3.5 MARINE BIOLOGY

3.5.1 Introduction

3.5.1.1 Definition of Resource

For purposes of this EIS/OEIS, marine biological resources are defined as marine flora and fauna and habitats that they occupy, occurring within the Point Mugu Sea Range, Mugu Lagoon, and the intertidal and nearshore environment of San Nicolas Island and Point Mugu. This section specifically addresses marine invertebrates and flora. Fish and sea turtles are addressed in Section 3.6, marine mammals are addressed in Section 3.7, and seabirds are addressed in Section 3.8. Threatened and endangered species, as defined by the U.S. Fish and Wildlife Service (USFWS), are also addressed. Species that are federally listed are afforded a degree of regulatory protection, which entails a permitting process including specific mitigation measures for any allowable (incidental) impacts on the species. Species that are proposed to be listed by the USFWS are treated similarly to listed species by that agency; recommendations of the USFWS, however, are advisory rather than mandatory in the case of proposed species. A federally listed endangered species is defined as any species, including subspecies, that is "in danger of extinction throughout all or a significant portion of its range." A federally listed threatened species is defined as any species "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." "Proposed" endangered or threatened species are those species for which a proposed regulation has been published in the Federal Register, but a final rule has not yet been issued.

3.5.1.2 Regional Setting

The Sea Range straddles the ocean off Point Conception which is considered a major geographic feature that affects marine biological diversity. North of Point Conception, the marine resources are under the influence of the cold, southward flowing California Current. The shape of California's coastline south of Point Conception creates a broad ocean embayment known as the Southern California Bight (SCB). The SCB encompasses the area from Point Conception south to Mexico and is influenced by two major oceanic currents: the southward flowing, cold-water California Current and the northward flowing, warm-water California Countercurrent (refer to Figure 3.4-1). These currents mix in the SCB and strongly influence patterns of ocean water circulation, sea temperatures, and distributional trends in marine flora and fauna assemblages along the southern California coast and the eight Channel Islands (Murray and Littler 1981; Engle 1994). These factors cause extreme differences in species composition and abundance both north and south of Point Conception, as well as within the SCB.

Bottom topography in the SCB varies greatly from broad expanses of well developed continental shelf lands to deep basins (refer to Figure 3.4-2). Southwest of the Channel Islands is the Patton Escarpment, a steep ridge with contours bearing in a northwesterly direction; this ridge drops approximately 4,900 feet (1,500 m) to the deep ocean floor. Between the Patton Escarpment and the mainland lie the Santa Rosa-Cortez Ridge, three deep shelf basins (Santa Cruz, Santa Monica, and Santa Catalina to the south), Santa Barbara Basin to the north, two important channels (Santa Barbara and San Pedro), and a series of escarpments, canyons, banks, and sea mounts (e.g., Cortez Bank, Tanner Bank, 60-Mile Bank, Farnsworth Bank, and Lausen Sea Mount), some of which are located outside Sea Range boundaries (refer to Figure 3.4-2). Banks and sea mounts possess unique physical characteristics that affect local biological processes. They are the focus of upwelling which results in increased primary, and perhaps secondary productivity, and attracts pelagic fishes and their predators (i.e., seabirds and marine mammals) (Cross and Allen 1993). In the SCB, nutrient rich upwelling occurs mainly from February through August when surface waters, driven offshore by winds, are replaced by colder, richer waters overturning from below. Thorough and frequent mixing of these waters create conditions which support a rich and varied marine flora and fauna year-round (Leatherwood et al. 1987).

The Channel Islands National Marine Sanctuary (CINMS) encompasses the waters within 6 NM (11 km) of San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara islands (Figure 3.5-1). The Channel Islands National Park (CINP) boundaries extend 1 NM (1.9 km) beyond the coast of each of these islands. The CINMS was established in 1980 for the purpose of protecting areas off the southern California coast which contain significant marine resources. The CINMS is located over the continental shelf (refer to Figure 3.4-2), with water depths generally less than 360 feet (110 m). Waters surrounding the Channel Islands are relatively undisturbed and provide a habitat for a diverse assemblage of marine organisms.

A Presidential Proclamation signed on 11 January 2000 established the California Coastal National Monument, an area on the California coast extending from mean high tide to a distance of 12 NM (22 km) offshore. The monument comprises all lands above water in this area, including islands, rocks, exposed reefs, and pinnacles above the high water mark that are owned by the U.S. Government. Establishment of the California Coastal National Monument does not enlarge or diminish existing federal authority or use of adjacent waters. In addition, islands, rocks, exposed reefs, and pinnacles that are already reserved for other purposes are not affected by this designation. San Nicolas Island, as well as the other Channel Islands within the Sea Range, are located outside this designation.

EO 13089, *Coral Reef Protection*, was issued to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment. EO 13089 states that each federal agency whose actions may affect U.S. coral reef ecosystems: a) identify their actions that may affect U.S. coral reef systems; b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. No coral reefs are located within the temperate waters of the Point Mugu Sea Range.

A significant marine water resource at Point Mugu is Mugu Lagoon (refer to Section 3.4.3.1). Mugu Lagoon is one of the largest salt marshes in southern California. It is relatively undisturbed and provides a habitat for a diverse assemblage of marine organisms.

