# APPENDIX D
# MARINE HABITAT SUMMARY

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**Table D-1. Summary of Intertidal and Subtidal Habitat Types. Data Summaries Derived from the North Coast MPA EIR (Horizon Water and Environment LLC 2012a, 2012b), North Central Coast MPA EIR (ICF Jones & Stokes 2009a, 2009b), Central Coast MPA EIR (Jones & Stokes 2006, 2007), and South Coast MPA EIR (URS 2010a, 2010b) and Select Peer-Reviewed Sources (Dailey et al. 1993; Thompson et al. 1993)**

| Region and Habitat | Characteristics |
|---|---|
| ***North Coast*** | |
| Sandy/Gravel Beaches | Sandy beach represents less than 1/3 of the shoreline in the North Coast region. Sandy beach communities are structured in large part by grain size, slope of the beach, and wave energy. Fine- to medium-grained sand beaches are the most common type along the North Coast, and gravel beaches are the least common type. Beaches are dynamic systems, changing with wind and wave action. Generally, sand erodes from beaches in the winter and is redeposited in the summer, resulting in annual changes in beach slope and width. Seasonal fluctuations in sand abundance are affected by the development of hardened shores and human-made sand-retention structures. Beach sand, decaying seaweed, and other detritus support a variety of invertebrate animals. Snails, bivalves, crustaceans, insects, spiders, isopods, amphipods, and polychaetes are among the organisms that inhabit sandy beaches, and several of these provide nourishment for larger vertebrate animals, including coastal populations of the western snowy plover. Many other species, including pinniped mammals, use sandy beaches for resting and rearing young. Beach types include:<br>1) Gravel beach – includes beaches composed of sediments ranging from pebbles to boulders; often steep with wave-built berms. Attached algae, mussels, and barnacles are present on lower stable substrata. This beach type makes up 7 percent of all the beaches in the North Coast region.<br>2) Mixed sand and gravel beach – characterized by a moderately sloping beach with a mix of sand and gravel, which may have zones of pure sand, pebbles, or cobbles. Sand fraction may get transported offshore in winter. More stable substrata support algae, mussels, and barnacles. These beaches make up 11 percent of all the beaches in the North Coast region.<br>3) Coarse-grained sand beach – characterized by a moderate-to-steep beach of variable width with soft sediments, which may be backed by dunes or cliffs, and scarce fauna. Often located near river mouths and estuaries, this beach type makes up 8 percent of all the beaches in the North Coast region.<br>4) Fine- to medium-grained sand beach – characterized by a flat, wide, and hard-packed beach that experiences significant seasonal changes in width and slope. Upper beach fauna is scarce; lower beach fauna includes sand crabs. These beaches make up less than 25 percent of all the beaches in the North Coast region. |
| Rocky Shores | Rocky shore habitats and their associated ecological assemblages make up nearly 1/3 of the shoreline of the North Coast region. Rocky shores include headlands and points such as Point Saint George, Patrick's Point, Trinidad Head, Cape Mendocino, Punta Gorda, and Mendocino headlands, as well as much of the coast at Fort Bragg. Exposed wave-cut platforms are the most common rocky shore type along the North Coast. Rocky intertidal communities vary in composition and structure with tidal height and wave exposure and with underlying geology. Beds of mussels (*Mytilus* spp.), surfgrass (*Phyllospadix* spp.), and algal assemblages from turfs (*Endocladia muricata*, etc.) to low canopies of leathery kelps (*Pterygophora californica, Postelsia palmaeformis*) are distributed in patches throughout the rocky shoreline. The structure created by these beds, turfs, and canopies provides suitable settlement substrate for many larval and juvenile intertidal organisms. Such areas supporting this high biodiversity are referred to as "biogenic habitats." In addition, intertidal boulders, platforms and cliffs, as well as tidepools, are home to many species of snails, barnacles, anemones, crabs, sea stars, and fishes. Also, rocky shores in the North Coast region provide important rookery/haul-out sites for pinnipeds, including harbor seals, California sea lions, and Steller sea lions. The following rocky shore types have been mapped along the North Coast: |

| Region and Habitat | Characteristics |
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| | 1) Exposed rocky cliff – characterized by a steep intertidal zone (>30° slope) with little width and little sediment accumulation; includes strong vertical zonation of intertidal communities. Approximately 1/4 of the rocky shore in the North Coast region is this type.<br>2) Wave-cut rocky platform – includes flat rocky benches of variable width, with irregular surface and tidepools. Shore may be backed by scarp or bluff with sediments or boulders at base. Some sediment accumulation occurs in pools or crevices. May support rich tidepool and intertidal communities. Over 70 percent of the rocky shore in the North Coast region is exposed, wave-cut platform in bedrock.<br>3) Sheltered rocky shore – characterized by bedrock shores of variable slope (cliffs to ledges), sheltered from wave exposure. These shores, which comprise less than 1 percent of the total shoreline in the North Coast region, make up roughly 2 percent of the rocky shores. |
| Hardened Shorelines | Jetties, seawalls, and other human-made structures cover slightly less than 9 percent of the shoreline in the North Coast region. Shorelines around major ports and harbors, especially Crescent City Harbor, Humboldt Bay, and the Noyo River mouth, are predominately human-made shorelines. Structures such as jetties and seawalls provide habitat for intertidal algal (e.g., *Fucus, Mastocarpus, Polysiphonia* spp*.)* and invertebrate (e.g., *Anthopleura spp. Cancer productus, Pachygrapsus crassipes*) assemblages similar to those found in naturally occurring, rocky intertidal areas. The invasive bryozoan, *Watersipora subtorquata*, colonizes the submerged surfaces of boats and floating docks in addition to the hardened shoreline structures. |
| Coastal Marshes and Tidal Flats | Coastal marshes support high levels of biological productivity and provide habitat for many species. Marshes also regulate the amount of fresh water, nutrient, and sediment inputs into the estuaries and play an important role in filtration for estuarine water quality. Marshes along estuarine margins contribute to the stabilization of shorelines and store floodwaters during coastal storms. Vegetation patterns and dominant species in coastal marshes vary with levels of salinity, which is determined by precipitation patterns and changes in freshwater inputs. Tidal flats are associated with coastal rivers as well as bays and estuaries, including the Smith River mouth, Mad River, Humboldt Bay, the Eel River estuary, and the mouth of the Mattole River. These areas provide essential foraging grounds for migratory bird species because of the presence of invertebrates, including clams, snails, crabs, worms, and the burrowing ghost shrimp (*Neotrypaea californiensis*), as well as eelgrass (*Zostera* spp.). Eelgrass also provides habitat for juvenile fish species (e.g., *Sebastes* spp.) and Dungeness crab (*Cancer magister*), among other species. Soft sediments support large populations of worms, clams, and snails – among other species– and are important foraging area for shorebirds. Extensive mudflats occur in north and south Humboldt Bay, as well as in the Eel River estuary. |
| Estuaries and Lagoons | Estuaries provide critical ecosystem services (e.g., filtering sediments and nutrients from the watershed, stabilizing shorelines, providing flood and storm protection). Their condition is closely tied to the condition of the surrounding watershed. Estuaries also are utilized for many recreational activities (e.g., fishing, boating, kayaking, wildlife viewing, interpretation/education activities). Estuaries form at the mouths of rivers and streams, where freshwater and saltwater meet. Specific characteristics of estuaries vary, based on salinity. The salinity may change seasonally and over longer time frames, depending on freshwater inputs and creation or removal of barriers between the estuary and the open coast. Two types of estuaries are found in the North Coast region: (1) bodies of water that are permanently or semi-permanently open to the ocean; and (2) bodies of water that are seasonally separated from the sea by sand bars, commonly referred to as lagoons. Estuaries contain open water and soft-bottom habitats, coastal marsh, and tidal flats, and, in some cases, eelgrass beds. Lagoons generally have a low level of freshwater input. In general, lagoons and estuaries that are open, at least periodically, and are characterized by estuarine vegetation and tidal influence were included in the Marine Life Protection Act (MLPA) planning process. The North Coast region contains at least a portion of 22 estuaries and lagoons, 16 of which are greater than 0.5 square miles ($mi^2$) in area. Humboldt Bay is the largest estuary in the North Coast region and the second largest estuary in California, after San Francisco Bay. Other relatively large estuaries or lagoons include the Eel River estuary, Lake Earl, Big Lagoon, and the Klamath River estuary.<br>Humboldt Bay is a marine embayment located along the central coast of Humboldt County consisting of Humboldt Bay proper, South Bay, |

