

Please note: The following document was not available during the development of the April 1, 2009 *Memorandum on Pending Military Closures at San Clemente Island and San Nicolas Island*.

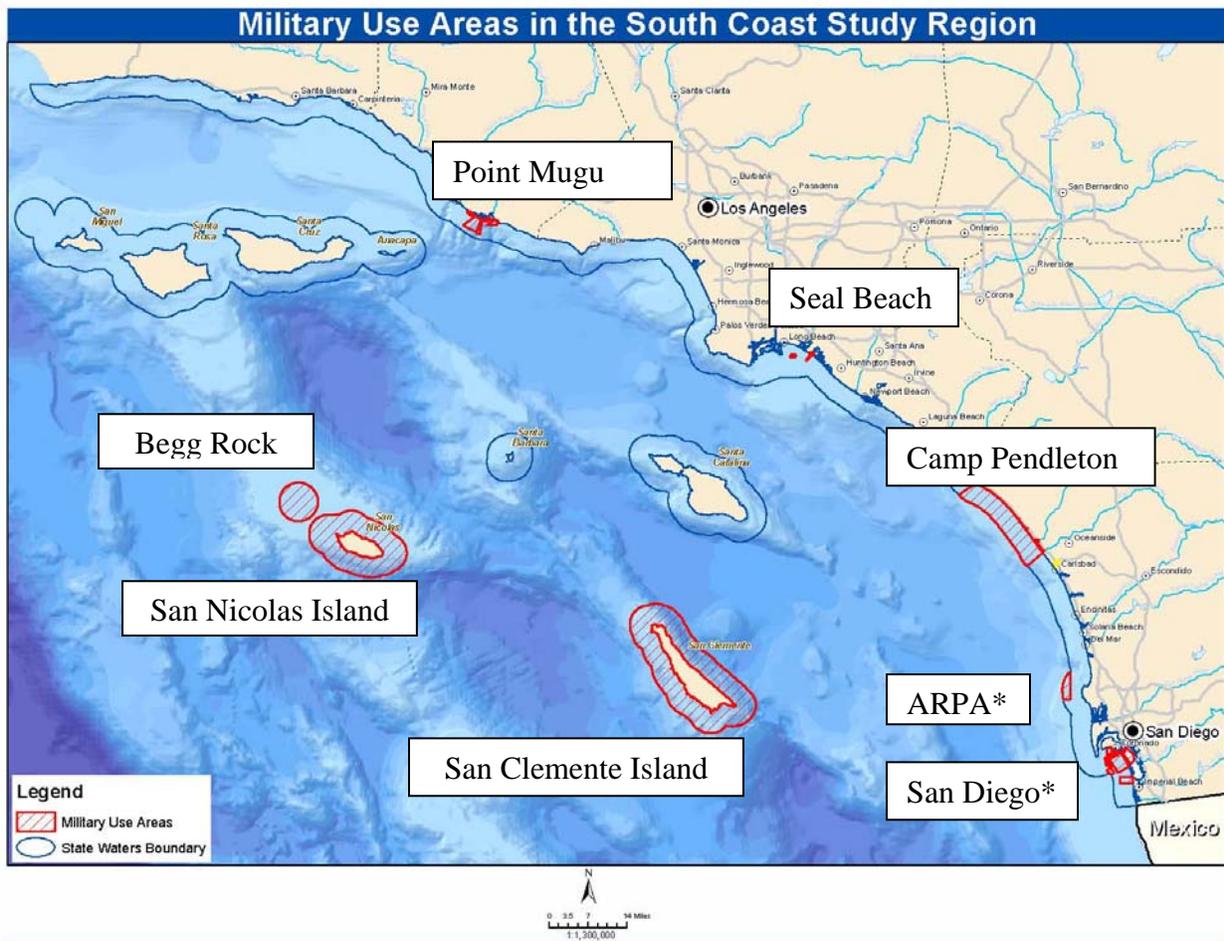
California MLPA Master Plan Science Advisory Team
Draft Analysis of Military Use Areas in the MLPA South Coast Study Region
March 27, 2009 Draft

The Marine Life Protection Act (MLPA) Blue Ribbon Task Force (BRFT) has requested that the MLPA Master Plan Science Advisory Team (SAT) provide descriptions and analyses of the military use areas located in the MLPA South Coast Study Region (SCSR). Specifically, the SAT was asked to describe and analyze:

- the ecological characteristics of the island and mainland areas used by the military,
- the habitats represented in these areas, and
- the ecological linkages between these and other southern California sites and particularly between the islands and the mainland coast.

The SAT also was asked to include any other important considerations for effective marine protected area (MPA) network design.

Figure 1. Military Use Areas (red) in the MLPA South Coast Study Region



**ARPA is the Advanced Research Project Agency Area. "San Diego" includes military use areas at North Island and Silver Strand.*

This document represents the SAT response to the BRFT request. Emphasis has been placed on the military use areas at San Clemente Island and San Nicolas Island because of their large size, location with respect to the SCSR, and the significant roles these islands play in meeting the objectives of the MLPA, particularly with regard to the size and spacing guidelines developed by the SAT for the SCSR.

~~Seven-Eight~~ important military use areas identified by the U.S. Department of Defense in the MLPA South Coast Study Region include Point Mugu; Seal Beach; Camp Pendleton; Advanced Research Projects Agency (ARPA) Training Area and San Diego (including North Island and Silver Strand) ~~along the Southern California Mainland Area~~; San Clemente Island; and San Nicolas Island and Begg Rock (Figure 1).

A variety of military activities occur in the designated military use areas some of which impact marine organisms and their habitats. Together, the ~~seven-eight~~ military use areas identified represent a total of ~~462-469.5~~ mi^2 or 20% of the ~~2297.52-350.9~~ mi^2 of mapped habitats in state waters in the SCSR. The military use areas that include the greatest amount of area are ~~Camp Pendleton (63.8~~ mi^2), San Clemente Island (209.88 mi^2) and San Nicolas Island (125.2 mi^2), and ~~Camp Pendleton (64.4~~ mi^2), and Begg Rock (463-38.0 mi^2). The two island areas account for 3743 mi^2 or 7980% of the mapped habitats in the SCSR, which are used by the military.

The SAT conducted a preliminary habitat analysis using interim seafloor habitat data, which was presented to the BRTF on February 16, 2009. The interim habitat data set contained both coarse scale and fine scale data, gathered at different resolutions and stitched together to form a continuous surface. The interim data likely overestimated the amount of rocky seafloor and several areas were known to have different habitat than indicated on the interim seafloor habitat map. However, the interim data were the only continuous seafloor habitat data available to the SAT when the BRTF made its initial request for an analysis of military use areas.

Since the initial request by the BRTF, the sea floor habitat data were updated with high resolution data from side-scan sonar mapping conducted by R. Kvittek (California State University, Monterey Bay). The updated seafloor habitat data distinguish hard and soft seafloor habitats. The bathymetry data have a depth dependent resolution consisting of 2m, 5m and 10m bands. These bands were combined and resolved to a final interpolated resolution of 2m. Focal statistics, along with algorithmic clustering or neighborhood functions, were applied in order to remove imperfections or topological errors in the data.