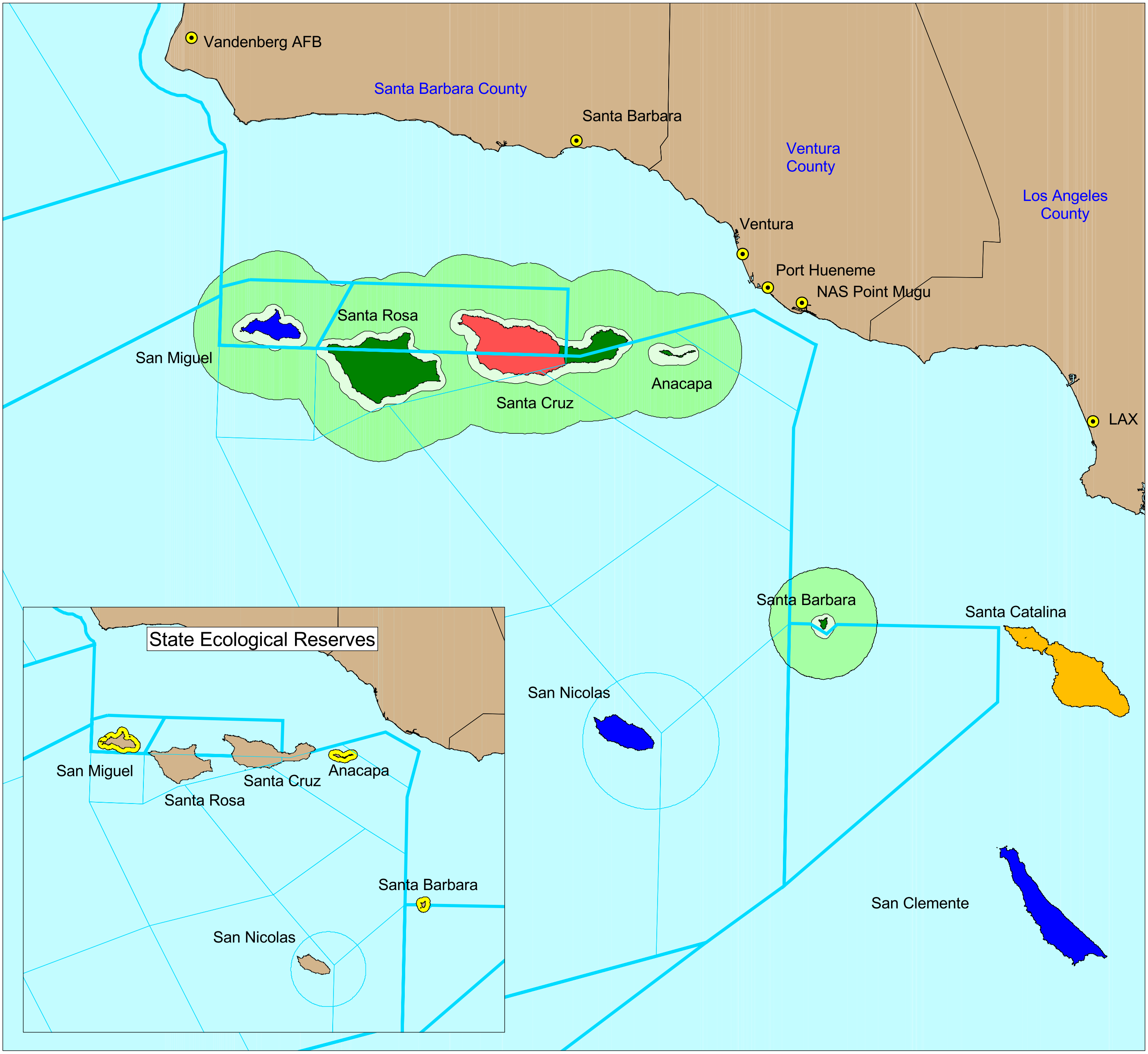
3.5.1.3 Region of Influence

This section describes the marine biological resources that occur at the Point Mugu Sea Range, Point Mugu, and San Nicolas Island. Descriptions are based on literature surveys, previously conducted field surveys, and existing Geographic Information System (GIS) databases. For the purposes of this EIS/OEIS, the region of influence (ROI) consists of three major marine habitats: the Point Mugu Sea Range, Point Mugu (Mugu Lagoon and sandy beaches/nearshore environment), and the intertidal and nearshore subtidal areas surrounding San Nicolas Island. Fish and sea turtles are discussed in Section 3.6, and marine mammals are discussed separately in Section 3.7.

3.5.2 Point Mugu Sea Range

The Point Mugu Sea Range encompasses a 36,000 square mile (93,200 km^2) area that includes regions of complex bathymetry which provide diverse habitats for a variety of marine life. Soft substrates, such as sandy beaches, shelves, and slopes, are abundant along the mainland and the offshore islands. Hard substrates, such as the rocky intertidal, shallow subtidal reefs, deep rock reefs, and kelp beds, are also common along the coasts of the mainland and islands. Beyond the depths of kelp beds (greater than

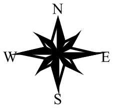
Island Ownership and Channel Islands National Park and Marine Sanctuary Boundaries



Ownership
Private
Nature Conservancy
National Park Service
Navy

National Park/Sanctuary Boundaries
Channel Island National Park
Channel Island National Marine Sanctuary

State Ecological Reserves



Projection: Universal Transverse Mercator
North American Datum 1927
Zone 11
Scale shown is 1:1,375,000

Figure 3.5-1

100 feet [30 m]), approximately 3 percent of the sea floor consists of rubble and rocky outcrops inhabited by marine invertebrate assemblages (Dailey et al. 1993). On the continental shelf regions, sand and gravel substrate is typically interspersed between these rocky areas. Offshore, the Channel Island shelves, Santa Rosa-Cortez Ridge, and Tanner and Cortez banks (refer to Figure 3.4-2) consist primarily of base rock and rocky outcrops that may be covered with a thin layer of sediment. Hard substrates occur to depths of over 1,640 feet (500 m) in the ROI and include sea mounts and man-made structures. Because they exceed diving depths (typically about 100 feet [30 m]) and cannot easily be sampled with coring devices or trawls, deep, hard substrate assemblages are the least-studied benthic habitats in the Sea Range. The following subsections broadly describe the marine flora and benthic marine invertebrates of the Sea Range.