| Region and Habitat | Characteristics |
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| | and Arcata Bay. Humboldt Bay is the largest estuary in the North Coast region, encompassing an area of 27.44 $mi^2$. The Humboldt Bay National Wildlife Refuge is located in South Bay. Humboldt Bay contains a number of diverse habitats, including tidal flats, salt marsh, and eelgrass beds. Approximately 40 percent of the known eelgrass in the State occurs in Humboldt Bay. Eelgrass beds in South Bay are denser than those of Arcata Bay, contain 78 percent to 95 percent of the total eelgrass biomass in the bay, and are recognized as one of the most important locations of eelgrass growth on the entire U.S. west coast. |
| Seagrass Beds | Seagrass habitats are extremely productive ecosystems that support an abundant and biologically diverse assemblage of aquatic animals, many of which are commercially important. The most common type of seagrass in estuaries and sheltered coastal bays in California is *Zostera marina* or eelgrass. A second species of eelgrass has been discovered in Humboldt Bay and the Eel River estuary, the nonnative dwarf eelgrass (*Z. japonica*). Eelgrass is a marine flowering plant that often forms dense beds. Attributed mostly to their structural complexity and high productivity, eelgrass beds provide refuge, foraging, breeding, or nursery areas for a variety of invertebrates, fish, and birds. The long leaves and extensive root system also create a stable environment by reducing water flow and trapping particles, which consequently enhances sediment deposition, improves overall water quality, and increases recruitment of young fish and invertebrates. Approximately 40 percent of the known eelgrass in the State occurs in Humboldt Bay. Mapped eelgrass beds in Humboldt Bay total 7.08 $mi^2$. Within the North Coast region, eelgrass has also been reported in the Smith River estuary, Crescent City Harbor, Eel River estuary, Ten Mile River estuary, Noyo River estuary, Big River estuary, and Albion River estuary. The most common type of seagrass along the open coast of California is surfgrass (*Phyllospadix* spp.), also a flowering plant, which forms beds that fringe nearly all of the rocky coastline at the zero-tide level, down to several meters below the zero-tide level. Surfgrass serves as an important habitat for a variety of fish and invertebrates, as well as algae; however, it is not well mapped in the North Coast region. |
| Kelp Beds | Two primary canopy-forming kelp species occur in California: (1) giant kelp (*Macrocystis* sp.*)* and (2) bull kelp (*Nereocystis luetkeana)*. Both species have geographic limitations – giant kelp span the northern and southern hemispheres in temperate waters, and bull kelp are primarily found in the northern hemisphere in temperate-to-cold waters. These two species exist along the Central California coastline in separate or mixed stands. North of Santa Cruz, bull kelp becomes the dominant canopy-forming kelp. Beneath the canopy are understory kelp and, on the bottom substrate, more encrusting or shrub-like algae. Kelp forests in the North Coast region are dominated by bull kelp (surface canopy), *Pterygophora californica* and *Laminaria setchellii* (understory), and foliose algae beneath. Total kelp canopy coverage in the waters of the North Coast region has ranged from a low of 0.08 $mi^2$ in 2005, to a high of 2.76 $mi^2$ in 2008. These numbers reflect a similar trend occurring along the entire coast of California, with kelp persistence shrinking and growing over the same period. The majority of the kelp observed by the survey is found from the Fort Bragg area to the southern end of the North Coast region, with patchiness in areas near Crescent City. |
| Hard Bottoms/ Rocky Reefs | In shallow marine waters, rocky reefs (or hard bottoms) provide hard substratum to which kelp and other algae attach. In deeper water, hard substratum provides a place for many species of deep-water invertebrates to attach themselves. In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. In the North Coast region, rocky reefs are much less common than soft-bottom habitats at all depth zones. Approximately 6 percent of the total North Coast region area can be characterized as hard bottom at any depth. The majority of rocky substrata in the North Coast region is shallower than 100 meters (m). |
| Soft Bottoms | Nearshore and offshore soft-bottom environments range from flat expanses to slopes and basin areas. Soft-bottom habitats lack the complex, three-dimensional structure of hard-bottom substrata and are somewhat less diverse in species assemblages than rocky reefs. However, soft-bottom habitats can vary, depending on the compositional sediment type. Soft-bottom habitats can also be highly dynamic in nature, as sediments shift because of wave action, bottom currents, and geological processes. Sandy and soft bottoms provide essential habitat for important, commercially fished species, such as Pacific halibut (*Hyppoglossus stenolepis*) and Dungeness crab (*Cancer magister*). Available data indicate that soft-bottom habitats are much more common than hard-bottom habitats at all depth zones. |

| Region and Habitat | Characteristics |
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| | The majority of the entire North Coast region deeper than 100 m can be characterized as soft bottom. Over 3/4 of the nearshore zone (from 0 to 30 m) can be characterized as soft bottom. Soft-bottom habitats in different depth zones are considered separate habitats. |
| Underwater Pinnacles | Pinnacles are vertical rocky features that are tens of meters in diameter and height, with a cone-shaped geometry. They can be distinguished from large boulders by their geologic origin. Pinnacles are generally a product of in-place erosional processes acting on rocky outcrops, while boulders are the result of erosional processes in other locations and the resulting movement of large rocks. Pinnacles are probably located in State waters in the North Coast region, but they are not well mapped. Pinnacles can be important bathymetric features that attract fish and invertebrates, and they are popular recreational diving locations. |
| Submarine Canyons | Submarine canyons are submerged, steep-sided valleys that cut through the continental slope and occasionally extend close to shore. They have high bathymetric complexity, support unique deep-water communities, and affect local and regional circulation patterns. Submarine canyon habitats receive sediment and detritus from adjacent shallow areas and act as conduits of nutrients and sediment to deeper offshore habitats. Canyons provide habitat for young rockfish and flatfish that settle in nearshore waters to grow and move offshore as adults. Canyons also attract concentrations of prey species and provide important foraging opportunities for seabirds and marine mammals. Four submarine canyons extend into State waters in the North Coast region. All four are located along the Lost Coast, between Cape Mendocino and Point Delgada. From north to south, the canyons are Mendocino Canyon, Mattole Canyon, Spanish Canyon, and Delgada Canyon. These canyons have not been extensively studied. |
| Offshore Rocks and Canyons | More than 20,000 islands, rocks, exposed reefs, and pinnacles are included in the statewide California Coastal National Monument. The monument was designated by presidential proclamation in January 2000 and extends along the entire California coast. The monument extends from the mean high-tide line to 12 nautical miles (nm) offshore and was designed to protect the biological and geological values of offshore rocks and islets and the important forage and breeding grounds of associated marine birds and mammals. Offshore rocks provide approximately 141 linear miles of rocky shoreline habitat in the North Coast region. The North Coast region contains two offshore reefs, one isolated offshore rock, and two larger nearshore islands, as well as numerous nearshore rocks and islets. Blunts Reef, located approximately 3 miles (mi) northwest of Cape Mendocino, and Saint George Reef, extending from 2 to 6 mi northwest of Point Saint George, each has a series of wash rocks and islets rising just above sea level. Each reef provides foraging and resting opportunities for marine birds and mammals. Saint George Reef in particular contains numerous pinniped haul-out sites and a seabird nesting colony. Two larger, nearshore islands provide haulout and nesting sites for a large number of marine birds and mammals. Prince Island is located near the mouth of the Smith River and harbors nine species of nesting seabirds. Castle Rock is located slightly more than 0.5 mi offshore of Crescent City and provides nesting habitat for 11 species of marine birds, as well as haul-out locations for numerous pinniped species. Castle Rock is designated as a National Wildlife Refuge, and it is closed to the public. The island is home to the second largest nesting seabird colony south of Alaska. A number of the offshore rocks and islands are identified by the Yurok Tribe as part of the cultural landscape. In 2006, the Bureau of Land Management (BLM) created a steward agreement with the Yurok Tribe, which provides a framework for how the two parties work together to meet the mission of the California Coastal National Monument. |
| ***North Central Coast*** | |
| Sandy/Gravel Beaches | Significant expanses of continuous sandy shores areas occur along the San Francisco, San Mateo, Marin, Sonoma, and southern Mendocino County coasts. Pocket beaches are found throughout the region, especially along the Sonoma and Marin County coastlines. Sandy beach communities are structured in large part by grain size, slope of the beach, and wave energy. Beaches are dynamic systems that change with wind and waves; generally sand erodes from beaches in the winter and is redeposited in the summer, resulting in annual changes in beach slope and width. Barrier beaches and sand spits form at the mouths of larger rivers. Small pocket beaches occur where rocky cliffs are eroded along exposed coasts. Rivers deposit sediments and create barrier beaches and sandspits, such as those at the mouths of the Garcia, Gualala, and Russian Rivers and Bolinas and Limantour estuaries. A variety of invertebrates live in the sand and in |