The updated seafloor habitat data have two major limitations, both of which are related to areas where data could not be collected. Given the available resources provided at the outset of the mapping effort, priorities were established to ensure that more critical areas were mapped first. The recent seafloor mapping effort focused on the mainland of the south coast study region and Santa Catalina Island, while the northern Channel Islands, San Clemente Island, and San Nicolas Island were mapped in the recent effort. Also, data were not collected in shallow nearshore areas, which are inaccessible to vessels with sonar equipment.

Figure 2 shows locations mapped using side-scan sonar. The habitat analysis of military use areas presented here is based on the sidescan sonar mapping and does not include all nearshore or island seafloor habitats. Therefore, the habitat analysis underestimates nearshore hard and soft bottom habitats in all bioregions and does not include information about the seafloor at San Nicolas Island, Begg Rock and much of San Clemente Island. Some sidescan sonar mapping was conducted around the northern Channel Islands during former mapping efforts (U.S. Geological Survey, Ocean Imaging, and California State University, Monterey Bay) and these were included in the habitat analysis presented here. Because of the large gaps in the fine-scale seafloor habitat map, the SAT also included, in Appendix A, an analysis based on coarse-scale seafloor habitat data, which include nearshore and island areas.

Figure 2. Map of seafloor habitats from side-scan sonar mapping efforts. Mapped habitats are hard bottom (red) and soft bottom (tan). Areas in light blue (state waters) and dark blue (federal waters) were not mapped using the side-scan sonar.



The five bioregions identified for the SCSR contain different amounts of marine habitats identified by the SAT as important for MPA planning (Table 1). These habitats include consideration of bottom type, depth, and biogenic habitat. ~~The seven-eight~~ military use areas also are of different sizes and occur throughout the region, therefore their impact on the MLPA planning process will differ by bioregion.

¹Table 1. Amount of Available Habitat in the MLPA South Coast Study Region by Bioregion

Habitat	East Channel Islands	Mid Channel Islands	West Channel Islands	North Mainland	South Mainland	Total
Sandy & gravel beaches (miles)	61.4	27.5	40.7	102.5	147.5	379.6
Rocky intertidal & cliff (miles)	62.3	83.9	75.0	30.6	28.9	280.7
Linear kelp (miles)	49.4	24.1	70.4	24.2	30.1	198.2
Average kelp area (square miles)	4.0	1.1	10.3	2.7	2.8	20.9
Hard 0 - 30 m (square miles)	1.2	5.4	11.7	4.7	29.9	53.0
Hard substrate at 20m (miles)	36.3	18.8	31.2	10.4	28.1	124.7
Hard 30 - 100 m (square miles)	5.7	4.7	13.6	1.7	5.9	31.6
Hard 100 - 200 m (square miles)	0.2	0.5	1.7	0.3	0.9	3.6
Hard 200 - 1000 m (square miles)	1.0	0.01	0	0.8	0.4	2.2
Soft 0 - 30 m (square miles)	7.8	22.0	37.8	141.4	208.3	417.3
Soft substrate at 20m (miles)	59.0	59.4	60.9	121.6	117.5	418.5
Soft 30 - 100 m (square miles)	54.7	97.4	92.7	226.2	111.9	582.9
Soft 100 - 200 m (square miles)	37.6	15.3	11.2	29.9	45.4	139.4
Soft 200 - 1000 m (square miles)	110.8	1.5	0.01	23.0	69.7	205.0
Unknown 0 - 30 m (square miles)	18.2	11.5	66.0	47.8	79.7	223.2
Unknown 30 - 100 m (sq mi)	35.8	79.3	177.1	0.4	16.1	308.7
Unknown 100 - 200 m (sq mi)	34.8	46.8	58.8	0.4	1.3	142.0
Unknown 200 - 1000 m (sq mi)	93.6	82.2	29.3	0.7	0.7	206.4
Total area (square miles)	422.6	365.2	499.8	477.3	586.0	2,350.9
ESI shoreline length (miles)	126.1	111.4	115.9	174.0	519.1	1,046.5

¹*Revised habitat analysis based on fine-scale seafloor habitat data derived from side-scan sonar mapping (R. Kvitek, California State University, Monterey Bay). The fine-scale habitat map does not include nearshore areas due to physical limitations of this mapping technique and does not include some areas around the Channel Islands (Figure 2). Some information about nearshore hard bottom habitats is derived from maps of kelp canopy. Other nearshore and some island habitats are classified as unknown. A habitat analysis based on coarse-scale data (including nearshore and island habitats) is contained in Appendix A.*

Habitat Representation in the Military Use Areas

The military use areas contain more than 25% of ~~seven~~^{two} different habitat types in SCSR state waters (Table 2). These are kelp (28% of linear kelp and 35% of kelp area) and hard bottom at 20 m (32%). Military use areas also include large percentages of habitats classified as “unknown” bottom type between 30-100 m (40%), 100-200 m (41%) and 200-1000 m (56%). A habitat analysis using coarse scale data (Appendix A) provides some insight into the potential habitat representation in areas classified as “unknown.” These include hard bottom at 200—3000 m depth (31%), hard bottom at 30—100 m depth (30%), kelp (28%), hard bottom at 100—200 m depth (27%), soft bottom at 200—3000 m depth (27%), and a proxy of hard bottom at 0-30m depth (26%).

¹**Table 2. Percentage of Available Habitats Identified for the MLPA South Coast Study Region found in the ~~Seven~~^{Eight} Military Use Areas**

Habitat	Study Region Total	Military Use Areas Total	Percent in Military Use Areas
Sandy & gravel beaches (miles)	379.6	64.3	17%
Rocky intertidal & cliff (miles)	280.7	52.6	19%
Linear kelp (miles)	198.2	56.1	28%
Average kelp area (square miles)	20.8	7.3	35%
Hard 0 - 30 m (square miles)	52.9	4.0	7%
Hard substrate at 20m (miles)	124.7	40.1	32%
Hard 30 - 100 m (square miles)	31.6	5.3	17%
Hard 100 - 200 m (square miles)	3.6	0.0	0%
Hard 200 - 1000 m (square miles)	2.2	0.0	0%
Soft 0 - 30 m (square miles)	417.3	61.2	15%
Soft substrate at 20m (miles)	418.5	57.0	14%
Soft 30 - 100 m (square miles)	582.9	31.3	5%
Soft 100 - 200 m (square miles)	139.4	3.0	2%
Soft 200 - 1000 m (square miles)	205.0	0.2	0%
Unknown 0 - 30 m (square miles)	223.2	44.8	20%
Unknown 30 - 100 m (sq mi)	308.7	125.0	40%
Unknown 100 - 200 m (sq mi)	142.0	58.4	41%
Unknown 200 - 1000 m (sq mi)	206.4	115.0	56%
Total area	2,350.9	469.5	20%