3.5.2.1 Marine Flora

Most of the marine flora in the Sea Range comprises phytoplankton. Phytoplankton are microscopic plants that live in patchy abundance throughout the water column. The distribution of plankton is dependent upon many factors including light intensity, salinity, temperature, currents, nutrients, and their reproductive cycles and predators (Smith 1977). Phytoplankton comprise mainly diatoms and dinoflagellates, which carry out photosynthesis and form the basis of the aquatic food chain. They are a food source for the larger zooplankton (microscopic animals) which in turn are a food source for invertebrates, fish, and other large marine species such as baleen whales.

About 70 percent of the known algae species from California are known to occur in the SCB, and thus within the Point Mugu Sea Range (Dailey et al. 1993). The high percentage is attributed to the wide range of coastal habitat provided by the mainland and offshore Channel Islands. Most quantitative descriptions of the seasonal abundance and distribution of marine flora focus on nearshore kelp communities; deep water (i.e., greater than 100 feet [30 m]) algae are virtually unknown despite the availability of submersibles and video technology (Dailey et al. 1993). Kelp beds form a unique shallow water community which provides habitat for a range of additional algal species, invertebrates, and fish (discussed in Section 3.6). Extensive stands of giant kelp (*Macrocystis*) extend from the sea floor to the surface to form a vertically structured habitat off the mainland and offshore islands. Although the surface area of kelp beds varies over time, aerial surveys in the mid-1970s indicated that the SCB supported a kelp canopy area of approximately 34 square miles (88 km^2) (Hodder and Mel 1978 as cited in Dailey et al. 1993). About half of the kelp occurred along the mainland of the SCB, with 28 percent attributed to the southern Channel Islands (San Clemente, Santa Catalina, Santa Barbara, and San Nicolas islands) and 20 percent attributed to the northern Channel Islands (Anacapa, Santa Cruz, Santa Rosa, and San Miguel islands). San Nicolas Island alone provided more than 14 percent of the total kelp canopy observed in the entire SCB.

Most kelp forests occur on hard, rocky substrate (although one form of *Macrocystis*—*M. angustifolia*—often forms forests attached to only sand and cobbles). Kelp forests are dynamic over both short- and long-term (greater than 80 years) scales. Changes in kelp coverage have been attributed to a variety of complex factors including water temperature fluctuations (e.g., higher water temperatures associated with El Niño events have been implicated for kelp forest reductions), nutrient availability, storm events (wave-induced surge and storm waves can detach kelp stands), and sedimentation.

3.5.2.2 Benthic Marine Invertebrates

Benthic marine invertebrates live primarily in or on the sediment. Many species, known as infauna, are sedentary and live buried in the sediments for their entire life. The mobile species typically move freely on the surface of the sediments (epifauna) but usually bury themselves in the sediment for concealment, protection, or to feed. Infaunal assemblages in the offshore region of the Sea Range are generally impoverished due to sediment type, the absence of hard-bottom reefs, and sediment transport caused by cross-shelf movement of material seaward from shallower to deeper regions (SAIC and MEC 1995).

A - Nearshore Continental Shelf

Several clam species are common or abundant on the nearshore continental shelf. Pismo clams (*Tivela stultorum*) are the predominant species on the beach foreshore. Assemblages on shallower portions of the shelf are frequently dominated by sand dollars and tubicolous polychaetes of the genera *Diopatra*, *Nothria*, *Onuphis*, *Owenia*, and *Pista*. Dominant clams include species of the genera *Tellina*, *Macoma*, and *Spisula*. In mid-depth portions of the shelf, patches of the geoduck (*Panopea generosa*) are common. In deeper portions of the shelf, deposit feeders become more important. These include tubicolous polychaetes such as maldanids, the burrowing echiuroid (*Listriolobus pelodes*), sea cucumbers, and several species of small deposit-feeding bivalves. The small clam (*Cardita ventricosa*) is one of the more common clams in deeper portions of the shelf (Jones 1969). In addition, numerous predatory and opportunistic invertebrates (i.e., scavengers) are common in these assemblages (e.g., various crabs, hermit crabs, starfish, and snails).

B - Offshore Regions

The populations in deep benthic assemblages are randomly dispersed due to physical conditions that are fairly homogeneous, and natural disturbances (e.g., predation) that are either of very low intensity or occur randomly in space and time. In general, the abundance and distribution of deep benthic assemblages appear to be persistent and stable in the SCB (Dailey et al. 1993). In general, the marine invertebrate assemblages inhabiting deep water regions (greater than 100 feet [30 m]) can be characterized by depth. As depicted in Figure 3.5-2, species composition and abundance changes with increasing water depth and with changes in the relief of the rock substrate. Species most common to each of the major deep benthic assemblages, as well as information on abundance and diversity, are briefly summarized below (as cited in Dailey et al. 1993).