| Region and Habitat | Characteristics |
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| | wracks of decaying seaweed and other detritus on the sand surface. There are numerous species of shorebirds, such as sanderlings, marbled godwits, and willets that feed at the water's edge. Western snowy plovers and California least terns nest on sandy beaches and coastal dunes. Pinnipeds haul out on isolated beaches and sands spits, including gravel and fine- to medium-grained beaches. Sand dollars, polychaetes, clams, crabs, surfperches, flatfishes, and other fishes live in the surf zone. Beach types in the North Central Coast have been mapped as linear shoreline features and classified based on grain size, including:<br>1) Gravel beach – beaches composed of sediments ranging from pebbles to boulders; often steep with wave-built berms. Attached algae, mussels, and barnacles are found on lower stable substrata.<br>2) Mixed sand and gravel beach – moderately sloping beach with a mix of sand and gravel; may be zones of pure sand, pebbles, or cobbles. Sand fraction may get transported offshore in winter. More stable substrata support algae, mussels, and barnacles.<br>3) Coarse-grained sand beach – moderate-to-steep beach of variable width with soft sediments, typically at river mouths; may be backed by dunes or cliffs; fauna sparse.<br>4) Fine- to medium-grained sand beach – flat, wide, and hard-packed beach; significant seasonal changes in width and slope. Upper beach fauna are scarce; lower beach fauna include sand crabs, amphipods, and polychaetes. Fine- to medium-grained sand beaches are the most common type in the North Central Coast of California, while gravel and coarse-grained beaches are relatively uncommon. |
| Rocky Shores | Rocky shore habitats and their associated ecological assemblages are found throughout the North Central Coast study region. Rocky intertidal communities, from the splash zone to the lower intertidal, vary in composition and structure with tidal height and wave exposure. Intertidal boulders, platforms, and cliffs, as well as tidepools, are home to many species of algae, barnacles, anemones, snails, mussels, crabs, sea stars, other invertebrates and fishes. Boulders such as those at Point Reyes Headland may serve as haul-out sites for some pinnipeds such as California sea lions. Mussel beds (*Mytilus* spp.), sea palm (*Postelsia palmaeformis*), algal beds (*Endocladia muricata* and many other species), and surfgrass (*Phyllospadix* spp.) are distributed in patches along rocky shores but support high biodiversity. Many birds, including the Black Oystercatcher, which is a Species of Special Concern, use rocky shores. In addition to the tidal height and steepness, the underlying geology of a rocky coast can affect the ecological communities present. The following rocky shore types have been mapped in the North Central Coast study region:<br>1) Exposed rocky cliff – steep intertidal zone (>30° slope) with little width and little sediment accumulation. Strong vertical zonation of intertidal communities; barnacles, mussels, limpets, sea stars, anemones, crabs, and macroalgae abundant.<br>2) Exposed rocky cliff with talus boulder base/boulder rubble – same as exposed rocky cliff, but with boulders at base of cliff.<br>3) Exposed wave cut rocky platform – includes flat rocky benches of variable width with irregular surface and tidepools. Shore may be backed by scarp or bluff with sediments or boulders at base. Some sediment accumulation in pools and crevices. May support rich tidepool and intertidal communities with algae, barnacles, snails, mussels, sea stars, crabs, and polychaetes.<br>4) Sheltered rocky shore – bedrock shores of variable slope (cliffs to ledges) that are sheltered from wave exposure. The intertidal community may include algae, mussels, barnacles, anemones, polychaetes, sea stars, snails, and crabs. Sheltered rocky shores are rare in North Central California; however, they are found inside bays and estuaries, particularly along the shores of Tomales Bay. Extensive stretches of rocky shore are found along the Sonoma and Marin County coasts and around the Farallon Islands. Smaller stretches of rocky shores are interspersed with large sandy beaches along the San Francisco and San Mateo County coasts. Throughout the North Central Coast study region, exposed wave-cut rocky platforms are the most common rocky shoreline type, while rocky cliff with talus boulder base and boulder rubble are among the least common types. |
| Tidal Flats and | Tidal flats and marshes occur primarily around the edges of bays and estuaries (e.g., Bolinas Lagoon, Drakes Estero, Estero de Limantour, Tomales Bay, Estero Americano, and Estero San Antonio). Tidal flats are sandy or muddy expanses that are exposed at low |

| Region and Habitat | Characteristics |
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| Marshes | tides and provide important foraging ground for shorebirds due to the abundance of invertebrates such as clams, snails, crabs, and polychaetes. High densities of sandpipers, willets, yellowlegs, and avocets can be found on tidal flats at low tide. Herons and egrets forage at the water's edge. Brandt's cormorants and Brown Pelicans also utilize these areas. Tidal sand bars serve as haul-out and colony sites for harbor seals. At high tide, tidal flats become important foraging habitat for estuarine fish (e.g., sculpins, sanddabs, halibut, leopard sharks). Coastal marshes support high levels of productivity and provide habitat for many species. Marshes also regulate the amount of fresh water, nutrient, and sediment inputs into the estuaries and play an important role in estuarine water quality. The position of marshes along estuarine margins and their dense stands of persistent plants also make them essential for stabilizing shorelines and for storing floodwaters during coastal storms. Vegetation patterns and dominant species in coastal brackish marshes vary with the salinity regime, which depends on precipitation, evaporation, tidal exchange and freshwater inputs. The following shoreline types have been mapped as linear features of the coastline:<br>1) Salt and brackish marshes – includes intertidal areas with emergent vegetation, either salt marsh or brackish marsh. The width of marsh varies from a narrow fringe to extensive areas and provides important habitat for a variety of species.<br>2) Exposed tidal flats – includes intertidal flats composed of sand and mud. The presence of some wave exposure generally results in a higher presence of sand than in sheltered tidal flats; occurs in bays and lower sections of rivers. Sediments in tidal flats are generally water saturated, with the presence of infaunal community that attracts foraging shorebirds. This habitat is used as roosting sites for birds and haul-out sites for marine mammals.<br>3) Sheltered tidal flats – includes intertidal flats comprised of silt and clay (e.g., mudflats). Present in calm-water habitats, sheltered from wave exposure, and frequently bordered by marsh. Soft sediments support large populations of polychaetes, clams, and snails; important foraging area for migrating shorebirds. |
| Hardened Shorelines | None characterized within the North Central Coast region. |
| Estuaries and Lagoons | Estuaries and lagoons are very productive coastal ecosystems that play a key role as nursery habitat for many coastal invertebrates and fish. Coastal bays and estuaries in the region are an important part of the Pacific Flyway and host thousands of shorebirds and waterfowl on their migrations. Anadromous species such as salmonids and lampreys must pass through estuaries on their migration pathways. Steelhead trout in the North Central Coast spend a significant part of their juvenile phase in coastal estuaries. Since estuaries and lagoons are important habitat linkages between marine, aquatic, and terrestrial habitats, their condition is closely tied to the condition of the surrounding watershed. Estuaries provide critical ecosystem services, such as filtering sediments and nutrients from the watershed; stabilizing shorelines; and providing flood and storm protection. Estuaries are also utilized for many recreational activities (e.g., fishing, clamming, kayaking, wildlife viewing).<br>Bodega Harbor is a moderately sized bay that forms behind the granitic Bodega Head (headland) and the sandspit that extends from Doran Beach. It is an important harbor for commercial and recreational fishing boats. Recreational shellfish gathering also occurs in the estuary. Habitats present in the bay include tidal mudflats, sandflats, and marsh, as well as protected shallow subtidal waters and eelgrass beds. This area is a top birding spot in Sonoma County. The harbor has some water quality issues, including those associated with agricultural uses in the watershed and local municipal runoff and boatyards.<br>Tomales Bay, in western Marin County, is the largest embayment in the North Central Coast study region, covering 11 $mi^2$. The mouth of the bay is at the southern end of Bodega Bay and it extends in a southeasterly direction along the San Andreas Fault. The bay is long and narrow (12 mi long and $<$1 mi wide) and has an average depth of 20 feet (ft). The mouth of the bay is open, and tides, rather than wind, dominate current patterns in the bay. There are three mixing regimes within the bay: (1) significant flushing from the mouth of the bay to Hog Island; (2) sluggish mixing in mid-bay (Pelican Point to Sandy Point); and (3) less exchange in the upper bay to the south. The watershed area of the bay is approximately 216 $mi^2$ and includes four major drainages. Tomales Bay is categorized as an impaired water |

