1.0 Introduction

The Marine Life Protection Act (MLPA) was signed into law in 1999. The MLPA directs the state to redesign California's system of marine protected areas to increase its coherence and effectiveness in protecting the state's marine life and habitats, marine ecosystems, and marine natural heritage, as well as to improve recreational, educational and study opportunities provided by marine ecosystems. To the extent possible, the system is to be designed and managed as a network.

In August 2004, the California Resources Agency, California Department of Fish and Game (CDFG), and the Resource Legacy Fund Foundation signed a memorandum of understanding launching the MLPA Initiative and implementation of the MLPA in the central coast. Among other actions, the MLPA Initiative established the MLPA Blue Ribbon Task Force, the Master Plan Science Advisory Team (SAT), a statewide stakeholder interests group, and MLPA Initiative staff. A second memorandum of understanding, effective January 1, 2007, continues the public-private partnership for planning and implementation of marine protected areas (MPAs) in the north central coast.

By December 2006 five key objectives were achieved by the MLPA Initiative: (1) a draft Master Plan Framework for MPAs was developed, (2) alternative proposals for MPAs in the central coast study region were developed and submitted to CDFG, (3) a strategy was recommended for long-term funding for MPA implementation and management, (4) a report was prepared with recommendations to increase coordination and collaboration among state and federal agencies with the authority to manage marine resources, and (5) a recommended executive order was submitted to secure agreement among state agencies to complete implementation of a statewide Master Plan for MPAs by 2011. The stakeholder process for regional MPA planning in the central coast study region was completed in 2005-2006 and in 2006 a draft Master Plan for MPAs was completed (CDFG 2005a). The California Fish and Game Commission approved a set of central coast MPAs, with associated regulations, on April 13, 2007.

A regional stakeholder group is being convened in 2007 to begin evaluating and redesigning existing MPAs for the area extending from Alder Creek near Point Arena in Mendocino County to Pigeon Point in San Mateo County. This draft *Regional Profile for the North Central Coast Study Region* provides background information on the biological, oceanographic, socioeconomic, and governance setting for the MLPA North Central Coast Study Region. This regional profile is intended to provide basic regional information to support stakeholders and policy-makers in their understanding of the marine resources and heritage of the region, in evaluating existing MPAs within the study region, and in developing alternative MPA proposals. The information is provided in the form of text summaries, tables, selected maps (with links to other computer-accessible maps), and technical appendices. It is anticipated that the regional stakeholders and SAT will provide additional information to augment this profile through a joint fact-finding process.

The regional profile helps provide the context to develop alternatives that will meet the goals and objectives of the MLPA. The goals of the MLPA are:

- Goal 1: To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems.
- Goal 2: To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.
- Goal 3: To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity.
- Goal 4: To protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value.
- Goal 5: To ensure that California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.
- Goal 6: To ensure that the state's MPAs are designed and managed, to the extent possible, as a statewide network.

The best readily available data are being compiled for use in the MLPA North Central Coast Study Region planning process. This regional profile provides an overview of some of that data. All data in a spatial geographic information system (GIS) format are being housed in the California Marine Geodatabase at the University of California, Santa Barbara. Appendix I provides a list of the currently available spatial data layers; this list is dynamic and will be updated as new data become available.

2.0 General Description of the Study Region

The MLPA North Central Coast Study Region covers state waters extending from a line due west of Pigeon Point to a line extending due west from Alder Creek, five miles north of Point Arena, and includes state waters around the Farallon Islands, but does not include San Francisco Bay (see Map 1). The shoreward boundary was drawn at the beach for creeks and rivers, at the extent of tidal reach in lagoons and estuaries, and at the Golden Gate Bridge (to exclude San Francisco Bay). Lagoons (such as Abbots Lagoon) that are mostly or entirely closed to tidal inundation and dominated by brackish-freshwater species are not included in the study region.

To facilitate the display of information and evaluation of alternative MPA designs, the region has been divided up into 6 sub-regions as follows:

1. Alder Creek/Point Arena to Horseshoe Point
2. Horseshoe Point to Bodega Head
3. Bodega Head to Double Point
4. Double Point to Point San Pedro
5. Point San Pedro to Pigeon Point
6. Farallon Islands

The coastline covers a straight-line distance of 146 miles (mi), but it is actually much longer due to the undulations of the coastline (over 363 mi). In general, state waters extend from the mean high tide line to 3 nautical miles (nmi) seaward. However, state waters also include an area of 94.3 square miles around the Farallon Islands, which are located 28 miles offshore of the San Francisco Bay.

The study region encompasses approximately 763.5 square miles and extends from the shoreline (mean high tide) to a maximum depth of approximately 382 feet (63.7 fathoms) off the Farallon Islands. The study region includes a broad array of habitats from intertidal to hard and soft bottom habitats on the continental shelf. The edge of the continental shelf, where it transitions downward to become the continental slope, is called the shelf-slope break, which occurs at approximately 200 meters; the continental slope is generally outside of the study region as the maximum depth in the region is 116 meters (380 feet, 63.4 fathoms). The continental shelf varies in width along the study region from 3.6 mi at its narrowest location to 27.2 mi at its widest location (where it extends beyond state waters) along the 100 meter contour. There are no submarine canyons in state waters in the region; however, there are some large canyons in federal waters. While much of the marine seafloor in the region is soft (sand or mud) bottom there are also rocky reefs, pinnacles, and rocky outcrops. Preliminary mapping of hard and soft bottom habitats in the entire study region is underway.

The MLPA North Central Coast Study Region is a portion of the California Current large marine ecosystem. The California Current is considered globally important for biodiversity because of its high productivity and the large numbers of species it supports (World Wildlife Fund 2000). The California Current has its origins in the Gulf of Alaska and flows southward along the West

Coast toward the equator. It is one of only four temperate upwelling zones in the world where seasonal winds blow surface water away from the coast, causing cold nutrient-rich water from deep in the ocean to upwell, or rise, to the surface. The California Current is one of the most productive of the eastern boundary currents and is characterized by seasonal upwelling of cold nutrient rich water, periodic El Niño - Southern Oscillation climatic events, and decadal climatic shifts (United States Global Ocean Ecosystems Dynamics 1994).

Major upwelling centers occur at Point Arena and Point Reyes, with extensive coastal upwelling also occuring along the entire Sonoma coast. During the upwelling season, the waters are rich in nutrients that fuel highly productive and diverse ecosystems, with large numbers of top predators that are dependent on this seasonal abundance of prey resources. The nutrient rich upwelled waters fuel a productive pelagic foodweb that includes phytoplankton, krill, coastal pelagic species (anchovies, sardines, squid, etc), fish, seabirds, marine mammals, and sharks. High local productivity also attracts many migratory species. During non-upwelling seasons and El Niño years, the nutrients that flow out from San Francisco Bay become more important (NOAA 2004). Relative to other parts of the state, this study region is very important to many species of top predators that are key players in the coastal and open ocean food webs. There are specific areas in the region important as foraging and breeding grounds for populations of some top predators (Karl et al 2001; Yen et al 2004).

The ecology of the study region has been relatively well characterized in several publicly available summary documents (Airame et al 2003; NOAA 2003; Karl et al. 2001) as well as numerous scientific studies. This section provides an overview of important geographic and ecological features of the region, generally described from north to south. More specific information is provided in habitat descriptions (section 3.0) and subregional summaries (section 10.0).

Point Arena at the northern end of the study region is a rocky peninsula with a lighthouse on an elevated coastal plain in Mendocino County. Just north of Point Arena, the Garcia River empties into the ocean from a small estuary. The Gualala River enters the ocean about 18.6 miles south of Point Arena and forms a coastal lagoon behind a sandbar.

The Sonoma coast is characterized by a relatively narrow shelf, seasonal upwelling, a steep rocky coastline, and nearshore rocky reefs. The Russian River, which drains a very large watershed in Sonoma and Mendocino counties, meets the ocean at Jenner where a coastal lagoon forms behind a sandbar and a freshwater tidal plume extends from the coast during the wet season.

Bodega Head is a granitic peninsula, with coastal dune systems around the headland, located south of the Russian River. Bodega Harbor is a protected harbor southeast of Bodega Head and is an important regional port, with open water and mudflat habitats. There are several large bays or estuaries in the northern half of the study region including Bodega Bay, Tomales Bay, Estero Americano, Estero San Antonio, Drakes Estero and Estero de Limantour, and Bolinas Lagoon. These estuarine areas are located on the Pacific Flyway and support numerous migrating waterfowl and shorebird species. The unique shallow water eelgrass beds and wetlands in large and small estuaries are nursery grounds for many invertebrates and fish.

The Marin coastline is characterized by a broader shelf and steep rocky cliffs. Point Reyes is a large peninsula that exends offshore and greatly influences local ocean circulation patterns. There are several large coastal protected areas including Point Reyes National Seashore and the Golden Gate National Recreation Area.

San Francisco Bay is not part of the planning region; however the mouth of San Francisco Bay and the area seaward of the Golden Gate bridge is included. All of the rivers of California's Central Valley (including the Sacramento, American, and San Joaquin rivers) and the rivers surrounding the San Francisco Bay Area drain to the sea under the Golden Gate Bridge. The large freshwater tidal plume that extends seaward for miles beyond the Golden Gate Bridge on ebb tides is unique feature of the region. This plume reaches its greatest extent on ebb tides during the rainy winter season. There are several ports within San Francisco Bay from which commercial shipping, fishing, recreational, and passenger vessels travel through the study region.

The Gulf of the Farallones includes one of the broadest sections of continental shelf on the West Coast of the U.S. (NOAA 2004). The entire area of the Gulf of Farallones is influenced by coastal upwelling and the San Francisco Bay tidal plume. The broad flat shelf is mostly sandy and muddy and relatively shallow (<120 meters) and provides important habitat and forage area for seabirds, marine mammals and fish. The waters around the Farallon islands are nutrient-rich and support high productivity and many species of top predators, including the world's largest congregation of white sharks. Gray whales, humpback whales and blue whales feed in the area. The Farallon Islands are located 28 miles west of San Francisco on the edge of the shelf-slope break and are a biological hotspot for breeding seabirds and marine mammals. Only 4 rocky islands on Farallon ridge emerge from the ocean: Southeast Farallon, West End, Middle Farallon, and North Farallon Island. There are 12 species of seabirds that breed on the islands, the largest concentration of breeding seabirds in the lower 48 states. The area supports California's largest population of harbor seals.

South of the mouth of San Francisco Bay, the coastlines of San Francisco and San Mateo counties are characterized by sandstone cliffs, sandy beaches, and small coastal streams. Half Moon Bay/Pillar Point is an important regional port for commercial and recreational fisheries. Pescadero Marsh is one of the larger coastal lagoons along this stretch of coast.

The study region abuts five coastal counties: San Mateo, San Francisco, Marin, Sonoma, and Mendocino. The coasts surrounding San Francisco Bay and the San Mateo coast support the largest concentration of human population in the study region. The marine resources of the region support commercial and recreational fisheries and many non-consumptive economic activities such as coastal tourism and recreation. The important ports in the region include Bodega Harbor and Half Moon Bay/Pillar Point. The port of San Francisco is not in the study region; however, vessels that harbor there fish in and transit the region. The marine resources of the region support commercial and recreational fisheries and many non-consumptive economic activities such as coastal tourism and recreation.

3.0 Ecological Setting

The study region includes a wide variety of ecosystems, habitats and species that are important for regional marine biodiversity, sustainable resource use, and natural heritage. While only overlapping with the southern half of the study region, the characterization of natural history and biodiversity in the Monterey Bay National Marine Sanctuary (MBNMS) is applicable to the study region. MBNMS has been characterized as having high biodiversity, with 26 species of marine mammals, 94 species of seabirds, 345 species of fishes, 4 species of sea turtles, 31 phyla (thousands of species) of invertebrates and more than 450 species of marine algae (NOAA 2004). The Gulf of the Farallones National Marine Sanctuary (GFNMS) is characterized as having 36 species of marine mammals, 54 species of breeding birds, and 25 threatened or endangered species (NOAA 2006).

The biodiversity of this marine region was one of the driving factors in the designation of the Farallones National Wildlife Refuge in 1909, the Point Reyes National Marine Seashore in 1962 (established 1972), the Golden Gate National Recreation Area (GGNRA) in 1972, the Gulf of Farallones National Marine Sanctuary (GFNMS) in 1981, the UNESCO Golden Gate Biosphere Reserve in 1988, the Cordell Bank National Marine Sanctuary (CBNMS) in 1989, and the Monterey Bay National Marine Sanctuary in 1992.

The study region has been relatively well studied. The profile drew from existing studies and several key sources should be used to complement and expand upon the information in this regional profile. The following is a partial list of documents that broadly characterizing the region's ecology and summarize some scientific research from a variety of original sources:

- NOAA, 2004. *The Monterey Bay National Marine Sanctuary Site Characterization* (available online at: http://bonita.mbnms.nos.noaa.gov/sitechar/).
- Airamé, S., S. Gaines, and C. Caldow. 2003. *Ecological Linkages: Marine and estuarine ecosystems of central and northern California.* NOAA, National Ocean Service. Silver Spring, MD. 172p. (available at: http://biogeo.nos.noaa.gov/products/canms_cd/data/pdfs/ELR.pdf).
- NOAA, 2004. A *Biogeographic Assessment of North-Central California: To Support the Joint Management Plan Review for Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries* (2004) (available online at: http://biogeo.nos.noaa.gov/products/canms_cd/).
- Karl, Herman A, John L. Chin, Edward Ueber, Peter H. Stauffer, and James W. Hendley II (eds,) 2001. *Beyond the Golden Gate—Oceanography, Geology, Biology, and Environmental Issues in the Gulf of the Farallones.* Reston, VA; U.S. Geological Survey: Denver, CO: USGS Information Services. (available online at: http://pubs.usgs.gov/circ/c1198/)
- Evens, Jules G. 1993. *The Natural History of the Point Reyes Peninsula.* Point Reyes, California: Point Reyes National Seashore Association.

- NOAA, 2006. *Gulf of the Farallones National Marine Sanctuary Draft Management Plan*. Prepared as part of the Joint Management Plan Review. October. [http://sanctuaries.noaa.gov/jointplan/drafts/gf_mp.html]
- Rintoul, C., B. Langabeer-Schlagenhauf, K.D. Hyrenbach, K.H. Morgan, and W.J. Sydeman. A*tlas of California Current Marine Birds and Mammals: Version 1.* Unpublished Report. PRBO Conservation Science, Petaluma, California. (http://www.prbo.org/cms/docs/marine/CCS_Seabird_Mammal_Atlas.pdf)
- CDFG, 2001. *California's Living Marine Resources: A Status Report* (ANR Publication #SG01-11) California Department of Fish and Game, http://anrcatalog.ucdavis.edu

3.1 Ecosystems and Habitats

The MLPA requires that MPAs in each bioregion, with specific reference to state marine reserves, encompass a representative variety of marine habitats and communities across a range of depths and environmental conditions (Section 2857(c) of the MLPA). The MLPA specifically mentions the following habitats in reference to their inclusion in a system of MPAs: rocky reefs, intertidal zones, sandy or soft ocean bottoms, underwater pinnacles, seamounts, kelp forests, submarine canyons, and seagrass beds. In addition, the SAT recommended considering specific depth zones, estuaries, upwelling areas, retention areas, and freshwater plumes from coastal rivers as additional habitats for MPA siting (CDFG 2005a). Seamounts are not found in state waters. Submarine canyons and waters greater than 200 meters depth are not found in state waters in the study region.

The SAT identified two different types of kelp forests that occur in the state, *Macrocystis pyrifera* and *Nereocystis lutkeana,* as separate habitats for the purposes of MPA siting, since each type of kelp forest hosts distinguishable assemblages of organisms. The kelp forests in the MLPA North Central Coast Study Region are dominated by bull kelp. The SAT also identified underlying geology (e.g. granitic versus sandstone or shale substrata) as important in structuring the composition of communities on rocky reefs and rocky intertidal zones.

Regional habitats are described below and spatial data on the distribution of most habitats has been provided, to the extent possible, given readily available information (Maps 2a-2f, 3a-3f, and 4a-4b). Table 1 provides a summary of the amount of each habitat in the study region, the bioregion (Point Conception to Oregon border), and the state (Mexico border to Oregon border, excluding San Francisco Bay). San Francisco Bay was excluded from the bioregional and statewide analysis as it represents a distinctive large estuary (the largest on the West Coast) that is not directly comparable to smaller estuaries on the open coast and the inclusion of San Francisco Bay significantly complicates the analysis of shoreline and estuarine amounts. This summary shows the relative rarity of different habitats within the study region, as well as the contribution of the study region towards total amount of each habitat in the bioregion and state.

Table 1: Approximate Amount of Each Habitat in North Central Coast Study Region, Bioregion, and Statewide in State Waters

Habitat	Amount in Study Region	% of Study Region Area	Amount in Bioregion	% of Bioregion Area	Amount in State waters	% of State waters area	GIS Data Source / Comments
Total Area (area, mi^2)	763.5		2891.0		5549.7		
Shoreline[1] (Length, mi)							
Total Shoreline Length	367.6		1604.3		2826.5		NOAA-ESI 2002, 2006 / Does not include SF Bay
Intertidal: Rocky shores	169.5	45.9%	620.6	38.7%	944.0	33.4%	NOAA-ESI 2002 / Does not include SF Bay
Intertidal: Sandy beaches	188.3	51.0%	787.0	49.1%	1293.5	45.8%	NOAA-ESI 2002, 2006 / Does not include SF Bay
Intertidal: Coastal marsh	51.8	14.0%	246.0	15.3%	320.3	11.3%	NOAA-ESI 2002, 2006 / Does not include SF Bay
Intertidal: Tidal Flats	60.6	16.4%	239.9	15.0%	280.3	9.9%	NOAA-ESI 2002, 2006 / Does not include SF Bay
Hard and Soft Bottom Habitats and Canyon (Area, mi^2)							
Total Hard and Soft Bottom and Canyon Habitat	760.7		3824.8		6947.0		Total area includes all subtidal habitats from Greene et al 2004
Coarse-scale Rocky Habitat 0-30m	63.5	8.3%	155.9	5.4%	209.1	3.8%	Greene et al 2004 / Underestimates amount of rock in state waters[3]
Coarse-scale Rocky Habitat 30-100m	53.8	7.0%	121.3	4.2%	233.7	4.2%	Greene et al 2004 / Underestimates amount of rock in state waters[3]
Coarse-scale Rocky Habitat 100-200m	0.0	0.0%	18.4	0.6%	139.3	2.5%	Greene et al 2004 / Underestimates amount of rock in state waters[3]
Coarse-scale Rocky Habitat >200m	0.0	0.0%	21.5	0.7%	144.2	2.6%	Greene et al 2004 / Underestimates

Habitat	Amount in Study Region	% of Study Region Area	Amount in Bioregion	% of Bioregion Area	Amount in State waters	% of State waters area	GIS Data Source / Comments
							amount of rock in state waters[3]
Total Coarse-scale Rocky Habitat (all depths)	117.2	15.4%	317.0	11.0%	726.2	13.1%	Greene et al 2004 / Underestimates amount of rock in state waters[3]
Coarse-scale Soft Bottom Habitat 0-30m	237.2	31.1%	1299.7	45.0%	2023.3	36.5%	Greene et al 2004 / Over estimates amount of soft in state waters[3]
Coarse-scale Soft Bottom Habitat 30-100m	401.3	52.6%	1876.1	64.9%	3033.7	54.7%	Greene et al 2004 / Overestimates amount of soft in state waters[3]
Coarse-scale Soft Bottom Habitat 100-200m	5.0	0.7%	181.6	6.3%	385.4	6.9%	Greene et al. 2004 / Over estimates amount of soft in state waters[3]
Coarse-scale Soft Bottom Habitat >200m	0.0	0.0%	145.5	5.0%	593.7	10.7%	Greene et al 2004 / Over estimates amount of soft in state waters[3]
Total Coarse-Scale Soft Bottom Habitat (all depths)	643.5	84.3%	3502.9	121.2%	6036.1	108.8%	Greene et al 2004 / Over estimates amount of soft in state waters[3]
Canyon 0-30m	0.0	0.0%	0.7	< 0.1%	1.7	< 0.1%	Greene et al 2004
Canyon 30-100m	0.0	0.0%	6.4	0.2%	11.3	0.2%	Greene et al 2004
Canyon 100-200m	0.0	0.0%	11.5	0.4%	20.1	0.4%	Greene et al 2004
Canyon >200m	0.0	0.0%	62.1	2.1%	90.4	1.6%	Greene et al 2004
Total Canyon (all depths)	0.0	0.0%	80.6	2.8%	123.4	2.2%	Greene et al 2004
Underwater Pinnacles	NA		NA		NA		Data not available
Estuarine and Nearshore Habitats (Area, mi^2)							
Kelp 2005	0.9	0.1%	10.6	0.4%	42.2	0.8%	CDFG 2005

Habitat	Amount in Study Region	% of Study Region Area	Amount in Bioregion	% of Bioregion Area	Amount in State waters	% of State waters area	GIS Data Source / Comments
							aerial survey
Kelp 2004	1.4	0.2%	14.3	0.5%	45.5	0.8%	CDFG 2004 aerial survey
Kelp 2003	1.2	0.2%	14.4	0.5%	49.3	0.9%	CDFG 2003 aerial survey
Kelp 2002	1.7	0.2%	19.5	0.7%	36.6	0.7%	CDFG 2002 aerial survey
Kelp 1999	2.5	0.3%	8.6	0.3%	23.0	0.4%	CDFG 1999 aerial survey
Kelp 1989	3.4	0.4%	31.4	1.1%	53.6	1.0%	CDFG 1989 aerial survey
Average Kelp	1.8	0.2%	16.5	0.6%	41.7	0.8%	
Estuary	19.5	2.5%	93.4	3.2%	148.5	2.7%	National Wetlands Inventory; California Natural Diversity Database; NOAA-ESI 2002; USGS Topos
Seagrass: Surfgrass (Length, mi, % of shoreline)	68.8	18.6%	NA		NA		
Seagrass: Eelgrass	6.0	0.8%	17.9	0.6%	41.7	0.8%	Morro Bay National Estuary Program; Elkhorn Slough Foundation; CDFG Tomales Bay data; Humboldt GIS Atlas
Oceanographic Habitats							
Upwelling center[2]	2 major centers at Pt. Arena and Pt. Reyes		6 major centers		6 major centers		NOAA Coastwatch Sea Surface Temperature
Retention area	One retention area south of Point Reyes		NA		NA		Wing et al 1998, Largier 2004
Freshwater plume	Coastal river		NA		NA		

Habitat	Amount in Study Region	% of Study Region Area	Amount in Bioregion	% of Bioregion Area	Amount in State waters	% of State waters area	GIS Data Source / Comments
	mouths and mouth of SF Bay						

Notes: 1. Shoreline percentages may add up to more than 100% since more than one type can be present in a given location; San Francisco Bay was not included in the shoreline analysis. 2. Major upwelling centers in the state include: Cape Mendocino, Pt. Arena, Pt. Reyes, Davenport, Pt. Sur, Pt. Conception. 3. Finer-scale mapping of hard/soft substrata is currently underway and will be provided soon

3.1.1 Depth Categories

Based on information about fish depth distributions in California (Allen et al, 2006), the SAT has recommended considering habitats as they are represented in the following depth zones:

- Intertidal
- Intertidal to 30 m (0 to 16 fm, 0 to 98 feet)
- 30 to 100 m (16 to 55 fm, 98 to 328 feet)
- 100 to 200 m (55 to 109 fm, 328 feet to 656 feet)
- 200 m and deeper (109 fm and deeper, 656 feet and deeper)

The intertidal zone includes habitats such as sandy beaches, rocky shores, tidal flats, and coastal marsh that are subject to periodic tidal inundation. The 0-30m depth zone is considered the euphotic zone where light penetrates to support photosynthetic activity. Beyond 30m, light penetration diminishes and different assemblages of species occur. The depth zone from 100-200m is the approximate depth of the shelf-slope break, which is an area of high diversity characterized by both shelf and slope assemblages. At 200m and below the continental slope drops down to the abyssal plain where deep sea communities occur.

