sediment quality and trace elements. Benthic invertebrate communities are monitored annually at the same six stations. Potential entrainment of fish and invertebrates on the cooling water intake screens are evaluated every two months. Trace elements are analyzed annually in bivalves sampled near the discharge conduit.

Table 3.5-6
Municipal Wastewater Treatment Plants Discharging into the Study Area

Municipal Wastewater Treatment Plants	Receiving Water	Level of Treatment	Volume Discharging (mgd)
City of Lompoc	Santa Ynez River	Secondary	3.72
Goleta	Santa Barbara Channel	Primary/Secondary	5.2
Santa Barbara	Santa Barbara Channel	Secondary	8.1
Montecito	Santa Barbara Channel	Secondary	1.1
Summerland	Santa Barbara Channel	Tertiary	0.17
Carpinteria	Santa Barbara Channel	Secondary	1.5
Oxnard	Santa Barbara Channel	Secondary	19.5

Note: mgd - million gallons per day

In Gaviota, Chevron U.S.A. Inc. (Chevron) Gaviota Oil/Gas operates a seawater desalination plant, a wastewater treatment plant for produced water from crude oil and natural gas production, and a wastewater disposal system operating under a NPDES Self-Monitoring Program. The outfall separates the oil and gas from the produced water, which is treated by means of induced-gas flotation and settling and is discharged to the Pacific Ocean through a 5,200-foot outfall and diffuser system. Chevron discharges combined desalination plant wastewater and treated oil and gas plant wastewater to the ocean through the Santa Barbara Channel. The U.S. EPA classifies this as a minor discharge.

3.5.4.3 Non-point Source Discharges

Non-point source pollution does not originate from individual, identifiable sources like industrial facilities, municipal sewage treatment plants, or offshore oil platforms. The U.S. EPA (2000a) identifies non-point source pollution as the nation's largest source of water quality problems, and runoff from urban areas as the largest source of water quality impairments.

Non-point source pollution results when rainfall or irrigation runs over the land or through the ground, picks up pollutants, and carries them to streams, rivers, wetlands, and coastal waters (U.S. EPA 2000a). It is widespread because it can occur whenever activities disturb the land or water. Agriculture, forestry, grazing, construction, physical changes to stream channels, septic systems, urban runoff, and habitat degradation are all potential sources of non-point source pollution (U.S. EPA 2000).

The most common non-point source pollutants are sediments and nutrients such as fertilizers. Other non-point source pollutants may include:

- Herbicides and insecticides from urban and agricultural runoff;

- Oil, grease, toxic chemicals, and heavy metals from urban runoff;
- Bacteria, viruses, and nutrients from livestock, pet wastes, and faulty septic systems;
- Accidental spills of fuels and other hazardous materials; and
- Air pollutants that settle out of the atmosphere onto the ocean.

The mainland watersheds that drain into the ocean in the Study Area all include urban and agricultural lands that yield non-point source pollutants. The two largest watersheds, those of the Santa Maria and Santa Clara Rivers, both encompass large agricultural areas. The Santa Clara River watershed has a large component of urban land as well. From Rincon to Goleta, 41 creeks enter the Santa Barbara Channel from the south side of the Santa Ynez Mountains. Many of these creeks flow through urban and agricultural areas along the coast and transfer non-point source pollutants directly into estuaries and coastal waters. Runoff from winter storms accelerates the delivery of non-point source pollutants to the marine environment. The Santa Clara and Ventura rivers are the largest contributors to non-point source pollution into the Santa Barbara Channel.

There are also a number of watersheds located on the four northern Channel Islands. A recent study by SCCWRP, under contract by the State Water Resources Control Board, surveyed water quality in State Water Quality Protection Areas around the four northern islands (SCCWRP 2003). The results of this study are summarized below.

San Miguel Island is unprotected from and directly exposed to all storms and ocean turbulence that comes its way. There are no roads and a few structures that are well beyond 100 meters of the coast. These structures—as well as a leach field located near the ranger station—are not likely to contribute to discharges into the CINMS. Although it is unlikely that the leach field could drain to the CINMS, this area was listed as a potential source of discharge. Twenty-nine outlets to the ocean (gullies or streams) were identified for this island.

Santa Rosa Island is the second largest of the Channel Islands and has approximately 46 miles of shoreline. It is a diverse island of grass-covered rolling hills, steep canyons, creeks, rocky intertidal areas and sandy beaches. Forty-one outlets (gullies or streams) were recorded for Santa Rosa Island. There are few potential anthropogenic sources upstream of these outlets, with the exception of road drainage and previous grazing impacts. The Central Coast Regional Water Quality Control Board has issued a cleanup and abatement order to the NPS requiring it to develop a road management plan, since the roads on this island do contribute to erosion and downstream deposition of sediment. No point sources were seen during the survey of this island. Santa Rosa Island has few structures and hosts mainly campers and hikers.

Santa Cruz Island is the largest of the Channel Islands and has approximately 77 miles of shoreline. The coastline of this island is diverse, consisting of sheer cliffs and bluffs, beaches, and grasslands. The Nature Conservancy owns and manages the western 75 percent of the island; the eastern 25 percent is owned and managed by the NPS. Sheep ranching was historically practiced on this island and areas where vegetation was depleted are still visible. Sixty-five outlets (gullies or streams) were recorded for this island. There are few potential anthropogenic sources upstream of these outlets, with the exception of previous grazing impacts. No point sources were observed during the survey for this island. Santa Cruz Island has few structures and hosts mainly campers and hikers. The inland Central Valley, somewhat distant from the islands' coast, has a few structures that house visiting scientists doing research on island flora and fauna.

Santa Barbara Island is surrounded by volcanic cliff walls and has only two facilities, a ranger station that is staffed by the NPS, and a landing facility, both of which are listed as non-point sources. Near the ranger station there is a leach field and three portable toilets. Although doubtful that the leach field contributes any significant discharge, it is listed as a potential non-point source discharge. The few visitors to the island are limited to some camping and hiking, but the primary activities take place offshore and include diving and fishing. There are no roads and only a few small foot trails.

Anacapa is the smallest of the Channel Islands and consists of three small islets. Ocean waves have eroded the perimeter of the island, creating steep sea cliffs and exposing the volcanic origins of air pockets, lava tubes, and sea caves. There are few structures on the island, which include a museum, visitor center, and a lighthouse. Activities on the island include camping and hiking. Only the boat landing facility for Anacapa Island was classified as a non-point source discharge.

Potential impacts to marine ecosystems from non-point source pollution include: lowered photosynthesis and oxygen levels, introduction of disease, disturbance to spawning and nursery areas, loss of food sources (trophic disruption) and habitats, chemical disturbances, destruction of benthic biota, resuspension of fine sediments, and interference with filter feeding and respiratory functions of marine organisms.

3.5.4.4 Regulatory Setting

Point Source Discharges

Numerous statutes address a variety of issues related to point source discharges to marine ecosystems. Federal statutes include the Federal Water Pollution Control Act (FWPCA) (33 U.S.C.1251 *et seq.*); the Rivers and Harbors Act of 1899 (33 U.S.C. 401 *et seq*.); titles I and II of the Marine Protection, Research, and Sanctuaries Act (commonly known as the Ocean Dumping Act) (33 U.S.C. 1401 *et seq.*); the Oil Pollution Act of 1990 (OPA) (33 U.S.C. 2701 *et seq.* and scattered); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601 *et seq.*); and the Coastal Zone Management Act (16 U.S.C. 1451 *et seq*.).

In addition, state statutes that bear relevance to point source discharges include the Porter Cologne Water Quality Control Act (California Water Code Sections 13000–14958, *et seq*.); the California Coastal Act (California Public Resources Code Sections 30000–30900); and the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act of 1990 (California Government Code Sections 8574.1–8670.5 and California Public Resources Code Sections 8750–8751).

Over the past 20 years, emphasis on point source pollution control has produced significant improvements in water quality. Dischargers are required to obtain permits specifying requirements to be met, including conditions for discharge, effluent standards, discharge improvement schedules, and self-monitoring activities.

Effluents

Federal. In 1972, the Congress enacted the FWPCA, which established the National Pollution Discharge Elimination System (NPDES), a permitting process to regulate point source discharges of pollutants to navigable waters of the United States. The U.S. EPA issues NPDES permits in federal waters and has delegated authority to the State Water Resources Control Board (SWRCB) to issue these permits in state waters. Permits are issued for discharges from sources such as offshore oil and gas platforms, municipal wastewater treatment plants, industrial outfalls, and storm water.

All NPDES permits for discharges affecting any land or water use or natural resource of the California coastal zone also require a determination by the California Coastal Commission that the activity is consistent with California's Coastal Management Program.

Section 402(p) of the FWPCA requires urban storm water outfall systems to be considered point sources and established a permit system that became effective in October 1992. The classification of urban stormwater as a point source can be somewhat confusing. Typical examples of point sources are discharges from discrete wastewater treatment facilities. Stormwater drainage usually emanates from many widely-dispersed sources and is often mistakenly thought of as a non-point source discharge. The 1987 CWA amendments require municipalities and industries to apply for an NPDES permit to discharge storm water into storm drains. The State Water Resources Control Board has adopted two general NPDES permits addressing storm water discharges associated with industrial and construction activities.

State. The State Water Resources Control Board has the primary responsibility to protect California's coastal and ocean water quality pursuant to the Porter-Cologne Water Quality Control Act. This act has provisions for enforcing water quality standards through issuance of Waste Discharge Requirements (WDRs). As stated previously, the State Water Resources Control Board has been delegated authority by the U.S. EPA to administer the NPDES program for discharges in state waters.

A Comprehensive Water Quality Control Plan for the region has been adopted by the Regional Water Quality Control Board (RWQCB). This plan identifies existing and potential beneficial uses and establishes water quality objectives for coastal waters. The RWQCB also enforces both state WDRs and NPDES permits issued to individual dischargers, subject to the approval of the State Water Resources Control Board and U.S. EPA. Dischargers are required to establish self-monitoring programs for their discharges and submit compliance reports to the RWQCBs.

Most NPDES permits and WDRs are combined into one permit. The State Water Resources Control Board has established regulations to implement these measures through water quality control plans that include the California Ocean Plan (Ocean Plan), Regional Water Quality Control Plans (Basin Plans), and Thermal Water Quality Control Plan (Thermal Plan). Both the Ocean and Basin plans identify beneficial uses within the area being addressed and lay out numerical and narrative objectives for waste discharges, as well as implementation procedures for achieving these objectives. The Ocean Plan applies to ocean waters, defined as the "territorial marine waters of the state as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons." If a discharge outside the territorial waters of the state could affect the quality of the waters of the state, the discharge may be regulated to ensure no violation of the Ocean Plan will occur in ocean waters (California Resources Agency 1997).

Enforcement of WDRs or NPDES permits by the RWQCB is done when monitoring or other sources indicate a violation of permit conditions. Cease and Desist Orders and Cleanup and Abatement Orders can be issued along with stiff financial penalties for noncompliance.

Fill and Dredged Materials

Authorization to dispose of dredged materials in the ocean, within enclosed coastal waters, or on land is provided through a variety of federal and state permit processes. Under authority of the Rivers and Harbors Act, Section 404 of the FWPCA, and the Ocean Dumping Act, the USACE develops, controls, maintains, and conserves the nation's navigable waters and wetlands. The USACE regulates development of any project involving fill, construction, or modification of waters of the United States.

For example, pursuant to Section 103 of the Ocean Dumping Act, the USACE is authorized to permit disposal of dredged material into the ocean if the USACE determines that "the dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." However, the USACE is prohibited from issuing such a permit if the U.S. EPA finds that the proposal cannot meet its criteria established for disposal site selection pursuant to Section 102 of the Ocean Dumping Act. Federal permits for dredged material disposal cannot be issued, pursuant to Section 401 of the FWPCA, unless the State Water Resources Control Board issues or waives a certification that the proposed activity will not violate state water quality standards. In addition, the State Water Resources Control Board regulates discharges of dredged materials into state waters by issuing WDRs through its Porter-Cologne Water Quality Control Act authority. Finally, the California Coastal Commission has authority over disposal of dredged materials pursuant to the federal consistency provisions of the CZMA.

Marie Debris and Ocean Dumping

Reducing marine debris resulting from garbage disposal is one of the objectives of the 1973/1978 International Marine Pollution Convention (MARPOL Treaty) and the federal Marine Plastics Pollution Research and Control Act of 1987, which specifically targets plastic debris. Plastic debris is especially troublesome as marine species can become entangled in plastic products and frequently mistake the products for food.

The USCG is the federal agency charged with enforcing MARPOL-related regulations for trash, garbage, and plastics disposal at sea and requirements for sewage-holding tanks aboard vessels, although enforcing these regulations is logistically difficult. The RWQCBs have regulatory authority in marinas, but limited resources are available for enforcement.

Non-point Source Discharges

In the past few years, public awareness and government management efforts have turned to several complex and pressing issues regarding non-point source discharges, including the impacts of petrochemical and metals runoff from urban areas; nutrients, pesticides, and sediment runoff from agricultural and forestry operations; heavy metals leaching from inactive mines; erosion from modification of stream channels; and runoff from marinas.

Federal. There have been three developments in non-point source pollution response at the federal level:

- Section 208 of the FWPCA focuses on issue identification, initial planning measures, and voluntary programs that should be considered with regard to non-point source pollution.

- Section 319 was added to the FWPCA, providing a more aggressive approach to controlling or minimizing non-point source pollution by committing federal funds for state management plans, demonstration projects, and implementation plans.

- Section 6217 of the *Coastal Zone Act Reauthorization Amendments of 1990* (CZARA) requires states with approved coastal management programs to develop Coastal Nonpoint Pollution Control Programs. The U.S. EPA and NOAA jointly administer this program at the federal level, while the California Coastal Commission, State Water Resources Control Board, and six coastal RWQCBs are required to develop and administer it at the state level.

State. The programs and policies of the State Water Resources Control Board for preventing non-point source pollution are included in its nonpoint source management plan prepared pursuant to Section 319 of the FWPCA and coastal nonpoint pollution control program pursuant to section 6217 of CZARA. Section 6217 requires the state to implement 56 enforceable management measures that have been identified by the U.S. EPA to address polluted runoff from all sources including: agriculture, forestry, urban areas, hydromodification, and abandoned mines. Although the emphasis of the program is currently voluntary, the relevant California statutes also provide enforcement mechanisms for these provisions.

As part of the nonpoint source management plan, the state has initiated a new program for Critical Coastal Areas as well. All watershed areas adjacent to ASBSs/SWQPAs are included in Critical Coastal Areas.

Water Quality Monitoring

Water quality monitoring is conducted in various locations along the California coast pursuant to permit requirements, voluntary programs, or efforts by government, the private sector, academic research institutions, industries, and various non-profit groups. Although multiple sources of water quality monitoring information exist, many portions of the coastline do not have regular sources and no comprehensive inventory currently exists to determine the full extent of these monitoring activities for the SCB. However, federal, state, and local agencies are striving to implement a regional monitoring program for the SCB.

The Southern California Bight Pilot Project, a regional monitoring program extending from Point Conception to the Mexican border, was implemented in 1994 to determine the ecological health of the region's waters. The pilot project involved cooperation by the four major ocean wastewater dischargers in the region, three coastal RWQCBs, the U.S. EPA, the CINMS, and an independent research facility, the SCCWRP. Since the pilot survey project in 1994, two additional surveys were conducted in 1998 and in 2003. Initial results from these surveys have been sufficiently promising such that regional monitoring has been proposed for other coastal regions.

The California Department of Health Services and many, but not all, of California's coastal counties conduct water quality testing and monitoring of coastal waters. Subsequent decisions to close beaches are based on non-compliance with Department regulations. County health departments are required to report beach closures to the State Water Resources Control Board where the data are entered into a centralized data collection system, and an annual beach closure report is prepared for the legislature.