| Region and Habitat | Characteristics |
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| | body because of pathogens. Tomales Bay has estuarine subtidal habitat, sheltered rocky shores, sheltered sand beaches, eelgrass beds, tidal flats, and coastal marsh. The bay is a top birding spot in Sonoma/Marin Counties; there are 163 species of birds known to occur there, with 122 species regularly or occasionally observed. The bay is an important stop and overwintering ground on the Pacific Flyway and shelters up to 20,000 shorebirds and 20,000 to 25,000 waterfowl. Productivity in the bay has been linked to both terrestrial and upwelling-derived nutrients. The bay is a nursery ground for many species of invertebrates and fish, including Dungeness crab, smelt, Pacific herring, Northern anchovy, Coho salmon, Steelhead trout, California halibut and other flatfish. Gray whales feed in the bay, and white sharks occur occasionally. Several species of elasmobranches (including leopard sharks, bat rays, and smoothhound sharks) are found within Tomales Bay and migrate from the outer portion to the inner portion of the bay to feed according to tidal and diurnal cycles, as well as associated changes in temperature and salinity. During the winter, these species leave Tomales Bay, presumably due to changes in temperature and salinity. There are 150 species of fish and 200 species of algae that may or do occur in the bay. The California freshwater shrimp, tidewater goby, Pacific herring, Coho salmon, and Steelhead trout are some endangered and threatened species found in the bay. Lagunitas Creek, which drains into the bay, has a relatively large population of returning Coho salmon. There are marine mammal haul-outs on tidal flats and beaches in the bay. The area below mean high tide in Tomales Bay is part of the Gulf of the Farallones National Marine Sanctuary. The Golden Gate National Recreation Area also has jurisdiction. Tomales Bay is part of the Golden Gate Biosphere Reserve, and was designated in September 2002 as a "Wetland of International Significance." Much of the western shoreline of Tomales Bay is protected as part of Point Reyes National Seashore and Tomales Bay State Park. There are 12 active shellfish State water bottom leases in Tomales Bay, with the largest located at the mouth of Walker Creek and in the southeast portion of the bay across from Teachers Beach. Tomales Bay has long been a popular and highly utilized location for recreational clamming. Clam Island and Seal Island, in the northwestern end of the bay, have produced large annual catches of gaper clams and other clam species over the decades. The bay is also utilized for other recreational activities, such as kayaking, angling, and wildlife viewing. The shores of Tomales Bay were home to coast Miwok. |
| Seagrass Beds | Seagrass habitats are very productive and biologically diverse. The most common type of seagrass in estuaries and sheltered coastal bays in California is *Zostera marina*, or eelgrass. It helps prevent erosion and maintain stability near shore by anchoring sediment with its spreading rhizomes and slowing water flow. Eelgrass beds provide foraging, breeding, or nursery areas for invertebrates, fish, and birds. Eelgrass beds cover much of the mud bottoms of Tomales Bay, Drakes Estero, Estero de Limantour, and the smaller esteros, including Estero Americano and Estero de San Antonio. Bolinas Lagoon had eelgrass beds historically, but does not currently. Eelgrass beds have been mapped in Tomales Bay and Drakes Estero and cover less than 0.8 percent of the North Central Coast study region. Total coverage of eelgrass beds is approximately 6.0 $mi^2$. The most common type of seagrass along the open coast is surf grass (*Phyllospadix* spp.), also a flowering plant, which forms beds that fringe nearly all of the rocky coastline at the zero-tide level down to several feet below the zero-tide level. The distribution of surfgrass along the North Central Coast study region has been mapped as linear segments that total 68.8 mi or 18.9 percent of the shoreline. |
| Hard Bottoms and Rocky Reefs | Hard-bottom habitats, or rocky reefs, are much less common than soft substrata in the region at all depth zones. The species that associate with hard bottoms differ greatly with depth and type of substratum; the amount of topographic relief changes with gravel, cobble, boulders, and smooth rock outcrop. Rocky reefs provide hard substratum to which kelp and other alga can attach in the nearshore (<30 m depth). In addition, many invertebrates such as deep sea corals, sponges, and anemones require hard substratum for attachment in deeper waters. In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. Hard-bottom habitat in each depth zone should be considered separate habitats. The ecological assemblages associated with rocky habitats can also be influenced by the type of rock (e.g., sedimentary vs. granitic reefs) or size of substrata (e.g., such as cobble vs. boulder). Rocky reefs in each of these geologically distinct zones are considered separate habitats. |
| Soft Bottoms | Soft bottom is the predominant habitat on the continental shelf throughout the North Central Coast study region. Nearshore and offshore environments include soft-bottom habitats in areas that range from flat expanses to sloping terrain. Soft-bottom habitats lack the structural |

| Region and Habitat | Characteristics |
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| | complexity and relief of hard-bottom substrata and are generally dominated by bottom-dwelling invertebrates and fishes; assemblages differ with depth. Soft-bottom habitats can be highly dynamic in nature, as sediments shift due to wave action, bottom currents, and geological processes. Landslides and slumps can extend offshore. Soft-sediment communities reach their peak in diversity of invertebrate epifauna and infauna around 70 to 230 m, especially in areas where the shelf is wide and riverine input is present. Soft-bottom habitats in different depth zones should be considered separate habitats. |
| Underwater Pinnacles | Pinnacles are vertical rocky features that are tens of meters in diameter and height, with a cone-shaped geometry. Pinnacles can be distinguished from large boulders by their geologic origin. Pinnacles are generally a product of in-place erosional processes acting on rocky outcrops, while boulders are the result of erosional processes in other locations and resulting movement of large rocks. Pinnacles can be important bathymetric features that attract certain fish and invertebrate species. |
| Submarine Canyons | None characterized within the North Central Coast region. |
| Offshore Rocks and Canyons | None characterized within the North Central Coast region. |
| ***Central Coast*** | |
| Sandy/Gravel Beaches | Within the Central Coast study region, significant expanses of continuous sandy shore occur along Monterey, Estero, and San Luis Obispo Bays, with shorter stretches of sandy beaches and pocket beaches along the Big Sur coast. Sandy beach communities are structured in large part by grain size, beach slope, and wave energy. Beaches are dynamic systems that change with wind and waves; generally, sand erodes from beaches in winter and is redeposited in summer, resulting in annual changes in beach slope and width. Barrier beaches and sand spits form at the mouths of larger rivers. Small pocket beaches occur where rocky cliffs are eroded along exposed coasts. Rivers deposit sediments and create barrier beaches and sandspits, such as those at the mouths of the Salinas, Pajaro, and Santa Maria Rivers. A variety of invertebrates live in the sand and in wracks of decaying seaweed and other detritus on the sand surface. There are numerous species of shorebirds, such as sanderlings, marbled godwits, and willets, which feed at the water's edge. Western snowy plovers and California least terns nest on sandy beaches and coastal dunes. Marine mammals haul out on isolated beaches and sands spits. Sand dollars, worms, clams, crabs, surfperches, flatfishes, and other fishes live in the surf zone. Beach types in the Central Coast study region have been mapped as linear shoreline features and classified based on grain size, including:<br>1) Gravel beach – beaches composed of sediments ranging from pebbles to boulders and are often steep with wave-built berms. Attached algae, mussels, and barnacles are found on lower stable substrata.<br>2) Mixed sand and gravel beach – moderately sloping beach with a mix of sand and gravel. There may be zones of pure sand, pebbles, or cobbles. Sand fraction may get transported offshore. More stable substrata support algae, mussels, and barnacles.<br>3) Coarse-grained sand beach – moderate-to-steep beach with variable width and soft sediments, typically at river mouths. It may be backed by dunes or cliffs. Fauna is scarce.<br>4) Fine- to medium-grained sand beach – flat, wide, and hard packed beach with significant seasonal changes in width and slope. Upper beach fauna is scarce; lower beach fauna includes sand crabs, polychaete worms, and amphipods. These beaches are the most common type in Central California. Tidal flats and marshes occur primarily around the edges of bays and estuaries (e.g., Elkhorn Slough and Morro Bay). |
| Rocky Shores | Rocky shore habitats and their associated ecological assemblages are found throughout the Central Coast study region, although they are absent in significant stretches of the coast in certain areas. Rocky intertidal communities, from the splash zone to the lower intertidal zone, |