Several of the seven habitats mentioned in the MLPA occur in only one depth zone, while others may occur in several depth zones. The area of each subtidal depth range within the study region are provided in Table 2, based on CDFG 2005a delineation of depth zones using Geophysical Data System 91m resolution data. The vast majority of the study region is at depths less than 100m; deeper water habitats are rare in state waters.

Table 2: Depth Zone as Percent of North Central Coast Study Region

Depth Zone	Area (mi^2)	Percentage of Study Region
Intertidal to 30 m (0 to 16 fm)	300.9	37.9%
30 to 100 m (16 to 55 fm)	455.1	59.6%
100 to 200 m (55 to 109 fm)	5.0	0.7%
200 m and deeper (109 fm and deeper)	0.0	0.0%

Note: 0.3% of the study region is unclassified.

The continental shelf in the study region is relatively wide, especially offshore of the San Francisco Bay and gets narrower to the northern part of the study region. Deep water habitats (greater than100m) are very rare in the study region.

3.1.2 Intertidal Zones

The shoreline represents a transition zone between the marine and terrestrial environments and includes many important ecosystems and communities, most of which are intertidal. Intertidal zones that have been mapped as linear features along the coastline include sandy beaches, rocky shores, tidal flats, coastal marsh along the shores of estuaries and lagoons, and man-made structures such as jetties and seawalls (see Maps 2a-2f).

Rocky shores: Rocky shore habitats and their associated ecological assemblages are found throughout the study region. Rocky intertidal communities, from the splash zone to the lower intertidal, vary in composition and structure with tidal height and wave exposure (Ricketts et al. 1985; Foster et al 1988). Intertidal boulders, platforms, and cliffs, as well as tidepools, are home to many species of algae, barnacles, anemones, snails, mussels, crabs, sea stars, and fishes. Mussel beds (*Mytilus* spp.), sea palm (*Postelsia palmaeformis*), algal beds (*Endocladia muricata* and many other species), and surfgrass (*Phyllospadix* spp.) are patchily distributed along rocky shores but support high biodiversity. In addition to the tidal height and steepness, the underlying geology of a rocky coast can affect the ecological communities present (Foster et al., 1988). The following rocky shore types have been mapped in the north central coast study region by NOAA for the Environmental Sensitivity Index (ESI) program (2006) (Table 3):

- **Exposed rocky cliff**: Steep intertidal zone (greater than 30 degrees slope) with little width and little sediment accumulation. Strong vertical zonation of intertidal communities; barnacles, mussels, limpets, sea stars, anemones, crabs, and macroalgae abundant.
- **Exposed rocky cliff with talus boulder base/boulder rubble**: Same as above but with boulders at base of cliff.
- **Exposed wave cut rocky platform**: Includes flat rocky bench 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.
- **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, sea stars, snails, and crabs. Sheltered rocky shores are rare in north central California (Table 3); 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 coasts and around the Farallon Islands. Smaller stretches of rocky shores are interspersed with large sandy beaches along the San Francisco and San Mateo coasts. Throughout the 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.

Sandy Beaches: Significant expanses of continuous sandy shores areas occur along the San Francisco and San Mateo coasts, with shorter stretches of sandy beaches and pocket beaches along the Sonoma and Marin 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 is eroded from beaches in the winter and 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.

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 that feed at the waters 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 north central coast have been mapped as linear shoreline features and classified based on grain size:

- **Gravel beach**: Beaches composed of sediments ranging from pebbles to boulders; often steep with wave-built berms. Attached algae, mussels, and barnacles on lower stable substrata.
- **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.
- **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 scarce.
- **Fine to medium-grained sand beach**: Flat, wide, and hard-packed beach; significant seasonal changes in width and slope. Upper beach fauna scarce; lower beach fauna include sand crabs.

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.

Tidal Flats and Coastal Marsh: Tidal flats and marshes occur primarily around the edges of bays and estuaries (e.g. Bolinas Lagoon, Drakes Estero, Tomales Bay, Estero Americano, Estero San Antonio). Tidal flats are sandy or muddy expanses that are exposed at low tides and provide important foraging ground for shorebirds due to 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 (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 is defined by precipitation patterns and changes in freshwater inputs. The following shoreline types have been mapped as linear features of the coastline:

- **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.
- **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. Used as roosting site for birds and haulout site for marine mammals.
- **Sheltered tidal flats**: Includes intertidal flats comprised of silt and clay (e.g. mudflats). Present in calm water habitats and sheltered from wave exposure; frequently bordered by marsh. Soft sediments support large populations of worms, clams, and snails; important foraging area for migrating shorebirds.

Table 3 is a summary of the linear length and percentage of total shoreline (363.3 mi as measured by the shoreline segments) for each shore type (including man-made seawall and riprap) in the study region based on data from NOAA -ESI (2006). Rocky shores and sandy beaches dominate the shoreline; marsh and tidal flat habitats are found only in sheltered bays and estuaries.

Table 3: Summary of the Amount of Shoreline Habitats in Study Region

Shore Type	Length in Study Region (mi)	Percentage of Total Shoreline in Study Region[1]
Exposed rocky cliffs	40.9	11.1%
Exposed rocky cliffs with boulder talus base	2.4	0.6%
Exposed wave cut rocky platforms	106.8	29.0%
Sheltered rocky shores	17.6	4.8%
Boulder rubble	1.9	0.5%
Gravel beaches	29.1	7.9%
Mixed sand and gravel beaches	48.8	13.2%
Coarse-grained sand to granule beaches	24.1	6.5%
Fine to medium grained sand beaches	86.9	23.5%
Salt and brackish water marshes	52.6	14.3%
Freshwater marshes	0.5	0.1%
Exposed tidal flats	9.1	2.5%
Sheltered tidal flats	51.7	14.0%

Riprap (man-made)	12.5	3.4%
Sheltered riprap (man-made)	3.2	0.9%
Exposed seawall (man-made)	1.1	0.3%
Sheltered man-made structures (man-made)	1.2	0.3%
Total shoreline length in study region	367.6	

Notes: 1. Many areas of the shoreline have more than one shoreline type present, so percentages have been calculated using total length of shoreline (not sum of lengths of all types)

3.1.3 Estuaries and Lagoons

Estuaries form at the mouths of rivers and streams where freshwater and saltwater meet; the salinity in estuaries and lagoons varies seasonally and over longer timeframes when the river mouths get closed by sand spits or other barriers. Lagoons are coastal water bodies that are cut off from the sea and generally have low freshwater inputs. California's estuaries contain open water and soft-bottom habitats, as well as habitats described elsewhere, such as coastal marsh, tidal flats, and eelgrass beds.

The study region includes some relatively large permanent estuaries or embayments: Bolinas Lagoon, Drakes Estero, Tomales Bay, and Bodega Bay. Small estuaries or lagoons are found at the mouths of coastal rivers and include: the Garcia River estuary, Russian River estuary, Estero Americano, Estero de San Antonio, Olema Marsh, Livermore Marsh, Marshall Marsh, Estero de Limantour, Rodeo Lagoon, Pescadero Marsh, and many others (Maps 2a-2f). The aerial extent of estuaries in the north central coast study region totals 19.5 mi^2 or 2.5% of the region (Table 1). The maps of coastal estuaries represent a composite from multiple sources, including the National Wetlands Inventory, California Natural Diversity Database, NOAA-ESI, and topographic maps.

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 (Ramer, 1991). Anadramous species such as salmonids and lampreys must pass through estuaries on their migration pathways (Boesch and Turner, 1984). Steelhead trout in the north central coast spend a significant part of their juvenile phase in coastal estuaries (McEwan and Jackson, 1996). 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.

Gualala River Estuary: There is a large sand bar at the mouth of the Gualala River that is generally closed with seasonal opening; a lagoon forms behind the sandbar much of the year. The Gualala River has small populations of coho salmon and steelhead and the estuary serves as nursery area and migration corridor for these species. Other species fish found in the estuary include roach, coastrange, prickly sculpin, starry flounder, and Pacific staghorn sculpin.

The watershed for the estuary covers 298 square miles, and water quality has suffered due to upland forestry and agriculture (Klamt et al 2002) The Gualala River is listed as an imparied water body for temperature and sedimentation/siltation (http://www.ncwap.ca.gov/gualala/synth_report.html).

Bodega Bay: Bodega Bay 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 commercial and recreational harbor. Habitats present in the bay include tidal mudflats, sandflats, and marsh as well as protected shallow subtidal waters. It is a top birding spot in Sonoma County. (http://www.bml.ucdavis.edu/bmr/location.html).

Tomales Bay: Tomales Bay, in western Marin County, is the largest embayment in the study region and it covers 11 square miles. 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 thin (12 miles long and less than 1 mile wide) and has an average depth of 20 feet. 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: there is significant flushing from the mouth of the bay to Hog Island, sluggish mixing in mid-bay (Pelican Point to Double Point), and less exchange in the upper bay to the south (Smith et al. 1971 cited in Ghodrati 2004). The watershed area of the bay is approximately 216 square miles and includes four major drainages (Fischer et al. 1996). Tomales Bay is categorized as an impaired water body because of pathogens (Ghodrati 2004)

Tomales Bay has estuarine subtidal habitat, sheltered rocky shores, sheltered sand beaches, eelgrass beds, tidal flats, and coastal marsh. The Tomales Bay Biodiversity Partnership is conducting inventories of species and habitats in the bay. The bay is a top birding spot in Sonoma/Marin Counties; there are 163 species of birds known to occur there, with 122 species regular or occasionally observed (Kelly and Stallcup, 2004). The bay is an important stop and overwintering ground on the Pacific Flyway and shelters up to 20,000 shorebirds and 20,000-25,000 waterfowl. Productivity in the bay has been linked to both terrestrial and upwelling-derived nutrients (Smith and Hollibaugh 1997). 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 (NOAA 1990). 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 (Ackerman et al 2000) and diurnal (Matern et al 2000) cycles as well as associated changes in temperature and salinity (Hopkins and Cech 2003, Miklos et al 2003). During the winter, these species leave Tomales Bay, presumably due to changes in temperature (Hopkins and Cech 2003) and salinity (Meloni et al 2002). There are 150 species of fish and 200 species of algae 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 returning coho salmon population. There are marine mammal haulouts on protected rocks and beaches in the bay. (Tomales Bay Biodiversity Partnership, 2006; Tomales Bay Watershed Council 2003; Evens 1993).

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 aquaculture 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 is an important area for recreational fishing, clamming, kayaking, and wildlife viewing. The shores of Tomales Bay were home to coast Miwok.

Estero San Antonio: Estero de San Antonio is small shallow estuary that drains into Tomales Bay and is part of the Gulf of Farallones National Marine Sanctuary. It has about 90 acres of open water and 200 acres of coastal marsh habitat and also includes mudflats and rocky shores. The 59 square mile Stemple Creek watershed drains into the estero. The character of the estuary has changed over time with land use and it continues to be affected by sedimentation, poor water quality, and altered hydrology. It is a Critical Coastal Area and an impaired water body (nutrients, sediment, and low dissolved oxygen). It has fairly constant shallow depths of 6-13 feet. While it was historically fully tidal, it is now seasonally closed (during late spring, summer, and fall) and has poor circulation and variable salinity (it can be hypersaline). It remains closed until late fall or early winter flood flows breach the sandbar at its mouth. (Philip Williams Associates, 1993). The tidewater goby breeds in the shallow waters of this estuary (NOAA 2006) and Dungeness crabs use the estero's eelgrass beds as a nursery area (Rodriguez 2004).

Estero Americano: Estero Americano is slightly larger shallow estuary that drains into Bodega Bay at the Sonoma-Marin County line and is located just north of Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary. The estuary is consistently 7 to 13 feet deep and has approximately 300 acres of open water and 400 acres of wetland habitat, which includes mudflats, seasonal brackish marsh, and freshwater march (University of Rhode Island 2007, Rodriguez 2004). Americano Creek is the sole tributary of the estero and drains a 49 square mile watershed which includes grazed pastureland, dense willow thickets, and coastal oak woodlands. This creek is dry for 4 to 6 months between late spring and fall (Rodriguez 2004). Estero Americano has some documented water quality problems, including excess nutrients and sedimentation/siltation and is listed as a Critical Coastal Area and impaired water body. When the mouth of the estuary is open, the estero experiences tidal influence for 4 miles upstream of Americano Creek, though a seasonal sandbar that restricts tidal flow forms during some years and periods of hypersalinity have been recorded. A large mudflat in the middle reach of the estuary periodically restricts flow between the upper and lower estero. The estero supports a rich diversity of species including 71 species of water/marsh birds, 44 species of marine and freshwater fish, over 70 species of benthic invertebrates, and 30 species of epibenthic invertebrates as well as several special status species such as the northwestern pond turtle, steelhead, and the tidewater goby (Rodriguez 2004).

Drakes Estero: Drakes Estero is located in the Point Reyes National Seashore, just south of Point Reyes and adjacent to Estero de Limantour. The estuary covers approximately 2,270 acres during the highest tides, with the central estuary encompassing 1,300 acres. Drakes Estero is less than 6 feet deep in most places, though the central channel is 25 feet deep, and connects to Drakes Bay via a narrow, 21 foot deep inlet. The estuary is protected from wave action by sand spits a Drakes and Limantour beaches and receives freshwater from 6 perennial

and 4 ephemeral streams that drain approximately 13.5 square miles of coastal scrub and grassland. The mudflats, sandflats, and eelgrass beds of the estuary support several native clam species and serve as important habitats for the larval and juvenile stages of lingcod, English sole, speckled sanddab, several species of nearshore rockfish, Dungeness crab, Pacific herring, and several shrimp species. Over 60 species of fish have been documented in the estero and over 100 species of shore and water birds have been observed in the winter, including special status birds such as Osprey, White Pelicans, Brown Pelicans, Peregrine Falcons, Black Brants, Western Snowy Plovers and Marbled Murrelets. Harbor seals inhabit the estuary year-round. Human activities affecting the estuary include recreation (such as kayaking), as well as cattle grazing and oyster farming. Only one company has a mariculture lease in the estuary and it is set to expire in 2012. Drakes Estero is the only Federal Marine Coastal Wilderness on the US west coast, south of Alaska, and is a Site of Regional Importance under the US Shorebird Conservation Plan, in addition to being located within both the Point Reyes National Seashore and the Gulf of the Farallones National Marine Sanctuary (NPS 2006).

Estero de Limantour: Estero de Limantour is an extensive salt water and brackish marsh system located to the east of Drakes Estero that is popular for both birdwatching and kayaking (Point Reyes National Seashore 2004). The estero covers nearly one square mile of area and is separated from the ocean by a Limantour spit (USEPA 2002). Muddy Hollow Creek is one of the key tributaries to the estero, though dams constructed in the 1950s and 60s restrict the water and sediment that flows to the estuary (Collins and Ketcham 2005). The estero, which was characterized as an impaired water body for pathogens in 2002, is dominated by pickleweed and inhabited by federally protected coho salmon and steelhead trout (Point Reyes National Seashore 2004, USEPA 2002, Collins and Ketcham 2005).

Bolinas Lagoon: Bolinas Lagoon is a 1,500 acre lagoon just south of the Point Reyes National Seashore with a 16.7 square mile watershed that includes Pine Gulch creek. Within the watershed, 75% of the land has been set aside for conservation purposes (Rodriguez 2004). Bolinas Lagoon empties into the ocean through a narrow channel at the north end of the sandspit at Stinson Beach. Habitats present in the lagoon include open water estuarine habitat, subtidal channels, eelgrass beds, mudflats and sandflats, saltmarsh and brackish marsh, and a flood shoal island. There are numerous species of shorebird and waterfowl that winter at the lagoon including the clapper and black rails, the saltmarsh common yellowthroat, and the California brown pelican, which are special status species (Rodriguez 2004). Harbor seals haul out on tidal flats in the lagoon. A restoration effort has been proposed in the lagoon in recent years and a feasibility study was conducted in 2002 (more information on this effort can be found at: http://www.spn.usace.army.mil/projects/bolinaslagoon and http://www.bolinaslagoon.org)

Pescadero Marsh: Located 35 miles south of San Francisco and covering approximately 588 acres, Pescadero Marsh is the largest wetland between San Francisco Bay and Elkhorn Slough (Agriculture Water Quality Alliance 2006). Both Pescadero and Butano creeks flow into Pescadero Marsh and drain 81 square miles of mostly wooded land. The estuary contains salty, brackish, and freshwater habitats that are important for salmonoids, including steelhead juveniles and smolts during late spring to early summer and adult steelhead in winter and early

spring (ESA 2004). The marsh also provides habitat for other special status species, including brackish water snails, red-legged frogs, the San Francisco garter snake, black and clapper rails, tidewater gobies, and coho salmon. Much of the watershed is used for commercial forestry and 5% of the watershed is used for agricultural production and some urban development has occurred (Agriculture Water Quality Alliance 2006). Both Pescadero and Butano Creeks are listed as Critical Coastal Areas and impaired water bodies (for sediment). The estuary itself is included in the Pescadero Marsh Natural Preserve.

3.1.4 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 (Abbott and Hollenberg 1976). It is a flowering plant, not an alga, and occurs in dense beds. 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 (Hoffman, 1986).

Eelgrass beds cover much of the mud bottoms of Tomales Bay, Drakes Estero, Bolinas Lagoon, and the smaller esteros. Eelgrass beds have been mapped in Tomales Bay and Drakes Estero and cover less than 0.8% of the study region (Table 1). Total coverage of eelgrass beds is approximately 6.0 mi^2 (see Maps 2a-2f).

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 meters below the zero tide level. The distribution of surfgrass along the north central coast study region has been mapped by the Minerals Management Service as linear segments that total 68.8 mi or 18.9% of the shoreline.

3.1.5 Kelp Forests

Kelp forests (also called kelp beds) within the study region are formed predominantly by canopy-forming bull kelp, *Nereocystis lutkeana* (Foster and Schiel 1985). Giant kelp dominates most kelp forests south of Davenport (outside of this study region). North of Davenport, bull kelp (*Nereocystis luetkeana*) becomes the dominant kelp. Kelp beds are persistent over time but exhibit marked seasonal and annual changes in the extent of the canopy, primarily due to winter storm activity and changing oceanographic conditions such as El Niño events (Ebling et al., 1985; Harrold et al., 1988; Zimmerman and Robertson, 1985).

Kelp beds are found primarily along the northern half of the north central coast study region (Sonoma coastline) where hard substrata is available in the nearshore; kelp beds are small and rare in the southern half of the study region. Kelp reproduces by spores. Although these spores may be viable up to a mile away, experiments have shown that recruitment density rapidly declined with distance from the adult stand; significantly lower recruitment was observed as little as 10 feet from adults (CDFG 2001). The kelp forests in the study region are well mapped at fine-scale resolution based aerial surveys in 1989, 1999, 2002, 2003, 2004, and 2005 by

CDFG. Total kelp abundance in the study region over the 6 survey years has ranged from a high of 3.4 mi^2 in 1989 to a low of 0.9 mi^2 in 2005.

Kelp forests are one of the most productive marine habitats along the coast of California and provide habitat and nursery areas for many species of fishes and invertebrates (Foster and Schiel 1985). Studies have shown that distribution and abundance of kelp beds and successional processes are affected by climatic and oceanographic changes, abundance of urchins and other grazers, as well as certain types of fisheries (Pearse and Hines 1979; Tegner et al 1997; Tegner and Dayton 2000). Kelp beds are important habitat and feeding grounds for many species. Juveniles of many nearshore rockfish species occur in the midwater or upper kelp canopy (Allen et al 2006). Juveniles and adults of many nearshore rockfish species, as well as cabezon, greenlings, lingcod, and many other species, associate with bottom habitats in kelp forests (Allen et al 2006). Sea otters, which have an important structuring role in kelp forest communities, occur in the southern part of the study region and are increasingly sighted as far north as Point Reyes.

There are no commercial kelp harvest leases in the north central coast study region. The administrative status of all kelp beds in the study region is “closed”.

3.1.6 Sandy/Soft Bottoms

Soft bottom habitats are the predominant habitat on the continental shelf and slope throughout the region (Eittreim, 2002). Nearshore and offshore environments include soft bottom habitats in areas that range from flat expanses to slopes. Soft bottom habitats lack the structural complexity and relief of hard-bottom substrata and are generally dominated by bottom dwelling invertebrates and fishes; assemblages differ with depth (Allen et al., in press; Johnson et al 2001). Soft bottom habitats can be highly dynamic in nature as sediments shift due to wave action, bottom currents, and geological processes. In erosional settings, landslides and slumps can extend offshore.

Soft bottom habitats predominate over hard bottom habitats in all depth zones (Table 4, Maps 3a-3f). Soft-sediment communities reach their peak in diversity of invertebrate epifauna and infauna around 70-230m, especially in areas where the shelf is wide and riverine input is present (J.Oliver, Moss Landing Marine Laboratory, pers.comm). Soft-bottom habitats in different depth zones should be considered separate habitats (CDFG 2005a).

Spatial mapped data on hard and soft bottom habitats are available for the entire study region at a coarse scale (1:250,000) based on data compiled by Greene et al (2004) for the *Fisheries Habitat Characterization of the California Continental Margin*. It is important to note that this coarse-scale habitat mapping includes very little data in near-shore state waters and over-represents the amount of soft bottom relative to hard bottom. Table 4 shows hard and soft bottom habitats by depth zone in the study region (Greene et al. 2004 coarse scale data). More refined seafloor habitat mapping for the north central coast study region is underway and preliminary results should be available in spring 2007.

Table 4: Approximate Amount of Hard and Soft Bottom Habitats by Depth Zone in Study Region

Depth Zone	Hard Substrata, mi^2 (% of depth zone area)	Soft Substrata mi^2 (% of depth zone area)
0-30m	63.5 (21.2%)	237.2 (78.8%)
30-100m	53.8 (11.8%)	401.3 (88.2%)
100-200m	0.0 (0.0%)	5.0 (100%)
>200m	0.0 (0.0%)	0.0 (0.0%)
Total	117.2 (15.4%)	643.5 (84.6%)

Note: These estimates based on Greene et al 2004 coarse-scale data and underestimate the amount of hard-substrata.

3.1.7 Hard Bottom / Rocky Reefs

Hard bottom habitats (also called “rocky reefs”) have been mapped only at a coarse-scale for the entire study region (Map 3a-3f); however, these data do not provide much detail, especially in near-shore waters, and greatly under-represent the amount of hard bottom. Several known rocky reefs exist within the study region and appear on nautical charts, including Saunders reef, Robinson reef, Sunken Reef, and Duxbury reef (Starr and Green 2007). More refined seafloor habitat mapping for the north central coast study region is underway and preliminary results should be available in spring 2007.

Rocky substrata are much less common than soft substrata in the region at all depth zones (Table 4). 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. (Cross and Allen, 1993). Rocky reefs provide hard substratum to which kelp and other alga can attach in the nearshore (<30m depth). In addition, many invertebrates such as deep sea corals, sponges, and anemones require hard substratum for attachment in deeper waters (Engle and Coyer, 1981). In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish (Carr, 1991; CDFG, 2001). Hard bottom habitat in each depth zone should be considered separate habitats (CDFG 2005a).