The NMSP is active in water quality monitoring, water quality research and education, and emergency response planning for the CINMS. In addition to the Southern California Bight monitoring project, the NMSP is currently supporting researchers from the University of California, Santa Barbara to implement the Plumes and Blooms Project, which is an ongoing study of storm water runoff impacts on the Santa Barbara Channel. The NMSP is also implementing other various education and outreach water quality programs as discussed further in Section 3.5.10 below.

3.5.5 Introduction of Non-native and Genetically Modified Species

A native species is essentially a species that lives in its place of origin. In this context, origin is considered in terms of thousands of years. Native species evolve by adapting to their local habitats; all forms of life are a result of a continuing process of interaction between their inherited traits and characteristics of their environment. A native organism lives within its natural and historical range and zone of dispersal. Introduced species fall into two categories. A non-native (or exotic) species is a

species (including any of biological matter capable of propagation) that is not native to the ecosystem(s) in which it occurs (i.e., a species transported beyond its natural range to places it could not get to either by itself or through natural dispersal, such as by wind, tides, currents). A genetically modified species is any organism into which genetic matter from another species has been transferred in order that the host organism acquires the genetic traits of the transferred genes.

Exotic species can be introduced to the marine ecosystem via the hulls of commercial and recreational vessels and live-well tanks. As described earlier, ballast water can also convey adults, larvae, spores, and seeds of an introduced species but not necessarily the natural predators associated with the adult form. Benthic organisms may also inadvertently be taken in with sediments in water uptake. There are a number of other ways that exotic species are introduced to coastal marine ecosystems:

- Attachment to an intended introduced species, such as oysters for commercial harvesting;
- Intended introduction for commercial and sport fishery, mariculture, or biocontrol efforts**;**
- Release of unwanted organisms by aquarists or bait fishermen; and
- Natural spread from original point of introduction.

It is not just ballast water, but also vessel hulls, rudders, propellers, seawater piping systems, intake screens, ballast pumps, and sea chests that are capable of inadvertently transporting species. Introduced species can also be transported by dredging/drilling equipment, dry docks, buoys, seaplanes, canals, marine debris, and recreational equipment (Carlton 2001). Animals purposely transported for research, restoration, education, and aquarium activities also have potential for illegal release, whether intentional or accidental.

Although a definitive list of exotic species does not exist for the Santa Barbara Channel, a few of the most common exotic species off the California coast are *Sargassum* (brown alga), *Undaria pinnatifida* (Asian kelp), *Caulerpa taxifolia*, American lobster, European flat oyster, and Japanese clam. The CINP Kelp Forest Monitoring Project has not found dominant communities of exotic species. A 2005 report on non-native species monitoring in west coast national marine sanctuaries and National Estuarine Research Reserves provided information on non-native sessile invertebrates in the Channel Islands region (deRivera *et al.* 2005). DeRivera *et al.* (2005) deployed settling plates at six Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) buoys and two piers (Oxnard Vintage Marina and Ventura West Harbor) in the Channel Islands region in 2004. After 182 days they found 16 non-native invertebrate species (six bryozoan, nine urochordate, and one crustacean species). These organisms were introduced through vectors including shipping (hull-fouling), fisheries (accidental introduction via oysters), and ballast water. The first west coast introductions of these species occurred in locations such as San Diego Bay, La Jolla, Long Beach Harbor, Drakes Estero, Monterey Bay, San Francisco Bay and Tomales Bay in California, and Scammon's Lagoon in the Sea of Cortez, Mexico. DeRivera *et al.* 2005. Once exotic species have become established in international ports, recreational vessels traveling within California waters can transport the species. The species may also expand their range simply by drifting as planktonic larvae in the California Current and affect regional marine environments. For example, Morro Bay, with no international shipping, has over 25 exotic species.

Striped bass (*Roccus saxatilis*) were intentionally introduced to California in 1879. The California Department of Fish and Game manages a striped bass sport fishery under the Striped Bass Management Conservation Plan. This conservation plan is designed to maintain the striped bass population and sport fishery while allowing for recovery of several threatened and endangered fish species (e.g., Sacramento

River winter-run chinook salmon and delta smelt) given potential striped bass predation on them. (Leet et al. 2001)

Once sources of exotic species are established at locations such as ports and harbors, intraregional travel can expedite and permit spread of the species. Approximately 10 percent of established introduced species become invasive (National Invasive Species Council 2001). The term "invasive" applies to non-native species that cause or are likely to cause harm to the economy, the environment or to human health (Executive Order 13112, Appendix 1). The estimated economic costs of species invasions are $137 billion per year (National Invasive Species Council 2001). With over 45,000 commercial cargo ships transporting 10 billion tons of ballast water around the globe every year, the rate of introductions is predicted to significantly increase (Carlton 2001).

Studies of exotic species in the San Francisco Bay and Delta estuary have described no less than 234 exotic species, with over 100 different species of aquatic invertebrates alone. Several of these species, including the European green crab (*Carcinus maenus*) may reach the Santa Barbara region in the near future, having recently been observed in Morro Bay (Grosholz 2003; Wasson *et al*. 2001). Moreover, studies of San Diego Bay have identified over 100 exotic species (U.S. Navy 2000). There has been a rapid increase of nonnative tunicates, for example, in southern California harbors and marinas and Asian kelp was recently discovered at Catalina Island (Silva *et al*. 2002).

Van Zyll De Jong *et al.* (2004) provide an example of long-term impacts from release of introduced species in Newfoundland and Labrador, Canada. While this study focused on species that are the subject of freshwater fisheries, the types of impacts described have broader relevance. Introductions began in these areas in the 1880s and have led to interspecific and intraspecific competition, predation, possible introduction of disease and parasites, genetic effects, and changes in community structure (Van Zyll De Jong *et al.* 2004).

Exotic species can have several types of impacts on native coastal marine species:

- Replacement of a functionally similar native species through competition;
- Reduction in abundance or elimination of an entire population of a native species, which can affect native species richness;
- Inhibition of normal growth or increased mortality of the host and associated species;
- Increased intra- or interspecies competition with native species;
- Creation or alteration of original substrate and habitat;
- Hybridization with native species;
- Other genetic effects;
- Transfer of new parasites and diseases; and
- Direct or indirect toxicity (e.g., toxic diatoms).

See also the information in section 3.5.3.3, entitled "Ballast Water Exchange and Other Management."

Exotic species have negatively impacted over 45 percent of listed threatened or endangered species in the United States; the establishment of exotic species is second to habitat loss as the major threat to native species diversity (Government Accounting Office 2002; Kimball 2001; Wilcove *et al*. 1998).

Genetically modified species may cause environmental impacts similar to those of non-native species, in addition to impacts unique to transgenic species when released into the environment (Kapuscinski and Hallerman 1990). In general, genetic modification of marine and aquatic organisms is used for the following purposes: to improve the quality and quantity of fish reared in aquaculture; as a detection tool for the prevention, control and management of diseases in aquaculture operations; to provide genetic markers used in population monitoring; for biofarming (e.g., freshwater Tilapia used to produce insulin); ornamentation; and for industrial applications (Aerni 2004). Kapuscinski and Hallerman (1990) suggested that genetically modified fish may exhibit three main categories of differences from their nongenetically modified counterparts: 1) physiological, 2) tolerance of physical factors (e.g., temperature, pH, or salinity), and 3) behavioral (e.g., seasonal migration, habitat selection, prey selection, territoriality, and reproduction); along with additional changes sought by geneticists such as increased resistance to certain diseases or to certain drugs. On a global scale approximately 35 fish species are the subject of transgenic research (Reichhardt 2000) and as of 2004, 14 fish species had been genetically modified for enhanced growth, though none had been approved for commercialization (Aerni 2004). In order for transgenic species to have a genetic impact on their nontransgenic counterparts their modified genes must spread through the wild population, which requires that the genetically modified individuals have a fitness advantage over their nongenetically modified counterparts in at least one of the following six components: juvenile viability, adult viability, age at sexual maturity, female fecundity, male fertility, or male mating advantage (Howard *et al.* 2004). According to Howard *et al.* (2004), when genetically modified individuals breed with nongenetically modified individuals within a population and the genetically modified individuals have a fitness advantage in one of the above components, the relevant modified gene will replace the natural gene in the population. However, when the genetically modified individuals have a fitness disadvantage in another component this has the potential to lead the affected population to extinction, a phenomenon the authors refer to as the "Trojan gene effect." For example, this phenomenon may occur when genetically modified males have a mating advantage relative to nongenetically modified males, but their resulting offspring, which also carry the modified gene, have reduced viability relative to offspring without the modified gene (Kapuscinski and Hallerman 1990; Howard *et al.* 2004).

Based on the numerous potential impacts of transgenic fish on natural ecosystems, and difficulty in assessing these potential impacts *a priori*, Kapuscinski and Hallerman (1990) recommended that special precautions be made to prevent use and release of transgenic fishes in proximity to environments with severely depleted or endangered species, environments with ongoing restoration projects, and for designated natural preserves. While proponents of genetically modified fish species suggest sterilization as a means by which to prevent many of the impacts associated with release of transgenic species, a zero risk of these impacts cannot be guaranteed since the current practice of developing all-female sterile offspring is less then 100% successful due to varying success in its application among different species and by personnel implementing these methods (Aerni 2004).

3.5.5.1 Regulatory Setting

Despite the threats posed by the introduction of exotic species to coastal economies and ecosystems, there is currently no federal monitoring program, ecosystem-based characterization, or biological inventory of exotic species associated with the CINMS.

Federal and state environmental policies have been adopted to address some of the threats posed by the introduction of exotic coastal marine species. The National Invasive Species Act of 1996 was passed to:

- Prevent unintentional introduction and dispersal of nonindigenous species into waters of the United States through ballast water management and other requirements;
- Coordinate federally conducted, funded, or authorized research, prevention, control, information dissemination and other activities regarding the zebra mussel and other aquatic nuisance species;
- Develop and carry out environmentally sound control methods to prevent, monitor, and control unintentional introductions of nonindigenous species from pathways other than ballast water exchange;
- To understand and minimize economic and ecological impacts; and
- stablish a program of research and technology development and assistance to states in the management and removal of zebra mussels.

Executive Order 13112 (1999) also supports prevention of introduction of invasive exotic species. In October 2001, the National Invasive Species Council (established by Executive Order 13112) published *Meeting the Invasive Species Challenge*, which is a comprehensive management plan and report that outlines the necessary policy actions to prevent and control the spread of invasive exotic species.

The following California Department of Fish and Game regulations also address issues associated with the introduction of exotic species:

- Fish and Game Code; Sections 2116-2126; Illegal transportation of certain species.
- Fish and Game Code; Sections 6300–6306; Infected, diseased or parasitized fish, amphibian or aquatic plants.
- Fish and Game Code; Sections 6440–6460; Control of aquatic nuisance species.
- Fish and Game Code; Sections 8596–8598; Control of aquaria pet trade.

The CDFG's OSPR is responsible for conducting research to determine the location and extent of exotic species populations in coastal and estuarine waters of the state.

On October 10, 2003, California Governor Gray Davis signed California Senate Bill 245, which bans ocean farming in state waters off the coast of California of exotic and genetically modified fish. The law also bans ocean farming of salmonids unless it is conducted on behalf of the CDFG or it is for the purpose of recovery, restoration, or enhancement of California's native salmon and steelhead trout populations.

See also the information in section 3.5.3.3, entitled "Ballast Water Exchange and Other Management."

3.5.6 Fishing

3.5.6.1 Commercial Fishing

Commercial fishing (by nets, traps, and lines, diving, and other methods) occurs at various locations off the coast of Southern California, including the Channel Islands, The nearshore waters along the coast from Ventura to Santa Barbara and the waters around the Channel Islands contain giant kelp beds that support numerous species. The majority of fish are caught within these areas. Fishery seasons are established and regulated by the California Fish and Game Commission and regulated by the California Department of Fish and Game, except for groundfish and wetfish (anchovies, sardines and mackerels) and highly migratory species (tunas, dolphinfish, wahoo, marlin and sailfish). Groundfish, wetfish, and highly migratory species are federally managed by the Pacific Fishery Management Council and NOAA's National Marine Fisheries Service.

Live fish trapping (e.g., rockfish, sheephead, and other nearshore species) occurs primarily in the shallower waters near the coastlines of the Channel Islands. Hook and line fisheries catch a variety of species on hand lines, longlines, rod and reel, and trolled gear. Lobsters are trapped in coastal waters since they are typically most abundant in rocky areas with kelp in depths of 100 feet (30 meters) or less. The waters off the majority of the Channel Islands provide extensive rocky kelp habitat since they generally have an offshore shelf that extends gradually into deeper waters. Gill nets are not allowed within 3 NM of the mainland coast, or within 1 NM of the offshore islands in the CINMS. Commercial drift gill netting for pelagic shark and swordfish occurs in the open waters throughout portions of the CINMS. This fishery, however, is only a small portion of the total industry in southern California.

Key target species for commercial fishing in the CINMS and SCB include:

- Squid;
- Sea urchin;
- Spiny lobster;
- Prawn;
- Nearshore and offshore finfishes (e.g., rockfishes and California sheephead);
- Coastal pelagic species (e.g., anchovy, sardine, and mackerel);
- Flatfishes (e.g., California halibut, starry flounder, and sanddabs);
- Rock crab;
- Sea cucumber; and
- Tuna.

The commercial harvest of kelp and other marine vegetation near the coastline is an established industry in Southern California, and is described below under section 3.5.6.3. However, in June of 2005, ISP Alginates, the country's largest kelp harvesting company, announced it would be closing its southern California facility early in 2006 and relocating to Scotland (McMahon 2005). The rising cost of labor,

fuel, and raw materials as well as recent increases in the company's water and sewage expenses were the major reasons behind the decision to stop southern California operations (McMahon 2005). ISP Alginates was the only company harvesting giant kelp in the Sanctuary region (Ugoretz 2002).

In 1999 (a record year for market squid), 737 fishing operations received over $36.7 million in revenue from fish and invertebrates caught in the CINMS. The 1996-1999 average revenue was $20.3 million. Nineteen (19) percent of the operations (141 operations) accounted for 82 percent of the total revenue (Leeworthy and Wiley, 2003).

In 1999 (including kelp harvesting—about $6 million annually- and including multiplier impacts defined in the glossary), commercial fisheries generated over $141.6 million in income and supported 4,056 full and part-time jobs in the seven-county area from Monterey County south through San Diego County. The 1996-1999 average was $82.9 million in income and 2,307 jobs. Supplies of commercial fishing products from the CINMS are a small portion of U.S. and world supply and therefore any reductions in CINMS catch would not be expected to have impacts on consumer prices and consumer's surplus. In addition, most commercial fisheries are either open access fisheries or over capitalized and therefore no producer's surplus or economic rents exist. Economic rents are most likely negative meaning reductions in fishing capacity would most likely yield positive benefits (Leeworthy and Wiley, 2003).

Brief descriptions of some of the more prominent fisheries in the Channel Islands follow below. More detailed descriptions are provided in *Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary – Final Environmental Document* (2002), available on line at http://www.dfg.ca.gov/mrd/ci_ceqa/index.html.

Prawn Prawn fisheries in the Sanctuary area have historically included trawl and trap fishing for spot prawns (*Pandalus platyceros*) and trawl fishing for ridgeback prawn (*Sicyonia ingentis*). Traditionally, a number of trawl boats fished year round for both ridgeback and spot prawns, targeting ridgeback prawns during the closed season for spot prawns, and targeting spot prawns during the closed season for ridgeback prawns. Live individuals accounted for 95 percent of spot prawn landings (from trap and trawl vessels combined), and for the period from 1997 to 1999 accounted for 28 to 68 percent of ridgeback prawn landings (Leet et al. 2001).