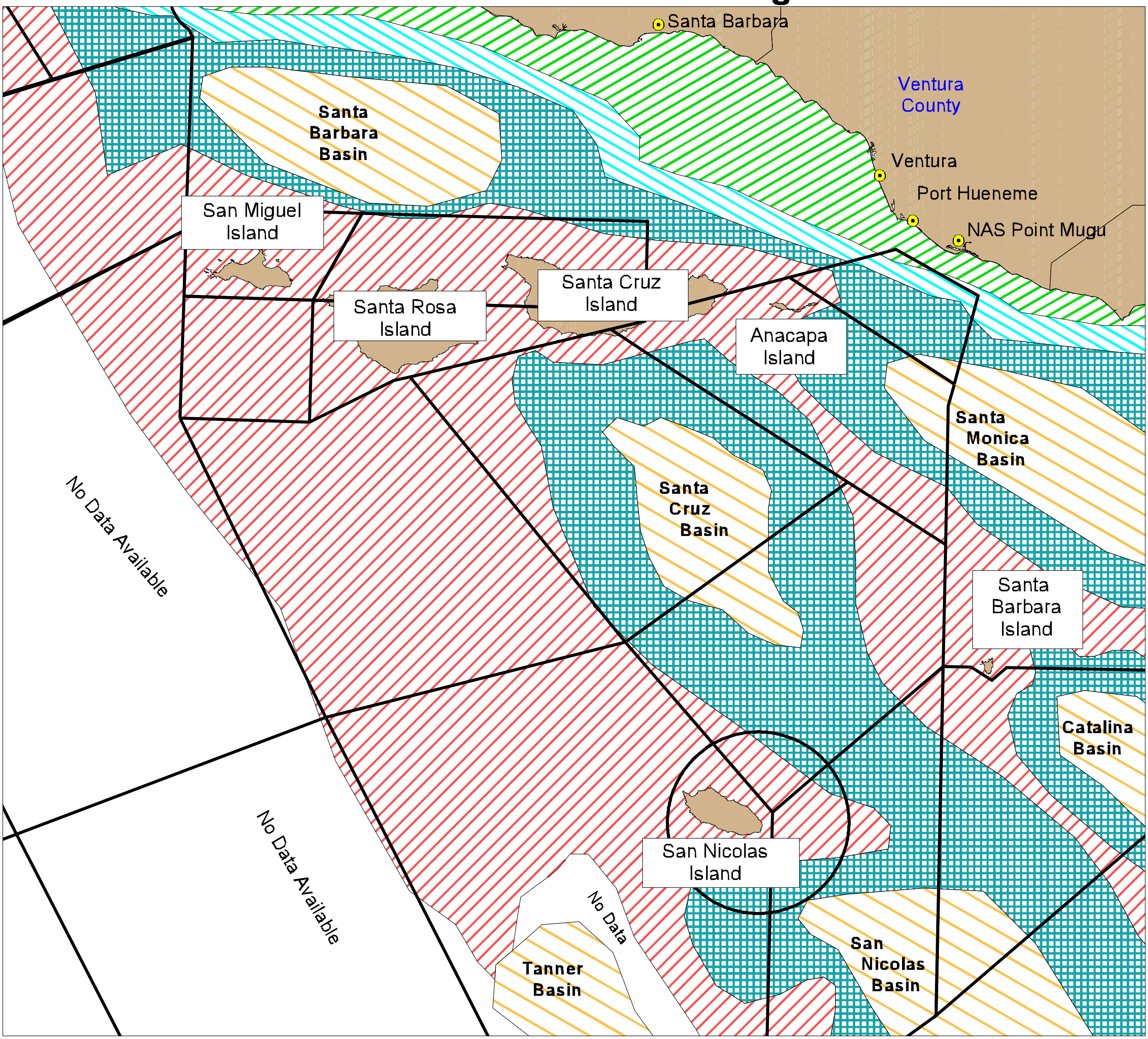
Mainland Shelf

The mainland shelf, with deep benthic marine invertebrates inhabiting areas from 100 to 492 feet (30 to 150 m) deep, has high species abundance and diversity relative to other deep benthic areas, although average diversity on the outer mainland shelf is similar to that on the offshore shelves, ridges, and banks (discussed below). Within this region, numbers of macrofaunal species, individuals, and species diversity decrease with increasing shelf depth. Most populations are randomly dispersed on the sea floor and are seldom uniformly dispersed. Dominant assemblages include polychaetes (*Spiophanes missionensis, Chloeia pinnata, Pectinaria californiensis, Paraprinospio pinnata, Maldane sarsi, Tharyx* spp.), ophiuroids (*Amphiodia urtica*), pelecypods (*Parvilucina tenuisculpta, Cyclocardia ventricosa*), ostracods (*Euphilomedes* spp.), and echiurans (*Listriolobus pelodes*).

Offshore Shelves, Ridges, and Banks

Soft sediments on the shelves of the Channel Islands, the Santa Rosa-Cortez Ridge, and the Tanner (south of the Sea Range) and Cortez banks provide unique benthic habitat. Offshore shelves, ridges, and banks exhibit the most diverse macrobenthic assemblages of the deep water regions in the Sea Range. The high species diversity is attributed mainly to the persistent upwelling (which affects the productivity of the area) and the wide range of sediment types. Assemblages that inhabit these areas extend to about 1,640 feet (500 m) and are much more spatially heterogeneous than on the mainland shelf. Dominant

Benthic Assemblages of the Southern California Bight



Legend

Point Mugu Sea Range

Benthic Assemblages

Mainland Shelf - Amphiodioa urtica, Lytechinus pictus

Offshore Shelves, Ridges, and Banks - Amphipolis squamata, Chloeia pinnata, Echnoids

Upper Slope - Maldane sarsi, Allocentrotus fragilis

Lower Slope - Anobothrus trilobata, Brissopsis pacifica, Byblis spp., Phyllochaetopterus sp.

Basins

San Nicolas Basin - Paraonid polychaetes, Nephasoma nicclasi

Catalina Basin - Tharyx sp., Ophiophthalamus normani, Scotoplanes sp.

N W E S

20 0 20 Nautical Miles

Projection: Universal Transverse Mercator, Zone 11
North American Datum of 1927
Scale shown is 1:1,000,000
Source: Dailey et al. 1993.

Figure 3.5-2

assemblages include polychaetes (*Chloeia pinnata, Lumbrineris* spp.), ophiuroids (*Amphipholis squamata, Amphiodia urtica*), pelecypods (*Parvilucina tenuisculpta*), ostracods (*Euphilomedes* spp.), and amphipods (*Photis californica*).