The ecological assemblages associated with rocky habitats can also be influenced by the type of rock (example, sedimentary versus granitic reefs or size of substrata, such as cobble versus boulder). Rocky reefs in each of these geologically-distinct zones should be considered separate habitats (CDFG 2005a).

3.1.8 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 (Gary Greene, Moss Landing Marine Laboratory, pers.comm).

Pinnacles are located in state waters along the north central coast but have not been mapped; they can be important bathymetric features that attract certain fish and invertebrate species (Carr, 1991; CDFG, 2001).

3.1.9 Submarine Canyons

There are no major submarine canyons in state waters in the north central coast study region. However, there are some major canyons well offshore in federal waters, including Bodega Canyon and Pioneer Canyon. Submarine canyons provide areas of high bathymetric complexity, support deep water communities, and effect local and regional circulation patterns. Offshore canyons provide habitat for adult stages of rockfish and flatfish that rear in nearshore waters and move offshore in their adult stages. In addition, offshore canyons and other bathymetric features are important foraging areas for seabirds and marine mammals (Yen et al 2004).

3.1.10 Oceanographic Habitats

The SAT recommended that habitat definitions in the MLPA be expanded to include oceanographic features that significantly affect productivity, ecological assemblages, and recruitment patterns. While highly complex and dynamic, some oceanographic features are relatively predictable or persistent and can be considered important habitats for spatial planning of MPAs.

In north central California, the main currents are the southward flowing coldwater California Current which is located far offshore (90-130 miles off the shelf-slope break) and the subsurface northward flowing warm water Davidson Current (just offshore of the shelf-slope break). The flow of the California Current is reduced in the winter and the Davidson Current becomes the dominant large current. Ocean circulation patterns are affected by winds, ocean temperatures and salinities, tides, coastal topography, and ocean bottom features (Breaker and Broeknow, 1994).

The study region is characterized by three “seasons” driven largely by oceanographic conditions. The seasons are the upwelling season, wind relaxation period, and winter storm period (Table 5). Upwelling of cold nutrient rich waters occurs in early spring and summer and generally peaks in May and June; however, there is significant variability in upwelling between years and with latitude (Pennington and Chavez, 2000). Upwelling is also associated with coastal features, such as headlands, and bathymetric features such as the shelf-slope break and offshore banks (Service et al., 1998).

Point Arena and Point Reyes are the significant upwelling centers in the north central coast study region; however, the entire area from Point Arena to the Devils Slide Rock area in San Mateo is connected by upwelling along the entire Sonoma Coast and Point Reyes area and the circulation patterns of the Gulf of the Farallones (Maps 4a and 4b).

Table 5: Oceanic Seasons in North Central California

Oceanic Season	Typical Months	Characteristics
Upwelling season	March – August	Upwelling is variable in duration and intensity; generally upwelling episodes are sustained for 7-10 days.
Wind relaxation	August – November	Winds are light and seas generally calm during the relaxation period.
Winter storms	November – March	Low pressure systems from Alaska generate southerly winds, large waves, and storms. The northward flow of the Davidson Current is enhanced during this season.

The California Current is also characterized by highly variable oceanographic conditions. The El Niño-Southern Oscillation is a large-scale change in atmospheric pressure, trade winds, and sea surface temperatures of the tropical Pacific that occurs every few years and has significant effects on the California Current System. During El Niño – Southern Oscillation events, there is a reduction in upwelling of cold nutrient rich waters, increased onshore and northward flow, increased sea surface temperature, and increased northward advection of warm subtropical waters. El Niño – Southern Oscillation events generally result in a decline in zooplankton and reductions in productivity that can affect fish, seabird, and marine mammal populations (Benson et al., unpublished; Marinovic et al., in press). Longer term decadal and multi-decade climatic cycles also affect a wide variety of marine organisms. Changes in atmospheric circulation in the central and northern Pacific and other factors yet unknown result in shifts in mean sea surface temperature every 20-30 years that have large-scale impacts on zooplankton and fish productivity throughout the region; the effects of these climatic regime shifts (called Pacific Decadal Oscillations) are just now being studied.

Oceanographic processes such as currents, water masses, and temperature influence marine biodiversity. Variation in factors such as water temperature, upwelling and currents determine areas of productivity where krill, squid, anchovy, seabirds, and marine mammals congregate in the pelagic ecosystem (Forney, 2000; Yen et. al., 2004). There are at least three types of bathymetric and oceanographic features that can be associated with biodiversity hotspots: bathymetric features (such as the shelf-slope break and the associated waters), predictable hydrographic features (such as fronts associated with currents and water masses) that persist temporally, and ephemeral hydrographic features such as upwelling plumes, eddies and filaments (Pelagic Working Group 2002; Yen et al 2004).

In addition, oceanographic processes and cross-shelf transport can significantly affect recruitment patterns of fish and invertebrates in intertidal and nearshore communities (Farrell et al 1991; Roughgarden et al 1991; Wing et al 1995). Strong upwelling and upwelling shadows south of major headlands can affect settlement of invertebrates, with crabs and urchins settlement correlated with relaxation events along the coast north of Point Reyes (Wing et al 1995). The importance of these processes and their predictability over time is leading to a greater emphasis on identifying persistent oceanographic features, such as upwelling areas, retention areas, and freshwater plumes as important influences on regional productivity, recruitment patterns, and the movement and distribution of many species. These features are very dynamic in space and time and therefore difficult to capture in static maps.

Upwelling zones: Major upwelling cells are typically found during the upwelling season at Point Arena, Point Reyes, and further south at Davenport (outside the study region). The north central coast study region has 2 of the 6 major upwelling centers in California. Upwelling centers at Point Arena and Point Reyes, as well as coastal upwelling along the Sonoma coast, are areas where seasonally cold nutrient rich waters rise to the surface near shore and are advected far offshore as eddies and jets. During the upwelling season, the entire area from Point Arena to the Gulf of Farallones is characterized by cold nutrient rich waters and there are no visible breaks between the upwelling centers (see Map 4). Map 4a shows seasonal sea surface temperature and chlorophyll levels developed by summarizing monthly averages for temperature (1996-1999) and chlorophyll (1998-2000) in 9 kilometer grids. The maps are representative of upwelling, intermittent upwelling, and winter storm periods. Map 4b shows sea surface tempertures prior to El Niño (August 1996-April 1997) and during El Niño (August 1997-April 1998); data presented are averaged for the given month and summarized in a 9 kilomter grid (borrowed with permission from Airame et al. 2004).

Upwelling is typically defined based on variation in sea surface temperature during the spring-summer upwelling season (March –September). Upwelling often peaks around and south of major headlands, resulting in sections of the coast being either upwelling dominated or in upwelling shadows (Graham and Largier, 1997). Large upwelling zones often result in the generation of offshore jets and squirts, where surface waters are carried tens to hundreds of kilometers offshore. Upwelling events typically last on the order of days or weeks.

Retention areas: Longshore coastal currents interact with headlands or other coastal features causing the formation of headland eddies or upwelling shadows on the lee side of headlands, especially where embayments occur (Graham and Largier, 1997). These eddies and upwelling shadows increase the retention (or reduce the dispersion) of planktonic organisms, and areas where they occur are considered retention areas (Largier, 2004). Even small embayments in the lee of small headlands can be localized retention zones (Roughan 2005; Wing et. al. 1998). Maps of retention areas are not available for the region. However, recent studies indicate that the Gulf of the Farallones is an important retention area for larvae (high concentrations of rockfish and crab larvae south of Point Reyes) that settle near the coast and to the north via a poleward movement of water during the relaxation period (Wing et al 1998).

River plumes: Freshwater flowing out of larger coastal rivers is lighter and warmer than the continental shelf waters and is visible as a distinct plume. In the region, coastal rivers and streams introduce freshwater, sediment, nutrients, and pollutants into localized nearshore waters. While typically localized in impact, these plumes can reach hundreds of kilometers offshore following El Niño storm events (Kudela and Chavez, 2004). Maps of rivers plumes are not available; however, large rivers in the region include the Garcia River (empties into the ocean just north of Point Arena), Gualala River, Russian River, San Joaquin and Sacramento Rivers (emptying into the ocean under the Golden Gate Bridge).

San Francisco Bay is the largest estuary on the West Coast and freshwater from the entire Central Valley of California drains into it. Ebb flows during spring tide can reach 6 knots. The

estuarine water flowing out of the Golden Gate is lighter and warmer than the continental shelf waters and is visible as a distinct plume. This tidal plume reaches its greatest extent during the spring snowmelt and this tidal front is an important foraging area for seabirds, especially from the large colonies on the Farallon islands (Largier, J.L., 1996, Wilkerson et al 2002). The plume exits the bay and extends out to the 30-40m contour, 20 miles from shore, and bends southward, as described in a study of continental shelf currents (Noble 1998, Karl et al 2001). High-frequency radar is being used to improve numerical circulation models in areas outside of the bay, including the Gulf of the Farallones.

3.1.11 Rocks and Islands

While not a habitat identified in the draft Master Plan (CDFG 2006), rocks and offshore islands in the study region represent important and unique areas of rocky intertidal habitat, shallow habitats offshore from the mainland, and important nesting/breeding areas for seabirds and marine mammals.

Farallon Islands: The four islands comprising the Farallon Islands are located 28 miles west of San Francisco and 20 miles south of Point Reyes. Situated in a large coastal upwelling center and supplemented with nutrients discharged from the San Francisco Bay estuary, these islands are an important biological hotspot along the California Coast. Twelve species of seabirds, including over 250,000 individuals, breed on the islands, including Leach's storm-petrel, the Ashy storm-petrel, Fork-tailed storm-petrel, Double-crested cormorant, Brandt's cormorant, Pelagic cormorant, Black oystercatcher, Western gull, Common murre, Pigeon guillemot, Cassin's auklet, Rhinoceros auklet, and Tufted puffin (USFWS 2002). In fact, the Farallon Islands have the largest number of breeding seabirds of any location in the lower 48 states (Mills et al 2005). The islands also have at least 35 regular visiting species, including Pacific and red-throated loons, red-necked and western grebes, black-footed albatross, pink-footed, Buller's, and black-vented shearwaters, herring and glaucous-winged gulls, black and surf scoters, the endangered California brown pelican, and the federally threatened marbled murrelet (Karl et al 2001).

At least 33 species of marine mammals visit the waters adjacent to the Farallon Islands, including the federally endangered blue, humpback, fin, sei, right, and sperm whales, and six pinnipeds breed or haul out on the islands, including the Northern fur seal, Guadalupe fur seal, Steller's sea lion, California sea lion, Harbor seal and Northern elephant seal (Karl et al 2001, USFWS 2002). The Farallones are also an important feeding ground for white sharks, which are protected by California state law and several international treaties (Karl et al 2001). In recognition of the Farallon Islands' rich biological value, the islands were designated a national wildlife refuge in 1909 (protection expanded in 1969). Further protection was given to the area with the designation of the Farallon Islands State Game Refuge in 1971, the Gulf of the Farallones National Marine Sanctuary in 1981, and the Farallon Islands Ecological Reserve (now State Marine Conservation Area) in 1991. In 1988, the Farallon Islands were internationally recognized as part of the UNESCO Golden Gate Biosphere Reserve. The islands and their surrounding waters have been used by humans in the past for harvesting fur seals and seabird eggs as well as a disposal location for dredge material and nuclear waste. A lighthouse, originally constructed in 1853, is located on Southeast Farallon Island. Today, the

Farallon Islands are used primarily for long-term ecological research and as a wildlife viewing location, though public access is limited. Point Reyes Bird Observatory Conservation Science, in cooperation with the US Fish and Wildlife Service, has been conducting year round, continuous wildlife research, monitoring, and stewardship in the Farallones since 1968 and has specific programs that focus on seabirds, terrestrial birds, white sharks, seals and sea lions (PRBO 2005, USFWS 2002; Warzybok et al 2006). Data showing areas of biodiversity for marine birds and mammals in the Farallon Islands and throughout the study region are shown in maps 5a-5f.

Other Rocks/Islets: Statewide, over 20,000 islands, rocks, exposed reefs and pinnacles are included in the California Coastal National Monument, which was designated by presidential proclamation in January of 2000 and runs along the entire California coast (1,100 miles). The monument is designed to protect the biologic and geologic values of these features and the important forage and breeding grounds of associated marine birds and mammals. Some of the notable offshore rocks with seabird colonies located within the north central coast study region include:

- Hog Island in Tomales Bay
- Bird Rock near Tomales Point
- Double Point Rocks, Point Resistance Rocks, and Millars Point Rocks, south of Point Reyes
- Devil's Slide Rock and San Pedro Rock on the San Mateo coast
- The Farallon Islands

3.2 Important Regional Species

A brief discussion of regional species likely to benefit from establishment of MPAs, species currently described as depleted or overfished, and species that receive special protections due to their legal status (protected, threatened, or endangered) is provided below.

3.2.1 Species likely to benefit from MPAs

The MLPA requires that species likely to benefit from MPAs be identified. The identification of these species will contribute to the identification of habitat areas that will support achieving the goals of the MLPA. The SAT for the central coast process drafted a list of species likely to benefit from MPAs (see Appendix II for the list for the central coast, with information on life history). It is anticipated that the SAT assembled for the north central coast study region will review and refine the list for this study region.

Species were included in the central coast list if they meet one or more of these conditions:

- They occur in the study region.
- They are taken directly or indirectly in commercial and/or recreational fisheries.
- They have life history characteristics that make them more conducive to protection by MPAs, such as: sedentary behavior, long life spans, slow growth, or associations with

> habitats that need additional spatial protection. An MPA would be expected to increase the species abundance or spawning biomass if the species is at an abnormally low abundance or abnormally low size frequency (i.e. below the range of natural fluctuations).

While this list is approximate, it should be noted that there are other species that may benefit or even diminish from the establishment of an MPA. In addition, it should be noted that many species have not yet been assessed for abundance or size frequency or their full life history requirements are not yet known.

3.2.2 Depleted and Overfished Species

In its second goal in Section 2853(b), the MLPA refers to the term "depleted" in reference to marine life populations.

State Managed Fisheries: While there is no formal definition for this term as related to state fisheries management, the CDFG applies this term to five species of abalone, all of which were previously harvested commercially.

The Marine Life Management Act includes the following definition of a "depressed" fishery:

> "Depressed," with regard to a marine fishery, means the condition of a fishery for which the best available scientific information and other relevant information that the Commission or Department possesses or receives indicating a declining population trend has occurred over a period of time appropriate to that fishery. With regard to fisheries for which management is based on maximum sustainable yield, or in which a natural mortality rate is available, "depressed" means the condition of a fishery that exhibits declining fish population abundance levels below those consistent with maximum sustainable yield.

Federally Managed Fisheries*:* The Magnuson Stevens Fishery Conservation Management Reauthorization Act of 2006 defines "overfishing" and "overfished" as a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce a maximum sustainable yield on a continuing basis (GovTrack.us 2006). The National Marine Fisheries Service (NMFS) has applied the Magnuson Stevens Act to develop a formal definition for the term "overfished": any stock or stock complex whose size is sufficiently small that a change in management practices is required to achieve an appropriate level and rate of rebuilding (www.pcouncil.org/facts/acronyms.pdf). The term generally describes any stock or stock complex determined to be below a minimum biomass threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized. The rebuilding target is 40% of unfished levels for stocks such as groundfish. Any species assessed to be between 40% and 25% are managed under "precautionary zone" management, where harvest rates are reduced to slow depletion rate.

It should be noted that many species have not yet had their populations assessed. General information on what is known about the status of harvested species can be found in *California's*

Marine Living Resources: A Status Report (CDFG 2001 and CDFG 2004a) at www.dfg.ca.gov/mrd/status/. In addition, information on species managed by the Pacific Fishery Management Council can be found at www.pcouncil.org/groundfish.

Abalone: Currently all five major species of abalone in central and southern California are depleted, a result of cumulative impacts from commercial harvest, increased market demand, recreational fishery expansion, an expanding population of sea otters, pollution of mainland habitat, disease, loss of kelp populations associated with El Niño events, and inadequate wild stock management CDFG (2001). Only red and black abalone are distributed within the North Central Coast study region, although black abalone are relatively rare.

A recreational fishery for red abalone occurs north of a line drawn through the center of the mouth of San Francisco Bay. The use of scuba or surface-supplied air to take abalone is prohibited. Currently, management of the sport fishery is guided by the Abalone Recovery and Management Plan (CDFG 2005b). Under the interim management plan in the Abalone Recovery and Management Plan, the northern sport red abalone fishery continues with existing regulations that control take and provides for a sustainable fishery. The interim management plan employs a loose total allowable catch that is adjusted by the use of size limits (7 inches minimum), seasonal closures (Dec. through March and July), catch limits (both daily bag limit of three and annual limit of twenty-four) and an abalone taken reporting system (punch card). Possible adjustments to the total allowable catch can happen every three years based on fishery independent assessment of eight index sites and overall annual take estimated from punch card information.

The Abalone Recovery and Management Plan has recommendations on the use of MPAs for abalone management and recovery. The plan advises that new or expanded MPAs should be established to address the shortcomings of the current MPAs, including an insufficient range of habitats and scientific understanding of abalone population dynamics. Specific areas are not delineated, but criteria are proposed for consideration in the MLPA process.

The recovery of sea otters has resulted in suppressed populations of abalone where sea otters occur (Hines and Pearse, 1982). The Abalone Management Plan states that abalone recovery (i.e. to a status in which a fishery may be permitted) may not be possible within the established range of sea otters. Sea otters occur in the study region from Pigeon Point to approximately Half Moon Bay (CDFG 2001). So this interaction between sea otters and abalone should be considered in this area.

Groundfish (rockfishes, flatfishes, etc): There are seven federal groundfish species which are currently declared by NMFS to be overfished (note: lingcod was under a rebuilding plan until 2006, when it was found to be rebuilt). Six of the seven overfished groundfish species occur within the North Central Coast study region:

- Bocaccio
- Canary rockfish
- Cowcod
- Darkblotched rockfish

- Widow rockfish
- Yelloweye rockfish

The seventh, Pacific Ocean perch, is uncommon within the study region. Five of the overfished species are distributed primarily on the shelf, while darkblotched rockfish is found primarily on the slope. Based on their life history traits and habitat requirements (Yoklavich 1998; Parker *et al*. 2000; Parrish *et al*. 2000), the shelf species in particular could potentially benefit from the establishment of MPAs, including MPAs in which the primary goal is not related to fishery management, if appropriate habitats are protected in a way that is consistent with the life history and behavior of the species. It should be noted that as a result of fishery closures recommended by the Pacific Fishery Management Council and implemented by NMFS, overfishing of the above mentioned groundfish species is no longer occurring. However, the rebuilding plans for these species will take considerable time (decades) to achieve success; until then, these species continue to be considered as overfished and are managed under federal rebuilding plans. In addition to these species, several groundfish species are considered by NMFS to be in the "precautionary zone" – a population level that is below the level capable of producing Maximum Sustainable Yield (defined federally as below 40% of unfished biomass).

Copper rockfish, another shelf rockfish species that has not yet been formally assessed, is considered to be vulnerable to and may have already undergone localized depletion (CDFG 2001). This species occurs within the study region and is a good candidate for benefiting from additional protection through the establishment of MPAs.

The concern over shelf rockfish species is evidenced by the establishment of significant recreational and commercial fishery closures in 2002, in the form of Rockfish Conservation Areas (RCAs). Within the study region in 2007, the depth-based recreational RCA and non-trawl commercial RCA each cover approximately 31.5% of the study region with full-time closures focused primarily on the shelf. These area closures and accompanying small optimum yields (a form of annual catch limit), are significantly limiting factors in the study region and federal waters, and often prevent access to healthy stocks of fish (with the exception of nearshore stocks).

In addition, the Nearshore Fishery Management Plan identified MPAs as a management strategy appropriate for nearshore fish stocks, but deferred implementation of any new MPAs for meeting Nearshore Fishery Management Plan objectives to the MLPA process. The 19 species covered by the Nearshore Fishery Management Plan are: black rockfish, black-and-yellow rockfish, blue rockfish, brown rockfish, cabezon, calico rockfish, California scorpionfish (not found within study region), California sheephead (sparse within the study region), China rockfish, copper rockfish, gopher rockfish, grass rockfish, kelp greenling, rock greenling, kelp rockfish, monkeyface eel, olive rockfish, quillback rockfish, and treefish.

Areas of importance for demersal (bottom-dwelling) fish density and diversity in the top 20th percentile, as mapped by the NOAA Biogeographic Assessment off North / Central California, are shown on Maps 6a and 6b. Identification of these fish diversity and density hotspots was

based on data from CDFG hook and line recreational data (for the 5-200m range) and NMFS shelf, slope, and midwater trawl data (NOAA 2004).

3.2.3 Special Status Species

Some fish, marine mammals and seabirds of the north central coast study region, whose populations have declined, receive special protections under either the state or federal Endangered Species Act (ESA). In addition, marine mammals are protected under the Marine Mammal Protection Act and migratory seabirds and shorebirds in the study region are protected under the Migratory Bird Treaty Act. Many of these species are also highly mobile.

The presence of MPAs along the north central coast can help to provide healthy ecosystems and habitats that support the full range of biodiversity, including declining populations of special status plants and animals. In addition, protection of seabird and marine mammal nesting and rookery sites, juvenile nursery habitat (such as estuaries for salmonids and flatfish), areas identified as critical habitat, and important foraging areas within MPAs can help to provide additional protections, increase public awareness, and support monitoring and enforcement efforts.

Some specific locations in the north central coast study region host many special status species. Tomales Bay, for instance, has California freshwater shrimp, tidewater gobies, coho salmon, steelhead trout, Pacific herring, as well as pinnipeds, like Steller sea lions, and numerous birds, like the western snowy plover (The Tomales Bay Watershed Stewardship Plan 2003). The Farallon Islands, on the other hand, is the largest U.S. seabird colony south of Alaska and contains 30% of California's nesting seabirds. The Farallon Islands host 12 species of nesting seabirds (including the ashy storm-petrel, Brandt's commerant, pelagic commerant, Cassin's auklet, rhinocerous auket, and tufted puffin (Mills et al 2005) and at least 33 species of marine mammals, including the federally endangered blue, humback, fin, sei, right, and sperm whales and the federally threatened steller sea lion, guadalupe fur seal, and southern sea otter (Karl et al 2001). Point Reyes National Seashore is home to over 30 species of federally recognized endangered, threatened, and species of concern dependent on coastal and marine environments. A complete list of these species can be found at: http://www.nps.gov/archive/pore/nature_wldlf_tande.html.

A complete listing of State listed endangered or threatened species updated October, 2006 can be found at: http://www.dfg.ca.gov/whdab/pdfs/TEAnimals.pdf. A complete listing of Federally listed endangered or threatened species updated November of 2006 can be found at http://www.nmfs.noaa.gov/pr/species/esa.htm.

A list of special status species expected to occur in the region compiled by the MBNMS and edited with information from the GFNMS and PRBO is provided in Appendix IIc. A brief description of selected species follows.

In addition, Point Reyes Bird Observatory Conservation Science recently compiled information regarding abundance and distribution of birds and marine mammals in the Gulf of the

Farallones in addition to other locations. This information can be viewed at: http://www.prbo.org/cms/docs/marine/CCS_Seabird_Mammal_Atlas.pdf.