The trawler fleet operates from Fort Bragg south to the United States-Mexico border. Most vessels operate out of Monterey, Morro Bay, Santa Barbara, and Ventura, although a number of Washington-based vessels participate in prawn fisheries during the fall and winter. The ridgeback trawl fishery began in 1965. Although the fishery for spot prawns started in the early 1930s when prawns were caught incidentally in Monterey area octopus traps, a trawl fishery did not begin in the Channel Islands area until 1974 (Leet et al. 2001). In 1985 a spot prawn trap fishery developed in the Southern California Bight and was concentrated around the Channel Islands.

Landings and revenue from these three fisheries have varied tremendously since their inception (Leet et al. 2001). Landings decreased dramatically from 1985 to 1991 (population declines were confirmed by California Department of Fish and Game surveys during that time), but have since increased to over 1.4 million pounds in 1999 (Leet et al. 2001, 2001; Thompson et al. 1993). In 1999, 30 commercial fishing operations received over $725 thousand in revenue from prawn caught in the CINMS. The 1996-1999 average was about $703 thousand (Leeworthy and Wiley, 2003). In 2002 the California Fish and Game Commission voted to close the spot prawn trawl fishery, regulations for which went into effect in 2003, while the ridgeback prawn trawl fishery remains open by permit.

Spiny Lobster (*Panuliris interruptus*) Since the late 1800s, there has been a commercial lobster fishery in southern California. Commercial lobster fishing occurs in shallow, rocky areas from Point Conception to the Mexican border and off the islands and banks of the Sanctuary area. Most of the fishery is in water less than 98 feet deep, although the fishery has expanded to include deeper habitats. A sport fishery (hand capture) is popular among scuba divers in the Channel Islands area.

The peaks and valleys that have characterized this fishery are not unexpected in a fishery strongly influenced by the weather, El Niño and La Niña events, and the export market. Seasonal landings in the 200,000 to 400,000 pound range rose following World War II and peaked in the 1949-1950 season, with a record 1.05 million pounds landed. A general decline followed for the next 25 years, reaching a low of 152,000 pounds in the 1974-1975 season. Landings remained between 400,000 and 500,000 pounds for nine consecutive seasons in the 1980s. Landings ranged from 600,000 to 957,000 pounds through much of the 1990s and subsequently decreased. About 90 percent of the legal lobsters taken in the commercial fishery weigh between 1.25 and 2.0 pounds, which produces the size of tail desired for the restaurant trade. Most of the harvest in recent years has been exported to Asian countries and France. However, depressed economies overseas have resulted in an effort to re-establish domestic markets. (Leet et al. 2001)

The commercial fishery for California spiny lobster is among the highest in commercial value. In 1999, 46 commercial fishing operations received over $950 thousand in revenue from spiny lobsters caught in the CINMS. The 1996-1999 average was about $922 thousand (Leeworthy and Wiley, 2003).

Rock Crab The rock crab fishery is made up of three species: yellow rock crab (*Cancer anthonyi*), brown rock crab (*Cancer antnnarius*) and red rock crab (*Cancer productus*). Approximately 95 percent of the landings in this fishery come from southern California, although rock crabs inhabit the nearshore waters of the entire State (Leet et al. 2001).

In 1999, 71 commercial fishing operations received over $313 thousand in revenue for all types of crabs caught in the CINMS. The 1996-1999 average was $343.7 thousand (Leeworthy and Wiley, 2003).

Red Sea Urchin (*Strongylocentrotus franciscanus*) The red sea urchin commercial dive fishery is one of the most important California fisheries. This fishery is relatively new, having developed over the last 30 years, and caters mainly to the Japanese export market (Leet et al. 2001). The gonads of both male and female urchin are the object of the fishery and are referred to as “roe ”or “uni,” in Japanese. Gonad quality depends on size, color, texture, and firmness. Algal food supply and the stage of gonad development affect quality and price. The highest prices are garnered during the Japanese holidays around the new year.

The urchin fishery in southern California began in 1971 as part of a National Marine Fisheries Service program to develop fisheries for underutilized marine species (Leet et al. 2001). The fishery also was seen as a way to curb sea urchins’ destructive grazing on giant kelp. There have been two periods of rapid fishery expansion in California. The first culminated in 1981 when landings peaked at 25 million pounds in southern California. Contributing to this rapid escalation of the fishery was a group of fishermen and boats involved in the declining commercial abalone dive fishery. Sea urchin landings decreased following the El Niño of 1982-1983, when warm water weakened or killed kelp, the primary food source for sea urchins. Catches did not recover until 1985-1986, helped in part by the strengthening of the Japanese yen relative to the U.S. dollar, favoring California fishermen and exporters. Prices for urchin from the south are typically higher than for urchins from northern California due to the longer market presence and consistently higher gonad quality. The majority of sea urchin landings in southern California come from the northern Channel Islands off of Santa Barbara, where large and accessible

stocks once occurred (Leet et al. 2001). In the last few years the red urchin fishery has become fully exploited throughout its range in northern and southern California. The purple sea urchin, which occurs over the same geographical range, is also harvested in California, but only on a very limited basis.

In 1999, 331 commercial fishing operations received almost $6 million in revenue from sea urchins caught in the CINMS. The 1996-1999 average was about $5.3 million (Leeworthy and Wiley, 2003).

Sea Cucumber Most sea cucumber catch is taken in southern California waters, with commercial divers almost exclusively harvesting the warty sea cucumber (*Parastichopus parvimensis*) while trawlers primarily take the California sea cucumber (*P. californicus*). Divers take sea cucumbers as far south as offshore from San Diego, but most of the commercial catch is from the four northern Channel Islands in depths of 36-120 feet (Leet et al. 2001).

The warty and California sea cucumbers support an expanding commercial fishery that began in 1978 and peaked in 1998 at nearly 900,00 pounds (Leet et al. 2001). Most of the California and warty sea cucumber product is shipped overseas to Hong Kong, Taiwan, China, and Korea. Chinese markets within the United States also purchase a portion of California 's sea cucumber catch. The majority are boiled, dried, and salted before export, while lesser quantities are marketed as a frozen, pickled, or live product. The processed sea cucumbers can sell wholesale for up to $20 per pound. Studies of the biomedical properties of various sea cucumber chemical extracts, such as saponins, and chondroiton sulfates, are being conducted by western medical researchers investigating the efficacy of these substances for pharmaceutical products (Leet et al. 2001).

In 1999, 61 commercial fishing operations received $269 thousand in revenue for sea cucumbers caught in the CINMS. The 1996-1999 average was about $168 thousand (Leeworthy and Wiley, 2003).

Abalone Chinese Americans started the California abalone fishery in the 1850s, targeting green abalone (*Haliotis fulgen*) and black abalone (*H. cracherodii*) in the intertidal zone. Following the closure of shallow waters to commercial harvest in 1900, Japanese Americans began diving to collect abalone. The only commercially harvested species reported for the period 1916 to 1943 was red abalone (*H. refuscens*). In southern California commercial harvest of abalone was prohibited from 1913 to 1943, then reopened to increase wartime food supplies. Following World War II the fishery serially depleted one species of abalone after another, despite stable landings (at that time the fishery was managed as a single-species fishery though it targeted several species). The fishery alternated from targeting red, to pink (*H. corrugata*), to green, to white (*H. sorensensi*), and finally to black abalone. Since the 1960s a combination of factors including an increase in fishing pressure, an increase in the sea otter population, and an increase in gear efficiency led to a southward expansion from the original center of the fishery in Monterey.

The Department of Fish and Game determined that targeted abalone species had suffered stock collapse due to overfishing. In 1992 the black abalone fishery was closed after further significant stock decline associated with a bacterial disease known as "Withering Foot Syndrome" (Karpov et al. 2000). In 1997, California Senate Bill 463 closed all of California to commercial abalone harvest. However, between 1988 and 1997, over $2.5 million of abalone was harvested from the CINMS (Leeworthy and Wiley, 2003).

Market Squid For over 100 years market squid (*Loligo opalescens*) has been harvested off the California coast from Monterey to San Pedro. The squid fishery has expanded into one of the largest fisheries in volume and economic value in California. Expanding global markets, especially in China and the

Mediterranean, coupled with a decline in squid product from other parts of the world, has fueled a rapid expansion of the California squid fishery (Hastings and MacWilliams 1999).

The majority of market squid harvest is centered in the northern Channel Islands region, mainly in the Sanctuary area. The peak of the fishery targets the squid mating and egg laying behavior and occurs during fall and winter in Southern California. On a good net set, tons of squid may be harvested. Squid are minimally processed, mainly in San Pedro, California, frozen and shipped around the world, predominately to markets in the Mediterranean and China (Hastings and MacWilliams 1999). Annual squid catches can be greatly influenced by El Niño events. In 1999 (a record year), 169 commercial fishing operations received over $26.5 million in revenue from market squid caught in the CINMS. The 1996-1999 average revenue for the fishery was $13 million (Leeworthy and Wiley, 2003).

Nearshore Finfishes The Nearshore Fisheries Management portion of the California Marine Life Management Act (MLMA; 1998) defined nearshore finfish species as rockfish, California sheephead, greenlings, cabezon and other species found primarily in rocky reef or kelp habitat in nearshore waters. In the subsequent analyses in this document, the category *rockfish* includes all species of rockfish and cabezon. Since the early 1990's greater emphasis has been placed on identifying individual fish species harvested from this group and avoiding market categories that combine multiple species.

The development of the live/premium fishery in the late 1980's resulted in increasing commercial catches of many species of rockfish occupying the nearshore environment in and around kelp beds. The principal goal of this nontraditional fishery is to deliver fish live to the consumer in as timely a manner as possible. This fishery has increased substantially since 1988, and it continues to supply communities with live and premium quality fish. The impetus of this fishery is the unprecedented and increasing high price paid for live fish.

In 1999, 128 commercial fishing operations received over $553 thousand in revenue from all rockfish caught in the CINMS. The 1996-1999 average was about $549 thousand. Wetfish (anchovies, sardines and mackerels) are a significant fishery in the CINMS and are caught by many of the same operations that fish for market squid. In 1999, 37 commercial fishing operations received over $605 thousand in revenue from wetfish caught in the CINMS. The 1996-1999 average for wetfish was about $301 thousand. (Leeworthy and Wiley 2003)

Other significant finfish fisheries included California sheephead (1999, 92 commercial fishing operations received $153 thousand) and sculpin and bass (staghorn sculpin, yellowchin sculpin, rock bass, spotted sand bass, kelp bass, barred sand bass, white sea bass—1999, 43 commercial fishing operations received $103 thousand). The 1996-1999 averages were $235.9 thousand for California sheephead and $60.3 thousand for sculpin and bass revenues. (Leeworthy and Wiley 2003)

Other relatively minor fisheries included swordfish (1999, $21.5 thousand), shark (1999, $41.6 thousand), roundfish (sablefish, louvar, lincod, kelp greenling and Pacific Whitefish—1999, $37.3 thousand) and yellowtail (1999, $14.8 thousand). (Leeworthy and Wiley 2003)

Flatfishes The flatfish fisheries of interest include California halibut, starry flounder, sanddabs and other flatfish. California halibut is caught by trawl and hook-and-line, and is an important fishery in the State. Both recreational and commercial anglers prize flatfish and they are targeted from boats, piers, and the shoreline. Major fluctuations in landings of some species seem to indicate inconsistent recruitment and availability. In 1999, 85 commercial fishing operations received $323.6 thousand in revenue from flatfishes caught in the CINMS. The 1996-1999 average was almost $184 thousand (Leeworthy and Wiley, 2003).

Tuna The tuna category includes several highly migratory species, including albacore, bluefin tuna, yellowfin tuna, and bonito. Trolling or jig vessels take the majority of albacore, with a small portion using live bait. In addition, the wetfish fleet may target some tuna species during the summer. In some year, they may catch significant amounts of albacore (Leet et al. 2001). Historically, commercial effort for albacore has fluctuated over the past 100 years, based primarily on market and oceanic conditions.

In 1999, 19 commercial fishing operations received $53.7 thousand in revenue from tunas caught in the CINMS. The 1996-1999 average was $205.9 thousand (Leeworthy and Wiley, 2003).

3.5.6.2 Recreational/Sport Fishing and Consumptive Diving

Recreational (sport) fishing involves hook-and-line fishing from piers and docks, jetties, breakwaters, beaches and banks, private or rental boats, and commercial passenger fishing vessels. Recreational fishing also includes activities such as spear and net fishing. Recreational fisheries in the CINMS access both nearshore and offshore areas, targeting both bottom fish and pelagic fish species. Consumptive recreational divers use both private and rental boats and commercial passenger fishing vessels.

The coastlines around the Channel Islands are popular sportfishing areas; although the majority of kelp beds are within 1 NM of shore, some fishing areas extend far from shore and include lingcod and rockfish grounds west of San Miguel Island; tuna, broadbill swordfish, marlin, and mako shark waters south of Santa Cruz Island; and kelp beds offshore and surrounding portions of all of the islands.

The sportfishing industry in California is composed of commercial passenger fishing vessels, private boats, and shore anglers. The commercial passenger fishing vessels take groups of anglers out on half–day, 3/4–day, full day, and multi-day trips. Types of fish landed on commercial passenger fishing vessels include kelp bass, mackerel, California sheephead, halfmoon, and whitefish. Sport fishing for white seabass is also very popular. The majority of half and 3/4–day trips fish within or near the kelp beds except in the summer when California barracuda (*Sphyraena argentea*) and Pacific bonito (*Sarda chiliensis*) are present. Offshore fishing focuses on more mobile species like yellowtail, tuna, and white seabass. The largest numbers of fish caught for recreational purposes are caught within 3 miles of shore. Barred surfperch, California halibut, jacksmelt, pacific mackerel, kelp bass, rockfish, white croaker are a few of the species that represent the largest numbers caught. Commercial passenger fishing vessel dive trips are often multi-day trips going to one or more of the offshore islands. These trips focus on certain species during various seasons, such as lobster during the open season.

A large number of sport divers (both free divers and SCUBA divers) spearfish for many of the same species caught by hook and line. Species commonly targeted by consumptive divers include many rockfish species and kelp bass, halibut, yellowtail, and white seabass, as well as lobster and scallops. Divers are generally limited to the shallowest waters of the CINMS between the shallow intertidal to depths around 130 feet.

Recreational fishing can have a greater impact on the ecosystem than commonly thought and can be equal to or greater than the impact of commercial fishing (Schroeder and Love 2002). Although some stocks are healthy and support viable recreational fisheries, six species of fish popular with recreational fishermen have been declared overfished by the Pacific Fishery Management Council in the Study Area: cowcod, bocaccio, yelloweye, canary rockfish, lingcod, and Pacific ocean perch. Slow growth and late maturity make these species especially susceptible to decline from fishing pressure (Love and Schroeder 2003).

In 1999, 25 commercial passenger fishing vessel operators (18 fishing, 10 consumptive diving, 3 both fishing and consumptive diving), accounted for 176,700 person-days of activity in the CINMS (158.8 thousand person-days of fishing and 17.9 thousand person-days of consumptive diving). In addition, private boats accounted for 261.2 thousand person-days of activity within the CINMS (214 thousand person-days of fishing and 47.2 thousand person-days of consumptive diving).

In 1999, sports fishing and consumptive diving activity in the CINMS generated $24.7 million in income (including multiplier impacts), which supported 654 full and part-time jobs in the three-county area of Santa Barbara, Ventura, and Los Angeles counties. The commercial passenger fishing vessel industry received direct revenues of almost $8.8 million with over $420 thousand in profits. In addition, the recreators received about $15.5 million in consumer's surplus (nonmarket economic user value) (see glossary for definitions of "consumer's surplus" and "nonmarket economic user value") (Leeworthy and Wiley 2003).