Nearshore Upper Slope

More of the sea floor in the SCB exists on slopes than on any other habitat. (Submarine canyons are features of slopes that provide a different habitat and are discussed separately within this section.) The nearshore upper slope, at water depths between 492 to 1,640 feet (150 to 500 m), exhibits the third-highest species diversity of the offshore regions, but abundance is low relative to the mainland shelf and the offshore shelves, ridges, and banks. More burrowing species are found among slope macrofauna than in any other benthic habitat. This is probably due to sediment instability on the slopes; turbidity transports sediment downslope, creating an unstable habitat to which benthos (i.e., bottom-dwellers) must adapt. Dominant assemblages include polychaetes (*Chloeia pinnata, Pectinaria californiensis, Paraprinospio pinnata, Maldane sarsi Lumbrineris* spp., *Tharyx* spp.), pelecypods (*Cyclocardia ventricosa*), ostracods (*Euphilomedes* spp.), gastropods (*Mitrella permodesta*), and echiurans (*Arhynchite californicus*).

Nearshore Lower Slope

Macrobenthic species diversity and biomass decrease over slope depth, and on lower slopes, these parameters approach their lowest values. Dominant assemblages in nearshore lower slope regions at water depths of 1,640 to 2,461 feet (500 to 750 m) include polychaetes (*Maldane sarsi, Lumbrineris* spp., *Anobothrus trilobata*, *Tharyx* spp.), gastropods (*Mitrella permodesta*), mollusks (Aplacophora), pelecypods (*Saturnia californica*), and echiurans (*Listriolobus hexamyotus*).

Offshore Lower Slope

Offshore lower slope regions, with water depths of 1,640 to 4,921 feet (500 to 1,500 m), are also low in species abundance and diversity. Slope assemblages consist mostly of randomly dispersed populations. Dominant assemblages include amphipods (*Byblis* spp.), polychaetes (*Lumbrineris* spp., *Tharyx* spp., Paraonidae, *Phyllochaetopterus limicolus*), and ophiuroids (*Amphipholis squamata*, *Ophiura leptoctenia*).

Basins

Deep sea basins exhibit the lowest macrofaunal species abundance and diversity of any other benthic habitat in the offshore region. This impoverishment could be due to anaerobic conditions and high sedimentation rates typical of these areas. Assemblages in most of the basins studied are composed of randomly dispersed populations occurring at depths between 2,057 to 3,077 feet (627 to 938 m) in nearshore basins and between 4,452 to 8,435 feet (1,357 to 2,571 m) in offshore basins. The benthic assemblages of different basins (e.g., Santa Cruz Basin, San Nicolas Basin) have been found to differ slightly from one another, most likely due to differences in proximity to land and sources of sediment, sedimentation rate, and productivity of overlying water. Dominant assemblages include polychaetes (*Lumbrineris* spp., *Tharyx* spp., *Phyllochaetopterus limicolus*, Paraonidae), ophiuroids (*Ophiura leptoctenia*), gastropods (*Mitrella permodesta*), and mollusks (Aplacophora).

Submarine Canyons

The Mugu submarine canyon (refer to Figure 3.1-2) is the shortest of the submarine canyons crossing the continental shelf off southern California. Originating within 150 feet (46 m) of shore at the mouth of Mugu Lagoon, this canyon approaches shore closer than any of the other coastal submarine canyons in southern California. It is eroding shoreward at an appreciable rate, and it currently poses a threat to the stability of natural beach and man-made facilities on the adjacent beach at Point Mugu. This canyon, an extension of the watershed containing Calleguas Creek, extends approximately 9 NM (16 km) offshore across the continental shelf and the basin slope. The head of the submarine canyon is eroding primarily as a consequence of the "downcutting" effects of the sand flowing into the canyon from the lagoon and from beaches to the northwest. This downcutting is a result of wave-induced longshore transport (Bascom 1980) as well as submarine slides and sloughing of the hard substrate. At a depth of about 2,400 feet (730 m), the canyon becomes indistinguishable from the basin floor (Emery and Hülsemann 1963).

Infaunal assemblages in submarine canyons are impoverished due to sediment instability and, in some cases, freshwater discharge from shallow and deep aquifers. Species abundance and numbers of individuals decline with increasing depth in the canyons. The infauna is extremely impoverished in the deeper portions of the Mugu submarine canyon, where it merges with the floor of the Santa Monica Basin. Deposit feeders such as maldanid worms and heart urchins are more common, although some suspension feeding species also occur. The change from suspension feeding to deposit feeding correlates generally with a change in sediment texture from sandy silt to fine silts and clays. Near its mouth, the Mugu submarine canyon is severely impoverished, similar to Santa Monica Basin with which it merges (Hartman 1963). It is likely that the cause of this condition is very low concentrations of dissolved oxygen, which is depleted in the deeper portions of the canyon and in the adjoining basins.

Abyssal Region

West of the Patton Escarpment lies the abyssal region, where water depths range from 3,281 feet (1,000 m) to greater than 13,123 feet (4,000 m) (refer to Figure 3.4-2). This region is the least studied of all others addressed within this EIS/OEIS. Due to the great water depths benthic assemblages in the abyssal region are similar to those found in the deep basins. Similar to the deep basins, the deep abyssal region exhibits low macrofaunal species abundance and diversity and generally can be described as an impoverished habitat. Dominant benthic assemblages would be similar to those found in the deep basins (i.e., polychaetes, ophiuroids, gastropods, and mollusks).

3.5.2.3 Threatened and Endangered Species

On 29 May 2001, the National Marine Fisheries Service (NMFS) published a final rule to list the white abalone (*Haliotis sorenseni*) as an endangered species under the Endangered Species Act (ESA) (NMFS 2001). Abalone are marine gastropods that grow slowly and have a relatively long life span of 30 years or more. Young abalone seek cover in rocky crevices and under rocks, while adults are found in open, low-relief rock or boulder habitat. White abalone are typically found in relatively deep waters (i.e., 66 to 197 feet [20 to 60 m]) and are historically most abundant between 80 and 100 feet deep (25 and 30 m; NMFS 2001). It is estimated that only about three percent of the area with appropriate depths contain rocky substrate providing suitable habitat. White abalone may be limited to depths where algae grow, a function of light levels and substrate availability, because they are reported to feed less on drift algae and more on attached brown algae (Tutschulte 1976, Hobday and Tegner 2000a, as cited in NMFS 2001). The total California population of white abalone is estimated to be about 300 individuals.