Coho and chinook salmon and steelhead trout: Three species of salmon and steelhead trout (*Oncorhynchs* spp.) are considered endangered or threatened under the Endangered Species Act in the north central coast study region: Coho and Chinook Salmon and Steelhead Trout. Two Evolutionarily Significant Units (ESUs) of Chinook Salmon (*O. tshawytschus*) are listed as threatened. One is the California Coastal ESU, which includes the Russian River where populations are slowly increasing and were over 1,300 fish between 2002 and 2004. The other threatened Chinook Salmon ESU is the Central Valley Spring Run ESU, which has only three wild populations left in Mill, Deer, and Butte Creeks (fish have also recently returned to Big Chico Creek), mostly due to blocked access to traditional spawning areas by dams, which impair salmon migration. The Sacramento River Winter Run ESU, which was greatly affected by the construction of Shasta Dam, is listed as endangered and had escapement as low as 200 in during the 1990's. However, these numbers have increased to almost 10,000 female spawners in 2004. Both the Sacramento River and Winter Run and Central Valley Spring Run ESUs have spawning habitat outside of the study region; however, these fish populations inhabit California coastal waters during their adult lives and pass under the Golden Gate on their inland migration. In 1994, the Chinook Salmon fishery in the Farallon Islands, where they live during some of their adult stage, was valued at $24 million (Karl et al 2001).

One ESU of Coho Salmon (*O. kisutch*), the Central California ESU, is listed as endangered. This ESU runs from Punta Gorda in the north to the San Lorenzo River in the south. Of the 133 historical runs, only 56 (or 42%) are now considered occupied. The highest occupation is in Mendocino County (62% of historical runs), followed by Marin (40%), Sonoma (4%), and San Francisco Bay tributaries (0%). Central California Coho Salmon return to major rivers in the study region, including the Garcia, Gualala, Russian, and Tomales Bay Rivers, as well as numerous smaller creeks (Good et al 2005).

Three ESUs of Steelhead (*O. mykiss*) are listed as threatened in the north central coast study region. The Northern California ESU ranges from Redwood Creek in Humboldt to the Gualala River and is found in both the Garcia and Gualala Rivers. The Central California Coast ESU ranges from the Russian River, which probably hosted the largest historic population, to Soquel Creek, and includes some tributaries in San Francisco and San Pablo Bays. Both the Northern California and Central California Coast ESUs have benefited from a prohibition of ocean harvest of steelhead enacted in 2002. The California Central Valley ESU is also listed as threatened and it has been estimated that 95% of their traditional spawning habit is inaccessible due to dams, though they are thought to be widespread, if not abundant, in accessible streams and rivers. (Good et al 2005)

These species of salmon and steelhead are of a highly migratory nature and are not likely to directly benefit from the establishment of marine MPAs; however, due to their dependence on healthy estuarine environments during juvenile stages, estuarine MPAs where runs persist may benefit these species. Stream outlets with recent presence of these three salmonid species have been mapped (Maps 6a and 6b) based on a variety of sources (Adams et al 1999; Jigour et al 2004; Busby et al, 1996; Titus et al 2000).

North American green sturgeon: The southern distinct population segment of North American Green Sturgeon (*Acipenser medirostris*) is listed as threatened under the ESA. Population numbers have dropped for this distinct population segment due to habitat loss resulting from dam construction, including the Keswick and Shasta Dams on the Sacramento river and the Oroville Dam on the Feather River. Coastwide, ocean catch of green sturgeon have decreased from a high of 9065 in 1986, to 512 in 2003. Today, the Sacramento River contains the only known spawning population of the Green Sturgeon Southern distinct population segment (NMFS 2005).

Though green sturgeon do pass under the Golden Gate Bridge on their migration up the Central Valley rivers, these fish, similarly to salmon and steelhead, are a highly migratory species that are unlikely to directly benefit from MPAs. Though green sturgeon may benefit from protection of estuarine habitats that they utilize during juvenile life stages, these environments are located outside of the north central coast study region for the southern distinct population segment.

White sharks: White sharks (*Carcharodon carcharias*) are wide-ranging and known to inhabit coastal waters in the north central coast study region, though the population off California is small: probably a few hundred to a few thousand adults (Karl et al 2001). Subsisting mostly on marine mammals and scavenged large animal carcasses, white sharks often feed off the Marin Headlands and Farralon Islands, especially during the late summer and fall. In recent years, several San Francisco-based organizations have begun to offer cage-diving tours with white sharks in the Farallon Islands, which may have detrimental effects on the shark's well being. Though not formally protected under the Federal or State ESA, in 1994 the state of California placed white sharks on the list of species protected in state waters (Karl et al 2001). In addition, white sharks are protected under several international treaties. In 1996, white sharks were included in the World Conservation Union Red List of Threatened Species under the vulnerable category. In 2002, they were listed in appendices I and II of the Convention on Migratory Species. Most recently, in 2004, white sharks were included in the Convention on International Trade in Endangered Species of Fauna and Flora (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

Seabird colonies: The region supports a diverse assemblage of seabirds, many of whom aggregate into colonies, especially during the breeding season. The major marine bird breeding colonies in the study region are located at Point Reyes and in the North and South Farallon Islands (as well as in San Francisco Bay and Alcatraz Island, which are not included in the study region). Other major colonies are located at Fish Rocks, Gualala Point Island, Russian River Rocks, Arched Rock, Point Resistance, Millers Point Rock, and Devils Slide Rock (NCCOS 2003). Prey resources are often abundant because of the high productivity of the California current and there are numerous cliffs, offshore rocks and islands for roosting and nesting habitat. Most of the rocks and islets along the coast are protected in the California Coastal National Monument, managed by the Bureau of Land Management. Millions of seabirds migrate through or breed in the region annually. Many populations of seabirds in the region are sensitive to changes in oceanographic conditions, with reproductive success and population size fluctuating with changes in food availability associated with warm and cold

water events (Mills and Sydeman 2003; Ainley and Boekelheide 1990). Upwelling areas, persistent fronts, the shelf-slope break, and other bathymetric features are all important foraging areas for seabirds in the region (Yen et al 2004).

One important site for seabirds and shorebirds is Tomales Bay, which harbors at least nine state or federally threatened or endangered bird species. Both the California Clapper Rail, which is federally endangered and on the state threatened list, and the Black Rail, which is on the state threatened list, have been known to nest in Tomales Bay. Additionally, the Marbled Murrelet, which is on the federal threatened list, is a year-round resident of Tomales Bay. A total of 39 bird species with special status have been seen in Tomales Bay. While some of these birds have State or Federal ESA listings, others have special status as "Migratory Nongame Birds of Management Concern" by the USFWS, "California Special Concern Species" by CDFG, or are on the Audubon or Partners in Flight Watch List (Kelly and Stallcup 2003).

The Gulf of the Farallones is another important site for seabirds hosting 12 breeding species (common murres, Cassin's and rhinoceros auklets, western gulls, Brant's and pelagic cormorants, storm petrels, pigeon guillemots, and tufted puffins) and 35 regular visitors (Pacific and red-throated loons, red-necked and western grebes, black-footed albatross, pink-footed, Buller's, and black-vented shearwaters, herring and glaucous-winged gulls, and black and surf scoters), many of which have special status. Marbled Murrlets, which are federally threatened, visit the Farallon Islands during the winter (Karl et al 2001). The Farallon islands have the largest number of breeding seabirds of any location in the lower 48 states (Mills et al 2005).

Drakes Estero and Estero de Limantour, located within the Point Reyes National Seashore, also host large numbers of federally endangered, threatened, or species of concern, including Osprey, White Pelican, Brown Pelican, Black Brant, Western Snowy Plover and Marbled Murrelet (NPS 2006).

Other important breeding sites include numerous offshore rocks and pinnacles along the north central California coast. Some seabird species with colonies in the north central coast study region include common murres, pigeon guillemot, least tern (in San Francisco Bay, adjacent to the study region), black oystercatcher, pelagic cormorant, and Brandt's cormorant. Sea bird colony locations in the north central coast study region are shown on Maps 5a-5f, based on data compiled by USFWS (Sowls et al 1980; Carter et al. 1992).

Areas of high seabird diversity and density (top 20th percentile) based on a synthesis of data compiled by the NOAA Biogeographic Assessment of the region (NOAA 2004) are shown on Maps 5a-5f.

Southern sea otters: Populations of the Southern Sea Otter (*Enhydra lutris*) are concentrated mostly south of the north central coast study region, though sightings have occurred as far North as Point Reyes (Point Reyes Headlands, Double Point, Duxbury Reef) (NCCOS 2003) and even in the Farallon Islands (Steve Shimek pers. comm.). Once ranging from northern California to Japan to Punta Abreojos in Baja California Sur, including approximately 15,000 animals in California, southern sea otters are now mostly found from Purisima Pt in Santa Barbara County to Pt Año Nuevo in Santa Cruz County (USFWS 1995, 2003). The population

of sea otters was drastically reduced during the 18th and 19th centuries due to commercial hunting and has been generally increasing from as few as 50 individuals in 1914. The sea otter population fluctuates from year to year and 2735 animals were counted in the last statewide census (www.werc.usgs.gov/otters/ca-surveydata.html). In recent years, otters have been increasingly sighted within the north central coast study region, with up to 24 observations per year in Point Reyes, which might suggest that the range of sea otters could be increasing (Steve Shimek, the Otter Project, pers. comm.).

Otters have been shown to be a keystone species, exerting strong top-down control on their prey species where they are present (Estes and Palmisano 1974, Estes and Duggins 1995). Their predation on sea urchins has been shown to limit urchin abundance, allowing for the growth of giant kelp forests and associated species (Estes and Palmisano 1974, Estes and Duggins 1995). A study conducted within the north central coast study region suggests that the absence of sea otters off the Sonoma coast has contributed to increased red abalone density and size. The study further indicates that recovery of sea otter populations in this area may result in restoration of ecological biodiversity and function in benthic communities, but that the density and size of abalone populations may decrease (Fanshawe and VanBlaricom 2003).

Sea otters are listed as threatened under the federal endangered species act, depleted under the Marine Mammal Protection Act, and are considered a “fully protected species” by CDFG. Threats to otter populations include incidental drowning in gill and trammel nets, oil spills, toxic contaminants, other human impacts, and disease (Hanni et al 2003, Miller et al 2004, USFWS 2003).

***Pinnipeds*:** Like sea otters, populations of pinnipeds were hunted to very low levels during the 19th century. California sea lion and harbor seal populations are recovering. Six species of pinnipeds have either colonial rookeries or haulout sites in north central California based on data collected and compiled by NOAA and the USFWS (Mark Lowry, pers. comm.; Lowry 2002; Lowry and Carretta 2003, USFWS 2002) and summarized in Maps 5a-5f. Little to no information on historical abundances was available for California sea lions and harbor seals, although some early estimates are included for the purposes of comparison with later systematic censuses.

- ***California sea lion***: The range of the California sea lion, *Zalophus californianus*, extends from the Pacific coast of Baja California to southern British Columbia. These animals breed primarily in the southern part of their range from the Gulf of California to San Miguel Island. Commercial hunting in the 19th and early 20th centuries likely reduced California sea lion populations. In the late 1920s, only 1,000-1,500 California sea lions were counted on the shores of California. Since a general moratorium on hunting marine mammals was imposed with passage of the Marine Mammal Protection Act in 1972, the population has grown substantially to a current estimate of 237,000-244,000 animals. Between 1975 and 2001, the population grew at an average annual rate of 5.4%. California sea lions are opportunistic feeders on a variety of prey, especially seasonally abundant schooling species such as Pacific hake, northern anchovy, Pacific sardine, spiny dogfish, and squid. They tend to feed in cool upwelling waters of the continental shelf. In a recent study at Año Nuevo Island, sea lions were found to feed on rockfishes,

Pacific whiting, market squid, Pacific sardine, northern anchovy, spiny dogfish shark, and salmonids (Weise and Harvey 2005). California Sea Lions can be found in large numbers on Año Nuevo and the Farallon Islands where they have minor rookeries, as well as along the Point Reyes Headlands, Bodega Rock, Fish Rocks, and near the Golden Gate Bridge where they have haulout sites (NCCOS 2003, Karl et al 2001).

- ***Steller sea lion:*** The Eastern distinct population segment of the Steller Sea Lion (*Eumatopias jubatus*), also known as the Northern Sea Lion, extends from Cape Suckling Alaska to Central California, and is listed as threatened under the federal ESA. The north central coast study region is near the southern extent of the Steller Sea Lion, and haulouts can be found at Fish Rocks, Northwest Cape Rocks, Bodega Rock, Point Reyes, and in the Farallon Islands (NCCOS 2003). The Farallon Islands host one of the southernmost breeding colonies of the Steller Sea Lion and females and juveniles can be found in the Gulf of the Farallons year-round (Karl et al 2001). The diet of Stellar sea lions is dominated by a variety of fish (especially demersal roundfish) and squid (Pauly et al 1998) and in the Farallons they feed mostly on rockfish, sardines, smelt, squid, octopus, and salmonid fish.
- ***Northern elephant seal:*** The northern elephant seal (*Mirounga angustirostris*) was hunted almost to extinction by the late 1800s. Today there are breeding colonies at Año Nuevo Island and Point Año Nuevo (not in the study region), as well as in the Farallon Islands and on Point Reyes, where breeding occurs from December to March. High numbers of at-sea sightings of these deep diving marine mammals have occurred in the Gulf of the Faralones, as well as in the offshore, southern portion of the study region (NCCOS 2003). Squid dominates the diet of northern elephant seals (Pauly et al 1998).
- ***Harbor seal:*** Harbor seals, *Phoca vitulina*, are widely distributed in the coastal areas of the northern Pacific and northern Atlantic. Harbor seals in the eastern Pacific range from the Pribilof Islands in Alaska to Isla San Martin off Baja. Between the Mexican and Canadian borders, harbor seals have been managed as three separate stocks, of which one is the stock off California. After passage of the Marine Mammal Protection Act in 1972, harbor seal abundance grew rapidly until 1990, when stocks leveled off. There has been no net population growth in California since 1990 (Caretta et al. 2004). In 2002 the population was estimated at 27,863 animals. The north central coast study region has a high density of harbor seal haul out sites, especially in the region from Point Arena to San Francisco Bay, with particularly high abundances at Bodega Rock, Point Reyes, and the Marin Headlands (NCCOS 2003). They are also year-round residents in Drakes Estero, which is one of 5 major seal colonies in Point Reyes where 20% of the state's harbor seals reside (NPS 2006). The Gulf of the Farallones provides feeding grounds, haulout space, and pupping areas for another 20% of California's harbor-seal population (Karl et al 2001). While not colonial, harbor seals are gregarious while molting and resting and haul out in groups on sandbars and rock ledges along the north central coast study region. Harbor seals eat a wide variety of pelagic and benthic prey, including small schooling fishes such as northern anchovy, many species of flatfishes, bivalves, and cephalopods (Antonelis and Fiscus 1980, Weise and Harvey 2001 and references therein). In a southern California study, harbor seals were found to mostly eat rockfish, octopus, spotted cusk-eel, and plain midshipman (Stewart and Yochem 1994). Diet studies of harbor seals in central California did not find evidence of predation on

salmonids, though they are known to eat small salmonids in northern California (NMFS 1997).

- ***Northern fur seal:*** The northern fur seal (*Callorhinus ursinus*) was once abundant along the California coast, but populations rapidly decreased during the early 1800's. Prior to 1997, northern fur seals had not been known to breed within the study region for over 170 years (NOAA 2006). Today, relatively dense aggregations of these fur seals (1 seal per km^2) can be found in the Farallon Islands, where they feed on sablefish, rockfish, anchovies, squid, and crabs and have two potential breeding harems (Karl et al 2001). In August of 2006, 166 seals, including 80 pups, were counted in the Farallon islands census (an increase from 6 individuals in previous years) (PRBO 2006).
- ***Guadalupe fur seal:*** The only know breeding colony of Guadalupe Fur Seals (*Arctocephalus townsendi*) is located on Guadalupe Island, off the coast of Mexico, though increasing numbers have been observed in the Channel Islands, off southern California and even in the Farallon Islands off San Francisco (Marine Mammal Center 2001). This species is rarely seen within the study region.

Cetaceans: The entire California coast is part of the annual gray whale migration route and gray whales can be observed from shore. Harbor porpoises and bottlenose dolphin are relatively common in nearshore waters. Several species of federally endangered whales (blue, humback, fin, sei, right, and sperm whales) can be seen off the Farallon Islands where they feed on a variety of species including krill (primarily *Thysanoessa spinifera* and *Euphausia pacifica*), schooling fish (such as herring, juvenile rockfish, and anchovy), and occasionally red pelagic crabs during warm water conditions. Pacific white-sided dolphins, harbor porpoises, and Dall's porpoises can also be found in the Farallones, where they feed on schooling fish and squid (Karl et at 2001)

3.3 Areas of Biodiversity Significance

Spatial data are available to begin identifying specific locations in the study region that have high biodiversity significance based on the guidelines provided in the Master Plan Framework (CDFG 2005a) and results of regional scientific research and mapping efforts. Specific locations can be identified using existing maps, by overlaying relevant data layers in the Internet Mapping Service site, or conducting more sophisticated GIS analysis. The following is a partial list of types of areas that have regional biodiversity significance:

- Areas where numerous habitats are found in close proximity and areas with unique combinations of habitats
- Large estuaries (Tomales Bay, Drakes Estero, Bolinas Lagoon) with eelgrass beds, tidal flats, and coastal marsh (Maps 2a-2f)
- Stream outlets and estuaries with presence of coho, chinook, or steelhead populations (Maps 6a and 6b)
- Marine areas off headlands with adjacent upwelling centers, especially those with kelp forests and rocky reefs in retention areas in the lee of the upwelling center
- Large kelp beds (Maps 2a-2f) and nearshore rocky reefs (Maps 3a-3f)

- Areas of high bathymetric complexity which provide topographic relief and a variety of habitats in close proximity
- Rocky subtrata in all depth zones, since rocky habitat is much less common than soft-bottom habitat and is important for depleted rockfish species (Maps 3a-3f)
- Rocky intertidal shores, especially wave-cut rocky platforms (which provide habitat at diverse tidal elevations), boulder fields, and rare sheltered rocky shores (Maps 2a-2f)
- Seabird colonies and marine mammal rookeries and haulouts (Maps 5a-5f)
- Areas of high fish or seabird diversity and/or density (Maps 5a-5f, 6a-6b, and 7a-7e).

4.0 Land-Sea Interactions

Important land-sea interactions happen across variable time scales and wide geographic ranges. They vary significantly along the coastal region because they depend upon a unique combination of variables that include biotic and abiotic factors such as climate, geomorphology, human use, and ocean currents. Studying linkages between watersheds and coastal waters from multiple perspectives and beneficial uses—biological, ecological, human, etc.—helps managers understand how modification of these linkages impacts the effectiveness of an MPA in meeting its objectives. The consequences of these complex interactions at the land-sea interface can be beneficial (e.g., critical riverine and estuarine nursery habitats for coastal marine and anadromous species) or detrimental (e.g., point and non-point sources of pollution) and should be considered in the process of identifying appropriate sites for marine protected areas (Stoms et al. 2005).

Many linkages exist between watersheds and coastal waters. Watersheds bring freshwater and sediments to bays, estuaries, and the ocean, for example. Episodic and seasonal factors influence terrestrial input to marine environments. In the study region, substantial net export from rivers and estuaries to the ocean usually occurs during the rainy season and primarily during storm events. Furthermore, since the California Current is such a nutrient-rich upwelling zone, the contributions of nutrients from land use are not considered significant relative to ocean-derived nutrients (Coastal Reserves Working Group, 2005).

Four main classes of land-sea interaction should be considered when examining the effects of land use on the marine ecosystems of north central California:

- Watershed processes and the export of sediment and materials of terrestrial origin to estuaries and the ocean (particularly nutrients, persistent toxic chemicals and pathogens).
- Sediment input from coastal erosion, landslides, and disposal.
- Use of land and streams by marine-dependent species (e.g. sea lion haulouts, sea bird rookeries, anadromous fish).
- Socioeconomic interactions between land and sea at the coastal margin (e.g. beach closures or seasonal bans that may affect ecotourism and management of environments) (Coastal Reserves Working Group, 2005).

These four classes of land-sea interactions specifically affect nearshore and estuarine dependent species and habitats as well as marine species that spend some portion of their life cycle on land or freshwater (Coastal Reserves Working Group, 2005).

Understanding these watershed-coastal water linkages and land-sea interactions may help MPA managers prevent future degradation of MPA areas. For example, today the degradation of watersheds and freshwater ecosystems and the presence of barriers to fish passage have contributed to the decline of many native anadromous fish stocks throughout California, which are now in danger of extinction. Impacts on coastal watersheds (i.e. a stream or estuary) have

repercussions for the entire coastal ecosystem. Estuaries and bays are particularly vulnerable to coastal development, pollution and introduction of invasive species.

The following sections discuss the importance of these watershed-coastal water linkages, the effect of land use and watershed modification on rivers and coastal waters, and important regional programs related to coastal water quality.

4.1 Ecological linkages

Watersheds and coastal waters have many complex ecological linkages. Watersheds carry freshwater, nutrients, and sediments to bays, estuaries, and the ocean. San Francisco Bay, for instance, is a major source of nutrients for the Gulf of the Farallones during most winters and adds stability to nutrient supplies in coastal waters over a range of climatic variability events such as El Niño and La Nina (Wilkerson et al 2002). Throughout the study region many short streams flow into small estuaries in which mixing and dilution occur within a short distance of river mouths. Many of the estuaries, embayments, coastal lagoons, and remaining wetlands have high importance relative to their size and the number of resident and migrating species (Coastal Reserves Working Group, 2005). Studies have shown that some species, including flatfish, rely on intricate linkages between estuarine and coastal environments during different life stages (Brown 2006). There are quite a few bays and estuaries along the north central coast study region (see section 3.1.3) and they support thousands of birds during migration; numerous marine species use embayments, and estuaries as spawning and nursery grounds.

Some examples of critical ecological linkages along the north central coast study region are described below for selected marine species (based on Airamé et. al., 2003).

- **Anadromous fish** produce eggs and juveniles in fresh water. The juveniles then pass through estuarine environments to mature at sea and return through the estuaries as adults to migrate upstream in coastal rivers to reproduce. Rivers within the north central coast study region once supported large numbers of steelhead trout, coho and chinook salmon, and sturgeon. Today, however, due to degradation of watersheds and freshwater ecosystems and the presence of barriers to fish passage, many native anadromous fish stocks throughout California are threatened or endangered.
- **Shorebirds and waterfowl**, such as black rail, saltmarsh common yellowthroat, and saltmarsh song sparrow, inhabit coastal lagoons, estuaries, and salt marshes. Large numbers of shorebirds and diving ducks are attracted to eelgrass beds, where they feed on the eelgrass, fish, and invertebrate eggs and young. Many bird species use salt marshes, shallow intertidal flats, and lagoons during their annual migrations. The estuaries and bays of coastal California form part of the Pacific Flyway, one of the four principal bird migration routes in North America.
- **Marine Mammals**, such as California sea lions, northern elephant seals, and harbor seals, have many haulout sites, as well as a few rookeries on secluded rocks and sand beaches or tidal flats in the region.
- **Estuarine vegetation**, such as macroalgal mats, composed primarily of *Ulva* and *Enteromorpha* spp., may be carried on tides or currents to the open ocean, where they

provide shelter and food for numerous organisms, notably juvenile fishes. Eventually, these mats may wash up on shore, where they supply nutrients to sandy beach and rocky intertidal communities.

- **Fish**, such as sole, sablefish, hake, and rockfish, live as adults on the continental shelf and slope or in submarine canyons. They produce pelagic larvae that recruit to estuaries, bays, kelp forests, rock outcrops, and cobble fields. Some species, including Pacific herring, spawn in eelgrass beds, among other habitats. The structure of eelgrass beds provides protection from predation for juvenile invertebrates and fishes. Bat rays, leopard and smoothhound sharks, plainfin midshipman, Pacific herring, starry flounder, staghorn sculpin, several surf perch, jacksmelt, and topsmelt mate and bear their young in estuarine habitats.