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| | vary in composition and structure with tidal height and wave exposure. Intertidal boulders, platforms, and cliffs, as well as tidepools, are home to many hundreds of species of algae, fishes, and invertebrates, including barnacles, anemones, snails, mussels, crabs, and sea stars. Mussel beds, sea palm, algal beds, and surfgrass are patchily distributed along rocky shores but support a very diverse fauna. In addition to the tidal height and steepness of the shore, the underlying geology of a rocky coast can affect the ecological communities present. The most prominent of the shoreline types include:<br>1) Exposed rocky cliff – characterized by a steep, narrow intertidal zone (>30° slope) and little sediment accumulation. It also has strong vertical zonation of intertidal communities; barnacles, mussels, limpets, sea stars, anemones, crabs, and macroalgae are abundant.<br>2) Exposed wave cut rocky platform – includes flat rocky benches of variable width with irregular surface and tidepools. The shore may be backed by a scarp or bluff with sediments or boulders at its base. Some sediment accumulation occurs in pools and crevices. This habitat supports rich tidepool and intertidal communities with algae, sponges, anemones, barnacles, snails, mussels, sea stars, brittle stars, bryzoans, tunicates, crabs, isopods, amphipods, and polychaetes.<br>3) Sheltered rocky shore – includes bedrock shores of variable slope (cliffs to ledges) that are sheltered from wave exposure. This habitat supports rich tidepool and intertidal communities with algae, sponges, anemones, barnacles, snails, mussels, sea stars, brittle stars, bryzoans, tunicates, crabs, isopods, amphipods and polychaetes. Sheltered rocky shores occur in the Central Coast region but are very rare, typically found inside bays or estuaries. |
| Hardened Shorelines | None characterized within the Central Coast region. |
| Coastal Marshes and Tidal Flats | Tidal flats are sandy or muddy expanses that are exposed at low tides and provide important foraging ground for shorebirds because of the abundance of invertebrates such as clams, snails, crabs, and worms. High densities of sandpipers, willets, yellowlegs, and avocets can be found on tidal flats at low tide. Herons and egrets also forage at the water's edge. At high tide, tidal flats become important foraging habitat for estuarine fish (e.g., sculpins, sanddabs, California halibut, leopard sharks). Coastal marshes support high levels of productivity and provide habitat for many species. Marshes also regulate the amount of freshwater, nutrient, and sediment inputs into the estuaries and play an important role in estuarine water quality. The position of marshes along estuarine margins and their dense stands of persistent plants also make them essential for stabilizing shorelines and storing floodwaters during coastal storms. Vegetation patterns and dominant species in coastal brackish marshes vary with the salinity regime that is defined by precipitation patterns and changes in freshwater inputs. |
| Estuaries and Lagoons | The Central Coast study area includes two relatively large permanent estuaries, Elkhorn Slough and Morro Bay, and many small estuaries or lagoons at the mouths of coastal rivers: San Lorenzo, Pajaro, Salinas, Carmel, Little Sur, Big Sur, Arroyo de la Cruz, Santa Ynez, and many others. The aerial extent of estuaries in the Central Coast study region totals only 6.9 square nautical miles ($nm^2$). Coastal bays and estuaries in the region (especially Monterey Bay/Elkhorn Slough and Morro Bay) are an important part of the Pacific Flyway and host thousands of shorebirds and waterfowl on their migrations. Anadromous fish (e.g., salmonids) pass through estuaries on their migrations. Steelhead in the Central Coast region spend a significant part of their juvenile phase in coastal estuaries. Because estuaries and lagoons are important habitat linkages between marine, aquatic, and terrestrial habitats, their condition is closely tied to the condition of the surrounding watershed. Estuaries provide critical ecosystem services, such as filtering sediments and nutrients from the watershed, stabilizing shorelines, and providing flood and storm protection.<br>The Morro Bay estuary encompasses approximately 3.6 $mi^2$ of mudflats, open-water habitat, and tidal wetlands. This estuary supports a unique ecosystem containing numerous plants and animals and habitats, including open water and channels, subtidal and intertidal eelgrass beds, mudflats, coastal salt marsh, brackish marsh, freshwater marsh, and riparian woodland. These habitats support a number of special status species. Morro Bay is a significant estuarine nursery area, particularly for flatfishes. |

| Region and Habitat | Characteristics |
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| Seagrass Beds | Eelgrass beds, mapped in Morro Bay by the Morro Bay National Estuary Program and in Elkhorn Slough by the Elkhorn Slough National Estuarine Research Reserve, cover a very small portion of the study region. Total coverage of eelgrass beds in Morro Bay is approximately 0.8 $nm^2$, and coverage in Elkhorn Slough is 0.025 $nm^2$. There is an extensive seagrass bed on the shale reef off Del Monte Beach in Monterey, but the current condition of this bed is not known and it has not been mapped. The eelgrass beds in Morro Bay are the largest and least impacted of any in Central and Southern California. These unique beds are productive and complex environments. The beds serve as spawning and nursery grounds for many species of fish, including English sole (*Parophrys vetulus*) and California halibut (*Paralichthys californicus*). The density and diversity of benthic fauna are several times greater within the eelgrass beds than in other Morro Bay habitats. A vital community of epiphytic flora and fauna lives on the blades composing the thick foliage of the beds. The most common type of seagrass along the open coast is surfgrass (*Phyllospadix* spp.), also a flowering plant, which forms beds that fringe nearly all of the rocky coastline at the zero-tide level down to several meters below the zero-tide level. In some areas, such as Soquel Point, Santa Cruz County, surfgrass forms extensive beds. The distribution of surfgrass along the Central Coast study region has been mapped as linear segments that total 141 nm, or 38 percent of the shoreline. |
| Kelp Beds | Kelp forests are critical habitats for many marine species in inshore areas of Central California and are essential to maintain the diversity and abundance of marine life. The spectacular giant-kelp forests of California occur nowhere else in the world. Kelp forests (or kelp beds) are formed by two predominant canopy-forming, brown, macroalgae species in Central California, giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nereocystis lutkeana*). These two types of kelp forests differ in their biological productivity (giant-kelp forests are more productive) and species assemblages, and should be considered separate habitats. Kelp beds are quasi-permanent features, but the extent of their canopies changes seasonally and annually in response to seasonal growing conditions, winter storm activity, and oceanographic conditions (e.g., El Niño events). Kelp beds grow along much of the Central Coast study region on nearshore hard substrate. In general, beds can extend to a maximum depth of about 30 m. Extensive kelp beds are found in many areas of the Central Coast, such as Point Sur and Lopez Point. The kelp forests in Central California were well mapped at fine-scale resolution in 1989, 1999, 2002, and 2003 by California Department of Fish and Game (CDFG) aerial surveys. Kelp canopy extent averaged 10.83 $mi^2$ over the survey period; in some years, the Central Coast study region had almost half of the total statewide kelp bed extent. In 2003, there were 7.2 $mi^2$ of kelp bed in the Central Coast study region. |
| Hard Bottoms/ Rocky Reefs | Hard-bottom habitats, or rocky reefs, are well known to commercial and recreational fishermen, as well as other mariners and researchers, within the study region. There are hundreds, possibly thousands, of species associated with hard substrates along the Central Coast. The species that associate with hard substrata differ greatly with depth and type of substratum. Rocky substrata are much less common than soft substrata in the region at all depth zones, but they provide hard substrata to which kelp and other alga can attach in the nearshore (<30 m depth). In addition, many invertebrates such as deep-sea corals, sponges, and anemones require hard substrate for attachment and are found only on hard substrata in deeper waters. In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. The fauna of rocky reefs differ by depth zone and substratum type (i.e., the amount of relief changes with gravel, cobble, boulders, and smooth rock outcrop). Therefore, rocky reefs in each depth zone should be considered separate habitats. The ecological assemblages associated with rocky habitats can also be influenced by the type of rock (e.g., sedimentary vs. granitic reefs) or size of substrata (e.g., cobble vs. boulder). A unique natural feature of the Central Coast study region is an expanse of granitic outcrops in State waters from southern Monterey Bay (Point Pinos) to Point Sur. The region extending from the northern half of Monterey Bay north to Pigeon Point is characterized by sandstone and shale beds. South of Point Sur, the Franciscan Complex dominates (greenstone, serpentinite, argillite, and greywacke). Rocky reefs in each of these geologically distinct zones should be considered separate habitats. |
| Soft Bottoms | Most of the seafloor in the Central Coast study region is composed of unconsolidated sediments; therefore, soft-bottom habitats are found in estuaries, along sand beaches, and on the continental shelf and slope throughout the region. The continental shelf and slope |