Habitat	Study Region Total	Military Use Areas Total	Percent in Military Use Areas
(square miles)			
ESI shoreline length (miles)	1,046.4	132.2	13%

¹*Revised habitat analysis based on fine-scale seafloor habitat data derived from side-scan sonar mapping (R. Kvitek, California State University, Monterey Bay). The fine-scale habitat map does not include nearshore areas due to physical limitations of this mapping technique and does not include some areas around the Channel Islands (Figure 2). Some information about nearshore hard bottom habitats is derived from maps of kelp canopy. Other nearshore and some island habitats are classified as unknown. A habitat analysis based on coarse-scale data (including nearshore and island habitats) is contained in Appendix A.*

Of the five bioregions located in the SCSR, military use areas account for the greatest percentage of all mapped habitats in the East Channel Islands Bioregion (5044.9%) and the West Channel Islands Bioregion (26.933%; Table 3). The total mainland area identified as important for military use amounts to only 9% of mapped habitats with more than two-thirds of this located in Camp Pendleton in the South Mainland Bioregion.

The percentages of the mapped habitat of different types located in the military use areas differ by bioregion (Table 3). In particular, the military use areas in the East Channel Islands Bioregion and the West Channel Islands Bioregion, which include San Clemente Island, and San Nicolas Island, ~~plus and Begg Rock respectively~~, include contain large percentages of certain habitat types. No military use areas were selected for consideration in the Mid Channel Islands Bioregion.

In the East Channel Islands Bioregion, more than 50% of kelp, rocky shores, shallow hard bottom habitat (0-30m proxy, 20 m, and 30-100 m) are included in the San Clemente Island military use area. ~~Of the habitat classified as "unknown" in the East Channel Islands Bioregion, between 77% (0-30 m) and 100% (30-200 m) are included in the San Clemente Island military use area. Only a narrow strip of nearshore habitat on the west side of San Clemente Island was mapped using side-scan sonar.~~ In the new habitat analysis, most habitats on San Clemente emerge as "unknown." Based on coarse-scale data (Appendix A), San Clemente is likely to contain more than 50% of the hard bottom habitat (0-30 m), and over 35% of the hard bottom habitat in deeper waters for the East Channel Islands Bioregion. Coarse-scale data also suggest that state waters around San Clemente are likely to include more than 80% of the soft bottom habitat in the East Channel Islands Bioregion.

The contribution of the San Nicolas Island and Begg Rock military use areas to habitat availability in the West Channel Islands Bioregion is less, but includes more than ~~530%~~ of hard bottom habitat (30-100m) and more than 25% of beaches, kelp and more than 25% of beaches, hard and soft bottom habitats at 20 m. San Nicolas Island and Begg Rock were not mapped using side-scan sonar during the recent mapping effort. Consequently, most seafloor habitats around these features emerge as "unknown" in the new habitat analysis. Coarse-scale data (Appendix A) suggest that over 35% of shallow hard bottom habitat (0-30 m) and over 50% of the hard bottom habitat (30 – 100 m) are included in these military use areas for the West Channel Islands Bioregion. Also, coarse-scale data suggest that over 25% of soft bottom

habitat (0-200 m) and over 70% of deep soft bottom habitat (>200 m) within the West Channel Islands Bioregion found in military use areas at San Nicolas Island and Begg Rock. Habitat types with the greatest representation in military use areas in the South Mainland Bioregion include soft bottom at 0-30 m depth (26%), hard bottom at 30-100m depth (19%), and beaches (16%). ~~hard bottom habitats at 0-30m proxy, 0-30m and 30-100m depth and soft bottom habitats (30-100m, 100-200m and 200-3000m).~~ but

The percentage of different habitat types contained within the military use areas located in the North Mainland ~~and South Mainland Bioregions~~ is much less compared with the East Channel Islands and West Channel Islands Bioregions. The military use areas contribute no more than 5% of any habitat type within the North Mainland Bioregion ~~and no more than 24% within the South Mainland Bioregion~~ (Table 3). Coarse-scale data (Appendix A) suggest that, at Point Mugu, Seal Beach, Camp Pendleton and San Diego military use areas, unknown habitat is likely to be soft bottom habitat. At the ARPA Area, the unknown habitat is likely to be a mix of hard and soft bottom (30-100 m). ~~Habitat types with the greatest representation in military use areas in the South Mainland Bioregion include soft bottom at 0-30m depth (24%), hard bottom at 30-100m depth (21%), and beaches (16%).~~

¹Table 3. Percentage of the Available Habitat Types Identified for the MLPA South Coast Study Region found in the Seven-Eight Military Use Areas by Bioregion

Habitat	East Channel Islands Bioregion	Mid Channel Islands Bioregion	West Channel Islands Bioregion	North Bioregion	South Bioregion
Sandy & gravel beaches (miles)	40%	0%	26%	5%	16%
Rocky intertidal & cliff (miles)	56%	0%	21%	0%	6%
Linear kelp (miles)	67%	0%	30%	0%	6%
Average kelp area (square miles)	90%	0%	34%	0%	6%
Hard 0 - 30 m (square miles)	80%	0%	14%	0%	4%
Hard substrate at 20m (miles)	85%	0%	25%	0%	5%
Hard 30 - 100 m (square miles)	73%	0%	0%	0%	19%
Hard 100 - 200 m (square miles)	3%	0%	0%	0%	1%
Hard 200 - 1000 m (square miles)	0%	0%	-	0%	0%
Soft 0 - 30 m (square miles)	9%	0%	11%	2%	26%
Soft substrate at 20m (miles)	24%	0%	27%	4%	19%

Habitat	East Channel Islands Bioregion	Mid Channel Islands Bioregion	West Channel Islands Bioregion	North Bioregion	South Bioregion
Soft 30 - 100 m (square miles)	18%	0%	0%	1%	16%
Soft 100 - 200 m (square miles)	0%	0%	0%	3%	5%
Soft 200 - 1000 m (square miles)	0%	0%	0%	1%	0%
Unknown 0 - 30 m (square miles)	77%	0%	33%	3%	9%
Unknown 30 - 100 m (sq mi)	100%	0%	50%	0%	3%
Unknown 100 - 200 m (sq mi)	100%	0%	40%	0%	17%
Unknown 200 - 1000 m (sq mi)	98%	0%	78%	0%	2%
Total area (square miles)	50%	0%	33%	2%	15%
ESI shoreline length (miles)	48%	0%	23%	3%	8%

¹*Revised habitat analysis based on fine-scale seafloor habitat data derived from side-scan sonar mapping (R. Kvitek, California State University, Monterey Bay). The fine-scale habitat map does not include nearshore areas due to physical limitations of this mapping technique and does not include some areas around the Channel Islands (Figure 2). Some information about nearshore hard bottom habitats is derived from maps of kelp canopy. Other nearshore and some island habitats are classified as unknown. A habitat analysis based on coarse-scale data (including nearshore and island habitats) is contained in Appendix A.*

Ecological Characteristics of the Military Use Areas

The military use areas include key habitats in each bioregion and, in some cases, significant amounts of certain key habitat types within a bioregion and even within the entire SCSR. Because of the amount of habitat captured within their boundaries and their unique biological features, the military use areas ~~on~~ at San Nicolas Island, including Begg Rock, and San Clemente Islands will certainly play important roles within their respective bioregions in meeting the objectives of the MLPA. The military use areas on the mainland also might contribute to MLPA objectives depending on the location, size, and spacing of MPAs in submitted MPA proposals.