Understanding linkages between watersheds and coastal waters may help managers better design MPAs for resource protection and recreation and other uses, as well as examine and reduce negative impacts caused by agriculture, forestry, urbanization, and boating, to name a few (see 4.5, “Nonpoint Sources”).

4.2 Coastal Watersheds and Land Use in Study Region

The north central coast study region extends for over 367.6 miles along the Californian coast, includes 763.5 square miles of ocean, and drains nearly 4,200 square miles from 6 major watersheds. The north central coast study region also receives runnoff from an additional 59,000 square miles (40% of California’s total land area) from the San Francisco Bay drainage as it flows into the study region beneath the Golden Gate Bridge (Nichols et al 1986). The largest coastal watersheds of the region include the Big-Navarro-Garcia and Russian subbasins (Table 6). San Francisco Bay, which is not included in the study region, drains much of the interior of the state and the tidal plume under the Golden Gate Bridge is a very significant input into the study region.

Table 6: Major Watersheds in the Study Region

Hydrologic Unit Name	Area (hectares)	Area (square miles)
Mendocino Coast	414,046	1,598
Russian River	384,437	1,484
Bodega	38,235	147
Marin Coastal	88,557	341
San Mateo	66,566	257
Big Basin	95,175	367
COASTAL TOTAL	1,087,020	4,197
San Francisco Bay Drainage	15,300,000	59,074
TOTAL	16,387,020	63,271

Land use adjacent to the study region includes agriculture, timberlands, urban and rural developments, industrial uses, and parks and open space. Maps 8a-8c show the coastal basins

that touch the shoreline classified by the percentage of urban area, percentage of agriculture, and road density (linear kilometer of road/hectcres) (see 4.4.2, “Nonpoint Sources”).

4.3 Coastal Water Quality

Coastal water quality information is important in MPA planning to ensure that any potential threats to marine resources in MPAs from poor water quality can be identified and addressed through MPA siting or coordination with agencies with jurisdiction over water quality. *The Water Quality Control Plan for Ocean Waters of California* (California Ocean Plan), prepared by the State Water Resources Control Board (SWRCB), has been in effect since 1972 and is regularly updated. This plan outlines all of the requirements and implementation measures for management of waste discharge to the ocean (http://www.swrcb.ca.gov/plnspols/oplans/docs/bactffed.pdf).

Two government bodies share jurisdiction over the north central coast study region, along with the SWRCB, under the California Ocean Plan. The North Coast Regional Water Quality Control Board (RWQCB) manages Region 1, which is constituted by the North Coastal Basin and the Klamath River Basin. The north central coast study region includes the portion of the North Coastal Basin that touches the Pacific Ocean between Tomales Bay, in Marin county and Point Arena, in Mendocino County. The San Francisco Bay RWQCB manages Region 2, which includes the San Francisco Bay drainage basin and all or most of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties. The north central coast study region does not include San Francisco bay, so only the portions of Marin, San Francisco, and San Mateo Counties that are adjacent to the Pacific Ocean will be considered in this regional profile.

Each RWQCB has a unique “Water Quality Control Plan” (or “Basin Plan”), which contains three main types of information. First, each plan lists all of the water bodies in the region and the beneficial uses designated for those water bodies (e.g. recreation, wildlife, spawning, etc.). Second, each plan defines the water quality that must be maintained to support those beneficial uses. Last, each Basin Plan contains an Implementation Plan that describes the various regional programs, projects, and other actions that are necessary to achieve the water quality standards established in the plan. Beneficial uses along with the numeric or narrative objectives established to protect those uses jointly constitute federal water quality standards. These Implementation Plans include a description of statewide monitoring programs, such as the State Mussel Watch and Toxic Substances Monitoring Programs, as well as regional surveillance and monitoring programs and models, such as the Water Quality Model for the Russian River. The Basin Plan for Region 1 can be viewed online at: http://www.waterboards.ca.gov/northcoast/programs/basinplan/basin.html.
The Basin Plan for Region 2 can be viewed online at: http://www.waterboards.ca.gov/sanfranciscobay/basinplan.htm.

The State Water Resources Control Board establishes “areas special of biological significance” (ASBSs) though the California Ocean Plan. Individuals may nominate areas for designation as an ASBS and criteria for nomination include areas that are “intrinsically valuable or have recognized value to man for scientific study, commercial use, recreational use, or esthetic

reasons." Areas proposed for ASBS designation should have the potential to benefit from protection beyond that offered by standard waste discharge restrictions and other measures. These ASBSs are included in state water quality protection areas (SWQPAs) that are "designated to protect marine species or biological communities from an undesirable alteration in natural water quality…" (Public Resources Code Section 36700[f[). SWQPAs are one of six types of managed areas described in the Marine Managed Areas Improvement Act and within SWQPAs waste discharges are prohibited or limited.

There are 10 SWQPAs in the north central coast study region (Table 7). The majority of the SWQPAs in the study region are located downstream from rural watersheds, though some, notably the James V Fitzgerald Marine Reserve ASBS, are located downstream from urban water sheds.

Table 7: SWQPAs in the North Central Coast Study Region

SWQPA Name	Area (sq mi)	SWQPA ID Number
Kelp Beds at Saunders Reef ASBS	0.97	5
Del Mar Landing Ecological Reserve ASBS	0.12	2
Grestle Cove ASBS	<0.01	3
Bodega Marine Life Refuge ASBS	0.31	4
Bird Rock ASBS	0.11	14
Point Reyes Headlands Reserve and Extension ASBS	2.12	12
Double Point ASBS	0.13	13
Duxbury Reef Reserve and Extension ASBS	2.54	11
Farallon Islands ASBS	17.60	10
James V Fitzgerald Marine Reserve ASBS	1.57	9

Source: Baggett 2003

The California Critical Coastal Areas (CCAs), designated by the California Coastal Commission, significantly overlap with SWQPAs. These CCAs serve the dual goals of "improving degraded water quality, and providing extra protection from non-point source pollution (NPSP) to marine areas with recognized high resource value" (CCA website: http://www.coastal.ca.gov/nps/Web/cca_critdesc.html). Seventeen areas in the study region have been designated as Critical Coastal Areas (Table 8). This list of CCAs includes "impaired water bodies" identified in the section 303(d) list (see section 4.3.1 below), as well as marine managed areas, wildlife refuges, waterfront parks, and beaches and ASBSs.

Table 8: Critical Coastal Areas in the Study Region

Critical Coastal Area Name	CCA ID Number
Kelp Beds at Saunders Reef ASBS	16
Del Mar Landing Ecological Reserve ASBS	17
Gerstle Cove ASBS	18
Bodega Marine Life Refuge ASBS	19
Estero Americano	20
Estero de San Antonio	21
Walker Creek	22

Critical Coastal Area Name	CCA ID Number
Tomales Bay	23
Lagunitas Creek	24
Bird Rock ASBS	25
Point Reyes Headlands Reserve and Extension ASBS	26
Double Point ASBS	27
Duxbury Reef Reserve	28
James V Fitzgerald Marine Reserve ASBS	29
San Gregorio Creek	30
Pescadero Creek	31
Butano Creek	32

Offshore areas of the north central coast study region have several documented water quality problems. Dredge disposal sites, sunken vessels (including the SS Jacob Luckenbach, the Tanker Vessel Puerto Rican, and the USS Independence), and radioactive waste dump sites exist in federal waters off the Farallon Islands, which may affect local water quality (Dominic Gregorio pers. comm., NOAA 2006). In addition, San Francisco Bay, though not included in the north central coast study region, drains into the study region under the Golden Gate Bridge and has significant water and sediment quality issues (SWRCB 2006). A broad area adjacent to the Golden Gate Bridge may therefore experience degraded water and sediment quality resulting from its close proximity to San Francisco Bay and the export of broad range of contaminants found in the bay. Also, some localized nearshore coastal areas, harbors, lagoons, estuaries, and tributaries face a number of problems, including elevated levels of nitrates, sedimentation/siltation, pesticides and other persistent organic pollutants, metals, pathogens, detergents, and oils. These contaminants can result in a variety of biological impacts, including bioaccumulation, reduced recruitment of anadromous species (those, like salmon, that migrate from salt water to spawn in fresh water), mortality due to toxicity, pathogen contamination, and interference with recreational uses of coastal areas. These adverse water quality impacts can impair designated beneficial uses.

4.3.1 Impaired Water Bodies in the North Central Coast Study Region

When a water body does not meet established water quality standards, it is placed on an impaired waters list mandated by §303(d) of the federal Clean Water Act. (For this reason, this list is often called the 303(d) list, and waters on this list are referred to as “impaired” waters.) States are required to update this list every two years and work to resolve the problems associated with the listed water bodies. Typically, a Total Maximum Daily Load (TMDL) is developed for such impaired waters. A TMDL determines the total amount of the pollutant/stressor (e.g. pathogens, sediment, nutrients) that the water body can assimilate and still meet water quality standards. An implicit or explicit margin of safety is also factored into this analysis. The TMDL then allocates the allowable loading to all point and non-point sources to the water body and establishes an implementation plan to ensure that the allocations and water quality standards are achieved.

A number of water bodies in the north central coast study region are designated as impaired and can be seen in Maps 9a and 9b. Seven categories of water quality stressors, defined by the SWRCB and RWQCB's, might play a causal role in these indicators of impairment: 1)

persistent organic pollutants, 2) nutrients, 3) pathogens, 4) temperature, 5) pH or dissolved oxygen levels, 6) high coliform counts, and 7) suspended sediments in river discharges. Three water bodies in the north central coast study region are listed as high priority TMDL sites: the Gualala River, the Garcia River, and Tomales Bay.

The Gualala River, located 114 miles north of San Francisco in the northern portion of the study region, is listed as a high priority TMDL site for sedimentation and siltation. High erosion rates in the 300 square mile area that drains into the Gualala River have contributed to high levels of sediment, which has degraded the habitat for coho salmon and steelhead trout. Timber production, in addition to grazing and rural development, is the most common land use in the Gualala drainage basin, and is the likely main cause of increased sedimentation rates, especially when superimposed upon unstable geology and high precipitation in the drainage basin, which accounts for high natural erodability. (USEPA 2000)

The Garcia River discharge is located just north of Point Arena and has a high priority TMDL listing for temperature, which is related to sedimentation. As in the Gualala river, timber production is a major land use in the Garcia River basin and contributes to high erosion rates when combined with the natural erodability of the landscape. Increased sediment loads contribute to increased temperatures, which are detrimental to coho salmon and steelhead trout populations.

Tomales Bay, 30 miles northwest of San Francisco, is a high priority TMDL site within the study region due to the presence of harmful pathogens. The bay, which covers an area of 11 square miles, and its main tributaries, are considered impaired by pathogens present in human and animal waste. Such pathogens pose a threat to recreational users, shellfish consumers, and the bay's aquatic ecosystem. Potential sources for these pathogens include: on-site sewage disposal systems, small wastewater treatment facilities and sewage holding ponds, boat discharges, grazing lands, dairies, equestrian facilities, and municipal runoff (Ghodrati and Tuden 2005).

Tables 9 and 10 show impaired water bodies in regions 1 and 2, as well as pollutants/stressors and priority ranking.

Table 9: Impaired Water Bodies in Region 1

Name	Pollutant/Stressor	Priority
Gualala River Mendocino Coast HU, Gualala River HA	Sedimentation/Siltation, Temperature	High, Low
Garcia River Mendocino Coast HU	Temperature	High
Ukiah HSA Russian River HU, Upper Russian River HA	Sedimentation/Siltation, Temperature	Low, Low
Forsythe Creek Russian River HU, Upper Russian River HA	Sedimentation/Siltation, Temperature	Medium, Low
Coyote Valley	Sedimentation/Siltation,	Medium, Low

Name	Pollutant/Stressor	Priority
Russian River HU, Upper Russian River HA	Temperature	
Santa Rosa Creek Russian River HU, Middle Russian River HA	Pathogens, Sedimentation/Siltation, Temperature	Low, Medium, Low
Mark West Creek Russian River HU, Middle Russian River HA	Sedimentation/Siltation, Temperature	Medium, Low
Geyserville HSA Russian River HU, Middle Russian River HA	Sedimentation/Siltation, Temperature	Medium, Low
Dry Creek Russian River HU, Middle Russian River HA	Sedimentation/Siltation, Temperature	Medium, Low
Big Sulphur Creek Russian River HU, Middle Russian River HA	Sedimentation/Siltation, Temperature	Medium, Low
Guerneville HSA Russian River HU, Lower Russian River HA	Pathogens, Sedimentation/Siltation, Temperature	Low, Low, Low
Austin Creek Russian River HU, Lower Russian River HA	Sedimentation/Siltation, Temperature	Medium, Low
Laguna de Santa Rosa Russian River HU, Salmon River HA	Low Dissolved Oxygen, Nitrogen, Phosphorus, Sedimentation/Siltation, Temperature	Low, Low, Low, Low, Low
Stemple Creek/Estero de San Antonio Bodega HU, Estero de San Antonio HA	Nutrients, Sediment	Medium, Low
Estero Americano Bodega HU, Estero Americano HA	Nutrients, Sedimentation/Siltation	Medium, Low
Americano Creek Bodega HU, Estero Americano HA	Nutrients	Low
Lake Mendocino	Mercury	Low
Lake Sonoma	Mercury	Low

HU: Hydrologic Unit; HA: Hydrologic Area; HAS: Hydrologic Sub-Area

Table 10: Impaired Water Bodies in Region 2

Name	Pollutant/Stressor	Priority
Walker Creek	Mercury, Nutrients, Sedimentation/Siltation	Medium, Medium, Medium
Lagunitas Creek	Nutrients, Pathogens, Sedimentation/Siltation	Low, Low, Medium
Tomales Bay	Mercury, Nutrients, Pathogens, Sedimentation/Siltation	Medium, Medium, High, Medium

Name	Pollutant/Stressor	Priority
Lake Merced	Low Dissolved Oxygen, pH	Low, Low
Pacific Ocean at Rockaway Beach	High Coliform Count	Low
Pacific Ocean at Pacifica State Beach	High Coliform Count	Low
San Pedro Creek	High Coliform Count	Low
Pacific Ocean at Fitzgerald Marine Reserve	High Coliform Count	Low
San Vicente Creek	High Coliform Count	Low
Pacific Ocean at Pillar Point Beach	High Coliform Count	Low
Pacific Ocean at Venice Beach	High Coliform Count	Low
San Gregorio Creek	High Coliform Count, Sedimentation/Siltation	Low, Medium
Pomponio Creek	High Coliform Count	Low
Pescadero Creek	Sedimentation/Siltation	Medium
Butano Creek	Sedimentation/Siltation	Medium

4.3.2 Beach Closures

Beach closures are a direct indicator of the negative impacts to beneficial uses at beaches. The State of California has mandated beach water monitoring, which began in 1999. Weekly monitoring is required between April and October for beaches with more than 50,000 visitors annually or located adjacent to storm drains flowing during the summer. The waters are tested for coliform, fecal coliform, and enterococcus bacteria. Beach closings are generally triggered in three ways: by the presence of bacteria, discharge of untreated sewage, and excessive rainfall.

Table 11 lists the number of closure days for each year from 2002-2005 by county within the study region. This table also lists the number of incidences when beaches were closed for an extended period of time (7-13 consecutive weeks). Table 12 lists all beach closures in the study region in 2005. Many beaches in California are long, and closings are sometimes targeted for a certain section of the beach Therefore, some beaches may have more than one closing at the same time. Multiple closures at the same beach have been aggregated in this list (For more information about these data, see http://www.nrdc.org/water/oceans/ttw/sumcal.pdf.) The north central coast study region generally has had far fewer beach closures in comparison to the rest of California, though the overall number of closures has increased in recent years.

Table 11: Beach Closings/Advisories by County: Year–to-Year Comparison

	2005			2004			2003			2002		
County	**Days**	**X**	**P**	**Days**	**X**	**P**	**Days**	**X**	**P**	**Days**	**X**	**P**
Marin	363	2	0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mendocino	0	0	0	0	0	0	20	0	0	0	0	0
San Francisco	107	0	0	162	0	0	120	0	0	89	0	0
San Mateo	77	1	1	73	1	0	167	0	1	135	1	0

	2005			2004			2003			2002		
County	**Days**	**X**	**P**	**Days**	**X**	**P**	**Days**	**X**	**P**	**Days**	**X**	**P**
Sonoma	8	0	2	24	0	0	52	1	0	29	0	0
Study Region Counties Total	555	3	3	259	1	0	359	1	1	253	1	0
California Total	5,175	13	7	3,985	12	7	5,384	9	31	4,553	10	32

Source: SWRCB 2003.
X: Extended closing/advisory events lasting 7 to 13 consecutive weeks.
P: Permanent closing/advisory events lasting more than 13 consecutive weeks.
ND: No data.

Table 12: Beach Closures in 2005 in the Study Region by County

County	**Beach**	**Cause**	**2005 Closures**
Sonoma	Campbell Cove State Beach	Bacteria	2
Sonoma	Salmon Creek State Park Beach	Bacteria	3
Marin	Heart's Desire	Bacteria	1
Marin	Lawson's Landing	Bacteria	2
Marin	Miller Point	Bacteria	3
Marin	Chicken Ranch Beach	Bacteria	4
Marin	Millerton Point	Bacteria	1
Marin	Shell Beach	Bacteria	2
Marin	Bolinas Beach	Bacteria	4
Marin	Stinson Beach	Bacteria	3
Marin	Muir Beach	Bacteria	5
Marin	Rodeo Beach	Bacteria	1
Marin	Golden Hinde	Bacteria	2
San Francisco	Baker Beach	Preempt-rain/sew, Bacteria	18
San Francisco	China Beach	Preempt-rain	3
San Francisco	Fort Funston	Preempt-rain	3
San Francisco	Ocean Beach	Preempt-rain, Bacteria	15
San Mateo	Dunes State Beach	Bacteria	1
San Mateo	Fitzgerald Marine Reserve (Moss Beach)	Bacteria	1
San Mateo	Roosevelt State Beach	Bacteria	1
San Mateo	Venice State Beach	Bacteria	3

Source: NRDC 2006

4.4 Effects of Land Use on Coastal Waters

Consideration of ecological interactions between the land and the sea should be considered in MPA site selection. Modification of natural watershed land cover and ecological processes can significantly affect downstream rivers and coastal waters. A variety of land use practices in watershed areas results in degraded quality of receiving waters. Maps 8a-8c show the "human footprint" in coastal watersheds in the region as described by percent of land cover in agriculture and urban areas and road density. Generally, pollution caused by such practices is not concentrated at any one point, but is diffuse in nature. This type of pollution, therefore, is called nonpoint source pollution (NPSP). Additionally, there are spatially specific discharges of pollutants associated with industrial sources or wastewater treatment; such sources are called point sources. In order to understand how human activities in watersheds can effect the quality of receiving waters in the north central coast study region, it is useful to begin with a consideration of how local geology plays a role in watershed processes.

4.4.1 Impacts of Local Geology on Water Quality

The north central coast study region is a diverse and geologically active part of the California coastline. Situated between the North American and Pacific plates along the San Andreas fault system, this area is dominated by sedimentary rocks of the Franciscan complex, though granitic basement material is also exposed in places like the Farallon Islands and Point Reyes. The unstable nature of many of the sedimentary deposits has lead to high rates of erosion (with long term rates of approximately 30 cm/year) and large scale landslides. In the spring of 2006, the unstable nature of these formations was evidenced at Devil's Slide, south of Pacifica, when landslides resulted in several months of road closure.

The sedimentary formations in this region especially the mudstones, sandstones, siltstones, and shale, are highly erodible and mechanically weak. These sediments have been further weakened through fracturing and shearing caused by frequent fault movements. Coastal uplift, deep valleys eroded by streams, and seismic activity in these relatively weak rocks result in landslides and other forms of mass wasting (Alt and Hyndman 2000). Although mass wasting is a natural process, the rate and source of sediment are affected by human disturbance within many coastal watersheds in the study region. The amount and type of sediment entering stream systems can greatly affect stream dynamics and has detrimental impacts on salmonid populations (Federal Interagency Stream Restoration Working Group 2000). Siltstone and mudstone rocks fracture easily, and tend to break apart during the sediment transport process. The break up of siltstones and mudstones releases fine sediment into the stream. These types of sedimentary rock have a lower value as a spawning substrate than igneous or metamorphic rocks, and they are a source of fine sediment, which can be detrimental to salmonids. Therefore, even undisturbed watersheds dominated by sedimentary geology tend to produce lower quality salmonid habitat than a similar watershed dominated by either igneous or metamorphic geology.

Natural landslides and erosional processes provides sediment needed for coastal processes, as well as nutrients such as iron that are often limited in near-shore waters; however, increased

sediment delivery results in disruption of biological communities due to the smothering of marine habitats and increasing turbidity of the nearshore water column (MBNMS, 2003).

4.4.2 Nonpoint Sources

Superimposed onto this highly erodible geological landscape are the many human land use activities that can result in non-point source pollution (NPSP). Runoff from NPSP sources is the primary cause of impairment for more than 76 percent of the water bodies where TMDLs are required in California (SWRCB, 2005). Five sources of NPSP in the north central coast study region include: agriculture, forestry operations, urban areas, boating and shipping, and hydromodification.

Agriculture

The NPSP typically associated with agriculture include nutrients, animal waste, sediments, and pesticides that enter receiving waters by direct runoff to surface waters or seepage into ground water. Sediment, pesticides, and excess nutrients all effect aquatic habitats by causing eutrophication, turbidity, temperature increases, toxicity, and decreased oxygen (SWRCB 2005b). Major agricultural activities in the study region include confined animal facilities, grazing, vineyards, orchards, and cultivation of various other crops. Confined animal feeding operations, including dairy producers and ranchers, are significant sources of NPSP in the study region and are regulated by State and Regional water boards through point source and non point source programs (RWQCB-North Coast Region 2005, RWQCB-San Francisco Bay 2002). The watershed that drains into Tomales Bay is a one example of this kind of pollution, as livestock grazing and dairy farming are two of the largest land uses in the watershed, and significant numbers of beef, sheep, and dairy farms have existed in the area since the mid-1800s (Ghodrati and Tuden 2005). These agricultural land uses have had significant effects on water quality in Tomales Bay, which has TMDL listings for pathogens as well as for nutrients and sediment. Such NPSP poses a threat to both humans and aquatic ecosystems.

Forestry operations

The primary concern for forestry operations is that they tend to cause erosion, thus increasing sediment concentrations in receiving waters. Other impacts of forestry operations include increasing water temperatures because of removal of overstory riparian shade, depleting dissolved oxygen because of organic debris, and increasing concentrations of organic and inorganic chemicals because of harvesting, fertilizers, and pesticides (SWRCB 2005b). Forestry operations occur mostly in the northern portion of the study region, in the form of commercial logging and timberland use conversions (RWQCB-North Coast Region 2005). In this area, geologic instability and high precipitation rates concentrated over a few months of the year create naturally high erodibility. When combined with forestry operations, the resulting sedimentation and temperature changes in rivers, streams, and creeks in the northern portion of the study region may have detrimental effects on coho salmon and steelhead trout populations. Many of the coastal streams in the northern part of the study region are impaired by sediment or temperature.