3.5.3 Point Mugu

3.5.3.1 Mugu Lagoon

A - General

Mugu Lagoon is a large, shallow estuary (refer to Figure 3.4-5). As with all wetlands along the southern California coast, the biological composition of wetlands associated with Mugu Lagoon is constantly changing due to man-made and natural disturbances (Zedler 1982). Development of NAS Point Mugu (e.g., roads and buildings) has separated and segregated some portions of the lagoon (e.g., the western arm) thus changing the lagoon's hydrology and habitat compositions. However, in contrast to all other coastal lagoons in southern California, Mugu Lagoon has been the least affected by development (Onuf 1987). This is primarily due to the Navy's presence and conservation efforts, minimizing man-made effects in the area.

Natural disturbance in this habitat is associated with storm events. In most years, rainfall is light, resulting in little freshwater flow into the lagoon from Calleguas Creek, and changes in the sediment structure of the lagoon are generally minimal. However, periodic storm events fill Calleguas Creek and cause considerable input of freshwater and fine sediments into Mugu Lagoon. The lagoon biota tend to consist of mostly marine (saltwater) species that rely on daily tidal exchange for their water supply. Although extensive freshwater flushing can cause mortality in many marine species, this is a natural short-term event that generally does not cause long-term changes in species composition. Excessive sedimentation can, however, cause long-term changes in the species composition. Prior to 1978, the subtidal portions of the eastern arm were evenly dominated by eelgrass (*Zostera marina*) and unvegetated (mud) bottom. Storm events of 1978 caused substantial deposition of new sediments that buried the eelgrass beds, which subsequently died, changing the nature of the subtidal habitat in the lagoon from eelgrass habitat to entirely mud bottom (Onuf 1987).

B - Marine Flora

Both macro- and microflora contribute to the primary production in Mugu Lagoon and provide food for the animals living in the estuary. In addition, the macroflora provides structural habitat for animals. Dominant macroflora includes seagrasses, macroalgae, and emergent vascular plants. The microflora consists of phytoplankton in the water column and benthic diatoms and blue-green algae that cover the sediment.

Due to the loss of seagrass after storms in 1978, submerged macroalgae have become the dominant primary producers in the lagoon. The macroalgae are responsible for ten times more productivity than benthic microflora, which are twice as productive as phytoplankton (Onuf 1987). Although phytoplanktonic microflora contributes much less to the overall primary production of the lagoon, it is an important source of biodiversity (Zedler 1982).

Because of the lack of hard bottom in the lagoon, the only two common macroalgae are *Enteromorpha* spp. and *Ulva* spp. (Onuf 1987; Zedler 1982). These algae can form large mats during periods of low tidal circulation and contribute greatly to primary production. These algal "blooms" have two important roles: they provide shelter to small fish and invertebrates from predators, and they are used as a food source and thus contribute to the food chain.

C - Benthic Marine Invertebrates

The benthic resources of the lagoon consist of many plant and animal taxa. Studies summarizing the marine invertebrate communities of Mugu Lagoon are lacking or are dated (e.g., MacGinitie and MacGinitie 1969). The majority of data on benthic species are from Onuf's (1987) studies of the eastern arm. These data span a number of years that include pre- and post-storm events and provide the most comprehensive species list of benthic invertebrates of the eastern arm. This study suggests that individual invertebrate species are strongly influenced by sediment type and that the invertebrate taxa of Mugu Lagoon are typical of other southern California lagoons.

Wetland species are unique in that they tolerate fluctuating conditions in salinity, temperature, and sediment composition caused by storms. Their ability to handle the fluctuating conditions also influences the type of habitat (i.e., mud flats, subtidal, or upper marsh) in which each species lives. In general, the majority of species in the eastern arm had reductions in their respective populations after the large storm of 1978, but the smaller, worm-like species were most affected (reduced or eliminated) by changes in bottom sediment composition (Onuf 1987).

Two snails (*Cerithidea californica* and *Assiminea californica*) and one crab (*Pachygrapsus crassipes*) species tend to be the dominant large invertebrates that live on the mud flats. The snails are grazers on algal mats, and their presence has been shown to influence the abundance and patchiness of algal mats (Onuf 1987). The other large invertebrates (e.g., clams, shrimp, and worms) of the mud flats burrow in the mud and require daily inundation of seawater.

The most diverse assemblages of epi- and infaunal species occur in subtidal habitats of the lagoon. The most common epifaunal invertebrates are marine snails. Dominant infauna consist of: bivalves (clams and mussels); worms or worm-like organisms such as phoronids, sipunculids, nemerteans, and oligochaetes; and crustaceans (amphipods and ghost shrimp such as *Callianassa californiensis*).

Distance from ocean water inlet, depth, and sediment type all influence the distribution and development of infaunal assemblages. Larger, longer-lived animals tend to live closer to the ocean inlet. At least five species of long-lived clams are common in the subtidal sandy and sandy/mud bottom habitats in outer reaches of the lagoon. These include Pacific littleneck (*Protothaca staminea*), purple (*Nuttallia nuttallii*), Washington (*Saxidomus nuttalli*), California razor (*Tagelus californianus*), and Pacific gaper (*Tresus nuttallii*) clams. Smaller, more ephemeral infaunal invertebrates (e.g., worms) tend to live farthest away from the ocean inlet in muddier sediments. These sediments are subjected to periodic influxes of silt and freshwater, temperature extremes, and elevated salinity levels associated with warm periods in the summer. Common organisms of these habitats include oligochaetes, polychaetes (*Nereis* spp., *Capitella capitata*, *Streblospio benedicti*, and mud-tube building worms [*Pseudopolydora* spp.]), and gammarid amphipods. Most of these are short-lived, opportunistic organisms and are often referred to as ephemeral species. The dominant marine gastropod of the upper marsh is *Melampus olivaceus*.