San Nicolas Island, ~~and~~ Begg Rock and San Clemente Islands

San Nicolas and San Clemente Islands are two of the eight offshore islands commonly known as the Channel Islands. A variety of metrics and published studies of marine communities have found that each of the eight Channel Islands and to a greater extent all of the islands of the

San Diegan Province (the warmer parts or warm temperate waters of the SCSR that include Santa Catalina and San Clemente Islands) are unique (Seapy and Littler 1980, Engle 1993, Engle 1994, Pondella et al. 2005) and this distinctiveness is not a function of distance between the islands (Pondella et al. 2005). Each island differs in some degree from other islands, even those within the same bioregion, in terms of exposure to ocean thermal and circulation conditions, coastal topographic features such as shelf profile and substratum composition, exposure to wave action, and in the distance from influence of the densely populated southern California mainland; each island also supports different species, assemblages and species densities and biomass. Consequently, in developing proposals to meet the objectives of the MLPA, the following points need to be considered when assessing the role of the military use areas on San Nicolas Island, ~~Begg Rock (including Begg Rock)~~ and San Clemente Islands:

□ *Distinct Geographic Features*

As indicated, each island has geographic features, related to shore and coastline topography and orientation and location with respect to prevailing swell patterns in the SCSR that contribute to its distinct character. These conditions affect the nature of the biological communities that characterize the islands.

- The eastern shoreline of San Clemente Island is protected from most prevailing swell patterns and generally receives little wave exposure. This 'lee' effect results in the structuring of species assemblages and the resultant warm-water, wave-protected communities are duplicated only on the lee side of Santa Catalina Island in the entire SCSR.
- The western or windward side of San Clemente Island includes substantial bedrock, has a more gradual slope, and receives more wave exposure compared to any other site in its bioregion. The western or windward side of Santa Catalina Island is different in character, containing less bedrock and more boulders and with a more steeply sloping shoreline.
- San Nicolas Island ~~and, including Begg Rock, is are~~ farthest offshore and ~~is are~~ more exposed to open ocean conditions than any of the Channel Islands. ~~Its~~ The orientation of San Nicolas Island, with respect to the prevailing swell patterns, ~~creates~~ exposure to more severe sea states and wave conditions along both sides of the island. There are fewer coves and wave protected areas on San Nicolas Island.

□ *Distinct Biotic Features*

The placement in the ocean climate of SCSR makes these islands unique in terms of the biota they support within their bioregion. Both islands contain different mixtures of warm and cold temperate species distributed across their waters compared to other islands within their respective bioregions. The two islands also play important roles in supporting bird and mammal populations in the SCSR (see Marine Birds and Mammals Section below). Selected examples include:

- The unique northern range extensions of Panamic species to San Clemente Island [e.g., Panamic arrow crab (*Stenorhynchus debilis*), Warty sea slug (*Pleurobranchus*

areolatus), Arbacia sea urchin (*Arbacia incisa*), Guadalupe cardinalfish (*Apogon guadalupensis*), Pink cardinalfish (*A. pacificus*), Swallow damselfish (*Azurina hirundo*), Purple brotula (*Oligopus diagrammus*) (Engle and Richards 2001; Richards and Engle 2001)].

- The only consistent resident breeding population of the Southern Sea Otter (*Enhydra lutris nereis*) in the SCSR occurs on San Nicolas Island.
- The largest remaining remnant populations of the endangered black abalone (*Haliotis cracheroidii*) are found on San Nicolas Island. San Clemente Island once supported some of the highest densities of black abalone in the region along portions of its western coastline. Because of the availability of suitable habitat and its remoteness and inaccessibility, San Clemente Island represents a possible site for efforts to recover populations of this now rare species.
- San Clemente Island supports a remnant population of the endangered white abalone (*Haliotis sorenseni*).
- San Clemente Island supports the largest known populations of the rare purple hydrocoral, excluding populations found on the Farnsworth Bank pinnacle.
- Populations of the only rock-based morph, and one of only two known locations for the sand-based morph, of Elk Kelp (*Pelagophycus porra*) in the Channel Islands (Miller and Dorr 1994, Miller et al. 2000) occur on San Clemente Island.
- Unusual, deep eelgrass communities (*Zostera marina*) are abundant on San Nicolas Island (Engle and Miller 2005).
- Large areal coverage of kelp (*Macrocystis pyrifera*) communities occur on San Clemente and San Nicolas Islands. Together, these two islands have large kelp bed areas and together contribute 4648.3% of the total kelp coverage for the Channel Islands. The kelp beds at San Clemente Island account for 9089% of the kelp bed habitat in the East Channel Island Bioregion whereas San Nicolas Island kelp beds makes up 34% of the total kelp coverage in the West Channel Island Bioregion. These island kelp habitats occur in significantly deeper water than most kelp habitats due to water clarity.
- The entire waters of both San Clemente and San Nicolas Islands (including Begg Rock) were designated *Areas of Special Biological Significance* in 1974 to preserve their biologically unique and sensitive marine ecosystems for future generations.

☐ Remoteness and Accessibility

San Clemente Island, and San Nicolas Island, including Begg Rock,s are the most isolated and remote islands and features in the SCSR. This isolation from the mainland makes them particularly important to the MPA process due to their reduced exposure to the abundant anthropogenic stressors common to SCSR coastal waters. To amplify:

- Their remote nature (distance from the mainland) makes these island habitats less accessible to fishing and fished species show signs of less fishing pressure [e.g., larger

kelp bass (Young 1963) and sheephead (Hamilton et al. 2007), abundant giant seabass, and large lobsters are found on San Nicolas and San Clemente Islands].

- These island populations and communities are least likely to be influenced by the effects of mainland pollutants, which are readily carried offshore by runoff from storm events.
- These islands are the least impacted by invasive species, which generally have been brought into our region through shipping and often enter through mainland ports (e.g., the recent introduction of *Sargassum filicinum*) (Miller and Engle, in press).
- Because of their remoteness, these islands represent some of the better locations in the SCSR to evaluate the effects of anthropogenic stressors on marine populations and communities.
- They have unique larval sink and source processes (see section below on Ecological Linkages Between San Clemente Island and San Nicolas Islands and Other Southern California Mainland and Island Sites).