Urban Areas

The largest city in the study region is San Francisco: the 13th most populous American city according to the 2000 US Census. Some of the pollutants found in runoff from San Francisco, as well as other cities, include polychlorinated biphenyls, polyaromatic hydrocarbons, registered pesticides (e.g., diazinon and chlorpyrifos), mercury, copper, nickel, and other heavy metals, pathogenic bacteria, viruses, sediment, nutrients, trash, and plastics (San Francisco Estuary Institute 2006, SWRCB 2005b). Pollution from San Francisco Bay, which flows to the study region under the Golden Gate Bridge, potentially impacts the nearshore environment. Generally, this flow increases during winter months due to increased precipitation (Largier, J.L., 1996, Wilkerson et al 2002). Surface currents tend to carry these materials southeastward and slightly offshore. Though contaminants in the San Francisco Bay plume have not been explicitly tracked, sediments derived from the Sacramento-San Joaquin watersheds have been identified in a narrow strip north of the Golden Gate Bridge and in a much broader area, extending to the edge of the continental shelf, south of the Golden Gate (Karl et al 2001). Smaller municipalities, as well as road construction, throughout the study region also generate urban NPSP. In more rural parts of the study region, onsite disposal systems have become a source of pollution and are regulated as both NPSP and point source pollution (RWQCB-North Coast Region 2005, RWQCB- San Francisco Bay 2002).

Boating and Shipping

The port of San Francisco is heavily visited by cruise ships and commercial vessels, which can have significant impacts on the marine environment. In May of 2006, 23 cruise ships visited San Francisco with over 60,000 passengers and approximately 175,000 cruise ship passengers visit the city each year (Armstrong 2005, SFGOV 2006). The huge numbers of passengers aboard these ships, as well as the ships themselves, generate large amounts of pollution that can have adverse effects on the marine environment including sewage, gray water, oily bilge water, ballast water, hazardous wastes, and solid wastes (MBNMS 2005). Commercial vessels are another potentially significant source of pollution. The Monterey Bay National Marine Sanctuary reports approximately 4,000 large vessel transits through the sanctuary per year, with approximately 20% of these transits being crude oil tankers. The majority of the rest of the transits are large commercial vessels, such as container ships and bulk product carriers. The large commercial vessels are of particular concern in the north central coast study region, as they travel within 2 miles of shore and carry up to 1 million gallons of bunker fuel, which is similar to crude oil. The historical number of oil spills along the Pacific Coast is small, but the potential size and impact of such a spill on the marine environment is significant (MBNMS 2005). For instance, the 1984 sinking of the tanker vessel Puerto Rican off the Farallon Islands released 1.47 million gallons of oil which killed over 2,874 birds and had detrimental effects on elephant seals and northern fur seals and the larvae of Dungeness crab, rockfish, shrimp, and krill. The stern portion of this vessel sank with 365,500 gallons of bunker fuel, which has continued to discharge into the Gulf of the Farallones (GFNMS T/V Puerto Rican Factsheet). Ballast water from commercial vessels, as well as from cruise ships, is an additional concern as it is a potential source of invasive species which can have adverse affects on the marine environment. San Francisco Bay, for instance, is

considered one of the most invaded aquatic ecosystems in the world with over 255 introduced species (NOAA 2006).

Smaller ports in the study region, including marinas at Bodega Bay and Pillar Point Harbor, pose additional NPSP problems. Poorly flushed waterways, physical alteration of wetlands and benthic communities, and pollutants discharged from boat maintenance activities are some of the issues of concern in marinas, which are located near the water's edge and therefore not buffered or filtered by natural processes (SWRCB 2005b).

Hydromodification

Hydromodification includes the alteration of stream and river channels, installation of dams and water impoundments, and streambank and shoreline erosion. Such activities can reduce the quality of aquatic habitats by altering temperature and sediment transport (SWRCB 2005b). Large-scale hydromodification is not a major issue in the north central coast study region, though regional water boards throughout the study region address this issue through NPSP programs where appropriate (RWQCB- North Coast Region 2005, RWQCB- San Francisco Bay 2002).

4.4.3 Point Sources

There are also specific locations (point sources) where pollution enters coastal waters. Approximately 20 municipal wastewater treatment facilities are located in the north central coast study region and at least four discharge directly into the ocean (Table 13). The largest of these four treatment facilities is the San Francisco Oceanside Wastewater Treatment Facility which is one of the biggest dischargers of wastewater in the state, with an average dry flow of 17 million gallons per day and a maximum flow of 65 million gallons per day (Dominic Gregorio, SWRCB, pers. comm., www.sfwater.org). Many more treatment facilities discharge into San Francisco Bay, which enters the study region by flowing under the San Francisco Bridge. This includes the San Francisco Southeast Treatment Plant, which has an average dry flow of 67 million gallons per day and a maximum flow of 250 million gallons per day (www.sfwater.org). In the northern portion of the study region, on-site waste treatment and disposal systems are increasingly becoming permanent alternatives to centralized sewage systems. These on-site facilities have significant potential to cause water pollution, health hazards, and nuisance if not properly sited, designed, constructed, and maintained. As a result, the North Coast RWQCB has drafted specific polices with regard to such facilities (North Coast RWQCB Basin Plan).

In addition to municipal wastewater treatment and disposal systems, other kinds of permitted pollution discharge points exist in the region; these point sources are also shown in table 13.

Table 13: Point Sources in the North Central Coast Study Region

Point Source	Effluent	Pollution Rating
Municipal Wastewater Treatment Facilities		
Mendocino County Waste Water Disposal, Anchor Bay	Treated sanitary wastewater	minor

Point Source	Effluent	Pollution Rating
San Francisco City and County Oceanside Waste Water Treatment Plant	Treated sanitary wastewater	major
North San Mateo Waste Water Treatment Plant	Treated sanitary wastewater	major
Mid-Coastside Waste Water Treatment Plant	Treated sanitary wastewater	major
Other Permitted Pollution Discharge Points		
Bodega Bay Fish Farm	Aquaculture wastewater	minor
University of California, Bodega Marine Laboratory	Marine lab waste seawater	minor
USFWS, Southeast Farallon Island human waste disposal	Untreated liquid human waste and gray water	minor

Source: CDFG GIS data, Dominic Gregorio, SWRCB, pers. com.

Currently, there are no coastal powerplants that operate within the study region. The nearest powerplants are located in Santa Cruz (oil/gas), Fort Bragg (biomass), and within San Francisco Bay (oil/gas). (A map of California powerplants can be found at: http://www.energy.ca.gov/maps/power_plant.html).

4.5 Some Water-Quality Projects in the North Central Coast Study Region

The Master Plan Framework (CDFG 2005a) recognizes the importance of maintaining water quality and integrity of habitat along the California coastline. Many different water quality and watershed management programs exist throughout the study region. While not all of these programs will have a significant effect on regional implementation of the MLPA and designation of MPAs, they are nonetheless important for understanding how different efforts can be integrated and coordinated between MPA managers and other agencies and programs.

4.5.1 Water Quality Monitoring Programs in the Monterey Bay National Marine Sanctuary and the Gulf of the Farallones National Marine Sanctuary

The Water Quality Protection Program is a partnership of 25 federal, state and local agencies, public and private groups dedicated to protecting and enhancing water quality in the Monterey Bay National Marine Sanctuary and its watersheds. Using a collaborative approach involving key stakeholders in each issue, four detailed plans—urban runoff, marinas and boating, regional monitoring, and agriculture and rural lands—have been completed that aim to provide an ecosystem-based water quality management process (http://montereybay.noaa.gov/resourcepro/urban.html).

The Gulf of the Farallones National Marine Sanctuary (GFNMS) has several monitoring programs that gather information on water quality. The Beach Watch program, for instance, is a volunteer-based program that gathers coastal information from Año Nuevo to Bodega Bay and contributes to the Bay Area Oil Spill Contingency Plan

(http://www.farallones.org/documents/Beach_Watch_10_Year_Report.pdf). GFNMS also conducts Sanctuary Ecosystem Assessment Surveys of Pelagic Habitat, which monitor hydrographic conditions, physical features, and distribution and abundance of marine organisms in the Gulf of the Farallones and coastal Sonoma County.

4.5.2. U.S. Environmental Protection Agency Projects

The State Water Resources Control Board, via the Regional Water Board, is managing a number of U.S. Environmental Protection Agency (USEPA)-funded projects in the north central coast study region which address a wide range of water quality issues both in the receiving waters and the watersheds that drain to those waters. These projects include studies of various toxins and non-point pollution sources as well as analyses of sediment and gravel sources in creeks and rivers. More information on these projects can be found at http://www.epa.gov/Region9/water/projects/reg_1.html and http://www.epa.gov/Region9/water/projects/reg_2.html.

In addition, the USEPA monitors levels of various pollutants and stressors in the study region as part of the Total Maximum Daily Load (TMDL) process (see section 3.3.1 Impaired Water Bodies in the North Central Coast Study Region).

4.5.3 Other Water Quality and Monitoring Programs

Numerous government programs in California are working to address water quality problems that afflict the coast. The Region 1 and Region 2 RWQCB's are responsible for ten state water quality protection areas (SWQPA), formerly known as 'Areas of Special Biological Significance' (ASBS), in the north central coast study region. The California Coastal Commission has designated 17 Critical Coastal Areas (CCAs) in the study region (table 8), specifically to organize multiple layers of governments' response to non-point source pollution issues (California Coastal Commission, 2002) (more information on these programs can be found in section 4.3, Coastal Water Quality). The California Coastal Commission addresses water quality through other programs as well, including its Water Quality Unit, Local Coastal Programs, Interagency Coordination Committee, Model Urban Runoff Program, Contaminated Sediments Task Force, Snapshot Day, and First Flush programs (NOAA 2006).

The California State Mussel Watch Program, which started in 1977, collects transplanted and resident mussels and clams from the waters of California's bays, harbors, and estuaries to evaluate bioaccumulation of contaminants in tissues. Samples collected are analyzed for trace elements, pesticides, and polychlorinated biphenyls from sites along the California Coast including Fort Ross, the mouth of the Russian River, Bodega Head, Estero Americano, Estero de San Antonio, Tomales Bay, Point Reyes, Bolinas Lagoon, Tennessee Valley Creek, Point Bonita, Mile Rocks, Daly City, Pillar Point, the Farallon Islands (NOAA 2006). Similarly, other recent studies have used sand crabs as a biological indicator for use in long-term ambient monitoring of pollutants on the California coast. Tissues of sand crabs collected from 19 coastal beaches spanning a variety of land use types contained contaminants including petroleum and chlorinated hydrocarbons (from pesticides and polychlorinated biphenyls) and trace metals (Dugan, et. al. 2004).

Estuarine water quality monitoring is particularly important. In San Francisco Bay, The San Francisco Estuary Institute manages the Regional Monitoring Program for Water Quality in San Francisco Bay in conjunction with the Regional Water Quality Control Board for region 2 and the regulated discharger community. This adaptive, long term program gathers numerous kinds of data regarding contaminants and their effects on the ecology of San Francisco Bay (http://www.sfei.org/rmp/index.html). Another long term data has been collected by USGS and includes almost 30 years of data on salinity, temperature, suspended solids, dissolved oxygen, light penetration, and chlorophyll concentration for a 145 km transect (http://sfbay.wr.usgs.gov/access/wqdata/). In Tomales Bay, the Tomales Bay Watershed Council has outlined a 10-year plan for monitoring the chemical, physical, and biological characteristics of surface waters in the bay in conjunction with numerous partner organizations. The plan includes provisions for long term trend, source area, and baseline monitoring as well as the creation and maintenance of a database for water quality information. More information can be found at: http://www.tomalesbaywatershed.org/waterqualitymonitoring.pdf.

Under the direction of the California Environmental Protection Agency and with the assistance of the coastal Regional Water Quality Control Boards and three contractors—Southern California Coastal Water Research Project, San Francisco Estuary Institute, and the California Department of Fish and Game - an inventory of the coastal water quality monitoring programs in California has been completed, and a Web site for the inventory has been developed. The inventory identifies the agencies that conduct monitoring, where they sample, what they measure, how they analyze samples, and how to acquire more information about specific programs such as concentrations of particular analyses. This report can be accessed electronically at http://www.sfei.org/camp.

Some of these programs are volunteer-based and coordinate concerned citizens to obtain and analyze water samples on a regular basis. They include:

- The Sanctuary Citizen Watershed Monitoring Network
- Monterey Bay Sanctuary Snapshot Day
- The Clean Water Team Citizen Monitoring Program
- The Gulf of the Farallones NMS Beach Watch

5.0 Socioeconomic Setting

California's marine and coastal environments form part of the State's identity and support important economies that depend on healthy ocean resources. Socioeconomic conditions, affect marine resource use patterns, coastal livelihoods, and human activities. A brief overview of coastal counties, ocean economy, demographics, and resource use in the study region is provided as regional context.

Data from the U.S. Census Bureau, California Department of Finance, California Employment Development Department, and the National Ocean Economics Program were compiled for each county and are discussed below.

The National Ocean Economics Program's Ocean Sector and Industry Data includes only the industries which depend on and derive their source from the ocean and shoreline. Data are from six ocean industry sectors (defined by the National Ocean Economics Program), and include the number of establishments, number of people employed, wages paid, and gross state product. The ocean industry sectors are:

- **Coastal Construction** (marine construction).
- **Living Resources** (fishing, fish hatcheries and aquaculture, seafood markets and seafood processing).
- **Offshore Minerals** (limestone, sand and gravel; oil and gas exploration and production)
- **Tourism and Recreation** (amusement and recreation services, boat dealers, eating and drinking places, hotels and lodging places, marinas, recreational vehicle parks and campgrounds, scenic water tours, sporting good retailers, zoos and aquaria).
- **Transportation** (deep sea freight transportation, marine passenger transportation, marine transportation services, search and navigation equipment, and warehousing).

It is worth noting that recreational fishing is included in the "Tourism and Recreation" category and not in the "Living Resources" category.

Furthermore, the MLPA Initiative has collected and reviewed public documents (general plans, resolutions, etc,) related to marine uses from coastal public entities (counties, cities, special districts, parks).

5.1 Coastal Counties

There are 5 coastal counties that abut the north central coast study region. They are briefly discussed below, in order from north to south.

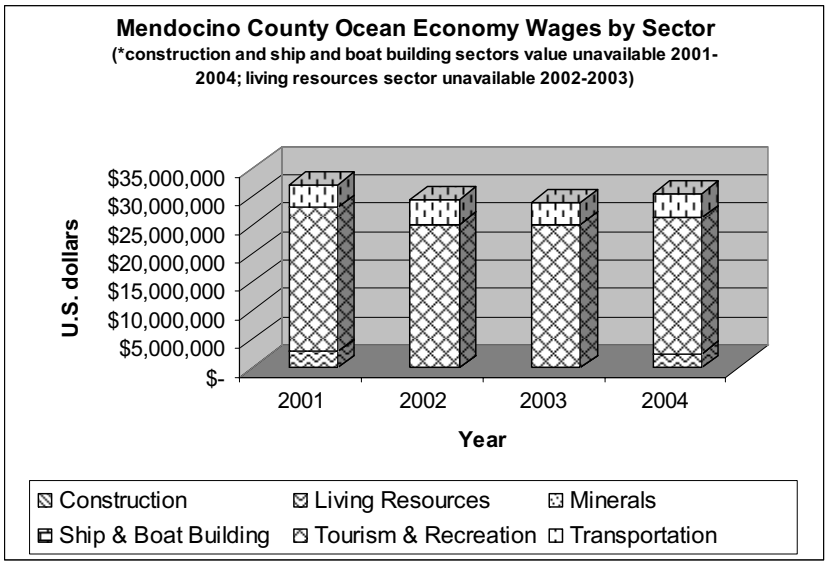
5.1.1 Mendocino County

Mendocino County encompasses 3,510 square miles and has a shoreline span of roughly 100 miles. The north central coast study region encompasses only the portion of Mendocino County

south of Point Arena which represents a shoreline span of roughly 20 miles. Tourism is the primary industry in the county, distributed among five distinct regions: Anderson Valley, South Mendocino coast, North Mendocino coast, Northern Mendocino county, and the Russian River Valley (Employment Development Department of California 2006).

The following economic data is for Mendocino County as a whole whereas the north central coast study region encompasses only the area south of Point Arena and therefore does not include the major population centers. In terms of the sectors of the economy which depend upon ocean resources, "tourism and recreation" surpassed all other sectors in wages earned, at roughly $25 million per year. By comparison, the "living resources" and "transportation" sectors total wages were roughly $2-$5 million annually (see Figure 1).

Figure 1: Mendocino County Ocean Economy Wages by Sector



Source: National Ocean Economics Program 2006
Note: All dollar values are converted to year 2000 equivalents. It should also be noted that contributions to California's Gross State Product and total wages by some sectors listed in Figure 1 for Mendocino County are not publicly available in order to protect the confidentiality of business establishments' information. Because of the lack of data on contribution to Gross State Product in Mendocino County, total wages is used to illustrate the scope of various sectors of the ocean economy.

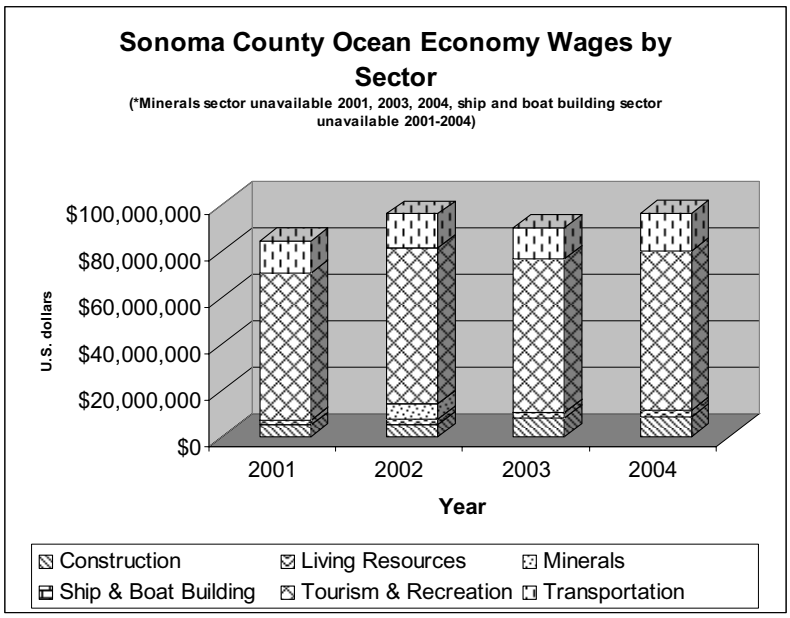
5.1.2 Sonoma County

Sonoma County encompasses 1,604 square miles and has a shoreline span of roughly 65 miles.

In terms of the sectors of the economy which depend upon ocean resources, "tourism and recreation" sector wages averaged roughly $65 million per year, far exceeding any other sector. The "transportation" sector followed with an average of roughly $15 million per year, followed by "construction" and "living resources" with averages of $5 million and $2 million, respectively.

The “minerals” sector data is unavailable 2001, 2003, 2004 and “ship and boat building” sector are unavailable 2001-2004 to protect the confidentiality of business establishments (Figure 2).

Figure 2: Sonoma County Ocean Economy Wages by Sector



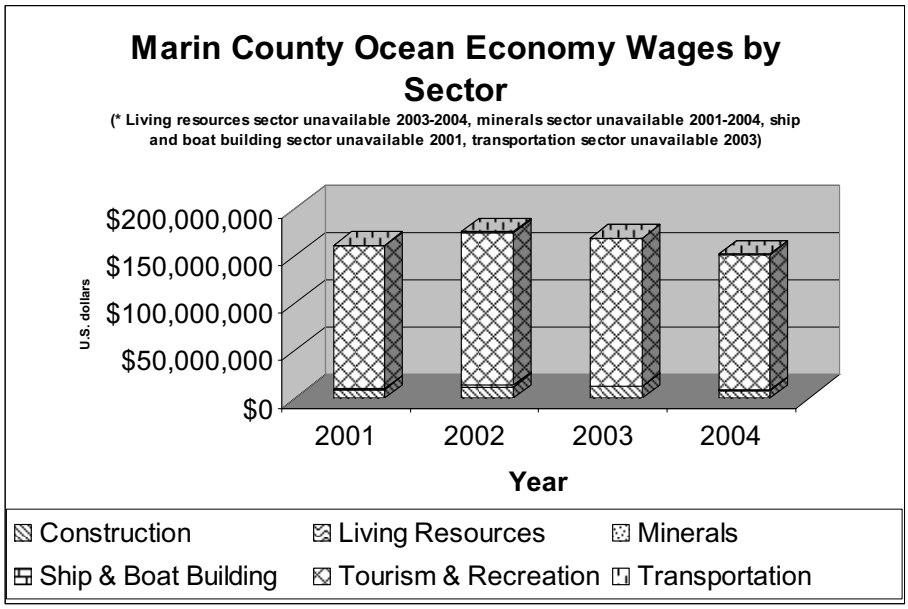
Source: National Ocean Economics Program 2006
Note: All dollar values are converted to year 2000 equivalents

5.1.3 Marin County

Marin County encompasses 580 square miles and its outer coast has a shoreline span of roughly 60 miles (excluding Tomales Bay) (Employment Development Department of California 2006).

In terms of the sectors of the economy which relate directly to ocean resources, “tourism and recreation” wages surpass all other sectors with roughly $150 million in wages annually. The “construction” sector follows with average wages of roughly $10 million. The “living resources” sector produced roughly $2 million annually in wages (2001-2002), while “ship and boat building” and “transportation” sectors produced less than $1 million annually in wages. Data on wages produced by the “minerals” sector was not available in order to protect the confidentiality of the few businesses in Marin county that participate in this sector (Figure 3).

Figure 3: Marin County Ocean Economy Wages by Sector



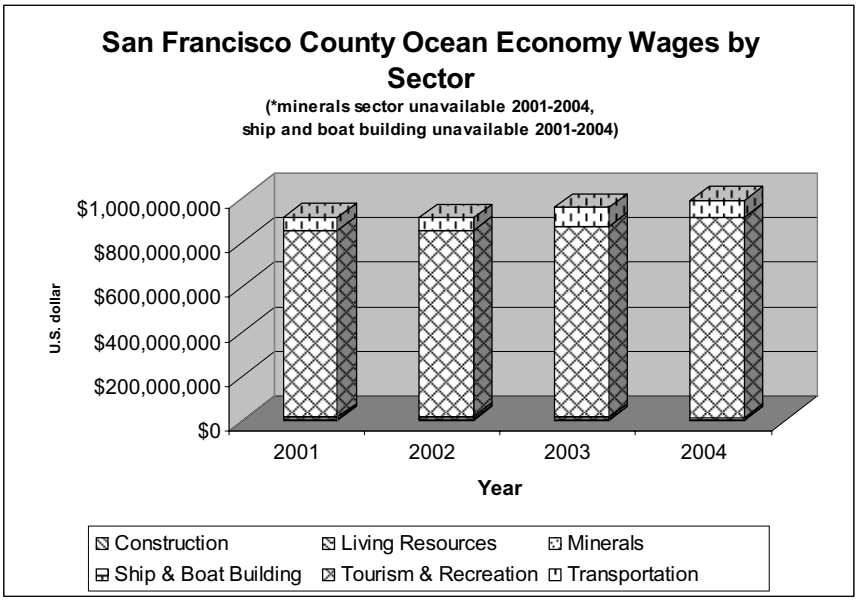
Source: National Ocean Economics Program 2006
Note: All dollar values are converted to year 2000 equivalents

5.1.4 San Francisco County

San Francisco County encompasses just 47 square miles and has a shoreline span of 8 miles west of the Golden Gate Bridge.

In terms of the sectors of the economy which depend upon ocean resources, “tourism and recreation” far surpassed all other sectors in terms of annual wages produced with $860 million. The “transportation” sector followed with $68 million in annual wages produced, followed by “living resources” and “construction” with $11 million and $4 million, respectively. The “minerals” and “ship and boat buildings” contribution to wages over the time period are not available (Figure 4).