| Region and Habitat | Characteristics |
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| | environments include soft-bottom habitats in areas that range from flat expanses to slopes to deep submarine canyons. Soft-bottom habitats lack the structural complexity and relief of hard-bottom substrata, but they support hundreds of species of bottom-dwelling invertebrates and fishes. These assemblages differ mainly with depth and sediment-grain sizes and supply of organic matter. Sediments recycle organic matter, replenish nutrients, and are sites of invertebrate production and trophic transfer within coastal ecosystems. Soft-bottom habitats can be highly dynamic in nature as sediments shift because of wave action, bottom currents, and geological processes. Many parts of the Big Sur coast are erosional, and landslides and slumps extend offshore in the nearshore waters. Many canyon heads are also alluvial in nature and dominated by shifting soft sediments. Soft-sediment communities reach their peak in diversity of invertebrate epifauna and infauna around 70 to 230 m, especially in areas where the shelf is wide and riverine input is present. Soft-bottom habitats in different depth zones should be considered separate habitats. Soft-bottom habitats are primary habitat for soles, turbots, halibut, sanddabs, flounders, and shrimp. Squid spawning grounds occur in many of the nearshore sandy bottoms of the Central Coast study region; major spawning grounds occur in Monterey Bay and the San Luis Obispo Bay area. |
| Underwater Pinnacles | Vertical rocky pinnacles up to tens of meters in diameter and height with a cone-shaped geometry also occur in the Central Coast study region. Pinnacles can be distinguished from large boulders by their geologic origin. Pinnacles are produced by erosion in other locations, and the resulting large rocks are moved into the region by geological processes. Pinnacles are scattered along the entire Big Sur coast and attract certain fish and invertebrate species. Pinnacles have been provisionally identified using bathymetric and fine-scale substratum data in a geographic information systems (GIS) analysis for area where fine-scale mapping is available; their area of pinnacle coverage cannot be calculated until seafloor mapping is complete. |
| Submarine Canyons | There are several large submarine canyons in the Central Coast study region. The Monterey Submarine Canyon is the largest of these and the most prominent topographical feature on Central California's shelf and slope. A significant portion of this canyon is contained within the study region. Soquel Canyon is an extension to the north of the main channel of the Monterey Submarine Canyon. Carmel Canyon, extending seaward from the mouth of the Carmel River, is a southern extension of the Monterey Submarine Canyon complex. The upper reaches of Partington Canyon, approximately 12 mi south of Point Sur, bring deep-water habitats close to shore along the Big Sur coast. Mill Creek Canyon is another large canyon offshore of the Big Sur coast. In addition, there are smaller canyons with their heads in State waters in the northern half of the study region. Canyons in State waters are rare, and the Central Coast study region has more canyons than other parts of the State. Of the 70 $mi^2$ of canyons mapped to date in State waters, 41 $mi^2$ are in the Central Coast study region. Submarine canyons are bathymetrically complex, support deep-water communities close to shore, and affect local and regional circulation patterns. The south side of Monterey Canyon is very productive because prey organisms migrate up from the canyon depths to feed and are transported by currents southward to be trapped in shallow shelf waters, where they are then preyed upon by fish, birds, and marine mammals. In addition to the canyons themselves, the canyon heads that occur in nearshore water are considered areas of high biodiversity because of the presence of a steep elevation gradient, variation in benthic topography, and other factors that support biological richness. Canyon heads vary in their structure from steep rocky relief to flat alluvial forms. Steep and rocky canyon walls provide shelter for many species of benthic fishes, including rockfishes and thornyheads; sedimentary canyon heads provide habitat for animals such as flatfishes. |
| Offshore Rocks and Canyons | Offshore rocks and canyons were not evaluated in the analysis of the Central Coast region. |
| ***South Coast*** | |
| Sandy/Gravel Beaches | Over 1/3 of the South Coast region is covered by sandy shorelines, with the majority of the mainland coast dominated by nearly continuous sandy beaches. Sandy beach communities are structured in large part by grain size, slope of the beach, and wave energy. Most Southern California beaches are made up of fine-grained sand; however a significant number of coarse-grained gravel beaches exist |

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| | on the Palos Verdes headland. Beaches with intermediate-grained sand also exist throughout the South Coast region. Beaches are dynamic systems that change with wind and waves; generally, sand erodes from beaches in the winter and is redeposited in the summer, resulting in annual changes in beach slope and width. Seasonal fluctuations in sand abundance are affected by the creation of hardened shores and of sand-retention structures such as groins. Sandy beaches also change over time, and these long-term changes and erosion rates are also affected by what backs the beach. Beach nourishment, the intentional addition of sand to beaches, occurs within the South Coast region in several locations. A variety of invertebrates live in the sand and in wracks of decaying seaweed and other detritus on the sand surface, although accumulation of these materials is moderated in many locations. Snails, bivalves, crustaceans, insects, spiders, isopods, amphipods, and polychaetes are among the organisms that inhabit sandy beaches; several serve as food sources for larger vertebrates, including the federally endangered western snowy plover. Typical sandy beach invertebrate species include sand crabs (*Emerita analoga*), polychaetes (*Nephtys californiensis*), gastropods (*Olivella biplicata*), and bivalves (*Donax gouldi*). Other species, including the western snowy plover, and California least tern, and many pinnipeds, utilize sandy beaches for resting or rearing young. Sandy beaches play a central role in the life cycle of some fish species, such as the California grunion (*Leuresthes tenuis*), which lays its eggs on Southern California beaches throughout the South Coast region. Beach types in the South Coast region have been mapped as linear shoreline features and classified based on grain size:<br>1) Gravel beach – a beach composed of sediments ranging from pebbles to boulders, often steep and with wave-built berms. Lower stable substrata host attached algae and small invertebrates. Gravel beaches, including boulder beaches, make up approximately 1/10 of the shoreline in the South Coast region, occurring on the mainland as well as offshore islands, with large portions on Palos Verdes, Santa Catalina, and San Clemente. Although intertidal boulder fields are included with gravel beaches, they can be ecologically similar to rocky intertidal habitats.<br>2) Mixed sand and gravel beach – a moderately sloping beach with a mix of sand and gravel, possibly including zones of pure sand, pebbles, or cobbles. The sand fraction of such beaches may be transported offshore in winter. More stable substrata support algae, mussels, and barnacles. This is the least abundant beach type in Southern California, occurring mostly in the Channel Islands and in isolated pockets on the mainland coast.<br>3) Coarse-grained sand beach – a moderate-to-steep beach of variable width with soft sediments. It may be backed by dunes or cliffs; fauna are scarce. These beaches are less abundant in the South Coast region than fine-grained and gravel beaches. They are often located near river mouths and estuaries.<br>4) Fine- to medium-grained sand beach – includes a flat, wide, and hard-packed beach that undergoes significant seasonal changes in width and slope. Upper beach fauna are scarce; lower beach fauna include sand crabs. These beaches make up nearly 1/5 of the South Coast region and a large percentage of the mainland shore. |
| Rocky Shores | Rocky shore habitats and their associated ecological assemblages make up less than 25 percent of the shoreline (not including human-made hardened shorelines) in the South Coast region. Along the mainland coast, rocky shores are relatively rare and are mostly found in the vicinity of headlands, such as Point Conception, Palos Verdes, La Jolla Point, and Point Loma. In contrast, much of the shoreline of the eight Channel Islands is dominated by rocky coast. Exposed rocky cliffs and platforms are the most common types of rocky shores, whereas sheltered rocky shores are relatively rare. Rocky intertidal communities, from the splash zone to the lower intertidal zone, vary in composition and structure with tidal height and wave exposure and with underlying geology. Mussel beds (*Mytilus* spp.), algal beds (*Endocladia muricata*, *Hesperophycus californicus*, *Silvetia compressa*, and many other species), and surfgrass (*Phyllospadix* spp.) are distributed patchily along rocky shores and support high biodiversity, because these organisms create structure to which larval organisms can settle, and juveniles can find protection from predators and harsh environmental conditions. Such areas supporting this high biodiversity are sometimes characterized as “biogenic habitats.” In addition, intertidal boulders, platforms, cliffs, and tidepools are home to many species of snails, algae, barnacles, mussels, anemones, crabs, sea stars, and fish. Also, the mostly rocky shores of the Channel Islands and sandy beaches near rocky points on the mainland coast host a number of rookery/haul-out sites for pinnipeds, including |