⊖ **Begg Rock:**

Begg Rock, which is included in the San Nicolas Island military use area, is a unique, small island habitat that comes to the surface approximately 10 miles off the west coast of San Nicolas Island. It is characterized by its sheer, pinnacle-like profile and supports a unique invertebrate assemblage, which includes purple hydrocoral, shallow aggregations of *Metridium* and other anemones.

Mainland Military Use Areas

Because the mainland military use areas account for much less of the habitat available in the North Mainland and South Mainland Bioregions, these regions will receive less attention here. In the North Mainland Bioregion, the single military use area around Point Mugu includes coastal wetlands habitat and provides important habitat for marine birds (see Marine Bird and Mammal section below).

Four military use areas (Seal Beach, Camp Pendleton, ARPA Training Area, and San Diego) are located in the South Mainland Bioregion. Camp Pendleton, and the coastline to the north and south of this military use area, is characterized mostly by sandy beaches and intermittent low-lying soft rocky benches. These habitats support kelps and other hard-substratum inhabitants and are subject to more soft sediment influence than the better known, persistent rocky substratum communities that characterize headlands and other areas in the SCSR. As with Point Mugu, Camp Pendleton includes important coastal wetlands habitat. The offshore ARPA Training Area, although small in its overall extent, accounts for most of the hard bottom habitat (30-100 m) contributing to the 19% of this habitat in the South Mainland Bioregion. Similarly, the military use areas at (1) Camp Pendleton, and (2) North Island and Silver Strand, located near San Diego Bay, include the majority of the soft bottom habitat (0-30m depth) contributing to 20% and 6% ~~24%~~ of this habitat type, respectively, in this bioregion (Table 3).

All military use areas in the South Mainland Bioregion provide important areas for marine birds (see Marine Bird and Mammal section below).

Ecological Linkages between San Clemente Island and San Nicolas Island and Other Southern California Mainland and Island Sites

Connectivity through larval movement was evaluated in the south coast study region through realistic model simulations using Regional Ocean Modeling System (ROMS)¹. The model assumes larvae and some weakly swimming young life stages behave as particles, simply transported through ocean circulation. The circulation model is based on data gathered during the period of 1996 – 2003, including strong El Niño and La Niña events. Model simulations are done for several representative populations (see Table 4).

Modeling results (Table 4) suggest that there is limited recruitment from San Clemente Island to other areas of the SCSR. Most recruitment from San Clemente Island appears to be local, that is, the recruiting young were spawned by adults resident in suitable habitats around the island. For some species, including kelp bass and lingcod, adults from San Clemente Island contribute to local recruitment but not to recruitment in other locations in the study region. However, for lingcod, the model also predicts that San Clemente receives some recruits from populations at San Nicolas, Santa Barbara, and Santa Catalina islands. For cabezon and blue rockfish, the model predicts that adults on San Clemente Island also contribute a limited number of recruits to Santa Catalina Island. For rockfish, the mainland (particularly north from San Mateo Point to Santa Barbara) and most of the Channel Islands serve as sources of larvae that recruit at San Clemente Island. For species with longer pelagic larval duration, such as red sea urchin, the model predicts only limited local recruitment to San Clemente Island, plus limited recruitment from Santa Catalina, San Nicolas and Santa Barbara islands. Generally, San Clemente Island appears to have high local recruitment and tends to receive some larvae from other places in the study region, but the dispersal model suggests that this island has a limited role as a source of larvae to other places in the study region, with the strongest connections to Santa Catalina, which lies within the same bioregion (East Channel Islands).

Modeling results suggest that San Nicolas Island is connected to some of the other Channel Islands though the exchange of larvae and also receives larvae that originate along the mainland coast (Table 4). For some representative species, such as cabezon, lingcod and blue rockfish, adults on San Nicolas Island may produce young that recruit locally, while some young may be transported to nearby islands, including Santa Barbara, San Clemente and Santa Catalina Islands. Adults of species such as cabezon from San Nicolas Island also produce young that may be transported to San Miguel Island, which is in the same West Channel Islands Bioregion. Young of these species (represented by cabezon, lingcod and blue rockfish) produced in other locations, particularly the mainland coast north of San Mateo Point, may be carried on currents to San Nicolas Island where they may settle and grow. For some species, such as kelp bass, local recruitment is limited, but populations on San Nicolas Island

¹ Researchers are S. Mitarai, D. Siegel, J. Watson of University of California, Santa Barbara and C. Dong & J. McWilliams of University of California, Los Angeles

receive young that originate from the mainland coast, primarily between San Mateo Point and Port Hueneme, and on the northeastern side of Santa Catalina Island. For species with longer pelagic larval duration, such as red sea urchin, the model suggests that local adult populations contribute to recruitment at Santa Catalina and Santa Barbara Islands, but local recruitment from San Nicolas Island and recruitment from other areas of the south coast study region are limited. However, because the dispersal model does not fully incorporate the effects of nearshore circulation processes, local recruitment may be underestimated – for both San Nicolas and San Clemente Islands.

Table 4. Larval Connectivity for San Clemente Island (SCI) and San Nicolas Island (SNI). Listed are Modeling Results for Several Representative Species.

San Clemente Island		
<i>Species</i>	<i>From SCI</i>	<i>To SCI</i>
Kelp Bass	To SCI only	From SCI only
Lingcod	To SCI only	Limited from southern islands: SCI, SNI, Santa Barbara Island and Santa Catalina Island
Red Sea Urchin	A tiny bit of recruitment to SCI	A small amount of recruitment from Santa Catalina Island, SCI, SNI and Santa Barbara Island
Cabezon	To SCI and a bit to Santa Catalina Island	From mainland from San Mateo Point to Santa Barbara and all islands except San Miguel and Santa Rosa Island
Blue Rockfish	To SCI, a bit to Santa Catalina Island	From mainland north of San Mateo Point, from islands but not Santa Rosa
San Nicolas Island		
<i>Species</i>	<i>From SNI</i>	<i>SNI</i>
Kelp Bass	Very little local recruitment	From NE Santa Catalina Island and mainland coast from San Mateo Point to Port Hueneme
Red Sea Urchin	To Santa Catalina Island and Santa Barbara Island mostly	From no locations in the south coast study region
Lingcod	To all southern islands: SNI, Santa Barbara Island, SCI and Santa Catalina Island	From mainland from Santa Monica Bay to Santa Barbara, a bit from islands: Santa Cruz Island, Anacapa Island, SNI and Santa Barbara Island
Cabezon	To San Miguel Island and all southern islands (SNI, Santa Barbara Island, SCI, Santa Catalina Island)	From mainland from San Mateo Point to Santa Barbara and some islands: Santa Cruz Island, Anacapa Island, northern Santa Rosa Island, SNI, and Santa Barbara Island
Blue Rockfish	To all southern islands: SNI, Santa Barbara Island, SCI and Santa Catalina Island	From mainland from Palos Verdes Point to Point Conception, and islands: Santa Cruz Island, Anacapa

		Island, northern Santa Rosa Island, SNI, and Santa Barbara Island
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Marine Birds and Mammals

There are seven species of marine birds and four species of marine mammals that breed, rest and forage in the military use areas in the SCSR. The birds are: Brandt's cormorants (*Phalacrocorax penicillatus*), western gulls (*Larus occidentalis*), California least terns (*Sternula antillarum browni*), western snowy plovers (*Charadrius alexandrinus nivosus*), black oystercatchers (*Haematopus bachmani*), ashy storm-petrels (*Oceanodroma homochroa*), Xantus's murrelets (*Synthliboramphus hypoleucus*). The marine mammals include: California sea lions (*Zalophus californianus*), Pacific harbor seals (*Phoca vitulina richarii*), northern elephant seals (*Mirounga angustirostris*) and southern sea otters (*Enhydra lutris nereis*).