D - Threatened and Endangered Species

Rare, threatened, or endangered marine species are not known to occur in the Mugu Lagoon. Information on fish and sea turtles is presented in Section 3.6 and marine mammals in Section 3.7.

3.5.3.2 Sandy Beaches and Nearshore Environment of Point Mugu

A - General

The nearshore environment at Point Mugu is dominated by sandy beach habitat. Relative to other sandy beaches in southern California, recreational use is limited and this habitat remains undeveloped and in a natural state. The topography of the sandy beaches is strongly influenced by wave conditions. The beaches are composed of fairly coarse sand and are relatively steep. The foreshore extends out to a depth of about 10 to 12 feet (3 to 4 m) where the slope of the bottom decreases substantially. This slope marks the point of transition from beach into shallow shelf.

B - Marine Flora

Macroflora are not found on sandy beaches because they cannot attach to the small grains of sand. Some sandy beaches may, however, support assemblages of microflora (e.g., surf diatoms). Common genera of surf-zone diatoms include *Anaulus*, *Asterionella*, and *Chaetocerus*. Literature describing the ecological importance and abundance of surf-zone diatoms at Point Mugu is lacking. Therefore, a specific assessment of these microflora cannot be made.

C - Benthic Marine Invertebrates

Sandy beaches of Point Mugu are exposed to wave action and support fewer species than the lagoon (which is protected) or rocky shores where organisms can attach to the rock or find shelter in crevices. The dominant taxa are hard-shelled (e.g., clams and sand crabs) or soft-bodied (e.g., worms) mobile infauna that bury in the sand for protection from waves and predators.

Two clams are common (either over the long-term or seasonally) along the beaches of Point Mugu. The most important of these is the Pismo clam (*Tivela stultorum*). This large long-lived clam occurs at moderate densities along these beaches, especially between the lower edge of the surf zone and the outer edge of the foreshore; this clam is the subject of sport fishing pressure along the exposed beaches of southern and central California (Fitch 1961). The other important intertidal bivalve, the bean clam (*Donax gouldii*), is a relatively small species (Morris et al. 1980; Ricketts and Calvin 1968). It occurs sporadically in the surf zone in dense patches that can persist for up to 3 years. Animals in these patches tend to remain at a consistent tidal level regardless of tidal fluctuations. Dense bands of bean clams can extend for over 1 mile (2 km) along some beaches.

Besides clams, other important infaunal organisms include polychaete worms and crustaceans. Most of these species are seasonally abundant and are most common in spring and summer (Morris et al. 1980; Ricketts and Calvin 1984). Important polychaetes include the deposit-feeding bloodworm (*Euzonus mucronata*) and the predatory shimmy worm (*Nephtys californiensis*). The most common crustacean is the sand crab (*Emerita analoga*), a suspension feeder that also moves up and down the beach in response to changes in tidal level. Less common crustaceans include several amphipods that inhabit relatively specific tidal elevations extending from the upper intertidal level (e.g., beach hoppers of the family Talitridae) down to the lower intertidal zone (e.g., family Haustoriidae).

D - Threatened and Endangered Species

Rare, threatened, or endangered marine species have not been recorded for the nearshore environment of Point Mugu (CDFG 1994). Fish and sea turtles are addressed in Section 3.6 and marine mammals are addressed separately in Section 3.7.

3.5.4 San Nicolas Island

A - General

San Nicolas Island has few coves and is located far from the wave shadow of the other islands. Consequently, species that typically occur in calm waters are rare or absent (Engle 1994). Surface water temperature in the vicinity of San Nicolas Island typically ranges between 57° F (14° C) and 64° F (18° C). Ocean currents on the north shore of the island flow along its contours in a northwest to southeast direction at a speed of approximately 0.5 knots (0.9 km/hr). Since the island presents an obstruction to the prevailing flow of wind and swell, the southeastern shore is the most sheltered portion of the island (refer to Figure 3.4-1).

San Nicolas Island is far enough offshore to receive cold water from the California Current, yet far enough south to receive warm water from the California Countercurrent. Therefore, the subtidal species are considered to be intermediate (a combination of both northern and southern species) in relation to the other Channel Islands (Engle 1994). Another major influence on marine species distribution at San Nicolas Island is the geologic composition of the marine habitat. Bedrock is the dominant habitat type in shallow water around the Channel Islands, followed by boulder and sand. San Nicolas Island's shoreline consists of about 61 percent bedrock and 33 percent sandy beach (Engle 1994).