3.5.6.3 Kelp Harvesting

Giant kelp was first harvested along the California coast during the early 1900s (Leet *et al*. 2001). Many harvesting companies operated from San Diego to Santa Barbara beginning in 1911. Those companies primarily extracted potash and acetone from kelp for use in manufacturing explosives during World War I. In the early 1920s, having lost the war demand, kelp harvesting virtually stopped. In the late 1920s, giant kelp was again harvested off California.

Giant kelp is now primarily harvested in California for extraction of alginates and other compounds and to supply feed for abalone aquaculture companies. It is also used for the herring-roe-on-kelp fishery in San Francisco Bay (Leet *et al*. 2001). Giant kelp is now one of California's most valuable living marine resources and in the mid-1980s supported an industry valued at more than $40 million a year. The annual harvest has varied from a high of 395,000 tons in 1918 to a low of less than 1,000 tons in the late 1920s. Such fluctuations are primarily due to climate and natural growth cycles, as well as market supply and demand. From 1970 to 1979, the annual harvest averaged nearly 157,000 tons, while from 1980 to 1989 the average annual harvest was only 80,400 tons. The harvest was low in the 1980s because the kelp forests were devastated by the 1982–1984 El Niño and accompanying storms, and by the 200-year storm that occurred in January 1988. In most areas, the beds of giant kelp recovered quickly, with the return of cooler, nutrient rich waters. Harvests in California increased to more than 130,000 tons in 1989 and to more than 150,000 tons in 1990.

In the Sanctuary region, ISP Alginates was the only company harvesting giant kelp (Ugoretz 2002), though several small-scale harvesters operate along the mainland coast. During the 1990s, increasing international competition from Japan for the "low end," or less purified end of the sodium alginate market caused ISP Alginates to reduce harvests by about 50 percent (Leet *et al*. 2001). Previously, ISP Alginates anticipated California's harvest in this decade would be approximately 80,000 tons annually. The company uses specially designed vessels that have a cutting mechanism on the stern and a system to convey the kelp into the harvester bin. A propeller on the bow slowly pushes the harvester stern-first through the kelp bed, and the reciprocating blades mounted at the base of the conveyor are lowered to a depth of three feet into the kelp as harvesting begins. Regulations state that kelp may be cut no deeper than four feet beneath the surface. The cut kelp is gathered on the conveyor and deposited in the bin. These vessels can each collect up to 600 tons of kelp in one day. To facilitate its harvesting operations, the company conducts regular aerial surveys. The survey information is used to direct harvesting vessels to mature areas of kelp canopy with sufficient density for harvesting. In June of 2005, however, ISP Alginates announced that their southern California facility will be shutting down in early 2006 and relocating to Scotland due to increased costs at the southern California facility (McMahon 2005). This

decision has considerable economic implications for southern California; in 1999, kelp harvested from the CINMS and processed in San Diego had a processed value of about $6 million and generated between $6.2 and $7.8 million in income (including multiplier impacts), which supported 45 to 60 jobs in San Diego County (Leeworthy and Wiley 2003).

With proper management, the surface canopy can be harvested several times annually without damage to the kelp bed (Ugoretz and Parker 2002). However, harvesting kelp may have adverse effects on other inhabitants of the kelp forest community because the kelp canopy serves as important habitat for juvenile fishes (Carr 1989) and many species of invertebrates (Coyer 1979, Watanabe 1984). For example, significant reductions in turban snail species were observed in harvested areas compared with unharvested areas in Carmel Bay (Hunt 1977). Others, however, reported that kelp harvesting has little effect on the overall abundance of kelp forest fishes and invertebrates, even though numerous organisms are removed along with the cut fronds (Miller and Geibel 1973; North and Hubbs 1968). Clearly more research is needed to determine the extent to which kelp harvesting affects populations of canopy-dwelling species. It is worth noting that not all effects of harvesting are necessarily detrimental to the forest community. Removing the canopy increases light reaching the bottom and leads to increased recruitment and growth of giant kelp and understory algae (Reed and Foster 1984). Higher production of understory algae in areas of reduced kelp canopies has been linked to increases in food chain support for some reef fishes (Schmitt and Holbrook 1990).

3.5.6.4 Aquaculture

Aquaculture is the practice of culturing, growing and harvesting an aquatic species in a controlled setting. California has approximately 400 registered aquaculturists who raise products within intensive systems (Resources Agency of California 1997). Currently, Ecomar is using several of the OCS oil and gas structures in the Study Area to raise aquacultural products, such as mussels and other invertebrates. Eight-five percent of the state mussel production and 91 percent of abalone production occurs on land adjacent to the Study Area (Resources Agency of California 1997).

In addition to potentially disturbing the seabed, aquaculture operations have the potential to introduce anoxic conditions, disease pathogens, and exotic species into the environment. For example, Drake's Estero, which is located northwest of San Francisco, has supported productive commercial fisheries for oysters since the 1960s. However, after the introduction of Pacific oysters (*Crassostrea gigas*) from Japan, native oyster species in Drake's Estero exhibited up to 7 percent mild systemic and localized haplosporidian infections (Friedman 1996). Little is known regarding the extent of invasion and damage to marine resources of the Channel Islands from the inadvertent or intentional release of exotic species. Damages from exotic species can range from habitat alteration or destruction, introduction of pathogens threatening human health, and/or predation or competition with native species.

3.5.6.5 Regulatory Setting

A variety of regulations are currently used to manage fisheries in the CINMS. These include total prohibitions on the take of certain species, seasonal closures, and other regulations. Tables 3.5-7a and 3.5-7b summarize some of the major commercial and recreational, respectively, fishing regulations currently in place in southern California. These tables are not complete listings of fishing regulations, but are included to show the level of protection currently provided to certain species or species groups. Marine reserves and conservation areas have recently been established that also regulate fishing activity in CINMS in addition to the regulations listed in Table 3.5-7a and 3.5-7b. Fishery seasons are established and regulated by the California Fish and Game Commission and regulated by the CDFG. Fishery seasons are also established and regulated by NMFS, based on the advice and recommendations of the Pacific

Fishery Management Council, and in coordination with the State of California, for federal waters off of California.

3.5.7 Marine Bioprospecting

Biodiversity prospecting, or bioprospecting, is the activity of seeking a useful application, process, or product in nature. In many cases, bioprospecting is a search for useful organic compounds in microorganisms, plants, and fungi (NPS 2003). Bioprospecting in the ocean can provide products other than seafood, such as ornamental marine life, raw materials, and medicines. For example, marine bioprospecting collected an extract (arabinosides) from the sponge *Tethya crypta* that led to more than $50 million in annual sales of derived antiviral medicines (NMFS 2001; Norse 1993). The most common use of marine bioprospected materials to date is for the production of pharmaceuticals.

What differentiates marine bioprospecting from other extractive activities (such as commercial fishing or kelp harvesting) is the genetic value of the bioprospected resource. For example, studies of the biomedical properties of various sea cucumber chemical extracts, such as saponins, and chondroiton sulfates, are being conducted by Western medical researchers investigating the efficacy of these substances for pharmaceutical products (Leet *et al*. 2001).

Marine bioprospecting may include sampling and can lead to extraction of a living marine resource for commercial purposes. Within the CINMS, there is no known bioprospecting at this time. However, there are MMS funded research projects investigating the potential beneficial properties of marine life attached to the submerged structure of a sample of offshore oil platforms in the Santa Barbara Channel. The implications of marine bioprospecting within the Study Area are not clearly understood. Nonetheless, removing marine life or plants for bioprospecting may potentially lead to habitat and ecosystem alterations.

3.5.7.1 Regulatory Setting

The NPS (2001) describes its management goal with respect to bioprospecting as follows: "Bioprospecting can sometimes be a consequence of an academic science project. Clearly, such serendipitous bioprospecting is allowed and even encouraged by federal law and NPS policy. Other bioprospectors have a clear goal such as discovering a new medicine or a new enzyme or other useful compound. Targeted bioprospecting is also allowed in the NPS since it is a part of broad scientific inquiry. Harvesting is not allowed. A wide range of scientific inquiry is encouraged and permitted as long as it will not lead to adverse impacts on park resources or values. Biological material is never sold to researchers, nor may they acquire ownership rights in any other way. Just as the National Institutes of Health (NIH) grant permittees license to use biological materials acquired from NIH in exchange for certain negotiated benefits without transfer of ownership, park research permits do not grant any exclusive or propriety rights to the researcher."

The NPS has dealt with this issue and established policies. The NPS (2001) notes: "Any scientist who wants to study microorganisms in national parks must get a research permit. Research permits are only issued to legitimate scientists who can show that they will not harm national parks in any way. Permits are never issued for harvesting natural products. In fact, federal regulations prohibit harvesting of any natural product from national parks. Scientists are only allowed to take small research samples out of the park and they are not allowed to sell or commercialize those research samples. If a scientist makes a practical or useful discovery during his or her research, the scientist's knowledge may be commercialized, but never the national park sample."

Table 3.5-7a

General Summary of Commercial Fishing Prohibitions in Southern California

Species	Gear Type	Regulated Season	Regulations
Abalone			Abalone may not be taken, possessed, or landed for commercial purposes.
All Groundfish (some exceptions)	All Gear Types	March 1 – April 30	Closed Season
All Groundfish (some exceptions)	Non-trawl (Fixed)	Jan 1 – Dec 31	Fishing is prohibited in waters greater than 60 fathoms and less than 150 fathoms south of Point Conception.
All Groundfish (some exceptions)	Trawl	Jan 1 – Feb 28 and Nov 1 – Dec 31	Fishing is prohibited in waters greater than 75 fathoms and less than 150 fathoms along the mainland, and from the shoreline to 150 fathoms around the islands.
All Groundfish (some exceptions)	Trawl	Mar 1 – Oct 31	Fishing is prohibited in waters greater than 100 fathoms and less than 150 fathoms along the mainland, and from the shoreline to 150 fathoms around the islands.
Sheephead	All Gear Types	March 1 – April 30	Closed Season
All Species – Marine Resources Protection Zone	Gill Nets and Trammel Nets		Prohibited in waters less than 70 fathoms or within 1 nautical mile, whichever is less, around all of the Channel Islands[1]
Rockfish	Gill Nets and Trammel Nets		Use Prohibited in State waters for the take of rockfish.
Rockfish & Lingcod	Gill Nets and Trammel Nets		Prohibited in waters less than 70 fathoms in depth south of Point Sal, except drift and set gill nets shall not be used in waters less than 100 fathoms in depth at Sixty-Mile Bank. Prohibition on the take of rockfish in State waters applies.
Swordfish & Shark	Drift Gill Nets	Feb 1 – April 30	Closed Season
Swordfish & Shark	Drift Gill Nets	May 1 – Aug 14	Use prohibited within 75 nautical miles of the mainland coast between the westerly extension of the CA-OR boundary and the westerly extension of the US-Mexico boundary.
Swordfish & Shark	Drift Gill Nets	May 1 – July 31	Use prohibited within 6 nautical miles westerly, northerly, and easterly of the shoreline of San Miguel Island between a line extending 6 nautical miles west from Point Bennett and a line extending 6 nautical miles east from Cardwell Point and within 6 nautical miles westerly, northerly, and easterly of the shoreline of Santa Rosa Island between a line extending 6 nautical miles west

[1] All Channel Islands include San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente.

Species	Gear Type	Regulated Season	Regulations
			from Sandy Point and a line extending 6 nautical miles east from Skunk Point.
Swordfish & Shark	Drift Gill Nets	May 1 – July 31	Use prohibited within 10 nautical miles westerly, southerly, and easterly of the shoreline of San Miguel Island between a line extending 10 nautical miles west from Point Bennett and a line extending 10 nautical miles east from Cardwell Point and within 10 nautical miles westerly, southerly, and easterly of the shoreline of Santa Rosa Island between a line extending 10 nautical miles west from Sandy Point and a line extending 10 nautical miles east from Skunk Point.
Swordfish & Shark	Drift Gill Nets	Dec 15 – Jan 31	Use prohibited in ocean waters within 25 nautical miles of the mainland coast.
Squid	Round Haul Nets	Jan 1–Dec 31	Season closed from noon Friday until noon Sunday each week.
Yellowtail, barracuda, white seabass, salmon, steelhead, striped bass, and shad	Round Haul Nets		Use prohibited to take these species.
All Species	Trawl Nets		Prohibited out to 3 miles offshore mainland coast. (Except California halibut trawl grounds, 1-3 miles offshore between Pt. Arguello and Pt. Mugu). Special restrictions apply.
Halibut	Trawl Nets	March 15 – June 15	Closed Season - California Halibut Trawl Grounds. Use prohibited in waters 1-3 nautical miles from the mainland shore between Pt. Arguello and Pt. Mugu.
Pink Shrimp	Trawl Nets	Nov 1 –March 31	Closed Season for Pacific Ocean Shrimp.
Prawns & Shrimp	Traps		Use prohibited from Point Conception south to the Mexican border inside 50 fathoms depth.
Spot Prawn	Traps	Nov 1 –January 31	Closed Season between line drawn due west from Pt. Arguello and US-Mexico boundary.
Spot Prawn	Trawl		Use prohibited
Sea urchin (Red)		Various Closures - April through October	In April - May, September - October the closed days are Friday through Sunday. In June and August the closed days are Thursday through Sunday. In July the closed days are Wednesday through Sunday.

Table 3.5-7a, Page 2 of 2

Note: This is not a complete reproduction of all fishing regulations (e.g., size limits and gear restrictions) and should not be used for legal compliance. **Source**: CDFG 2002.

Table 3.5-7b

General Summary of Recreational Fishing Prohibitions in Southern California

Species	Regulated Season	Regulations
Abalone		May not be taken
Garibaldi, giant (black) sea bass, gulf and broomtail grouper, canary rockfish, cowcod rockfish, yelloweye rockfish, white shark		May not be taken
Grunion	4/1 – 5/31	Closed Season
Rockfish, cabezon, greenlings, CA sheephead, ocean whitefish, and bocaccio.	1/1 – 2/28	Closed Season for boat-based anglers; open year-round for divers and shore-based anglers[1].
Rockfish, cabezon, greenlings, CA sheephead, ocean whitefish, and bocaccio	3/1 – 4/15	Take is prohibited in waters greater than 60 fathoms and less than 30 fathoms south of Point Conception.
Rockfish, cabezon, greenlings, CA sheephead, ocean whitefish, and bocaccio	4/16 – 8/31, and 11/1-12/31	Take is prohibited in waters greater than 60 fathoms south of Point Conception.
Rockfish, cabezon, greenlings, CA sheephead, ocean whitefish, and bocaccio	9/1-10/31	Take is prohibited in waters greater than 30 fathoms south of Point Conception.
CA scorpionfish (sculpin)	1/1 – 9/30	Closed Season for boat-based anglers; open year-round for divers and shore-based anglers.
CA scorpionfish (sculpin)	10/1-10/31	Take is prohibited in waters greater than 30 fathoms south of Point Conception
CA scorpionfish (sculpin)	11/1-12/31	Take is prohibited in waters greater than 60 fathoms south of Point Conception
Lingcod	1/1-3/31, and 12/1-12/31	Closed Season for boat-based anglers, divers, and shore-based anglers.
Lingcod	April 1 – April 15	Take is prohibited in waters greater than 60 fathoms and less than 30 fathoms south of Point Conception.
Lingcod	4/16 – 8/31, and November 1-November 30	Take is prohibited in waters greater than 60 fathoms south of Point Conception.
Lingcod	9/1-10/31	Take is prohibited in waters greater than 30 fathoms south of Point Conception.
Lobster	First Thur. after 3/15 to the Fri. before the 1st Wed. in October	Closed Season
Salmon	9/29 – 4/2	Closed Season

Note: This is not a complete reproduction of all fishing regulations (e.g., size limits and gear restrictions) and should not be used for legal compliance. **Source:** CDFG 2002.