Brandt's cormorants are endemic to marine habitats along the west coast of North America (Wallace and Wallace 1998) while western gulls are endemic to the California Current System (Pierotti and Annett 1995). Neither species is listed under state or federal endangered species acts. However, Brandt's cormorants were listed in the U.S. Fish and Wildlife Service's Seabird Conservation Plan as having a moderate conservation concern due to their vulnerability to human-caused disturbance (USFWS 2005). California least terns were listed as endangered under both the U.S. and California Endangered Species Acts after losing much of their breeding habitat to coastal development and increased use of coastal beaches in the 1950s and 1960s (Thompson et al. 1997). Western Snowy Plovers require breeding habitat similar to that of least terns and have been listed as a threatened species under the U.S. Endangered Species Act (Powell and Collier 2000).

Black oystercatchers are listed as a species of conservation concern by the U.S. Fish and Wildlife Service (USFWS) and named a focal species for priority conservation action (Tessler et al. 2007). Ashy Storm-Petrels are considered a species of conservation concern by both the UFWS and California Department of Fish and Game (Brown et al. 2003) and a petition to list the bird as threatened or endangered has been submitted to the U.S. Secretary of Interior (Wolf 2007). Xantus's murrelets are listed as threatened under California's Endangered Species Act and are candidates for listing under the U.S. Endangered Species Act (Burkett et al. 2003).

A resident breeding population of the southern sea otters (*Enhydra lutris nereis*), listed as threatened under the U.S. Endangered Species Act of 1973, occurs on San Nicolas Island. Except for southern sea otters, none of the other marine mammals listed in this document are listed under state or federal endangered species acts. However, all marine mammals are protected under the U.S. Marine Mammal Protection Act.

Table 4 lists the species utilizing habitat on each military property in southern California and shows the percent that each area's bird and mammal populations contribute to the total populations for the respective MLPA bioregion and SCSR.

- San Nicolas Island supports the majority of the western gulls and western snowy plovers and a large proportion of the California sea lions, Pacific harbor seals and northern elephant seals for the West Channel Islands Bioregion. It also supports a large proportion of the SCSR’s western gull, California sea lion, and northern elephant seal populations and the only consistent resident breeding population of the southern sea otter.
- San Clemente Island supports all of the Brandt’s cormorants and black oystercatchers, the majority of the ashy storm-petrels and western gulls, and a large proportion of Xantus’s murrelets and Pacific harbor seals for the East Channel Islands Bioregion.
- Point Mugu supports a large proportion of the California least terns and western snowy plovers for the North Mainland Bioregion and a large proportion of the western snowy plovers from the SCSR.
- Camp Pendleton and the Navy’s property in San Diego Bay support large proportions of the California least tern and western snowy plover populations for both the South Mainland Bioregion and the SCSR.

Marine mammal rookeries (breeding sites) are not included in Table 3 because data on population estimates for these rookeries were not available. However, the location of rookeries within the SCSR has been well documented.

- San Clemente Island supports all of the California sea lion and northern elephant seal rookeries for the East Channel Islands Bioregion and 15% and 3% for the SCSR, respectively.
- San Nicolas Island supports 12% of the California sea lion and 32% of the northern elephant seal rookeries for the West Channel Islands Bioregion and 12% and 26% for the SCSR, respectively.
- Point Mugu supports one of two Pacific harbor seal rookeries in the North Mainland Bioregion, with only three existing for the entire SCSR.

Table 4. Breeding and haul-out population estimates for marine birds and mammals, dependent on military properties in southern California, categorized within MLPA bioregions. Also shown are the percent that each local population contributes to the total bioregion population and total population for a given species in the MLPA South Coast Study Region.

Bioregion	Population	Percent of Bioregion Population	Percent of Study Region Population
West Islands Bioregion			
<i>San Nicolas Island</i>			
Brandt’s Cormorant	290	5.4	5
Black Oystercatcher	2	3.8	2.4
Western Gull	2,800	70.7	28.1
Western Snowy Plover	44	89.8	9.5
California Sea Lion	51,397	44.4	41.0
Pacific Harbor Seal	784	20.3	10.2

Bioregion	Population	Percent of Bioregion Population	Percent of Study Region Population
Northern Elephant Seal	11,301	36.7	36.6
East Islands Bioregion			
<i>San Clemente Island</i>			
Ashy Storm-Petrel	<100	~50	3.2
Brandt's Cormorant	40	100	0.7
Black Oystercatcher	4	100	4.9
Western Gull	112	68.3	1.1
Xantus's Murrelet	20	28.6	1.1
Pacific Harbor Seal	104	35.0	1.4
North Mainland Bioregion			
<i>Point Mugu Navy</i>			
California Least Tern	760	40.0	5.5
Western Snowy Plover	60	40.3	12.9
South Mainland Bioregion			
<i>Seal Beach Navy</i>			
California Least Tern	332	2.8	2.4
<i>Camp Pendleton</i>			
California Least Tern	3,208	27.0	23.3
Western Snowy Plover	117	43.8	25.2
<i>San Diego Navy (all)</i>			
California Least Tern	2,948	24.8	21.4
Western Snowy Plover	56	21.0	12.0

Summary

Habitat Features

Together, the military use areas represent a total of 414,469.5 mi² or 18.020% of the 2297,235.9 mi² of mapped habitats available in state waters in of the SCSR. The military use areas including the greatest amount of area are Camp Pendleton (63.8 mi²), San Clemente Island (488.0209.8 mi²), and San Nicolas Island (134.025.2 mi²). Camp Pendleton (64.4 mi²), and Begg Rock (38 mi²). The two island areas and Begg Rocks account for 322-373 mi² or 77.89% of the state waters used by the Military. military use areas in the SCSR.

Military use areas account for the greatest percentage of the East Channel Islands Bioregion (5044.9%) and West Channel Islands Bioregion (3326.9%) (Table 3). The total mainland area assigned to military use amounts to only 9.0 % of mapped habitats, with more than two-thirds of this located in Camp Pendleton in the South Mainland Bioregion.

The military use areas in the East Channel Islands Bioregion and the West Channel Islands Bioregion, which include San Clemente Island, and San Nicolas Island, including and Begg Rock, respectively, include contain large percentages of certain habitat types. No military use areas were selected for analysis from the Mid Channel Islands Bioregion.