| Region and Habitat | Characteristics |
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| | harbor seals (*Phoca vitulina richardsi*), California sea lions (*Zalophus californianus*), and Northern elephant seals (*Mirounga angustirostris*), as well as colony/roosting areas for seabirds, including pigeon guillemots (*Cepphus Columba*), pelagic cormorants (*Phalacrocorax pelagicus*), Brandt's cormorants (*Phalacrocorax penicillatus*), and Xantus's murrelets (*Synthliboramphus hypoleucus*). The following rocky shore types have been mapped in the South Coast region:<br>1) Exposed rocky cliff – characterized as a steep intertidal zone (>30° slope) with little width and little sediment accumulation. Strong vertical zonation of intertidal communities; barnacles, limpets, mussels, and algae are key species groups associated with exposed rocky cliffs. Over half of the rocky shoreline in the South Coast region falls into this category.<br>2) Wave-cut rocky platform – includes flat rocky benches of variable width with irregular surface and tidepools. The shore may be backed by scarp or bluff with sediments or boulders at base. There may be some sediment accumulation in pools and crevices. Habitat supports rich tidepool and intertidal communities; barnacles, limpets, rockweed, mussels, turfweed (*Endocladia muricata*), and surfgrass are key species groups associated with wave-cut rocky platforms. Nearly half of the rocky shoreline in the South Coast region falls into this category. A small amount, near Point Conception, is cut into bedrock.<br>3) Sheltered rocky shores – this describes bedrock shores of variable slope (cliffs to ledges) that are sheltered from wave exposure. Algae, sea anemones, barnacles, and snails are key species groups associated with sheltered rocky shores. Sheltered rocky shores (not including manmade hardened shoreline) are rare in Southern California and exist in limited locations on Santa Cruz and Santa Catalina islands. |
| Hardened Shorelines | Nearly 1/3 of the South Coast region shoreline is composed of jetties, seawalls, and other human-made structures. Shorelines in and around major ports and harbors, especially the ports of Long Beach and San Diego, tend to be dominated by this shoreline type. |
| Coastal Marshes and Tidal Flats | Tidal flats and marshes occur throughout the South Coast region and are often associated with coastal creeks and rivers, as well as bays and estuaries (e.g., Santa Clara River, Upper Newport Bay, and San Diego Bay). Constituting less than 3 percent of the South Coast region, these sandy or muddy expanses that are exposed during low tides provide important foraging grounds for shorebirds due to the abundance of invertebrates such as clams, snails, crabs, and worms. Salt marshes are intertidal areas with emergent salt marsh vegetation. The width of marsh varies from a narrow fringe to extensive areas and provides important habitat for a variety of species. Salt marsh occurs throughout the South Coast region, including Carpinteria, Point Mugu, Upper Newport Bay, Bolsa Chica, and numerous other estuaries. Exposed tidal flats include intertidal flats composed of sand and mud, occurring in bays and lower sections of rivers. The presence of some wave exposure generally results in a higher presence of sand than in sheltered tidal flats. Sediments in tidal flats are generally water-saturated with the presence of infaunal community that attracts foraging shorebirds. Exposed tidal flats are used by birds as roosting sites. Exposed tidal flats are generally more abundant than sheltered tidal flats in the South Coast region. Sheltered tidal flats include intertidal flats composed of silt and clay, such as mudflats. Present in calm-water habitats and sheltered from wave exposure, they are frequently bordered by marsh. Soft sediments support large populations of worms, clams, and snails, making them important foraging grounds for migrating shorebirds. Sheltered tidal flats are relatively rare in the South Coast region. |
| Estuaries and Lagoons | The South Coast region contains at least a portion of nearly 40 estuaries and lagoons. The largest estuaries include Anaheim Bay, Newport Bay, and San Diego Bay, which are large systems with significant habitat diversity, including mudflats, shallow areas, and deeper channels. Several other estuaries, such as Mugu Lagoon and Bolsa Chica Wetlands, are relatively large, while most other estuaries and lagoons are less than 0.5 $mi^2$ in area. Many of these smaller estuaries are seasonally closed to tidal influence by sand bars. The southern portion of the South Coast region, particularly from the Long Beach waterfront to the California–Mexico border, has a number of medium- to small-sized estuaries and lagoons. The aerial extent of estuaries in the entire South Coast region totals 36.6 $mi^2$, or 1.6 percent of the region. The location and extent of some estuaries and lagoons have changed in recent years as a result of coastal restoration projects. Estuarine restoration projects that have occurred in recent years include efforts within Mugu Lagoon, the Ballona Wetlands, Malibu Lagoon, Bolsa Chica Wetlands, and the Tijuana River Estuary, among others. Areas that were historically estuaries have been lined with |

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| | seawalls, riprap, and other human-made structures throughout the South Coast region, especially in the vicinity of major ports and harbors. |
| Seagrass Beds | Eelgrass beds are known to be located in protected estuaries and bays throughout the South Coast region (e.g., San Diego Bay, Newport Bay, Mission Bay, and Mugu Lagoon historically). Eelgrass beds are also located along the mainland coast and have been found at six of the eight Channel Islands (Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Catalina, and San Clemente Islands). The distribution of seagrass along the South Coast region has been mapped as linear segments that total 4.69 $mi^2$, or 0.2 percent of the South Coast region area, though this figure underrepresents the amount of eelgrass present as it does not include open coast eelgrass beds. The most common type of seagrass along the open coast is surfgrass (*Phyllospadix* spp.), which forms beds that fringe rocky coastline areas from the zero-tide level to approximately 10 to 15 ft below the zero-tide level. Surfgrass habitat in the South Coast region is not well mapped, although its distribution has been mapped as linear segments that total 72 mi, or 6.9 percent of the shoreline, located mostly off the northern Channel Islands, as well as off Point Conception, and along the San Diego County coast. |
| Kelp Beds | Two different types of kelp forests are predominant in the State, giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nereocystis luetkeana*), identified as separate habitats. Except for a few records from San Miguel Island, bull kelp does not occur in Southern California; however, the related deep-water elk kelp (*Pelagophycus porra*) occurs at depths of 60 to 270 ft on rock and sand along the mainland (e.g., Point Loma) and at several of the Channel Islands (Santa Catalina, San Clemente, Santa Barbara, and Santa Cruz). Other kelps typically are smaller or low-lying and may be referred to as understory canopy kelps. These include palm kelps (*Eisenia arborea*, *Pterygophora californica*), boa kelp (*Egregia menziesii*), and oarweeds (*Laminaria* spp., *Agarum fimbriatum*). Giant kelp makes up the most well-known type of kelp forest in the South Coast region. Giant kelp forms dense canopy areas that are utilized by many kinds of marine life. Giant-kelp forests generally form over rocky substrate; thus they are somewhat limited within the South Coast region. Areas of particular kelp abundance include Point Conception, Coal Oil Point, Point Dume, Palos Verdes Point, La Jolla Point, Point Loma, and the vicinity of the offshore islands, most notably San Miguel, Santa Rosa, San Nicolas, and San Clemente islands. Giant-kelp forests within the South Coast region are well mapped at fine-scale resolution. Total kelp abundance in the South Coast region has ranged from a low of 12 $mi^2$ in 1999 to a high of 31 $mi^2$ in 2004. |
| Purple Hydrocoral | Although not typically considered a habitat type, purple hydrocoral has been included on the list of key and unique habitats for the South Coast region. Little-known colonies of purple hydrocoral (*Stylaster californicus* [*Allopora californica*]) inhabit subtidal depths (up to 315 ft) from Vancouver Island (Canada) to central Baja California (Mexico). Hydrocoral colonies occur on current-swept rocky reefs and pinnacles. These purple or pink-red hydrocorals resemble small branching tropical staghorn coral (to 53 centimeters [cm]). Sessile, filter-feeding adults produce planktonic larvae with limited dispersal. Slow-growing (approximately 0.8 cm per year) colonies may live well over 30 years. At least four obligate commensals are supported by the hydrocoral colonies – two polychaetes, one snail, and one barnacle. Purple hydrocoral is rare, at least within scuba diving depths. Its abundance in deep-water is largely unknown (i.e., documented at Tanner and Cortes banks, south of San Nicolas Island, Farnsworth Bank, west of Santa Catalina Island, northern end of San Clemente Island). |
| Hard Bottoms/ Rocky Reefs | Hard-bottom habitats, or rocky reefs, are much less common than soft substrata in the South Coast region at all depth zones, covering about 7 percent of the region. The species that associate with hard bottoms differ greatly with depth and type of substratum; the amount of topographic relief changes with gravel, cobble, boulders, and smooth rock outcrop. Rocky reefs provide hard substratum to which kelp and other algae can attach in the nearshore zone (<100 ft depth). In addition, many invertebrates such as deep sea corals, sea fans, sponges, and anemones require hard substratum for attachment in deeper waters. In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. Hard-bottom habitats in each depth zone are considered to be separate habitats due to differences in associated species. In addition, the ecological assemblages associated with rocky habitats can also be influenced by the type of rock (e.g., sedimentary vs. granitic reefs) or size of substrata (e.g., cobble vs. boulder). Rocky reefs in each of these geologically different zones support distinct ecological assemblages. A number of artificial reef structures exist within the |