3.5.8 Nonconsumptive Recreation and Tourism

Nonconsumptive recreational activities occur primarily in nearshore areas, particularly along the mainland and around the Channel Islands. Examples of common nonconsumptive recreational and tourist-related activities include nonconsumptive diving, boating (including motor boating and sailing), personal watercraft use (along the mainland shore), whale watching, and kayaking/sightseeing (this would include other wildlife viewing and scenic viewing).

3.5.8.1 Nonconsumptive Recreation and Tourist-Related Use

In 1999, nonconsumptive recreational and tourist-related uses accounted for 42 thousand person-days of use in the CINMS (excluding activity from private boats, which has not been estimated). Twenty-six charter/party/guide services brought passengers to the CINMS. Whalewatching accounted for almost 26 thousand person-days, nonconsumptive diving almost 11 thousand person-days, sailing about 4 thousand person-days, and kayaking/sightseeing a little over 12 hundred person-days.

In 1999, nonconsumptive recreation and tourist-related uses generated over $5 million in income, which supported 179 full and part-time jobs in Santa Barbara, Ventura, and Los Angeles counties. The charter/party/guide service industry received direct revenue from this activity of almost $2.6 million, with net profits of about $83 thousand. In addition, the recreators/tourists received almost $1.5 million in consumer's surplus (nonmarket economic use value) (Leeworthy and Wiley 2003).

CINP Visitation and Activities

There are several types of activities that occur in or near the CINMS that are associated with the CINP. Table 3.5-8 depicts annual visitation to the CINP since 1995. In 2003, an estimated 60,000 people visited and explored the waters associated with the CINP while 30,000 people visited the islands themselves.

The statistics in Table 3.5-9 do not include lesser amounts of air traffic above the northern Channel Islands, including (1) private or commercially hired flights landing on islands to transport persons not visiting the CINP (e.g., The Nature Conservancy property visitors), (2) private or commercially chartered flights transporting Park personnel, and (3) private aircraft flying over the CINMS and CINP.

Although many visitors access the CINP by boat, aircraft visitation also occurs. Table 3.5-9 depicts aircraft-based public visitation statistics from the CINP from 1995.

Table 3.5-8
Annual Visitors to Channel Islands National Park, 1995–2003

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total Park Visitors	12,600	12,749	17,313	12,365	15,649	12,301	19,388	11,825	60,000

Source: From Channel Islands National Park visitation statistics. 1995–2002. National Park Service Public Use Statistics Office. National Park Service. U.S. Department of the Interior. www2.nature.nps.gov; and 2003 data from www.nps.gov/chis/homepage.

Table 3.5-9
Aircraft-based Public Visitation for Channel Islands National Park, 1995–2002

	1995	1996	1997	1998	1999	2000	2001	2002
No. of Aircraft Flights to Santa Rosa Island by Park Concessionaires (for Park Visitation Trips only)	18	41	81	112	130	86	57	73
No. of Park-visiting Passengers Aboard Aircraft Flights to Santa Rosa Island by Park Concessionaires	123	207	458	587	763	375	158	456

Source: From Channel Islands National Park visitation statistics. 1995–2002. National Park Service Public Use Statistics Office. National Park Service. U.S. Department of the Interior. www2.nature.nps.gov.

3.5.8.2 Motorized Personal Watercraft

Motorized personal watercraft (MPWC), as defined by the NPS, means a vessel, usually less than 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing or kneeling on the vessel, rather than within the confines of the hull. The length is measured from end to end over the deck excluding sheer, meaning a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments, are not included in the measurement. Length is stated in feet and inches. 36 CFR 1.4(a). The recreational use of MPWCs is a year-round activity, with the majority of operators located in the coastal nearshore portion of the Study Area during spring and summer.

In general, the use of MPWCs is controversial due to concerns about their impacts upon human safety (not addressed here); noise pollution; air and water quality; and wildlife and their habitats.

While industry sponsored studies indicate that MPWCs are no louder than similar motorized vessels under analogous conditions, other studies indicate that because MPWCs travel repeatedly in the same area, continually leaving and reentering the water, they create rapid cycles of noise that disturb humans and wildlife (MOCZM 2002). Since most MPWC use occurs during the spring and summer, it has the potential to interfere with migration, feeding, nesting, and reproduction of wildlife. In addition, the maneuverability and shallow-water capabilities of MPWCs allow them to access sensitive and near-shore habitats (MOCZM 2002). Studies have shown that the use of MPWCs in nearshore areas can increase flushing rates, reduce nesting success of certain bird species, impact spawning fish, and reduce fishing success (Burger 1998, Snow 1989). The National Park Service (2000, 2004) identified several of these impacts along with interruption of normal activity, avoidance and displacement, loss of habitat use, interference with movement, direct mortality, interference with courtship, alteration of behavior, change in community structure, elevated noise levels, and damage to aquatic vegetation. Further, offshore marine mammals or surfacing birds may be unaware of the presence of these vehicles due to their low frequency sound; when the inability to detect the vehicles is combined with their high speed and rapid and unpredictable movements, both animals and operators are at risk (Snow 1989).

See also the discussion of MPWC in Chapter 2.

Although U.S. EPA studies have shown that 30 percent of non-road air pollution emissions stem from motorboats, jetboat, and MPWC engines combined, researchers have not been able to determine the particular contribution of MPWCs to either air or water pollution (MOCZM 2002). Water quality concerns related to use of MPWC, and in particular those with two-stroke engines, include discharge of oil and gas, and air pollutants such as volatile organic compounds, nitrogen oxides, particulate matter, and carbon monoxide (NPS 2000, 2004). The noise, air, and water pollution generated by MPWCs may adversely impact the living marine resources within the CINMS and throughout the Study Area through direct disturbances as well as environmental degradation. The following concerns regarding MPWCs were identified during NOAA's review of this issue:

- MPWCs are different from other types of motorized watercraft in their structure (smaller size, shallower draft, two-stroke engine, and exhaust venting to water as opposed to air) and their operational impacts (operated at faster speeds, operated closer to shore, make quicker turns, stay in a limited area, tend to operate in groups, and have more unpredictable movements);

- MPWCs have been operated in such a manner as to create a safety hazard to other resource users in the vicinity and interfered with other marine recreational uses;

- MPWCs may interfere with marine commercial users;

- MPWCs may disturb natural quiet and aesthetic appreciation; and

- MPWCs present a current and potential threat to resources and users of the marine environment.

Since 2000, because of the NPS ban of MPWC use within waters of the CINP, there has been no legal MPWC activity in that portion of CINMS. According to sightings from the Sanctuary's aerial monitoring program, the activity has occurred only rarely within CINMS. CINP has observed an increase in use of MPWC within the Park over the last several years, and Park staff issue several dozen warnings per year for violation of this ban (Fitzgerald 2005). However, along the mainland shoreline many participated in MPWC via access from mainland marinas and harbors. In 2002, an estimated 8,335 person-days of activity (from rental and private boats) took place along the shoreline of the Study Area (Ehler and Tetra Tech 2002). There was one rental business in Santa Barbara. In the two-county area of Santa Barbara and Ventura counties, this activity generated $399 thousand in income (including multiplier impacts), which supported 12 full and part-time jobs in the local economies.

3.5.8.3 Recreational Boating

Sailing and boating are popular recreational activities within the CINMS and larger Study Area. The Channel Islands are within reach of several ports for single or multi-day trips (CDFG 2002). Motorboats (including sailboats when using motors) yield impacts such as noise, and air and water pollution, which vary depending on factors such as the size, condition, and type of engine used. Vessels under sail and motor power have the potential to disturb marine life directly, and using and setting anchors can cause seabed disturbances.

Kayaking, when done responsibly, is a virtually no-impact sport. However, disturbance to seabird colonies and nesting sites may occur when kayakers travel too close to these sensitive areas. To avoid predators, cormorants, pelicans, oystercatchers and other seabirds roost on ledges, rocks, and pinnacles away from land. These roosting areas are, however, often within the range of kayakers. If approached

too closely, these birds will abandon their rookeries, leaving nests and young. Three species of seabirds, pigeon guillemots, oystercatchers, and Xantus' murrelets, nest in caves and are very susceptible to disturbance by kayakers entering these caves. A single disturbance may cause the loss of an entire season's young. In addition, pinnipeds at haul-out and rookery areas are very susceptible to a close approach from a kayak or small boat. Such animals will stampede into the water if approached too closely. With larger species such as California sea lions and northern elephant seals, pups can be trampled to death in a stampede. Chronic disturbances have resulted in the abandonment of some rookeries and haul-out sites in various regions.

See the previous section for a discussion of MPWC.

Boat Landings and Boat Landing Structures within the CINMS

There are several structures located on the Islands to accommodate boat landings. Primary structures associated with the northern Channel Islands include:

Anacapa Island. There are two moorings near the landing cove at East Anacapa Island. These are reserved for use by the NPS, USCG, and the NPS concessionaire. Private boaters must anchor a reasonable distance from these moorings.

Santa Cruz Island. Private boaters may land on the eastern 24 percent of Santa Cruz Island without a permit at any time. This area is managed by the NPS and is east of the property line between Prisoners Harbor on the north side and Valley Anchorage on the south side.

Santa Rosa Island. Boaters may land along the coastline and on beaches with a permit for day-use only. Beaches between and including Skunk Point and East Point are closed from March 1st to September 15th in order to protect the threatened western snowy plover (a seabird). Sandy Point at the west end is closed to landings year round. There is also a pier at Bechers Bay.

San Miguel Island. There are no piers or moorings at San Miguel Island; therefore, all private boaters must anchor. Overnight anchorages are restricted to Cuyler Harbor and Tyler Bight. Visitors may land only on the beach at Cuyler Harbor. No landing is allowed on rocks or islets.

Santa Barbara Island. The landing dock is available for unloading purposes only. No craft, including kayaks and inflatables, should be left moored to the dock.

In 1999, eight for-hire operations accounted for over 4,000 person-days of sailing and four operators accounted for over 12 hundred person-days of kayaking/sightseeing in the CINMS (information on private boats is not available). These operations received revenue of about $390 thousand and earned a little over $27 thousand in profit from these activities. These activities generated over $797 thousand in income, which supported 24 full and part-time jobs in Ventura and Los Angeles counties. In addition, those that participated in these activities received over $189 thousand in consumer's surplus (nonmarket economic use value) (Leeworthy and Wiley 2003).

3.5.8.4 Non-Consumptive Diving

If done correctly and if visits to any one site are minimized, non-consumptive diving can have limited impacts on marine habitats and can be an excellent mechanism for accessing and enjoying Sanctuary resources. However, overuse of popular locations or poor diving techniques can result in damage to CINMS resources including living marine resources and their habitats, and submerged cultural resources.

Benthic organisms are susceptible to divers intentionally or accidentally holding, touching, picking up, or covering organisms with sand. Divers entering from the beach can also impact rocky shore habitats.

In 1999, seven for-hire operations accounted for almost 11,000 person-days of nonconsumptive diving in the CINMS (information on nonconsumptive diving from private boats was not available). These seven operations received about $688,000 in revenue and earned about $46,000 in profit from this activity. This activity generated almost $1.6 million in income, which supported 47 full and part-time jobs in the three-county area of Santa Barbara, Ventura, and Los Angeles counties (including multiplier impacts). In addition, those participating in nonconsumptive diving received about $389 thousand in consumer's surplus (nonmarket economic user value) (Leeworthy and Wiley 2003).

3.5.8.5 Surfing and Windsurfing

Numerous popular surfing areas exist along the mainland shorelines within the Study Area. In addition, there are several surfing areas located around the Channel Islands, although they are not well documented. Boat or shore-based access to surfing and windsurfing areas has the potential to create disturbances of sensitive marine mammals or seabirds.

3.5.8.6 Wildlife Viewing

Wildlife viewing, especially whalewatching, occurs along the coast and at the islands. Whalewatching in the Channel Islands is extremely popular due to the high frequency of sightings and diversity of marine mammals to be seen. Day trips are offered from several area landings including Santa Barbara, Ventura, and Channel Islands harbors. Whalewatching can have negative effects on whale behavior when conducted improperly. Boats that approach too fast or too close can disrupt whale feeding, mating, migration, and other activities. Vessels can stay with the whales too long, especially when other vessels are waiting their turn for a closer look. Observations of interactions between humpback whales and vessels (including but not limited to whale watching vessels) have included whales approaching vessels, directing threats at vessels, and avoiding vessels by altering their behavior (e.g., increasing dive time, reducing surface time, surfacing without blows, initiating dives without raising flukes, and altering direction away from approaching vessels) (Au *et al.* 2000). Au *et al.* (2000) concluded that noise from vessels representative of the humpback whale watching industry in Hawaii, and maintaining the standoff distance of 91 meters required in Hawaii, should not cause harm to the whales' auditory systems. However, this study did not yield evidence as to whether or not the presence of the vessels, and the noise they generate, led to behavioral changes in the observed whales. Researchers studying killer whale watching in an ecological reserve in British Columbia found that the likelihood of whales leaving the reserves increased as increasing numbers of boats entered the area (Williams *et al.* 2002). Williams *et al.* (2002) found that in an experimental setting in which a vessel maintained a distance of 100 meters from killer whales, male killer whales covered 13% more distance along a circuitous path than that covered before the boat arrived, while female killer whales swam 25% faster. Beyond observations in experimental conditions, Williams *et al.* (2002) observed actual whale watching activities and found that: as boats got closer to males their swimming paths became less direct, they tended to swim faster, and their surface behaviors increased; as the number of whale watching boats increased the males' paths became more direct, they tended to swim slower, and their surface behaviors decreased; as boats got closer to females their paths were erratic but directional, and their dives tended to be shorter; as the number of boats increased the females' paths were less direct, and their dives were shorter. These observations likely result from the cumulative effect of numerous factors rather than a simple response of whales to whale watching vessels (e.g., age of animals, date and time of observation, total number of vessels, proximity of nearest vessel to whales) (Williams *et al.* 2002); however, these examples are indicative of whales altering their behavior in the presence of whalewatching vessels. The implications of such

behavioral modifications are not well understood. The effects of vessel-based wildlife viewing coupled with other vessel traffic can have a negative cumulative impact on whales.

In 1999, eight for-hire operations accounted for almost 26,000 person-days of whalewatching activity in the CINMS (information on whalewatching from private boats is not available). These eight operators received about $1.5 million in revenue and earned a little over $9,000 in profits from this activity. This activity generated over $3.6 million in income (including multiplier impacts), which supported 108 full and part-time jobs in Santa Barbara and Ventura counties. In addition, whalewatchers received almost $938,000 in consumer's surplus (nonmarket economic user value) from their whale watching activities in the CINMS (Leeworthy and Wiley 2003).

3.5.8.7 Regulatory Setting

The NPS currently prohibits the use of MPWCs within waters of the CINP.

3.5.9 Department of Defense Activities

The U.S. Air Force and U.S. Navy conduct training exercises, provide logistic support, and conduct military testing and evaluation projects for aircraft, ship, and missile programs in the Study Area. Vandenberg Air Force Base (AFB), and the Naval Base Ventura County (NBVC) at the Point Mugu and Port Hueneme coastal areas are the primary locations for these testing and training exercises. The following presents an analysis of the current level of U.S. Air Force and U.S. Navy military activities in the Study Area. Finally, operations of the USCG are discussed.

3.5.9.1 Vandenberg AFB

Overview

Vandenberg Air Force Base (AFB) is located on California's central coast between Los Angeles and San Francisco, about 55 miles northwest of Santa Barbara. Vandenberg's unique location provides 42 miles of Pacific Ocean shoreline, over 99,000 acres of varied terrain and restricted airspace for spacelift, ballistic test, aeronautical operations, and military exercises. A 15,000-foot runway, boat dock, railway system and several major highways service Vandenberg AFB.