Figure 4: San Francisco County Ocean Economy Wages by Sector



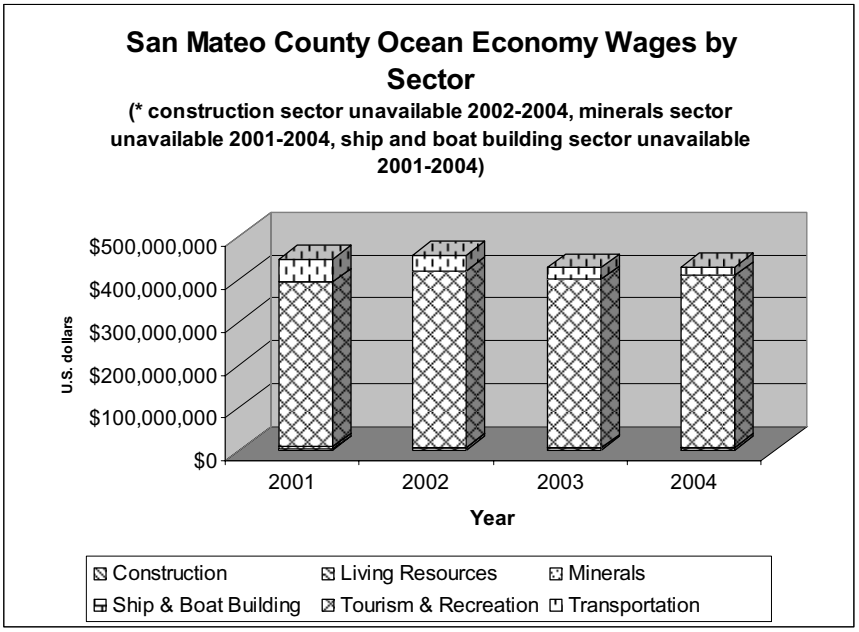
Source: National Ocean Economics Program 2006
Note: All dollar values are converted to year 2000 equivalents

5.1.5 San Mateo County

San Mateo County encompasses 531 square miles and has a shoreline span of roughly 50 miles. The north central coast study region encompasses most of San Mateo County with the exception of the portion of the county south of Pigeon Point (roughly 8 miles of coastline). The coastal Santa Cruz Mountains divide the county, with the western, coastal side being characterized by more rural activities such as farming, game preserves, watersheds, parks, and undeveloped lands.

Ocean industry data are presented below are for all of San Mateo County; however, as stated above, the study region does not include the entirety of the county. Like the other counties in the study region, the “tourism and recreation” sector far surpassed all other sectors in terms of wages produced with $400 million produced annually. The “transportation” and “living resources” sectors followed with $34 and $6 million in wages produced annually, respectively. Data on wages was unavailable for the “construction”, “minerals”, and “ship and boat building” sectors (Figure 5).

Figure 5: San Mateo County Ocean Economy Wages by Sector



Source: National Ocean Economics Program 2006
Note: All dollar values are converted to year 2000 equivalents

5.2 Coastal Communities

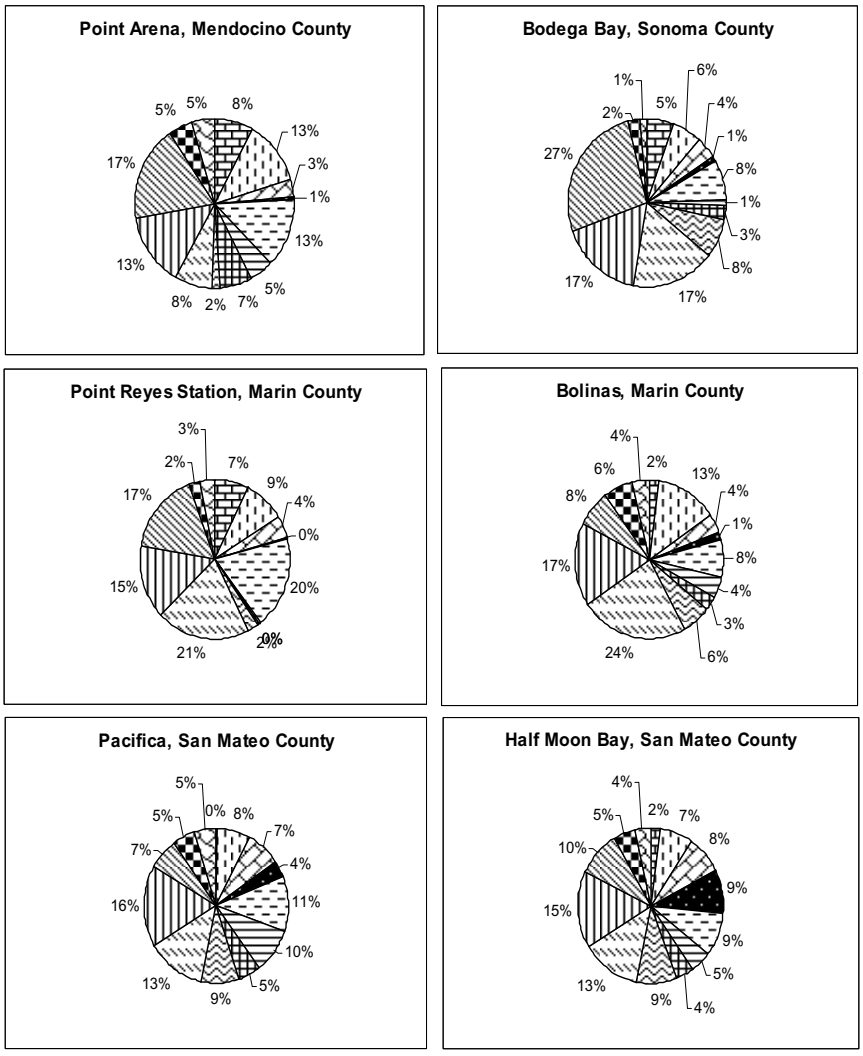
Table 14 below describes the characteristics of some of the major communities within the north central coast study region. Figure 6 describes the percent employment by sector of the same communities.

Table 14: Population, Unemployment, Per-Capita Income, Median Household Income, and % of Population Below Poverty Line for Some Communities Within the Study Region

Community	County	Population (2000)	Unemployment rate	Per-capita income	Median household income	% below poverty line
Point Arena	Mendocino	474	2.7%	12,591	27,083	26.0%
Bodega Bay	Sonoma	1,423	2.6%	37,226	56,818	4.0%
Point Reyes Station	Marin	818	1.1%	39,339	69,821	6.0%
Bolinas	Marin	1,246	0.7%	28,973	53,188	10.2%
Pacifica	San Mateo	38,390	2.5%	30,183	78,361	2.9%
Half Moon Bay	San Mateo	11,842	2.6%	37,963	78,473	6.1%

Source: U.S. Census Bureau 2006

Figure 6: Employment by Sector of the Economy for Several Coastal Communities Within the Study Region



Source: U.S. Census Bureau 2006

5.3 Population Projections

Most of the population of California lives near the coast. Seventy-six percent of California's population lives in coastal counties that represent only twenty-five percent of the state's total area (Kildow 2005). As of 2000, San Francisco and San Mateo counties have a greater population density than the remainder of the study region (Table 15). Major population centers adjacent to the north central coast study region include Santa Rosa, the eastern portions of Marin County, San Francisco and the broader Bay Area, and the largely urbanized eastern portion of San Mateo County, and the greater San Jose area.

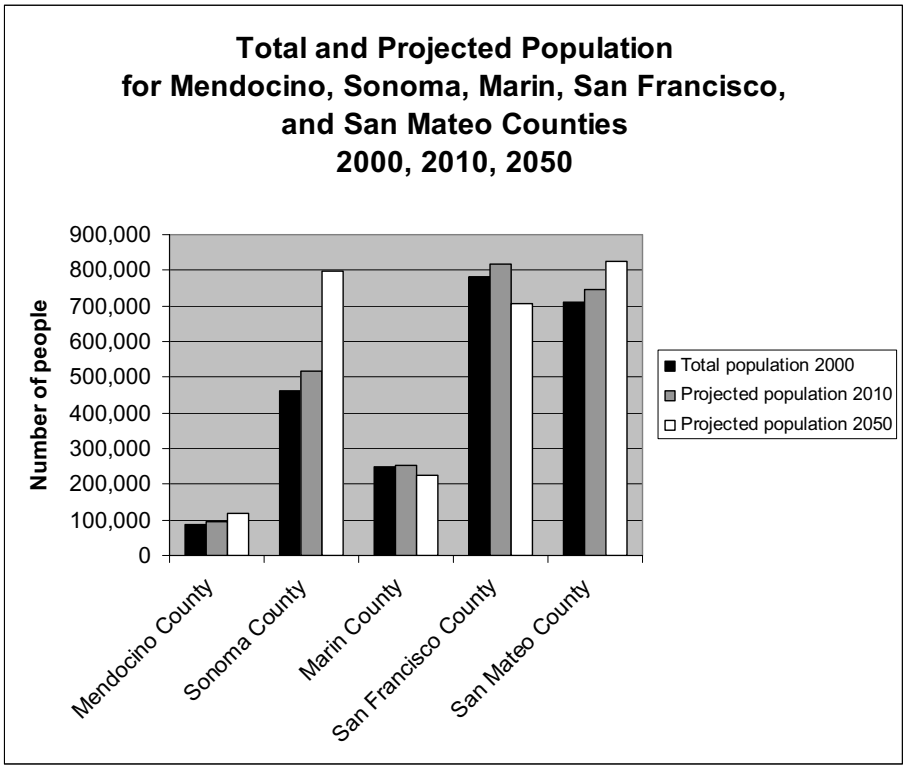
Population growth trends in coastal counties will result in increasing pressure on and impacts to coastal and marine resources and habitats. Based on a demographic model that incorporates fertility, migration, and survival rates, population projections indicate that Sonoma County will have the highest percent change in population growth (+11.84% for 2000-2010 and +72.71% for 2000-2050) among counties along the north central coast study region. Marin and San Francisco counties are expected to grow slightly between 2000 and 2010, but are expected to decrease by 9.4% and 9.6%, respectively by 2050 (Table 15, Figure 7). Rapid growth is occurring in the counties where the average population density is currently the lowest.

Table 15: Total Population, Population Change, and Projected Growth in Coastal Counties in the Study Region

Coastal County	Total population 2000	Projected population 2010	% Projected population change 2000-2010	Projected population 2050	% Projected population change 2000-2050	People per square mile (2000)*
Mendocino County	86,852	94,300	8.58%	118,621	36.58%	24.6
Sonoma County	461,347	515,968	11.84%	796,792	72.71%	291
Marin County	248,473	252,440	1.60%	225,127	-9.40%	475.7
San Francisco County	781,174	816,230	4.49%	706,192	-9.60%	16,634.4
San Mateo County	710,493	747,134	5.16%	826,342	16.31%	1,574.7

Sources: California Department of Finance 2004; U.S. Census Bureau 2006

Figure 7: Total and Projected Population for Mendocino, Sonoma, Marin, San Francisco, and San Mateo Counties for 2000, 2010, and 2050



Source: California Department of Finance 2004

5.4 Commercial Fisheries

The California Department of Fish and Game (CDFG) collects landings data for all commercial fisheries landed at California ports. Landing receipts that report poundage and ex-vessel value (price paid to fisherman) are submitted to CDFG by fish dealers and processors. The data provided in this section were extracted from this California Commercial Landings database. Maps 10a-10j show commercial logbook data for 11 different fisheries, including rockfish, California halibut, red abalone, dungeness and rock crab, herring, surfperch, flatfish, red urchin, squid, salmon, and shaks, skates, and rays.

Species included in analysis: All fish and invertebrate species caught in ocean waters in the study region were included in the landings data analysis. Because San Francisco Bay is not within the north central coast study region, species that are normally only found within the bay were excluded from all San Francisco Bay analyses below. These freshwater and estuarine species include roe herring, herring roe on kelp, bay shrimp, brine shrimp, Sacramento blackfish, carp, yellowfin goby, longjaw mudsucker, staghorn sculpin, shad, threespine stickleback, sucker, brown bullhead, hardhead, and bullfrog. However, some species or species groups may be caught either within the bay or in ocean waters of the study region, and landed at the same San Francisco Bay ports. These include California halibut, surfperches, shark unspecified, and leopard shark. Bay-caught fish and ocean-caught fish, could not be separated effectively from landing receipts. Therefore data for the San Francisco Bay port complex should be interpreted with this in mind.

Tomales Bay and Bodega Bay are within the study region, so the herring fishery is included in the analyses for these ports, however, freshwater species were excluded.

5.4.1 Port Complexes

For reporting purposes, CDFG organizes California ports geographically into nine port complexes along the entire state. California commercial landings from ports within each complex are combined for some tables in public reports, but other tables in public reports also list landings by individual ports provided there is more than one dealer in a port. The north central coast study region encompasses two port complexes: Bodega Bay and San Francisco. In addition, Point Arena and Anchor Bay, which are the two southernmost ports in the Fort Bragg port complex, are within the study region. The port of Princeton-Half Moon Bay is normally included in the San Francisco port complex, but for the purposes of providing more area-specific information in this report, it will be reported separately in this section and in Appendix III. All ports within the study region where landings have occurred in recent years (2003-2006) are listed in Table 16 with their average volume and value for the last 15 years (1992-2006), at both the port and port complex level.

During the 1992-2006 period, average annual landings in the north central coast study region totaled nearly 17 million pounds with an average annual ex-vessel value of almost $18 million (not adjusted for inflation) (Table 16). Important ports in the study region in terms of both volume and value are Bodega Bay, Point Arena, San Francisco, and Princeton-Half Moon Bay.

Table 16: Average Annual Commercial Landings from 1992-2006 at North Central Coast Study Region Ports that had Landings Activity in Recent Years (2003-2006)

Port Complex	Port	Average Recent Volume 2003-2006* (lbs)	Average Recent Value 2003-2006*	Average Volume 1992-2006* (lbs)	Average Value 1992-2006*
Fort Bragg**	Point Arena	708,961	$563,383	1,252,020	$1,418,598
	Total	708,961	$563,383	1,252,020	$1,418,598
Bodega Bay	Bodega Bay***	2,535,448	$5,157,652	4,269,742	$5,848,182
	Marshall	185,129	$63,829	299,538	$223,750
	Point Reyes	72,102	$144,718	63,394	$149,491
	Bolinas	72,500	$184,437	42,084	$117,224
	Tomales Bay	3,909	$4,442	33,000	$9,650
	Marconi Cove	1,611	$4,043	1,399	$3,634
	All Other Ports****	7,195	$21,606	10,362	$25,183
	Total	2,877,894	$5,580,727	4,719,519	$6,377,114
San Francisco	San Francisco	5,584,293	$8,934,710	5,140,240	$6,775,352
	Princeton - Half Moon Bay	4,226,037	$5,765,433	5,400,292	$6,252,059
	Sausalito	7,893	$22,565	228,087	$462,384
	Oakland	12,944	$26,932	117,897	$232,645
	Alviso	4,092	$2,734	1,783	$1,810
	Berkeley	33,862	$80,534	66,219	$121,450
	Richmond	11,621	$37,126	13,839	$41,508
	Alameda	7,243	$17,659	14,793	$30,217
	China Camp	6,632	$23,910	3,939	$10,475
	Emeryville	14,636	$21,093	5,474	$7,844
	South San Francisco	1,293	$3,330	2,189	$6,050
	All Other Ports****	28,122	$17,320	28,519	$45,181
	Total	9,938,668	$14,953,346	11,023,271	$13,986,975
All Ports Total		13,525,523	$21,097,456	16,994,810	$21,782,687

Note: Dollar values are adjusted for inflation (2006$).
*2006 data are preliminary (March 2007)
**Only the two southernmost ports in this port complex, Point Arena and Anchor Bay, were considered in the analysis.
***Prior to 1999, DFG reported confidential landings for Bodega Bay in the San Francisco “All Other Ports” category.
****”All Other Ports” category is the sum of other minor ports in the port complex.

Fishing Communities

Southern Fort Bragg port Complex - Point Arena/Anchor Bay: Port Arena and Anchor Bay are part of the Fort Bragg port complex but are the only two ports from the complex that are within the bounds of the study region. These two ports are located approximately 130 and 115 miles north of San Francisco, respectively. In 2006, there were 31 commercial vessels, 33 commercial fishermen, and 17 processors that reported landings in Point Arena with none reported for Anchor Bay (CFIS, March 2007). The top ten fisheries (see Appendix III-l for list of species included in each market category) landed in these ports in 2006, in order of importance (total value landed), were red urchin, salmon, nearshore finfish, Dungeness crab, lingcod, shelf rockfish, sablefish (non-trawl - line and trap), tuna, spot prawn (trap), and slope rockfish/grenadier (note that highly migratory (e.g. tuna) and trawl fisheries (e.g. slope rockfish) occur outside of state waters and therefore outside the study region. However, these fisheries are still considered economically important to this port complex and are included in the above analyses). The total value of all landings in 2006 was over four million dollars, with over half a million pounds landed.

Bodega Bay port complex: The Bodega Bay Port complex includes various ports north of San Francisco. The port complex delineation for the Bodega Bay port complex follows the Commercial Fishery Information System database guidelines and includes ports such as: Dillon Beach, Timber Cove, Marshall, Bodega Bay, Inverness, Point Reyes, Marconi Cove, Bolinas and Tomales Bay. In 2006, there were 302 commercial vessels, 311 commercial fishermen, and 84 processors that reported landings in these ports (CFIS, March 2007). The top ten fisheries landed in these ports in 2006, in order of importance (total value landed), were Dungeness crab, salmon, nearshore finfish, tuna, Dover sole/thornyhead/sablefish (trawl), "other" flatfish, California halibut, shelf rockfish, roe herring, and slope rockfish/grenadier (note that highly migratory (e.g. tuna) and trawl fisheries (e.g. slope rockfish) occur outside of state waters and therefore outside the study region. However, these fisheries are still considered economically important to this port complex and are included in the above analyses). The total value of all landings in 2006 was over five million dollars with more than two million pounds landed.

San Francisco Bay port complex: The San Francisco Bay Port complex includes various ports in and around San Francisco Bay. The port complex delineation for the San Francisco Bay port complex follows the Commercial Fishery Information System database guidelines and includes ports such as San Francisco, Princeton/Half Moon Bay (see below), Sausalito, Richmond, Oakland, and Berkeley. In 2006, there were 271 commercial vessels, 270 commercial fishermen, and 114 processors that reported landings in these ports (CFIS, March 2007). The major fisheries landed in these ports in 2006, in order of importance (total value landed), were Dungeness crab, California halibut, salmon, Dover sole/sablefish/thornyhead (trawl), “other flatfish,” sablefish (non-trawl – line and trap), nearshore finfish, slope rockfish/grenadier, shelf rockfish, and lingcod (note that trawl fisheries (e.g. sablefish) occur outside of state waters and therefore outside the study region. However, these fisheries are still considered economically important to this port complex and are included in the above analyses). The total value of all landings in 2006 was over six and a half million dollars with more than three million pounds landed.

Princeton/Half Moon Bay: The ports of Princeton and Half Moon Bay are a subset of the San Francisco Bay port complex where major commercial landings occur (second highest landings pounds and value in the north central coast study region) (Table 16). They are located approximately 30 miles south of San Francisco. The majority of commercial landings occur in Princeton at Pillar Point Harbor, where processing facilities exist, although small landings do occur along the beach in Half Moon Bay. In 2006, there were 163 commercial vessels, 175 commercial fishermen, and 72 processors that reported landings in these ports (CFIS, March 2007). The top ten fisheries landed in these ports in 2006, in order of importance (total value landed), were Dungeness crab, salmon, California halibut, other flatfish, sablefish (non-trawl - line and trap), sanddab, tuna, nearshore finfish, lingcod, and Dover sole/sablefish/thornyhead (trawl) (note that trawl fisheries (e.g. sablefish) occur outside of state waters and therefore outside the study region. However, these fisheries are still considered economically important to this port complex and are included in the above analyses). The total value of all landings in 2006 was near five million dollars with close to 3 million pounds landed.

The National Oceanic and Atmospheric Association's (NOAA) Northwest Fisheries Science Center has compiled a draft "Community Profiles" on the major ports in the study region and includes the ports of Bodega Bay, Corte Madera, Dillon Beach, El Sobrante, El Granada, Half Moon Bay, Novato, Point Arena, Princeton, San Jose, San Francisco, Santa Rosa, Sausalito, and Sebastapol. These profiles provide social and economic information, including history and status of the commercial fisheries at each port. (NOAA Fisheries Service, viewed April 15, 2007)

In a study commissioned by the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries, Ecotrust performed a socioeconomic profile of fishing activities and port communities associated with the sanctuaries (Ecotrust 2001). This study profiles both the historic fisheries, and the evolution of fishing activities occurring in the sanctuaries. The study includes information on actual numbers of boats actively engaged in each fishery, areas where the fishery is taking place, gear types, catch levels, a socio-economic profile of the harbors and marinas accessing the sanctuaries, and an understanding of markets, changing gear types, and changing fisheries management regulations that influence this profile and the community. Information exchange with mariners will provide important input to the profile.