In the East Channel Islands Bioregion, more than 50% of the ~~beaches, rocky shores, kelp, shallow hard bottom habitat (s at 0-30 m, proxy, 20-30 m, and 30-100-200 m, and 200-3000m), and soft bottom habitats at all depths (0-30m proxy, 0-30m, 30-100m, 100-200m, and 200-3000m)~~ are included in the San Clemente Island military use area. Of the habitat classified as “unknown” in the East Channel Islands Bioregion, between 77% (0-30 m) and 100% (30-200 m) are included in the San Clemente Island military use area. More than 3050% of kelp and more than 25% of beaches, hard and soft bottom habitat at 200-3000 m and a substantial portion (33 – 78%) of habitats classified as “unknown” more than 25% of beaches, kelp, hard bottom habitats at 0-30m (proxy), 0-30m and 30-100m depth and soft bottom habitats at 0-30m (proxy) are located within the San Nicolas Island and Begg Rock military use areas.

The military use areas contribute no more than 5% of any habitat type within the North Mainland Bioregion and no more than 26% within the South Mainland Bioregion (Table 3). Habitat types with the greatest representation in military use areas in the South Mainland Bioregion include soft bottom habitat at 0-30 m depth (26%), hard bottom habitat at 30-100m depth (19%), and beaches (16%).

The offshore ARPA Training Area accounts for 19% of the hard bottom at 30-100m depth and the military use areas at Camp Pendleton and San Diego Bay, including North Island and Silver Strand, include 26% of the soft bottom habitat at 0-30 m depth in the South Mainland Bioregion.

Because of their geological makeup and geographic features (e.g., ocean circulation and thermal conditions, shore and coastline topography and orientation, and location with respect to prevailing swell patterns), San Clemente Island, ~~and San Nicolas Island, and including Begg Rock,~~ contain important and sometimes large amounts of habitat that is often not replicated or poorly replicated in the SCSR.

Their large distances from the mainland reduce exposure of these islands to the abundant anthropogenic stressors common to SCSR coastal waters.

Biotic Features

These islands are unique in terms of the biota they support within their bioregion. Both islands contain different mixtures of warm and cold temperate species distributed across their waters compared to other islands within their respective bioregions.

The entire waters of both Islands (including Begg Rock) are *Areas of Special Biological Significance* in recognition of their biologically unique and sensitive marine ecosystems.

San Nicolas Island supports the only resident breeding population of the Sea Otter (*Enhydra lutris*) and the largest remaining remnant populations of the endangered black abalone (*Haliotis cracheroidii*) in the SCSR and supports unusual, deep eelgrass communities (*Zostera marina*).

San Clemente Island supports the largest known populations of the rare purple hydrocoral, excluding populations found on the Farnsworth Bank pinnacle, a remnant population of endangered white abalone, and populations of the only rock based morph and one of only two known locations for the sand-based morph of the Elk Kelp (*Pelagophycus porra*).

The kelp beds at San Clemente Island account for ~~90~~99% of the kelp bed habitat in the East Channel Island Bioregion whereas San Nicolas Island kelp beds makes up 34.5% of the total kelp coverage in the West Channel Island Bioregion. These island kelp habitats occur in significantly deeper water than most kelp habitats due to water clarity.

Linkages and Connectivity

Modeling results suggest San Clemente Island has high local recruitment and tends to receive larvae from other places in the study region, but has a limited role as a source of larvae to other places in the study region, with the strongest connections to Santa Catalina Island in the same East Channel Islands Bioregion.

Modeling results suggest that San Nicolas Island is connected to some of the other Channel Islands though the exchange of larvae and also receives larvae that originate along the mainland coast.

Marine Birds and Mammals

San Nicolas Island and San Clemente Island include important habitats and rookeries for marine birds and mammals.

San Nicolas Island supports the majority of the western gulls and western snowy plovers for the West Islands Bioregion and also supports a large proportion of the SCSR's western gull, population. It also supports a large proportion of the SCSR's California sea lion, and northern elephant seal populations.

San Clemente Island supports all of the Brandt's cormorants and black oystercatchers, the majority of the ashy storm-petrels and western gulls, and a large proportion of Xantus's murrelets and Pacific harbor seals for the East Islands Bioregion.

San Nicolas Island supports 12% of the California sea lion and 26% of the northern elephant seal rookeries and San Clemente Island supports 15% of the California sea lion and 3% of the northern elephant seal rookeries in the SCSR.

The military use area around Point Mugu includes coastal wetlands habitat and one of three Pacific harbor seal rookeries in the SCSR.

Camp Pendleton includes coastal wetlands habitat and the coastline to the north and south of this military use area, is characterized mostly by sandy beaches and intermittent low-lying soft rocky benches.

The military use area around Point Mugu and all military use areas in the South Mainland Bioregion provide important areas for marine birds. Point Mugu supports a large proportion of the western snowy plovers, and Camp Pendleton and the Navy's property in San Diego Bay support large proportions of the California least tern and western snowy plover populations for the SCSR.

Conclusions

Because the military use areas include large amounts of key habitat and contain unique biological communities within the SCSR, these areas will play significant roles in meeting the science objectives of the Marine Life Protection Act (MLPA).

The military use areas on San Nicolas Island (including Begg Rock) and San Clemente Island are particularly important to meeting MLPA objectives within the West Channel Islands and East Channel Islands Bioregions.

Contributions to the MLPA made by any proposed closures in military use areas can best be determined in the context of the alternative MPA proposals for the entire SCSR. Consequently, the SAT recommends that any proposed closures in military use areas be considered as part of the full SAT evaluation of these alternative MPA proposals. The full SAT evaluation is needed to assess the contribution of proposed closures in military use areas to ecosystem protection within each bioregion and the entire SCSR, and to determine the role of proposed closures in military use areas as part of an integrated regional network of MPAs.

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Appendix A. Habitat Analysis Using Interim Seafloor Habitat Data

Together, the ~~seven~~ eight military use areas identified represent a total of 462 mi² or 20% of the 2297.5 mi² of mapped habitats in state waters in the SCSR. The military use areas that include the greatest amount of area are Camp Pendleton (63.8 mi²), San Clemente Island (208 mi²) and San Nicolas Island and Begg Rock (163 mi²). The two island areas account for 371 mi² or 80% of the mapped habitats in the SCSR, which are used by the military.

The five bioregions identified for the SCSR contain different amounts of marine habitats identified by the SAT as important for MPA planning (Table A1). These habitats include consideration of bottom type, depth, and biogenic habitat.