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| | South Coast region. These artificial reefs are designed to mimic rocky reef habitats and have been constructed from a variety of materials. |
| Soft Bottoms | Soft-bottom habitats are the predominant habitat on the continental shelf and slope throughout the South Coast region. Nearshore and offshore environments include soft-bottom habitats in areas that range from flat expanses to slopes and basin areas. Soft-bottom habitats vary depending on the type of sediment; sediments made up of silt and clay are high in organic carbon, and polychaetes and gastropods dominate the infauna. By comparison, sediment composed mainly of sand particles has less organic carbon, and the most common infauna are ostracods, amphipods, and pelecypods. Soft-bottom habitats can be highly dynamic in nature as sediments shift due to wave action, bottom currents, and geological processes. The distribution of species in soft-bottom habitats is approximately 80 percent crustaceans, 10 percent microbenthos, 5 percent demersal fish, and 5 percent macrobenthos. In shallow waters, marine communities are less diverse in wave-influenced, ripple-marked sand habitats as compared to calm-water, stable-sand bottoms that can host a variety of invertebrates and fishes within and above the sand, as well as algae attached to worm tubes and eelgrass beds providing biogenic habitat. In deeper soft-bottom habitats, the population density lowers with depth, while the standing crop increases with depth; this makes for unique species assemblages at the various depths. Macrofaunal communities on the outer mainland shelf (30 to 150 m) have been sampled extensively (Allan Hancock Foundation 1965; Jones 1969; Fauchald and Jones 1979a,b, 1983; Thompson et al. 1987). Most mud areas of the shelf are inhabited by the red ophiuroid (*Amphiodia urtica*), co-occurring with various polychaete (*Spiophanes missionensis*, *Paraprionospio pinnata*, *Maldane sarsi*), crustacean (*Euphilomedes* spp.), and mollusk (*Cyclocardia ventricosa*, *Pectinaria californiensis*) species. |
| Natural Oil Seeps | Natural oil seeps are found offshore in the bight from Point Conception to Huntington Beach. These seeps are not rare off the Southern California coast, although they occur nowhere else in State waters. In the area of Coal Oil Point in Santa Barbara County, seepage has been estimated to occur at a rate of 50 to 70 barrels of oil per day. 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. Studies have shown no lasting detrimental effect on the marine environment from these natural oil seeps. |
| Underwater Pinnacles | Pinnacles are vertical, rocky features that are scores of feet in diameter and height, with a cone-shaped geometry. Pinnacles can be distinguished from large boulders by their geologic origin. Pinnacles are generally a product of in-place erosional processes acting on rocky outcrops, while boulders are the result of erosional processes in other locations and resulting movement of large rocks. Pinnacles are located in State waters along the South Coast region, especially near the Channel Islands, but have not been well mapped; they can be important bathymetric features that attract certain fish and invertebrate species. Pinnacles in the South Coast region are not categorized separately from other hard-bottom habitats. |
| Submarine Canyons | Several submarine canyons are located within the South Coast region. The most important canyons are located in waters near Point Hueneme, Point Mugu, Point Dume, Santa Monica Bay, Palos Verdes Point, Huntington/Newport Beach, La Jolla, and at the Channel Islands. Submarine canyons provide areas of high bathymetric complexity, support unique deep-water communities, and affect local and regional circulation patterns. Submarine canyon habitats receive sediment and detrital material from adjacent shallow areas and act as conduits of energy to deeper offshore habitats. Canyons provide habitat for young rockfish and flatfish that settle in nearshore waters to grow and move offshore as adults. In addition, concentrations of forage species found near submarine canyons are important for seabirds and marine mammals. |
| Offshore Rocks and Islands | Southern California has several large offshore islands, as well as numerous offshore rocks, that play a significant role within the South Coast region. Eight major islands, as well as many smaller rocks and islets, are located within the South Coast region. While offshore rocks and islands are not identified as separate habitats, these areas do represent unique areas within the region. Some of these islands and offshore rocks are described below:<br>San Miguel Island, the westernmost of the Channel Islands, is 14.5 $mi^2$ in size, and is part of Santa Barbara County. The U.S. Navy owns |

| Region and Habitat | Characteristics |
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| | San Miguel Island, and manages it jointly with the Channel Islands National Park. It is closest of the Channel Islands to Point Conception. A large marine mammal haulout exists at Point Bennett, and seabird breeding colonies reside at Prince Island, Castle Rock, and Richardson Rock. The island is surrounded by submerged pinnacles covered with invertebrates. Intertidal habitats surrounding San Miguel Island include significant amounts of sand habitat.<br><br>Santa Rosa is the second largest of the Channel Islands at about 83 $mi^2$ in size and is part of Santa Barbara County. A large reef lies on the north side of the island at Talcott Shoal. The island is known for coastal terraces, sandy beaches, and the largest coastal lagoon in the Channel Islands, as well as having a Torrey pine (*Pinus torreyana*) grove onshore. Sandy beaches on Santa Rosa provide breeding habitat for the western snowy plover.<br><br>Santa Cruz is the largest of the Channel Islands at over 96 $mi^2$ in size and is part of Santa Barbara County. The island lies in a transition zone between cool waters of the California Current and warm waters of the California Countercurrent. There are large sea caves along cliffs on the island and a high degree of recreational use due to a large number of anchorages.<br><br>Anacapa Island is the Channel Island closest to the mainland coast at a distance of 12 mi and lies within Ventura County. It is just over 1 $mi^2$ in size. Giant sea bass aggregate on the north side of the island, and California brown pelican, Xantus's murrelet, and western gull have breeding colonies on the island. In addition, 130 sea caves on Anacapa provide nesting sites for many birds. Anacapa Island and its surrounding waters receive a high degree of recreational use. In 1978, a small, no-take marine reserve was established by the State of California on the north side of Anacapa Island in an area that has been protected by National Park regulations since 1968.<br><br>Santa Barbara Island is the smallest of the Channel Islands at 639 acres (about 1 $mi^2$) and is part of Santa Barbara County. The island hosts a California sea lion rookery and over 11 species of breeding seabirds, including California brown pelican and Xantus's murrelet.<br><br>Santa Catalina Island: Is an area of Los Angeles County located 22 miles offshore of Los Angeles. Santa Catalina Island is approximately 75 $mi^2$ in size. Santa Catalina Island is one of three islands in the archipelago that is not part of the Channel Islands National Marine Sanctuary. However, it is an important visitor location with several permanent settlements, including Avalon and Two Harbors. Macrofauna around Santa Catalina Island are warm-water species, unlike the northern Channel Islands, where cold-water species are more typical. The island's Catalina Harbor is the largest offshore salt marsh of the seven marshes found along the islands in the South Coast region. Intertidal habitats surrounding Catalina Island include 35 percent bedrock, 50 percent boulder beach, and 15 percent sand habitats.<br><br>San Nicolas Island and San Clemente Island are both owned by the U.S. Navy, and are about 22 $mi^2$ and 57 $mi^2$ in size, respectively. While both islands are more remote than the other six Channel Islands, their waters are utilized by both commercial and recreational fishing operations. The deepest point in the South Coast region is located off the northwest corner of San Clemente Island. Aside from Santa Catalina Island, San Clemente is the only other island with macroinvertebrate communities dominated by warm-water species; intertidal habitats there include 69 percent bedrock, 17 percent boulder beach, and 14 percent sand. San Nicolas Island, located between the warm- and cold-water currents, has different macrofauna at various sites around the island. Intertidal habitats around San Nicolas Island include rock, as well as significant amounts of sand (35% of the shoreline). Effective June 21, 2010, a Safety Zone exists around San Clemente Island from the high-tide line, extending seaward 3 nm and divided into eight sections. Unless scheduled for hazardous military training and testing activities, six sections (A, B, C, D, E, and F) are available to the public for recreational and commercial activities (e.g. fishing, diving, sailing), while other zones are closed to public access. Section G (SWAT 1) Safety Zone is permanently closed to the public for all activities. Vessels must have authorization from KRAKEN (channel 16) to transit within 3 nm of San Clemente Island through section G. Wilson Cove Safety Zone is permanently closed to the public for all activities. However, vessels may transit parallel to the shoreline inside the Safety Zone between 2 nm and 3 nm offshore. Statewide, over 20,000 islands, rocks, exposed reefs, and pinnacles are included in the California Coastal National Monument, extending along the entire California coast. The monument was designed to protect the biological and geologic values of offshore rocks and islets and the important forage and breeding grounds of associated marine birds and mammals. |