North Vandenberg has a coastline facing west while much of the South Vandenberg coastline faces south. This unique geography permits launch azimuths ranging from 147 to 300+ degrees, enabling over-ocean ballistic and polar space launches. Vandenberg is the only location in the continental United States where spacecraft can be launched into polar orbit without overflying land. In addition, the West Coast Offshore Operating Area (WCOOA) provides about 200,000 square miles of over-water and sea-land transition zones for aeronautical and cruise missile testing.

The types of activities conducted at Vandenberg AFB which have or may have an impact on marine resources can be categorized into the following areas:

- Spacelift Operations
- Intercontinental Ballistic Missile and Missile Defense Testing and Operations
- Missile Testing and Aircraft Operations
- Military Training Exercises
- Boat Dock Operations

A description of each category is provided below.

Spacelift Operations

Spacelift operations consist of launching rockets for the purpose of inserting satellites into earth orbit. Launch vehicles, such as, but not limited to Titans, Atlas and Deltas, are generally composed of multiple stages that are stacked one upon another. Each stage consists of a rocket motor and a supply of propellant (fuel and oxidizer). After the propellant in one stage is consumed, the entire stage is jettisoned from the rest of the launch vehicle and the next stage is fired to resume powered flight. Some launch vehicles are configured with two or more strap-on boosters, which are attached to the sides of the launch vehicle. Strap-on boosters and the vehicle's first stage are fired concurrently in order to provide additional thrust during the initial minutes of flight.

Spent booster stages, strap-on boosters, and other launch vehicle debris are jettisoned into the Pacific Ocean during spacelift operations. Such objects could fall almost anywhere within the CINMS Study Area. Current launch rates indicate up to 5 launches overfly the current CINMS boundary of which one overflies San Miguel Island directly. Presently all spent stages for these trajectories impact outside the CINMS. Historically launch rates for spacelift (southerly trajectories) have varied and future launch rates are subject to change based on mission need. Eleven spacelift operations occurred between 1997, 1998 and 1999. In 1966, the number of spacelift launches peaked at about 46. Future projected launch profiles do not deposit spent stages inside the CINMS.

The need to insert payloads into polar and other highly inclined orbits drives the requirement to launch spacelift vehicles along a wide range of southerly launch azimuths. In addition, different launch vehicles have dissimilar hardware and dissimilar flight characteristics, which further expands the region where launch vehicle debris could fall into the ocean. Active precautionary measures are in place to minimize the likelihood of jettisoned objects falling in the Sanctuary or on oil platforms.

As previously mentioned, a typical booster stage consists of a rocket motor and a large tank used for storing propellant. The size of booster stages vary from vehicle to vehicle, but some of the larger booster stages can have a 10-foot diameter and be nearly 90 feet in height. Large strap-on boosters can have a 10-foot diameter and exceed 110 feet in height. Booster stages, which consist primarily of metal components, fall into the ocean after their propellant has been consumed. Residual amounts of propellant may reside inside booster stages when they fall into the ocean.

Jettisoned objects sink to the ocean floor and are not recovered due to the extreme difficulty in locating and recovering such objects in deep ocean waters. Furthermore, the high costs associated with deep recovery operations would be prohibitive. On rare occasion, launch anomalies occur. Variously sized fragments from a destroyed vehicle as well as pieces of unburned solid propellants could be dispersed over a wide area potentially inside portions of CINMS and the Study Area. Liquid propellants would likely burn during the explosion or evaporate shortly thereafter. To date, no "scheduled" or planned spent stages have fallen within the CINMS. There was a launch failure (Titan IV in Aug '93), however, that deposited debris in the CINMS area.

The Department of Defense (DoD), the National Aeronautics and Space Administration (NASA), other government agencies, and various commercial enterprises conduct Spacelift operations at Vandenberg AFB. As the appointed executive agent for space, the Air Force is responsible for ensuring public safety. As such, positive control measures are employed during all missile and space launch activities. All launch vehicles are equipped with flight termination packages and tracking systems that offer operators the ability to terminate thrust or destroy vehicles that follow non-nominal trajectories. DoD personnel are

entrusted with this responsibility during powered flight (the phase of flight when thrust is provided by engines/motors that includes overflight of the Sanctuary and Study Area). In this role, the DoD is responsible for positive flight termination actions taken for all launches whether they are DoD, civilian, or commercial in nature.

Intercontinental Ballistic Missile and Missile Defense Testing and Operations

Vandenberg AFB is the primary location in the United States where Intercontinental Ballistic Missiles (ICBMs) are launched for testing purposes. Ballistic missiles, such as, but not limited to, Peacekeeper and Minuteman, are usually launched to targets located near the Kwajelein Atolls in the South Pacific; however, some missiles are launched to targets in other broad ocean areas. The impact of ballistic missile testing is similar to the impact of spacelift operations.

Spent booster stages fall into the Pacific Ocean during ICBM testing operations. Highly variable testing configurations result in jettisoned objects falling over a wide area of the ocean. Jettisoned objects, and other missile debris, sink to the ocean floor and are not recovered due to the extreme difficulty in locating and recovering such objects in deep ocean waters. Furthermore, the high costs associated with deep recovery operations would be prohibitive. No ICBM missiles have deposited spent stages in the CINMS area. Future missile defense testing could overfly the CINMS; however, none are planned to deposit spent stages in the CINMS.

Missile intercept operations also occur from Vandenberg AFB, where a target missile is destroyed down range by an interceptor missile, laser, or other weapon system. Missile intercept operations result in debris being dispersed over a wide area of the ocean and potentially inside portions of the CINMS Study Area. Active precautionary measures are in place to minimize the likelihood of jettisoned objects falling in the Sanctuary or on oil platforms.

On rare occasion, ICBM and missile defense launch anomalies occur. Variously sized fragments from a destroyed vehicle as well as unburned solid propellants and some unburned liquid propellant (upper stages such as post boost vehicles), could be dispersed over a wide area potentially inside portions of the CINMS Study Area, but ICBM past anomalies have not deposited debris in the CINMS.

ICBM and missile defense testing operations at Vandenberg AFB are conducted by DoD. As the appointed executive agent for space, the AF is responsible for ensuring public safety. As such, positive control measures are employed during all missile and space launch activity. All launch vehicles are equipped with flight termination packages and tracking systems that offer operators the ability to terminate thrust or destroy vehicles that follow non-nominal trajectories. DoD personnel are entrusted with this responsibility during powered flight (the phase of flight when thrust is provided by engines/motors that includes overflight of the Sanctuary and Study Area).

Missile Testing and Aircraft Operations

Extending 200 miles offshore and traversing the entire west coast of the United States, the WCOOA provides the ideal airspace for testing military and civilian aircraft, ballistic missiles, guided missiles, and other weapon systems. Most WCOOA tests are conducted off the California coast due to the stable air mass, and due to the radar, telemetry, and optical sensors at Vandenberg AFB and the Naval Air Warfare Center at Point Mugu.

Different types of ballistic and guided missiles are launched from land, sea, and air (over water) for various reasons, including, but not limited to, testing guided missiles, intercept technologies for a national

missile defense system, and testing anti-aircraft artillery. The target area for some short-range missiles may only be a couple miles offshore, which could result in missile debris being deposited into the CINMS Study Area.

Active precautionary measures are in place to minimize the likelihood of jettisoned objects falling in the Sanctuary or on oil platforms. Currently, no past (or projected future) missile system launched from VAFB deposited spent stages in the CINMS area. Past aircraft overflight operations have occurred inside the CINMS, and such activity is expected to continue in the future, however.

Other operations conducted in the WCOOA consist of aircraft and aeronautical test operations. Airspace corridors (over-land and over-water) are routinely used for aircraft flight test operations. In addition, aircraft from other military installations routinely use the 15,000-foot landing strip at Vandenberg AFB for refueling and training exercises. Training exercises, involving both fixed wing and rotor aircraft, are conducted at all altitudes within the CINMS Study Area. Devices used for training include, but are not limited to, flares, chaff, and sea dye. Water survival training is also conducted within the study area, which consists of, but is not limited to, simulating emergency egress through a cockpit, practicing life raft usage, and hoisting people from the ocean. Low altitude flights near the shore of the islands are infrequent, but do occur occasionally.

Missile testing and aircraft operations in the WCOOA are conducted by DoD. As the executive agent for space, the Air Force is responsible for ensuring public safety. As such, positive control measures are employed during all missile and space launch activity. Except for some small missile systems having a maximum affected flight area entirely over water and away from populated areas (including oil platforms), all launch vehicles are equipped with flight termination packages and tracking systems that offer operators the ability to terminate thrust or destroy vehicles that follow non-nominal trajectories. DoD personnel are entrusted with this responsibility during powered flight (the phase of flight when thrust is provided by engines/motors that includes overflight of the Sanctuary and Study Area).

Military Training Exercises

Periodically, the Vandenberg AFB shoreline is used for military training exercises, which usually involve the movement of military personnel from ocean vessels and aircraft to the shore.

Boat Dock Operations

Vandenberg AFB is serviced by a boat dock. Boat dock operations include, but are not limited to, the unloading of rocket motors and large booster segments from barges. The boat dock is located within the CINMS Study Area and will require to be dredged from time to time.

Launch Discussion

Current launch rates indicate that up to 5 launches overfly the current CINMS boundary, of which one overflies San Miguel Island directly. Presently all spent stages for these trajectories impact outside the CINMS.

Table 3.5-10 Space Vehicle Launches from Vandenberg Air Force Base, Sonic Boom Measurements, Northern Channel Islands

Launch Vehicle	Date	Launch Site	Island Monitoring Location	Sonic Boom Peak Amplitude (psf)	Sound Exposure Level (dB) [A-weighted]
Titan IV	12 May 1996	SLC-4E S. VAFB	Crook Point, San Miguel	8.97	97.2
Titan IV	23 Oct 1997	SLC-4E S. VAFB	Kinton Point, Santa Cruz	1.1	86.8
Athena 2	27 Apr 1999	SLC-6 S. VAFB	Adams Cove, San Miguel	0.95	73.4
Titan IV	22 May 1999	SLC-4E S. VAFB	Harris Point San Miguel	1.84	78.5
Athena 2	24 Sep 1999	SLC-6 S. VAFB	Point Bennett, San Miguel	0.96	68.3
Delta II	21 Nov 2000	SLC-2 N. VAFB	Point Bennett, San Miguel	0.4	91.5
Atlas II	8 Sep 2001	SLC-3E S. VAFB	Cardwell Pt., San Miguel	0.75	79.4
Delta II	18 Oct 2001	SLC-2 N. VAFB	Point Bennett, San Miguel	0.0	83.5 (unweighted)
Delta II	11 Feb 2002	SLC-2 N. VAFB	Point Bennett, San Miguel	0.64	84.7
Atlas II	2 Dec 2003	SLC-3E S. VAFB	Point Bennett, San Miguel	0.88	99.310/7/2004

References: SRS Technologies monitoring reports

Historically launch rates for spacelift (southerly trajectories) have varied and future launch rates are subject to change based on mission need. Eleven spacelift operations occurred between 1997, 1998 and 1999. In 1966, the number of spacelifts peaked at about 46. Future projected launch profiles do not deposit spent stages inside the CINMS.

For CINMS, the National Marine Fisheries Service programmatic take permit would be the only applicable existing requirement. Under this permit the Air Force is required to conduct modeling to predict the likelihood of a sonic boom impacting the Channel Islands. No significant impacts have ever been detected, but pinnipeds on the Channel Islands may be briefly disturbed by sonic booms and the take permit allows for this level of impact.

3.5.9.2 United States Navy

The U.S. Navy has an extensive presence in Southern California through installations, offshore operating areas, and ranges (offshore as well as inland). Within the study area, installations are located at Point Mugu and Port Hueneme in Ventura County. These two facilities comprise the unified base command known as Naval Base Ventura County (NBVC). The installations at Point Mugu and Port Hueneme are composed of approximately 6,000 acres of prime real estate and include an airfield, a port facility and

light industrial activities. The installations host various Naval activities including the Pacific Fleet Seabee units, Pacific Fleet Early Warning Aircraft (E-2) squadrons, the Naval Surface Warfare Center Port Hueneme Division, the Naval Facilities Engineering Service Center, and Naval Air Warfare Center Weapons Division (NAWCWD), as well as a variety of other tenant organizations.

NAWCWD Point Mugu operates and controls the Point Mugu Sea Range, a 36,000 square mile area of military controlled airspace off the Southern California Coast (see figure 1). Although some Navy operations in the study area occur outside the Sea Range, most are conducted within the Sea Range boundaries. The Sea Range includes airspace overlying significant portions of the existing Sanctuary (78% of the Sanctuary) as well as the airspace above the land areas of several of the Channel Islands.

Figure 3.5-5 Point Mugu Sea Range

The Sea Range was established in 1946 after an extensive nationwide search for an operationally realistic ocean site to conduct testing and development of missiles and other Naval systems. The unique geography of this region, including coastal mountains, offshore islands, convex coastline and relatively good weather, led to the selection and designation of the Sea Range.

The Sea Range continues today to provide the Navy an operationally realistic environment for safely conducting controlled air, surface, and subsurface Navy testing and training. The combination of the geographic factors, instrumentation sites, unique test capabilities, proximity to Naval Forces, and highly skilled workforce provides the most advanced and efficient method for conducting weapon system tests and Fleet training necessary to ensure the readiness of Pacific Fleet units.

In addition to the Navy's presence within the Study Area, the Navy maintains substantial installations, operating areas and training ranges that rely on and enhance the Navy's presence at Point Mugu Sea Range and NBVC. Approximately one-quarter of the United States Fleet is stationed in San Diego, including three aircraft carriers. In addition, the United States Marine Corps maintains a significant presence at Marine Corps Base Camp Pendleton. As part of their interdeployment training cycle, these forces utilize the Point Mugu Sea Range, other operating areas off Southern California, and training ranges as far inland as Nevada and Arizona as they progress from basic unit level training through advanced task force exercises in preparation for the missions they anticipate conducting during overseas deployments. These operations range from single units to battle groups and multi-national exercises.

The Navy conducts a wide variety of activities within the Study Area and boundaries of the existing Sanctuary in support of operational training and testing. The exact activities vary based on current operational requirements, evolving technologies, and world events. The following sections describe baseline categories of activities that occur within the Channel Islands National Marine Sanctuary and the associated Management Plan Study Area.

Vessel, Aircraft, and Target Operations

Within the Study Area and Sanctuary, the Navy operates the full range of Navy ships, submarines, aircraft, weapons systems, sensors, and targets, including those based at Point Mugu and Port Hueneme, as well as those from other bases. In addition, foreign military units often participate with the Navy in testing and training operations.

U.S. Navy vessels operating in the area, including aircraft carriers, destroyers, cruisers, submarines, and various amphibious and small craft, utilize the Sea Range for testing, training, and experimentation. Also, the U.S. Navy operates a small fleet of specialized support boats and several larger vessels (ships) that support Sea Range operations. Operation of these vessels includes, but is not limited to, transits and operation of all shipboard systems. Ships routinely conduct anti-submarine warfare, surface-to-surface and surface-to-air warfare training, testing, and experimentation. They also perform maritime intercept operations and escort training. These are missions they are routinely required to perform during overseas deployments.

Within the existing Sanctuary, normal routine vessel operations are located primarily in areas outside 1 NM from the islands. Operations closer to the islands would normally be transit and vessels seeking shelter from weather conditions. However, the exact location of vessel operations is dictated by safety and mission requirements. Navy vessels do not discharge or exchange ballast water within the existing Sanctuary.

Aircraft operations include transits, air-to-air and air-to-surface operations involving both manned aircraft and unmanned air vehicles. Aircraft operations occur throughout the area at various altitudes and speeds, including supersonic operations. Overflight of the shorelines of the Channel Islands is normally above 1,000 feet, unless a lower altitude is required to accomplish the mission or training objective (e.g., low-level helicopter flight training). Requirement for such lower altitude flights over shorelines of the islands are rare (several per year) and are carefully planned to minimize noise impacts. Aircraft flights originate from Point Mugu, other bases, and ships at sea.