Table A1. Amount of Available Habitat in the MLPA South Coast Study Region by Bioregion

Habitat Type	East Channel Islands Bioregion	Mid Channel Islands Bioregion	West Channel Islands Bioregion	North Mainland Bioregion	South Mainland Bioregion
Beaches (linear mi)	61.39	27.51	40.70	102.51	147.70
Rocky Shores (linear mi)	62.31	83.92	75.01	30.40	28.88
Kelp - (linear mi)	49.40	24.13	70.38	24.23	30.07
Kelp – (area – sq mi)	3.14	0.86	8.11	2.87	2.91
Hard – 0-30m proxy (linear mi)	71.65	43.07	42.85	13.19	28.68
¹ Hard 0-30m (sq mi)	25.27	12.58	46.07	31.35	46.72
Hard 30-100m (sq mi)	89.28	16.79	41.24	22.63	13.59
Hard 100-200m (sq mi)	55.22	9.70	6.90	2.39	0.77
Hard 200-3000m (sq mi)	84.41	9.85	0.13	1.01	1.20
Soft –0 – 30m proxy (linear mi)	4.31	36.06	72.44	117.93	128.58
¹ Soft 0-30m (sq mi)	3.69	25.07	70.13	155.09	245.27
Soft 30-100m (sq mi)	15.26	186.94	250.01	215.82	148.57
Soft 100-200m (sq mi)	15.58	34.47	54.30	21.23	21.44
Soft 200-3000m (sq mi)	129.89	67.89	29.12	22.03	68.56
² Totals (mi)	123.70	111.43	115.71	132.91	176.57
³ Totals (sq mi)	418.61	363.30	497.90	471.56	546.12

¹*Barriers to mapping nearshore habitats limit the accuracy of classification of hard and soft bottom habitat at 0-30 m. The SAT developed a proxy measurement of habitat at 20 m depth to evaluate nearshore habitats.*

⁴*Accuracy of area estimates for shallow substrate is limited by barriers to mapping nearshore habitats.*

²*Total mapped shoreline type (miles)*

³*Total mapped area of bottom type (square miles)*

The military use areas contain more than 25% of seven different habitat types available in all SCSR state waters (Table A2). These include kelp (28% of linear kelp and 33% of kelp area), hard bottom 0-30m proxy (27%), hard bottom 30-100m (34%), hard bottom 100-200m (30%),

hard bottom 200-3000m (32%), soft bottom 100-200m (25%), and soft bottom 200-3000m (30%).

Table A2. Percentage of Available Habitats Identified for the MLPA South Coast Study Region Found in Military Use Areas.

Habitat Type	Study Region Total	Military Areas Total	% in Military Areas
Beaches (linear mi)	379.81	64.47	17%
Rocky Shores (linear mi)	280.51	52.55	19%
Kelp (linear mi)	198.21	56.10	28%
Kelp (area – sq mi)	17.89	5.86	33%
Hard 0-30m proxy (linear mi)	199.44	52.90	27%
¹ Hard 0-30m (sq mi)	161.98	31.82	20%
Hard 30-100m (sq mi)	183.53	62.08	34%
Hard 100-200m (sq mi)	74.98	22.35	30%
Hard 200-3000m (sq mi)	96.60	30.52	32%
Soft 0-30m proxy (linear mi)	359.33	44.55	12%
¹ Soft 0-30m (sq mi)	499.25	79.56	16%
Soft 30-100m (sq mi)	816.60	104.20	13%
Soft 100-200m (sq mi)	147.03	36.32	25%
Soft 200-3000m (sq mi)	317.50	95.45	30%

¹*Barriers to mapping nearshore habitats limit the accuracy of classification of hard and soft bottom habitat at 0-30 m. The SAT developed a proxy measurement of habitat at 20 m depth to evaluate nearshore habitats.*

**Accuracy of area estimates for shallow substrate is limited by barriers to mapping nearshore habitats.*

Of the five bioregions located in the SCSR, military use areas account for the greatest percentage of all mapped habitats in the East Channel Islands Bioregion (50%) and the West Channel Islands Bioregion (33%; Table A3). The total mainland area identified as important for military use amounts to only 9.0% of mapped habitats with more than two-thirds of this located in Camp Pendleton in the South Mainland Bioregion.

The percentages of the mapped habitat of different types located in the military use areas differ by bioregion (Table A3). In particular, the military use areas in the East Channel Islands Bioregion and the West Channel Islands Bioregion, which include San Clemente Island and San Nicolas Island respectively, include large percentages of certain habitat types. No military use areas were selected for consideration in the Mid Channel Islands Bioregion. In the East Channel Islands Bioregion, more than 50% of kelp, rocky shores, shallow hard bottom habitat (0-30m proxy and 0-30m), and soft bottom habitats at all depths (0-30m proxy, 0-30m, 30-100m, 100-200m, and 200-3000m) are included in the San Clemente Island military use area. The contribution of the San Nicolas Island and Begg Rock military use areas to habitat availability in the West Channel Islands Bioregion is less, but includes more than 50% of hard bottom habitat (30-100m) and more than 25% of beaches, kelp, hard bottom habitats at 0-30m proxy, 0-30m and 30-100m depth and soft bottom habitats (30-100m, 100-200m and 200-3000m).

The percentage of different habitat types contained within the military use areas located in the North Mainland and South Mainland Bioregions is much less compared with the East Channel Islands and West Channel Islands Bioregions. The military use areas contribute no more than 5% of any habitat type within the North Mainland Bioregion and no more than 24% within the South Mainland Bioregion (Table A3). Habitat types with the greatest representation in military use areas in the South Mainland Bioregion include soft bottom at 0-30m depth (24%), hard bottom at 30-100m depth (21%), and beaches (16%).

Table A3. Percentage of the Available Habitat Types Identified for the MLPA South Coast Study Region found in the Seven-Eight Military Use Areas by Bioregion

Habitat Type	East Channel Islands Bioregion	Mid Channel Islands Bioregion	West Channel Islands Bioregion	North Mainland Bioregion	South Mainland Bioregion
Beaches (linear mi)	40%	0%	26%	5%	16%
Rocky Shores (linear mi)	56%	0%	21%	0%	6%
Kelp (linear mi)	67%	0%	30%	0%	6%
Kelp (area – sq mi)	89%	0%	35%	0%	8%
Hard 0-30m proxy (linear mi)	50%	0%	40%	0%	0%
¹ Hard 0-30m (sq mi)	56%	0%	35%	0%	3%
Hard 30-100m (sq mi)	41%	0%	56%	0%	21%
Hard 100-200m (sq mi)	39%	0%	9%	0%	2%
Hard 200-3000m (sq mi)	36%	0%	6%	0%	0%
Soft 0-30m proxy (linear mi)	86%	0%	25%	4%	15%
¹ Soft 0-30m (sq mi)	88%	0%	18%	2%	24%
Soft 30-100m (sq mi)	83%	0%	27%	2%	13%
Soft 100-200m (sq mi)	100%	0%	37%	1%	6%
Soft 200-3000m (sq mi)	57%	0%	74%	0%	0%

¹*Accuracy of area estimates for shallow substrate is limited by barriers to mapping nearshore habitats limit the accuracy of classification of hard and soft bottom habitat at 0-30 m. The SAT developed a proxy measurement of habitat at 20 m depth to evaluate nearshore habitats.*