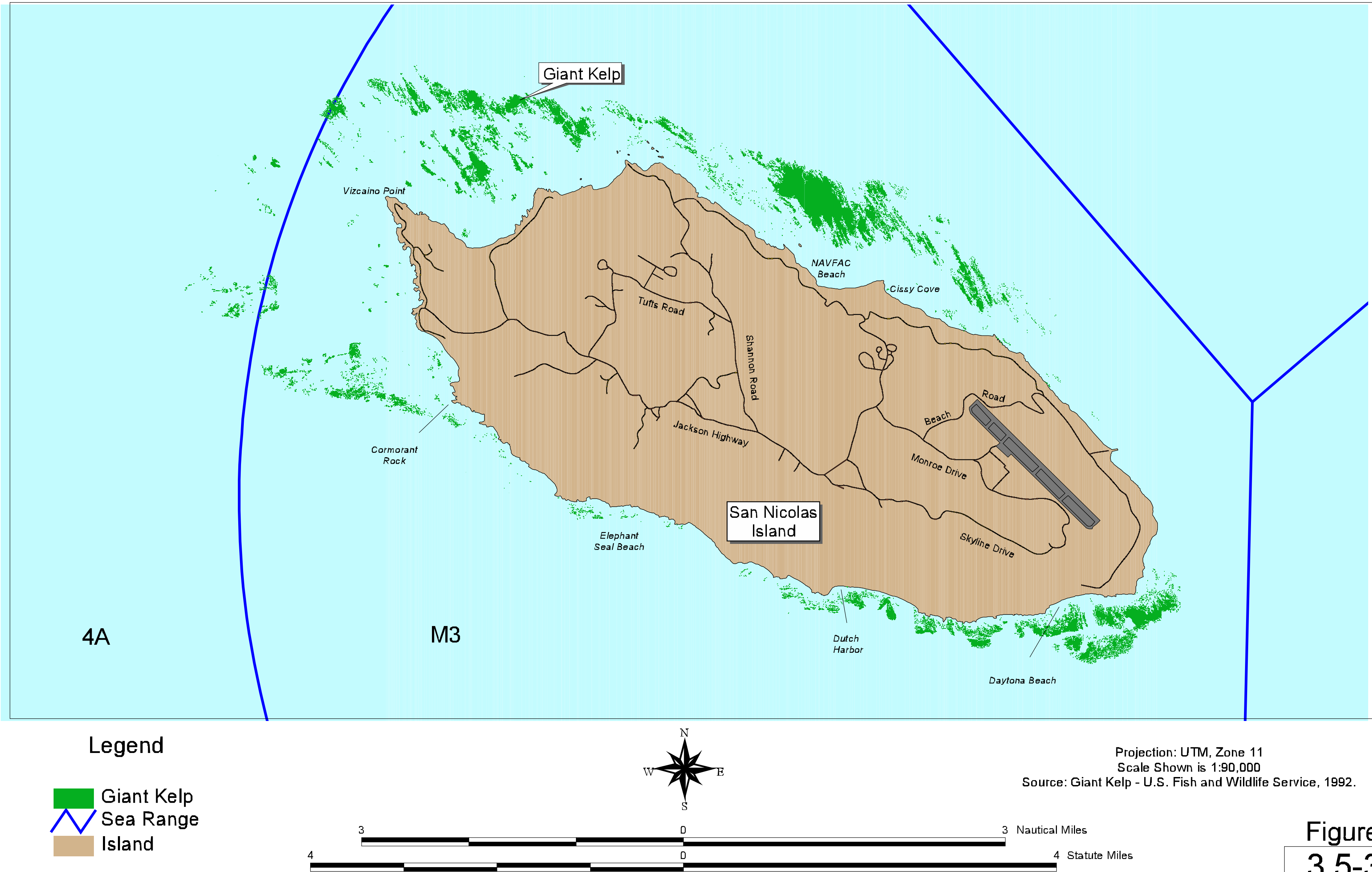
B - Marine Flora

San Nicolas Island is almost completely surrounded by marine flora (Figure 3.5-3). This is primarily due to the large amounts of rocky subtidal habitat that surrounds the island. The rocky habitat is ideal for giant kelp (*Macrocystis pyrifera*) and numerous species of red, green, and brown algae. The rocky intertidal algal assemblages at the west end of San Nicolas Island are distinctly different than algal assemblages of the other Channel Islands and the mainland (Murray and Littler 1981). This difference is primarily due to San Nicolas Island's location and oceanographic conditions (current flow and water temperature) (Murray and Littler 1981). In addition to differences in algal populations, San Nicolas Island may have some distinct differences in fish and invertebrate populations, but scientific studies to determine this have not yet been performed (Engle 1994).

Giant kelp surrounds the island except along the eastern edge. As discussed earlier in Section 3.5.2.1, San Nicolas Island provides a large percentage (14 percent) of the total kelp canopy of the entire SCB (Dailey et al. 1993) and about 30 percent of the giant kelp found in the Channel Islands (Engle 1994). Kelp forests are an important part of the marine ecosystem because they serve as food, shelter, substrate, and nursery habitat to migratory and resident species of fish and invertebrates (Richards and Kushner 1992).

Unlike the rocky habitats, sandy beaches do not support rich assemblages of different species of macroflora, the exception being surfgrass (*Phyllospadix torreyi*). In sandy areas, surfgrass is important habitat for fish and invertebrates for food and refuge. Although surfgrass is found offshore of sandy beaches, it requires hard substrate for its root structure to hold. This implies that the subtidal areas offshore of the sandy beaches have hard substrate that is buried just below the sand surface.

Kelp Distribution at San Nicolas Island



Projection: UTM, Zone 11
Scale Shown is 1:90,000
Source: Giant Kelp - U.S. Fish and Wildlife Service, 1992.

Figure 3.5-3

C - Marine Benthic Invertebrates

Benthic invertebrates are characterized by habitat type (i.e., rocky or sandy) in which they are found. Because rocky habitats are ideal for attachment of sessile (non-motile) invertebrates and are generally more stable than sandy beaches, rocky habitats support more invertebrate species than sandy habitats. Rocky habitat is common off San Nicolas Island and over 150 invertebrates are known for the island (NAWS Point Mugu 1997e). Invertebrates that inhabit rocky areas include sea stars, snails, nudibranchs, urchins, abalone, anemones, barnacles, mussels, worms, lobsters, crabs, and bryozoans. Both urchin and lobster support substantial sport and commercial fisheries (abalone has also been fished at San Nicolas Island but this fishery is currently closed [refer to Section 3.12, Socioeconomics]).

The invertebrate species that inhabit the shallow sandy areas of San Nicolas Island are similar to the species found along the sandy beach area of Point Mugu and include polychaetes, sea stars, olive snails (*Olivella biplicata*), and the spiny mole crab (*Blepharipoda occidentalis*).

D - Threatened and Endangered Species

Rare, threatened, or endangered marine species have not been recorded for San Nicolas Island (CDFG 1994). Information on fish and sea turtles is presented in Section 3.6 and marine mammals in Section 3.7.