Targets operated in the study area include both airborne and surface (boats/ships) targets. Airborne targets are remotely controlled and used to test weapon systems such as missiles or radar systems. They range from small missile-size to full airplane size and are designed to be recovered and reused. However, some targets are not recovered or are intentionally intercepted and destroyed. Aerial targets are launched from Point Mugu, San Nicolas Island, surface vessels, or aircraft. Surface targets are remote controlled vessels designed for testing or training in situations where personnel cannot safely be on-board. There is a wide range of surface targets used on the Sea Range. Normally surface targets are designed to withstand extensive damage for reuse. However, some targets include vessels ("hulks") that are intentionally sunk. Lastly, underwater targets are also used by submarines and torpedoes for testing and training. Target operations that involve missile intercepts or sinking targets are rarely performed within the existing sanctuary and are not currently done in the areas close to the islands.

Weapon Activities

The mission of Sea Range is to provide an operationally realistic location to test and evaluate weapon systems as well as to conduct training in the use of these weapon systems. The weapon systems employed cover the breadth of Navy (and DoD) weapons systems, including both offensive and defensive systems. There is an emphasis on missile and air warfare systems. These weapons systems activities generally occur south of the northern Channel Islands or in the vicinity of San Nicolas Island but may occur in other locations within the Study Area. Within the current Sanctuary boundary, weapon activities

are unusual and very limited in scope (e.g., overflight). Missile flights (and their associated safety chase aircraft) in the current Sanctuary boundary normally occur over ocean areas . In general, the categories of weapons can be classified as guns, bombs, missiles, and torpedoes. These weapon systems often do not use live warheads, but actual live fire of weapons does occur. Debris from intercepts is not recovered. The scenarios and conditions employed vary widely depending on the specific weapon system, operational requirement, and platform (aircraft, ship, submarine) employed. For simplicity, weapon systems activities can generally be described in the following categories:

- Air-to-Air: Typical scenario would involve aircraft firing missiles at airborne targets and aircraft engaged in air combat maneuvering. Missiles rarely fly over the existing sanctuary and such overflight operations are normally above 1,000 feet. The nature and scope of air-to-air activities involving aircraft firing missiles is documented within the Point Mugu Sea Range Environmental Impact Statement.

- Air-to-Surface: Typical scenario would involve aircraft firing weapons against surface (boat) targets or the target complex at San Nicolas Island. Firing of weapons from aircraft at targets does not normally occur within the existing Sanctuary boundary. When weapons are used against surface targets within the Sea Range, protective measures are in place to increase situational awareness of the training participants to minimize and avoid takes of marine mammals under the Marine Mammal Protection Act and Endangered Species Act. The nature and scope of air-to-surface weapons use is documented within the Point Mugu Sea Range Environmental Impact Statement.

- Surface-to-Air: Typically involves either ships firing weapons against airborne targets or weapons launched from Point Mugu or San Nicolas Island against airborne targets. Because of safety considerations, surface-to-air weapons are not normally used within the existing Sanctuary boundary. Debris is not normally recovered on the Sea Range. The nature and scope of surface-to-air weapons use is documented within the Point Mugu Sea Range Environmental Impact Statement.

- Surface-to-Surface: Typical scenario would be ships or weapon systems at Point Mugu or San Nicolas Island firing missiles or guns against surface targets (either vessels or the SNI target complex). Although missiles and targets are fired from Point Mugu seaward into the Sea Range approximately 150 times per year, they rarely fly directly over the existing Sanctuary boundary. Details of how these activities are conducted are analyzed in the Point Mugu Sea Range Environmental Impact Statement.

- Subsurface-to-Surface: Involves submarines firing missiles or torpedoes at surface vessels or land targets. Use of missiles and torpedoes may occur several times each calendar year depending on sea state and operational requirements. Because of safety considerations, these activities do not occur within the existing Sanctuary boundary. These activities are carefully scheduled in advance and require commanders involved in each event to utilize protective measures designed to increase situational awareness of exercise participants to avoid takes under the Marine Mammal Protection Act and Endangered Species Act.

- Subsurface-to-Subsurface: Involves submarines firing torpedoes at undersea targets. These engagements may occur several times each calendar year depending on sea state and operational requirements. Because of safety considerations, these activities do not occur within the existing Sanctuary boundary. These activities are carefully scheduled in advance and require

commanders involved in each event to utilize protective measures designed to increase situational awareness of exercise participants to avoid takes under the Marine Mammal Protection Act and Endangered Species Act.

- Surface-to-Subsurface: Involves ships firing missiles or torpedoes at undersea targets. These activities may occur several times each calendar year depending on sea state and operational requirements. Because of safety considerations, these activities do not occur within the existing Sanctuary boundary. These activities are carefully scheduled in advance and require commanders involved in each event to utilize protective measures designed to increase situational awareness of exercise participants to avoid takes under the Marine Mammal Protection Act and Endangered Species Act.

- Air-to-Subsurface: Involves aircraft firing torpedoes at undersea targets. Use of torpedoes may occur several times each calendar year depending on sea state and operational requirements. Because of safety considerations, these activities do not occur within the existing Sanctuary boundary. These activities are carefully scheduled in advance and require commanders involved in each event to utilize protective measures designed to increase situational awareness of exercise participants to avoid takes under the Marine Mammal Protection Act and Endangered Species Act.

The Sea Range has an extensive and well-established safety program that ensures all areas of potential hazard are clear of non-participants. This program includes public notifications as well as radar and physical searches of operating areas prior to commencement of operations.

Submarine and Antisubmarine Warfare

Submarine operations include, but are not limited to, transits, anti-submarine operations and anti-surface vessel operations. Antisubmarine warfare operations in the Study Area include submarine, deep submergence vehicle, surface vessel, and aircraft operations designed to detect, locate, and prosecute threat submarines or underwater warfare platforms. As discussed above, these operations include torpedo operations and the use of both passive and active acoustic devices. These acoustic devices may be autonomous (e.g. sonobuoys or remote controlled undersea vehicles) or be connected to vessels or aircraft (e.g. sonar systems). Acoustic sources are tonal and explosive and are used for seeking out submarines as well as communicating with U.S. and foreign submarines. Antisubmarine warfare activities also include deployment, maintenance, and abandonment of equipment secured to the ocean bottom, such as cables, hydrophones, or sonar arrays. In addition, naval aviation units conduct anti-submarine warfare training well below 1,000 feet in the Study Area. Within the existing Sanctuary, submarine and antisubmarine warfare operations are rare and normally limited to transitting/manuevering in the area and passive acoustic systems. To the extent active acoustic devices are used, the precise frequency levels are classified but protective measures are used by training exercise planners to increase situational awareness of unit commanders to ensure received levels by marine mammals in the area of acoustic activity do not result in takes under the Marine Mammal Protection Act and Endangered Species Act.

Mine Warfare

Mine warfare operations include, but are not limited to, mine laying from aircraft, surface vessels and submarines as well as mine sweeping. Within Bechers Bay off Santa Rosa Island, the Navy periodically conducts inert mine drops. On average there are two multi-aircraft mine drop exercises annually. The inert mines are steel jacketed concrete shapes that are often recovered for reuse (roughly 50% recovered). The mine shapes are dropped from aircraft for shallow water minefield deployment training. The drops

are done only after following safety clearance procedures, which ensure the area is clear of all non-participants.

Amphibious and Special Warfare

Amphibious warfare operations in the study area include, but are not limited to, surface vessels, subsurface systems, swimmers, and aircraft/helicopter operations designed to land and secure beaches for subsequent land based operations. The training exercises include manned raids, small craft landing, and special operations force insertions from aircraft, surface vessels or submarines at Point Mugu, Port Hueneme, Vandenberg Air Force Base and oil platforms. Landing operations are not conducted at the islands within the Sanctuary.

Explosive Ordnance Disposal

Explosive Ordnance Disposal operations include, but are not limited to, the location, assessment, disarming and, in some cases, detonation of ordnance and missile propulsion systems. With the exception of an emergency or safety disposal, these activities are not conducted within the boundary of the existing Sanctuary.

Decoys

To provide operationally realistic testing and training the Sea Range scenarios described above often also include the use of decoys, which are devices designed to reduce weapon system effectiveness by confusing sensor systems. Decoy use includes, but is not limited to, chaff, obscurants, flares, and undersea acoustic devices. The use of decoys occurs throughout the Sea Range and may inadvertently occur within the existing boundary of the Sanctuary. Use of decoys within existing Sanctuary boundary is rare because the types of activities being conducted do not normally occur within the existing Sanctuary boundary.

Chaff consists of aluminum strips deployed from aircraft or ships to confuse radar systems. Obscurants consist of smoke used in the study area that is deployed from ships or aircraft and is designed to confuse sensor systems. Flares consist of incendiary devices of two types: defensive flares fired from ships or aircraft designed to confuse heat-seeking missiles, and illumination flares fired from ships designed to provide surface illumination during darkness. Undersea decoys consist of devices that emit acoustic energy and are designed to confuse sensor systems.

Maintenance, Replacement, Removal, and Abandonment of Existing Facilities

Facilities that must be maintained, replaced periodically, or removed or abandoned include permanent facilities at the Navy installations and sites (e.g. pier side maintenance) as well as ocean submarine cables, and other miscellaneous facilities and equipment. Examples include, but are not limited to, hydrophone arrays, communications cables linking the mainland to the offshore islands, or submarine communication systems. A portion of an undersea communication cable running from Point Mugu to San Nicolas Island passes through the existing Sanctuary. Removal of this cable is not anticipated in the foreseeable future. Maintenance of this cable is conducted on a regular and as-needed basis.

Marine Research and Surveys

The Navy conducts oceanographic research and surveys within the Study Area. This activity involves the use of sound sources; sampling; placement of ocean bottom equipment, weather balloons; and the use of

vessels, divers, submarines, and satellites. Diving is also conducted for training and in support of other operations. Research and surveys within the existing Sanctuary are not conducted frequently.

Anchoring of Ships and Vessels

Naval vessels routinely anchor within the Study Area at various locations. Examples include, but are not limited to, range support boats anchoring during bad weather as well as long-term anchoring or mooring of surface target vessels. Vessels larger than 300 gross tons do not normally anchor within the existing Sanctuary and would rarely be within 1 NM of the islands within the Sanctuary.

Harbor Operations

The Navy operates the harbor at Port Hueneme. It is used for berthing of permanently assigned vessels and visiting ships. A portion of the harbor is leased to the Oxnard Harbor District for commercial use. Ships routinely transit through the proposed concept areas as part of naval operations.

Logistics Operations

Various logistics operations occur within the Study Area to support the testing, training, and experimentations operations described above. These include, but are not limited to, refueling operations (both planes and underway vessels), replenishment/re-supply operations (e.g. barges, supply ships, etc.), vessel towing, and salvage activities.

3.5.10 U.S. Coast Guard Activities

The USCG conducts search and rescue, marine environmental protection, law and international treaty enforcement, aids to navigation maintenance, marine safety, defense readiness, and training operations to support these activities within the Study Area.

The USCG operates a Marine Safety Detachment including two 87-foot coastal patrol boats (USCG Cutter *Blackfin*, located at Santa Barbara, and USCG Cutter *Blacktip* located at Oxnard), and a Station, (Station Channel Islands Harbor), and the East Anacapa Island Lighthouse. There is also another small boat station at Morro Bay, California (Station Morro Bay).

Station Channel Islands Harbor has three search and rescue (SAR) boats including a 21-foot boat, 41-foot utility boat, and a 44-foot motor lifeboat. The station provides quarterly maintenance to the East Anacapa Lighthouse. The lighthouse maintenance schedule is coordinated with the NPS. Noise from any heavy equipment is minimized during these maintenance activities. The three small boats are used to conduct smaller caliber fire exercises within the Study Area, and the *Blacktip* is currently used for larger caliber, live fire exercises within the Study Area.

The *Blackfin* is used for SAR and various law enforcement operations such as drug interdiction, migrant interdiction, and fisheries enforcement. The *Blackfin* is also used in live fire exercises within the Study Area. The Marine Safety Detachment conducts pollution response, marine casualty investigations, and annual platform inspections within the Study Area. Civilian crew boats and helicopters are used to transport USCG inspectors to and from the platforms for inspections as well.

The USCG Cutter *George Cobb* is a 175-foot buoy tender used for servicing aids to navigation throughout the area. These aids consist of mooring balls for USCG patrol boats operating in the area and

are located at Smugglers Cove at Santa Cruz Island, Coho Anchorage at Point Conception, and San Simeon. The *George Cobb* is also used to maintain harbor approach and channel buoys for the Santa Barbara, Ventura, Channel Islands, and Port Hueneme harbors. Other navigational and rock/reef warning buoys are maintained up the coast to San Simeon. NOAA also has four large weather buoys in the area, and these are serviced by the *George Cobb*. The USCG Aids to Navigation Team maintains aids to navigation light structures including Anacapa Light, Gull Island Light (off the south coast of Santa Cruz Island), and Southpoint Light on Santa Rosa Island. Gull Island and Southpoint Lights are accessed by USCG helicopters to land-servicing crews. The Aids to Navigation Team also has a 21-foot trailerable boat for aid servicing.

Other USCG units in California, such as Station Morro Bay, Marine Safety Office/Group Los Angeles-Long Beach, and Air Stations located in Los Angeles, San Diego, San Francisco, and Sacramento, transit and conduct training or actual search and rescue and law enforcement missions within the present CINMS boundary.

The USCG cooperates with several federal and state agencies, including but not limited to NMFS, the USFWS, the U.S. EPA, and the CDFG in carrying out its missions. The USCG performs marine mammal monitoring activities by reporting the location of marine mammals to NMFS during the execution of other mission activities.

3.5.11 Research and Education

3.5.11.1 Research

The CINMS is an important participant and collaborator in marine research. The Sanctuary's Sea Wolf aircraft, a former Air Force plane, is used to conduct monitoring as part of the Sanctuary Aerial Monitoring and Spatial Analysis (SAMSAP) program. The aircraft enables personnel to monitor activity and resources, survey Sanctuary users, conduct vessel traffic studies, observe the effects of shore runoff, perform aerial surveys during oil spill emergencies, and collect data on both marine mammals and the kelp forest. The aircraft can also be used for supervision and enforcement. Photography and video are used to record sightings. Special onboard equipment includes a Global Positioning System and laptop computer. Position information can be downloaded instantly to register the location of objects in sanctuary waters. Although NOAA has assigned the aircraft to both the CINMS and the Monterey Bay National Marine Sanctuary, the aircraft is primarily used within the CINMS.

The CINMS *R/V Shearwater* is the Sanctuary's new research vessel. Launched in 2003 this vessel is used primarily for research, and also serves as a host for educational field trips and emergency response in and around the Sanctuary. The *Shearwater* also includes wet and dry labs that allow on-board processing of samples and data. Extensive dive operations are supported by onboard facilities and equipment. The boat also has an A-frame and winch for oceanographic studies and observer stations for wildlife surveys. On board berthing, stowage, galley, and safety equipment allow for multi-day excursions with crews of up to ten scientists.

A summary of example research projects conducted in the Study Area follows:

- CalCOFI began publishing information on the ecology of the SCB in 1950 and continues to study the marine ecosystems of the SCB. Because of the research and data collection of CalCOFI investigators, the SCB is one of the most studied marine systems in the world.

- The Biological Resources Discipline of the USGS is conducting wide-ranging research on fishes of central and southern California.

- The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) is a consortium of four universities (Oregon State University, University of California at Santa Cruz and Santa Barbara, and Stanford University) investigating the physical and biological processes of the nearshore region along Oregon and California coasts. Among the many projects of PISCO, one project seeks to determine how fish stocks in distant locales are connected.

- Several faculty and professional researchers at the University of California at Santa Barbara have received support from the National Science Foundation for a long-term study of the biological and physical links between marine and coastal processes of the region, such as the Long-Term Ecological Research (LTER) Program.

- Scientists from federal, state, and local government agencies, universities, and private and volunteer agencies have formed a Multi-Agency Rocky Intertidal Network to monitor important shoreline processes. This network includes 61 sites located from San Luis Obispo to San Diego Counties on the mainland and Channel Islands.

- In 1999, the Santa Barbara Museum of Natural History published a 14-volume taxonomic atlas of the benthic fauna of the Santa Maria Basin and the western Santa Barbara Channel.

- A number of investigators at the National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara, California, are studying the ecology of the Study Area.

- The University of California at San Diego's Scripps Institution of Oceanography continues to study coastal physical oceanography to help improve the ability to forecast changes in the coastal ocean and atmosphere.

- The National Biological Survey and CINP continue to create inventories and conduct monitoring programs on the ecology of the northern Channel Islands, such as: rocky intertidal ecological monitoring, marine debris monitoring, seabird monitoring, kelp forest monitoring, terrestrial vertebrate monitoring, water quality inventories, land bird monitoring, island fox monitoring, and terrestrial vegetation monitoring.

- The CINMS staff, in partnership with CDFG and University of California, Santa Barbara scientists, recently completed a research cruise using the Delta Submersible. The purpose of this project was to collect baseline data for the newly established Marine Reserves.

- Ice Age Study focuses on research on stacked delta deposits that fringe the southern margin of the Santa Barbara Channel.

- Plfeger Institute of Environmental Research (PIER) strives to ensure healthy, sustainable oceans for our future, to develop the public's understanding and appreciation for the ocean and its life, and to act as stewards of the marine environment. Scientists at the Plfeger Institute are conducting research on the movement of giant seabass in the CINMS.

- The Collaborative Marine Research Program involves commercial fisherman and their unique skills and expertise with the CINMS in the gathering of vital data on natural resources, biophysical processes, and effects of human activities in order help the Sanctuary staff make informed management decisions.

- The NOAA Environmental Services Data Directory is a forms-based tool that allows users to search for publicly available environmental data held by public and private sources throughout the world.

Other research and data collection supported by the CINMS include participation in annual ocean and coastal conferences and meetings, and assistance in biological surveys, including a current baseline population study on Xantus' murrelets.

Biological Monitoring Programs

A characterization of existing monitoring programs in the CINMS is depicted in *Summary of Research Programs in the Channel Islands National Marine Sanctuary (*Abeles *et al.* 2003). These monitoring programs are developed by various federal, state, and local organizations including the CDFG, NOAA's Southwest Fisheries Science Center, CINP, the University of California at Santa Barbara's Marine Science Institute, and a number of other scientific organizations. In addition, a list of study organisms and techniques is provided in the summary of monitoring programs.

A variety of economically and ecologically important species are studied, such as sea urchin, abalone, sea bass, rockfish, seabird, pinniped, and humpback and blue whale populations. Several programs monitor marine communities, defined simply as a group of different species that occupy a particular habitat. Research programs have been established to monitor communities on sandy beaches and lagoons, rocky intertidal habitats, kelp forests, subtidal rocky reefs, soft bottom habitats, and in the open ocean. Research programs that monitor community dynamics generally include surveys of common species that occur in a particular habitat. Research on the environment includes mapping physical habitats, measuring variables such as water temperature, salinity, and oxygen content, tracking ocean currents and winds, and remote sensing. Several research programs attempt to monitor ecosystem dynamics, including both physical and biological variables. Recent efforts within the CINMS have emphasized seabird research, archeological/cultural research (primarily shipwrecks), and collecting baseline data for emerging management issues.

Channel Islands National Park

There are also a number of research and monitoring activities at the CINP. For example, the USGS - Biological Resources Discipline/NPS Cooperative Research Activities are involved in monitoring and research activities. A list of related publications and technical reports from the NPS for the northern Channel Islands is available online at http://www.nps.gov/chis/rm/HTMLPages/References.htm. The Channel Islands Field Station has cooperative agreements with CINP and the University of California at Santa Barbara that facilitate collaboration between field station scientists and university and Park biologists. The linkage with the university also provides opportunities to supervise graduate students in marine ecology and work in laboratories with flow-through seawater to allow housing temperate marine species. CINP provides access to the habitats of several rare and endemic plant species suffering from the impacts of exotic weeds and feral animals. The CINP also has a wealth of marine resources in need of study and management. Field station biologists analyze data collected from the CINP and assist with its extensive resource monitoring program.

Scientists at the Channel Islands Field Station conduct research on the ecology and conservation biology of sensitive plants and animals at the Channel Islands and along California's coast. In doing so, the field station supports information needs of the NPS, USFWS, and other state and federal clients such as the Department of Defense, Sanctuary, and CDFG. Some examples of ongoing research in plant ecology include rare plant demography, effects of grazing by feral animals on native plant communities, restoration ecology, and the distribution of exotic weeds. Examples of research in marine ecology are restoration strategies for the nearly extirpated white abalone, patterns of disturbance for threatened western snowy plovers, Marine Reserve design, and kelp forest community dynamics.

CINP Marine Monitoring Program Reports are available online, including on the kelp forest monitoring program, seabird monitoring, rocky intertidal monitoring, and sandy beach monitoring (http://www.nature.nps.gov/im/units/chis/HTMLpages/AnnlReports/MarineReports.htm).

3.5.11.2 Education

The CINMS provides a variety of outreach and education programs for teachers, students, resource users, and the general public. Sanctuary education and outreach efforts are focused in two strategic areas: (1) community involvement, partnerships, and community program development through interactive programs (training programs, workshops, special events, school programs) and (2) product development (printed materials, website development, audio visual materials, signs, displays, and exhibits) as critical education and outreach tools.

While addressing site-specific education and outreach needs, the CINMS Education Program strives to fulfill the NMSP's national education plan by (1) providing educational leadership in marine conservation and protection efforts, (2) promoting the sanctuaries' identity with site-specific application of projects and products, and (3) establishing a standard of educational excellence to be upheld by all 13 National Marine Sanctuary sites.

Additional information on coastal and marine education programs in the region can be found at the *Marine and Coastal Educational Resources Directory*, which is available online at http://www.coastal.ca.gov/publiced/directory/resdirectory/rdindex.html.

Interpretative programs aim to enhance public awareness and understanding of the significance of the CINMS and the need to protect its resources. The management objectives designed to meet this goal are:

- Enhance public access to relevant information on the CINMS, its goals, and resources;
- Improve opportunities for a wider public access to the CINMS and first-hand appreciation of significant CINMS resources;
- Broaden public support for the CINMS and CINMS management by offering on-site and off-site programs suited to visitors of diverse interests, ages, and skills;
- Provide for public involvement by encouraging feedback on the effectiveness of interpretive programs, collaboration with CINMS management staff in extension/outreach programs, and participation in other volunteer programs; and
- Collaborate with other organizations to provide interpretive services complementary to the NMSP.

Educational activities that CINMS staff have developed include:

- Interpretive exhibits, signage, and displays;
- Publications including newsletters (*Alolkoy*), brochures, posters, and an educational resource directory;
- A cooperative agreement with the Santa Barbara Maritime Museum;
- Cooperative development of the Santa Barbara Outdoor Visitors Center with the NPS and the CDFG;
- Sustainable Seas Expedition Educational Curriculum;
- Education programs and curriculum for teachers and students;
- Public programs, lectures and events; and
- Internship and volunteer programs.

A sample of classroom materials and online educational activities that incorporate real data from research activities associated with the CINMS follows:

- *Shipwreck Database* is a online database that includes information on shipwrecks from each of the five West Coast National Marine Sanctuaries.
- *Marine Mammal Sightings Database* reports marine mammal sightings in the Santa Barbara Channel.
- *Nautical Charts* introduces students to marine navigation and the main components of a nautical chart using a local chart for Channel Islands waters.
- *Monitoring a Habitat* describes how marine biologists monitor marine habitats in the CINMS.
- *Partner Educational Activities* works collaboratively with a variety of regional and national partners to develop educational activities for teachers and students.
- *JASON XIV: From Shore to Sea* explores the terrestrial and marine ecosystems that extend from California's coast to the CINMS to learn how such systems affect life on our planet.
- *Mapping an Ocean Sanctuary* includes the CINMS, the Center for Image Processing in Education, and National Geographic Society's Sustainable Seas Expeditions to help teachers bring geographic information systems (GIS) into their classrooms. The Mapping an Ocean Sanctuary curriculum and four day training workshop use Arcview software to explore maps and databases showing biological, geological, and economic features of the CINMS. Some specific topics include environmental monitoring, distribution of marine species, marine reserves, and commercial and recreational use patterns in the CINMS.

- *The Sanctuary and Center for Image Processing in Education* partnered to develop a GIS marine science curriculum and middle and high school teacher training program. GIS is a valuable visualization tool used by marine resource managers to map locations of animals and to understand ocean bathymetry, currents, sea surface temperature and more.

- *Project Oceanography* is a live television program designed for middle school science students. Each week during the school year, students can learn about a variety of ocean science topics right in their classroom.

- *Student Field Monitoring* supports the development of student and teacher participation in long-term field monitoring studies.

- *University of California at Santa Barbara Marine Science Institute Oceans to Classrooms* is a collaborative effort with CINMS and area teachers on developing kits and lesson materials for bringing ocean sciences into the classrooms. There is a floating laboratory component that includes stations for collecting water chemistry, plankton data, marine mammal sightings, and learning about marine navigation.

- *Waves on Wheels Program* supports a curriculum linked to state and local science standards and provides important outreach in Santa Barbara County.

- *Marine Reserves Digital Lab* includes an interactive marine reserves simulation of collaborative decision-making and negotiation over the establishment of marine reserves within the CINMS.

- *National Geographic Society's Sustainable Seas Expeditions* is a joint project of the National Geographic Society and NOAA efforts to explore, conduct research and develop public education programs about the National Marine Sanctuaries.

- *Project Oceanography Channel Islands Curriculum* is a collaborative effort of the CINMS and Project Oceanography (during the winter of 2002) to create three live educational television programs and educational activity packets for 6th to 8th grades highlighting research in the CINMS, intertidal monitoring, and marine reserves.

- *Channel Islands Naturalist Corps (CINC)* was established in 2001 as the Sanctuary Naturalist Corps but was expanded in 2003 through a joint effort with CINP to jointly train volunteers to interpret both Park and Sanctuary resources. CINC includes a group of volunteer ocean stewards dedicated to educating passengers on board local marine excursion vessels conducting whale watch tours, natural history tours, and island trips in the Santa Barbara Channel in the CINP and Sanctuary. Members provide education about the unique marine life. CINC volunteers collect valuable research on marine mammals and other important resources. Over 90 community volunteers, representing students, working professionals, and the retired, participate in the program. They attend a 5-week training class on Sanctuary programs and the physical, biological, and geological aspects of the CINMS and CINP. CINC volunteers represent the Sanctuary and the NPS on over 600 whale watch trips, attend numerous local outreach events, and educate over 100,000 local residents, tourists, and school children annually.

- *Dive trips* sponsored by the CINMS are geared toward non-consumptive use of the resources, and focus on the following activities: (1) underwater photography workshops with local experts on board to provide hands-on instruction, (2) fish survey trips during the month of July for the Great Annual Fish Count, and (3) year round fish surveys.

- *Diver Uplink Cruises* are special cruises for non-divers that offer a diver-conducted video tour of the kelp forests and underwater reefs using state-of-the-art equipment for full two-way interaction between observers and the dive team.

- Each year the CINMS partners with other organizations to coordinate and host several *Teacher Workshops*. These workshops are single-day to multi-day professional development opportunities. During these workshops, teachers learn the importance and value of the CINMS and learn strategies for integrating ocean studies into all disciplines, participate in field investigations, interact with the research community, learn scientific monitoring techniques, develop lesson plans and refine presentation skills. CINMS also conducts teacher workshops at local, regional, and national professional conferences each year.

- *Mountains to the Sea Watershed Curriculum* includes a partnership between the CINMS and Santa Barbara County's Project Clean Water in the development of a comprehensive watershed education program for 4th through 8th grade that introduces both teachers and students to the local watersheds of the region. The curriculum, in-class presentations, field trips, and resources cover a variety of topics including the water cycle, runoff, and the connection between our local creeks and the ocean. A variety of handouts, posters, and experiments are also included.

- *The Santa Barbara Maritime Museum* is located in the Waterfront Center in the Santa Barbara Harbor. The Museum preserves and presents to the public the maritime history of California's Central Coast, while providing an ongoing educational platform to study and record human interaction with the marine environment. The CINMS and the Museum are developing five interactive exhibits featuring the shipwrecks at the Channel Islands. Sanctuary staff also participate in ongoing lecture series at the Museum.

- *Cabrillo High School Aquarium* is located on the campus of Cabrillo High School in the Lompoc Unified School District. High school students are active participants in the daily maintenance, operation, and outreach programs of the aquarium. The CINMS partners with the aquarium on exhibits, including a weather kiosk display and other educational programs.

- *Santa Barbara Museum of Natural History Sea Center*, located on Stearns Wharf in Santa Barbara, California, reopened in 2005 after extensive renovations. The Sea Center contains a hands-on immersion laboratory that highlights the work of scientists who explore, monitor, and discover ways to preserve our oceans. The CINMS is collaborating with the Sea Center on educational exhibits and programs.

- *Parks as Classrooms* is the education program of the NPS in partnership with the National Park Foundation. It encompasses many different kinds of experiential education programs. Each year Park rangers at CINP share the Park resources with over 10,000 students in classrooms and nearly again that many at the Park visitor center. In-class

programs cover a variety of natural and cultural history topics for grades 2 through 5 in local schools. Programs at the visitor center meet the needs of classes from preschool through university level. All programs are tied to the curriculum students are studying.

- *Channel Islands National Park Visitor Center* has several marine and Channel Islands related educational displays including a rocky tidepool, elephant seal exhibit, and pygmy mammoth exhibit. There is also a theatre, bookstore, and Channel Islands Information Center.

- *Discovering The Channel Islands National Marine Sanctuary* is an adult education course administered by Sanctuary staff and offered alternately by Ventura College Community Services and Santa Barbara City College. The course allows students to explore the diverse kelp forests, rocky reefs, and sandy bottom communities of the CINMS. This course includes weekly evening lectures and an optional field trip to the Channel Islands.

- Aboard the *McArthur*, the *Sanctuary Quest Expedition* team conducted research, exploration, and monitoring within and adjacent to the CINMS. Over the long term, the expedition may help to provide a framework for understanding more about the efficacy and role of the sanctuary system in protecting and conserving marine resources, and to provide the impetus for continued regional research.

- *Coastal Watersheds Education Program* is run by several agencies and non-profit organizations and supported by the Sanctuary. It includes web-based and classroom activities that integrate and interpret current research program data sets, teacher research and monitoring training programs, and involving students in local volunteer monitoring projects.

- *South Coast Watershed Research Center* is a newly opened learning and resource center to enhance public awareness of the Santa Barbara watershed system located at Arroyo Burro Beach. The Sanctuary provides the center with exhibits that tie coastal processes to offshore systems.

- *Channel Islands Harbor Boating Instruction and Safety Center* is supported by the Sanctuary. The Sanctuary helps design exhibits and other literature for this center.

- *Caltrans Adopt-a-Highway Program* is a program that includes removing litter, planting and establishing trees or wildflowers, removing graffiti, and controlling vegetation along the California's State Highway System. The Sanctuary participates to prevent pollutants from entering California's waterways.

- *California Coastal Commission Coastal Cleanup Day* is an annual, one-day event during which volunteers gather at designated beaches to collect and remove trash and debris from beaches. Sanctuary staff serve as site leaders and coordinate volunteer efforts.

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