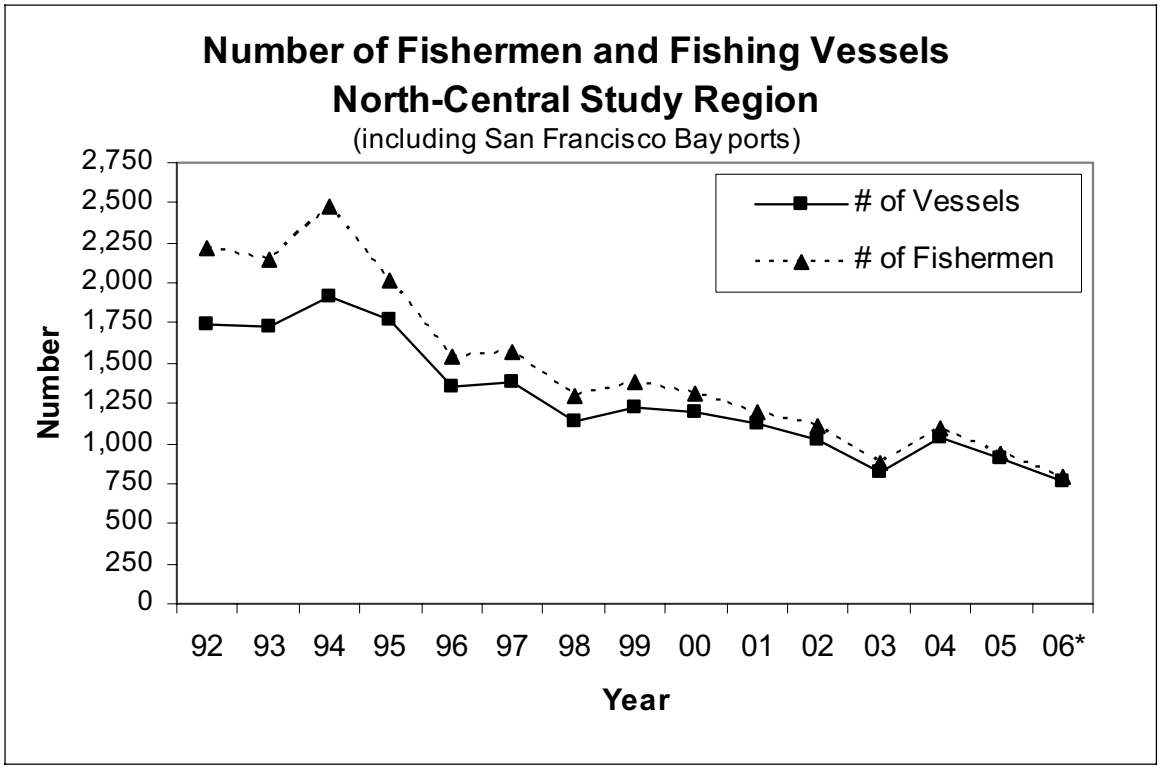
Final Groundfish Essential Fish Habitat Environmental Impact Statement (NOAA Fisheries Service 2005). This report provides socioeconomic data for fishing communities along the West Coast (California, Oregon and Washington). The document focuses on West Coast fisheries managed federally. Ports included from the north central coast study region are: Point Arena, Sonoma, Bodega Bay, Marin, Tomales Bay, Point Reyes, Sausalito, San Francisco, Contra Costa, Richmond, Alameda, Berkeley, Oakland, Alameda, San Mateo, and Princeton. Types of socioeconomic indicator data included are summarized within the Environmental Impact Statement in *Socioeconomic Table 4-1: Summary of Criteria for Evaluating Socioeconomic Consequences of the Alternatives*. Components of the Socioeconomic Environment are: federally managed fisheries, processors and buyers, consumers, safety, management and enforcement, communities, non-market values, and non-fishing values. The

table summarizes types of analyses and variables used to assess impact. Additional socionomic tables and figures are provided in Appendix E of the Environmental Impact Statement. Links to these sections can be found at http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/NEPA-Documents/EFH-Final-EIS.cfm

Fishermen and Vessels

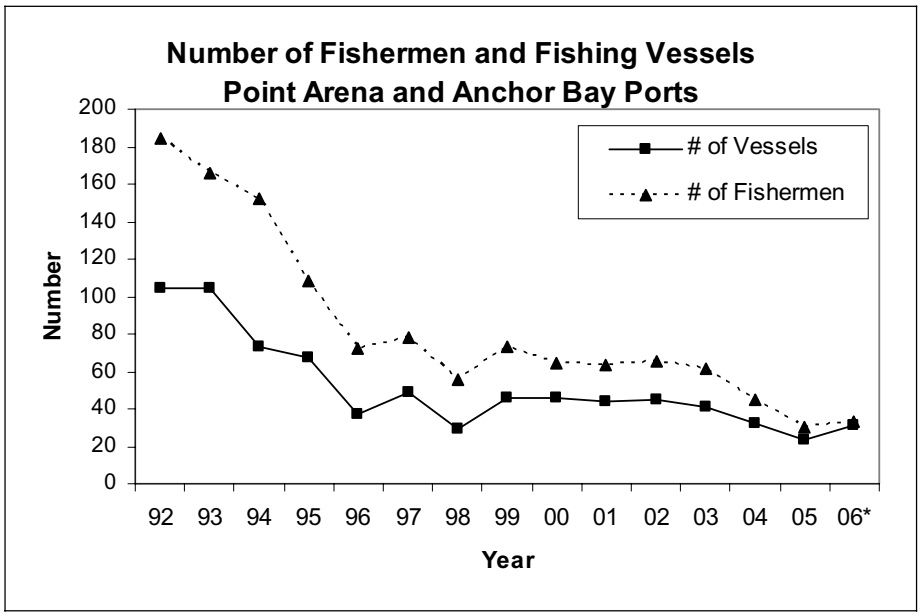
The overall number of commerical fishermen and vessels for the study region and San Francisco Bay combined has declined for the period 1992 through 2006 (Figure 8). The total number of fishermen and vessels by port complex can be viewed in Figures 9-12.

Figure 8: Total Number of Commercial Fishermen and Vessels for All Ports within the North Central Coast Study Region and San Francisco Bay, 1992-2006



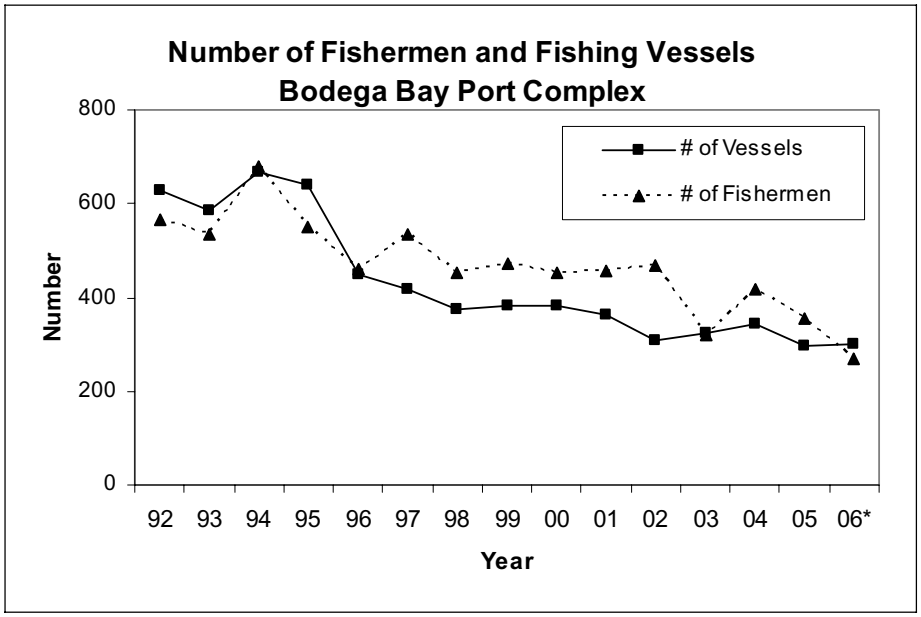
Source: Data were compiled from the Commercial Fishery Information System database (extraction date: 14 March 2007).
*Data for 2006 are preliminary.

Figure 9: Total Number of Commerical Fishermen and Vessels for All Ports within Point Arena and Anchor Bay Ports, 1992-2006



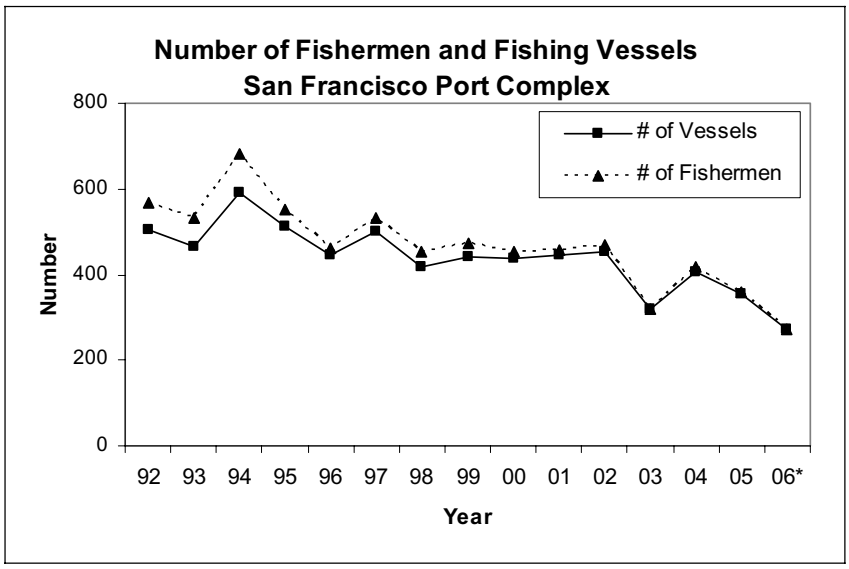
Source: Data were compiled from the Commercial Fishery Information System database (extraction date: 14 March 2007).
*Data for 2006 are preliminary.

Figure 10: Total Number of Commerical Fishermen and Vessels for All Ports within the Bodega Bay Port Complex, 1992-2006



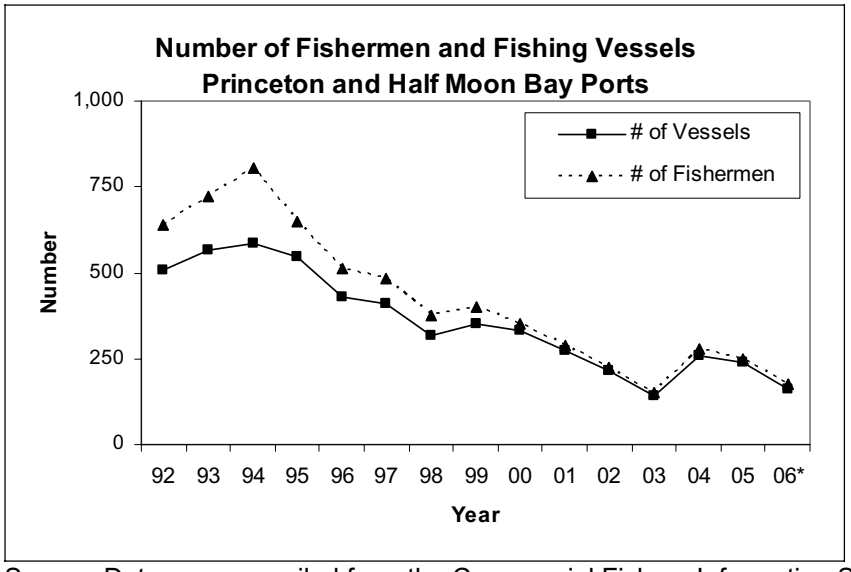
Source: Data were compiled from the Commercial Fishery Information System database (extraction date: 14 March 2007).
*Data for 2006 are preliminary.

Figure 11: Total Number of Commercial Fishermen and Vessels for All Ports within the San Francisco Port Complex, 1992-2006



Source: Data were compiled from the Commercial Fishery Information System database (extraction date: 14 March 2007).
Note: Port complex delineations follow existing CFIS guidelines with the exception of the Princeton/Half Moon Bay Ports, which were analyzed separately (see Figure 23). *Data for 2006 are preliminary.

Figure 12: Total Number of Commerical Fishermen and Vessels for All Ports within Princeton and Half Moon Bay Ports, 1992-2006



Source: Data were compiled from the Commercial Fishery Information System database (extraction date: 14 March 2007).
*Data for 2006 are preliminary.

5.4.2 Commercial Fisheries

This section provides data on the commercial fisheries in the north central coast study region. Average annual landings and value of commercial fisheries for the study region, and average annual landings by port complex for the years 1992-2006 are listed in Table 17. See Table 18 for a similar summary for recent years (2003-2006). The top ten commercial fisheries by average annual landings compose 94.9% of the total average annual landings from 2003-2006 and 95.6% of the total average annual value (Table 18).

Commercial catch is reported either by species or, in certain cases, “market categories.” Market categories include a variety of similar species, or species commonly sold as a generic category of fish. In the California Commercial Landings for 2005-2006, 105 categories of fishes and 14 categories of invertebrates were landed in the Bodega Bay and/or San Francisco port complexes, and/or Point Arena and Anchor Bay ports (not including estuarine categories that only occur outside the study region – see above) (CFIS 2007). These numbers attest to the high value and diversity of fishery resources in the north central coast study region. Because market categories may contain multiple species, these numbers do not correspond exactly to the number of species landed. In addition, the landings totals could include species harvested outside of the study region’s boundaries, but landed in study region ports.

Table 17: Average Annual Landings and Value for 1992-2006* for Major Commercial Fisheries in the North Central Coast Study Region, In Order of Highest Average Annual Landings for Study Region

	Average Annual Landings (lbs) by Port Complex					
			San Francisco Bay Port Complex			
Market Category Groupings**	Fort Bragg Port Complex***	Bodega Bay Port Complex	Princeton-Half Moon Bay Port	San Francisco Bay - All other ports	Average Annual Landings (lbs) for Study Region	Average Annual Value ($) for Study Region
Dungeness crab	17,552	907,632	770,706	1,083,318	2,779,208	5,461,658
Dover sole/Thornyheads/Sablefish Trawl	****	1,047,937	386,959	918,680	2,353,576	1,101,844
Salmon	18,525	610,273	747,232	744,925	2,120,956	4,490,437
Red urchin	1,202,886	786,646	27,880	40,728	2,058,140	1,663,251
Market squid	0	18,395	1,446,160	170,144	1,634,698	328,871
Shelf rockfish	544	525,928	300,122	803,573	1,630,167	792,139
Other flatfish	21	157,751	309,745	373,308	840,825	550,226
Sanddab	1	6,217	509,488	191,214	706,920	282,505
Coastal pelagics*****	20	1,056	423,026	151,318	575,420	51,289
California halibut	****	17,722	132,917	267,394	418,032	1,035,622
Herring	0	327,250	0	0	327,250	177,062
Sablefish, nontrawl	893	31,655	64,011	176,572	273,131	325,580
Tuna	368	84,882	25,328	156,879	267,458	273,213
Slope rockfish, grenadier	124	40,760	59,628	162,980	263,492	91,424
Lingcod	2,021	42,271	49,433	94,145	187,870	112,578
Swordfish	0	27,483	2,646	111,525	141,654	357,144
Nearshore fish	9,251	39,632	30,778	58,983	138,644	317,441
Skates, rays, sharks	45	7,440	29,605	54,512	91,602	44,722
Rock crab	****	10,629	40,477	3,978	55,085	68,911

Croaker	10	8,490	12,317	32,063	52,881	38,753
Red abalone******	0	5	29,240	140	29,385	224,615
Thornyheads, nontrawl	****	2,199	1,017	10,968	14,184	23,678
Ocean shrimp	0	11,158	442	****	11,599	5,110
Surfperch	13	2,267	173	9,038	11,491	23,194
Smelt	****	618	255	4,751	5,625	3,622
Dover sole, nontrawl	****	3,699	501	1,221	5,420	2,750
Spot prawn, trap	****	475	205	608	1,288	8,960
Grand Total	1,252,274	4,720,470	5,400,292	5,622,967	16,996,003	17,856,598
Percent of total landings	7	28	32	33		

*2006 data are preliminary
**See appx III-I for market categoies included in each grouping
***Only the two southernmost ports in this port complex, Point Arena and Anchor Bay, were considered in the analysis.
**** Data cannot be disclosed due to confidentiality considerations.
*****Includes Pacific sardine, northern anchovy, jack mackerel, and Pacific mackerel
******The commercial red abalone fishery was abolished in 1997.

Table 18: Recent Average Annual Landings and Value for 2003-2006* for Major Commercial Fisheries in the North Central Coast Study Region, In Order of Highest Average Annual Landings for Study Region

	Recent Average Annual Landings (lbs) by Port Complex					
			San Francisco Bay Port Complex			
Market Category Groupings**	**Fort Bragg Port Complex*****	**Bodega Bay Port Complex**	**Princeton-Half Moon Bay Port**	**San Francisco Bay – All other ports**	**Recent Average Annual Landings (lbs) for Study Region**	**Recent Average Annual Value ($) for Study Region**
Dungeness Crab	30,379	1,545,781	1,406,094	2,321,901	5,304,154	9,993,386
Market Squid	0	****	1,004,796	633,630	1,638,457	435,908
Salmon	36,079	862,040	556,845	772,983	2,227,947	6,431,117

Dover Sole, Thorneyhead & Sablefish (Trawl)	0	103,039	32,182	791,091	926,312	535,715
Red Urchin	627,125	50,344	****	15,121	692,804	354,942
Other Flatfish	****	37,537	245,250	264,853	547,640	473,450
California Halibut	****	16,913	164,217	323,155	504,311	1,383,945
Coastal Pelagic*****	****	287	485,507	170	486,031	20,144
Sanddab	****	404	217,686	39,715	257,705	121,896
Swordfish	0	0	0	158,232	158,232	388,902
Roe Herring	0	184,124	0	0	184,124	61,312
Slope Rockfish, Grenadier	11	8,126	6,054	135,189	149,377	71,393
Sablefish, Non-Trawl (Line and Trap)	0	4,145	40,794	101,161	146,099	241,639
Tuna	****	34,564	17,566	17,949	70,124	98,822
Shelf Rockfish	805	7,189	5,846	32,160	46,000	46,611
Nearshore Finfish	11,498	12,350	4,517	11,636	40,001	206,172
Skates, Rays & Sharks	****	1,454	15,660	21,110	38,371	21,473
Croaker	0	676	3,202	27,249	30,957	33,240
Lingcod	2,729	4,467	9,477	10,620	27,292	47,503
Surfperch	****	1,499	52	14,389	15,942	41,202
Rock Crab	0	3,049	9,269	3,031	15,349	33,750
Thornyheads (Non-trawl)	****	0	570	11,427	12,010	50,221
Dover Sole (Non-Trawl)	0	0	****	****	1,751	962
Smelt	****	298	208	4,146	4,535	3,755
Grand Total	708,624	2,877,867	4,225,792	5,710,918	13,525,525	21,097,457
Percent of total landings	5.2%	21.3%	31.2%	42.2%		

Note: Dollar values are adjusted for inflation (2006$).
*2006 data are preliminary
** See appx III-L for market categoies included in each grouping
***Only the two southernmost ports in the Fort Bragg port complex, Point Arena and Anchor Bay, were considered in the analysis.
**** Data cannot be disclosed due to confidentiality considerations.
*****Includes Pacific sardine, northern anchovy, jack mackerel, and Pacific mackerel

The commercial fisheries that are located in waters of the north central coast study region and/or are economically important to the fishing communities in the study region, and had landings in the years 2003 through 2006 are listed below (listed in descending order of average annual landings for all port complexes):

> ***Finfishes*****:** Salmon, Dover sole/thornyheads/sablefish (trawl), other flatfish, California halibut, coastal pelagics, sanddabs, swordfish, roe herring, slope rockfish/grenadier, sablefish (non-trawl – line and trap), tuna, shelf rockfish, nearshore finfish, skates/rays/sharks, croaker, lingcod, surfperch, thornyheads (non-trawl), Dover sole (non-trawl), and smelt
> ***Invertebrates*****:** Dungeness crab, Market squid, Red urchin, Rock crab
>
> *Note: Market categories represented by these groupings can be found in Appendix III-L.*

Commercial fisheries most likely to realize both short-term potential impacts to fishing activities and long-term potential benefits through increased species abundance and sustainability after new MPAs are established are those which occur primarily or significantly within state waters, i.e. within the study region. These fisheries target primarily residential, non-migratory species. Market categories that are fished in state waters include those listed below (in descending order of average annual landings):

> ***Finfishes***: Salmon*, other flatfish, California halibut, coastal pelagics*, sanddab, herring, sablefish (non-trawl – line and trap), shelf rockfish, nearshore finfish, skates/rays/sharks, croaker, lingcod, surfperch, thornyheads (non-trawl), Dover sole (non-trawl), smelt
> ***Invertebrates***: Dungeness crab, Market squid, Red urchin, rock crab
>
> *Notes: Market categories represented by these groupings can be found in Appendix III-L.*
> **Pelagic or migratory categories that may receive less direct benefit from MPAs.*

5.4.3 Commercial Landings

In general, total landings in the study region and each port area have declined over the period 1992 through 2006 (Figures 13-17). Total values have varied over these years, and show no consistent trend. Values have not been adjusted for inflation. Some practices have added value to landings over time, such as landing and selling fish live, e.g., nearshore rockfish, and the way some fish species are handled at sea, e.g., tuna processed for sushi-grade. Graphs of landings and value for each major commercial fishery are provided in Appendix III-k.

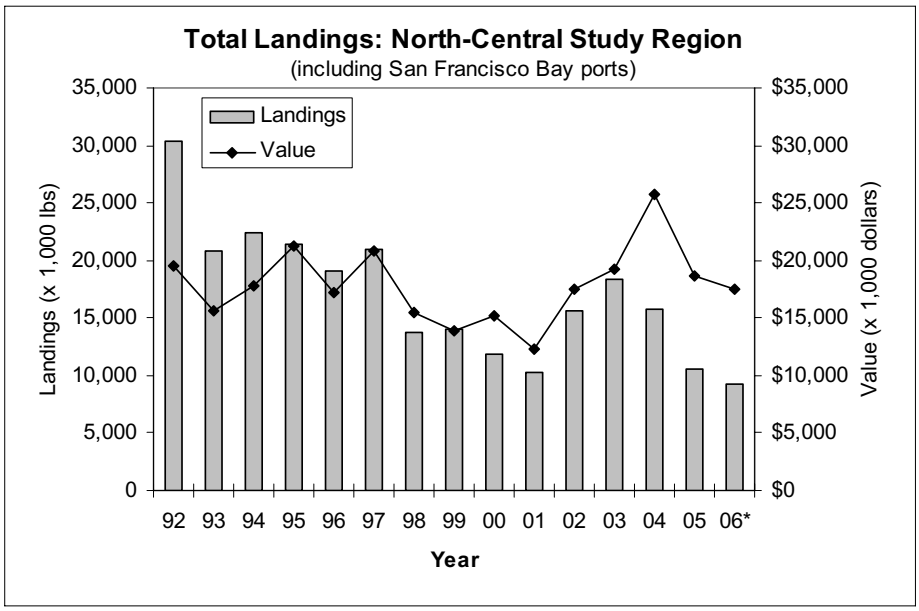
A critical component of commercial fisheries related to establishing or modifying MPAs is the area in which each fishery occurs. More specifically, the relative effort occurring in, and the relative value derived from, specific areas are key components to MPA planning. Landing receipts collected by CDFG require that catch locations for all market categories be included. This data is reported by coded 10-minute blocks. However, this data is usually filled in by the processors, rather than by the fishermen, and contains inaccuracies. For example, the Dungeness crab and California halibut data show major catches from areas west of the

Farallones Islands, where water is too deep for these species to occur. The MLPA Initiative plans to establish a contract to collect data to help fill the gaps in spatial catch information.

More information on commercial fisheries is included in Appendix III, including:

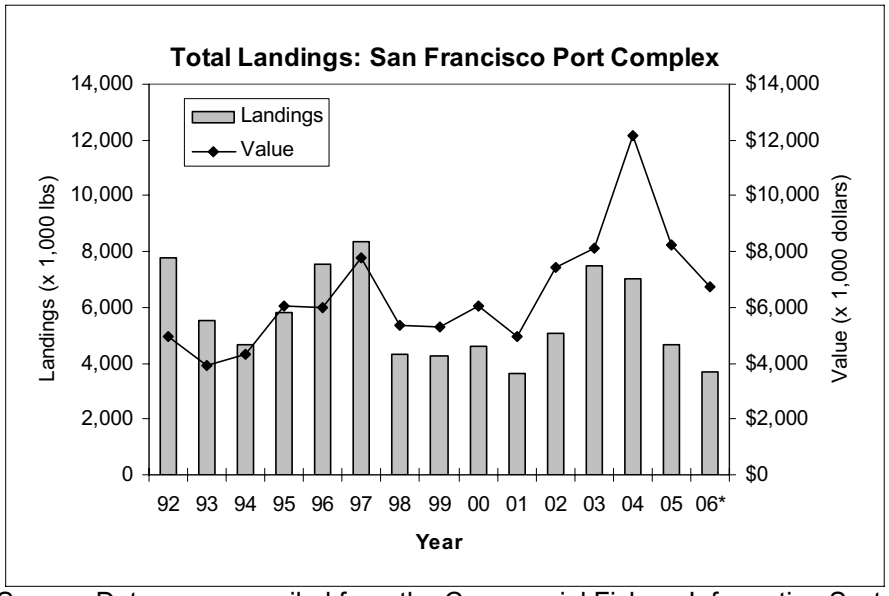
- Fishery summary tables, including number of fishermen and vessels, gear types, recent average annual landings (2003-2006), and average annual landings (1992-2006)
- Landings by market category and year for 2001-2006
- Fishery profiles, including regulations and graphs of landings for 1992-2006, and species included in market categories

Figure 13: Total Landings and Values for All Ports within the North Central Coast Study Region and San Francisco Bay, 1992-2006



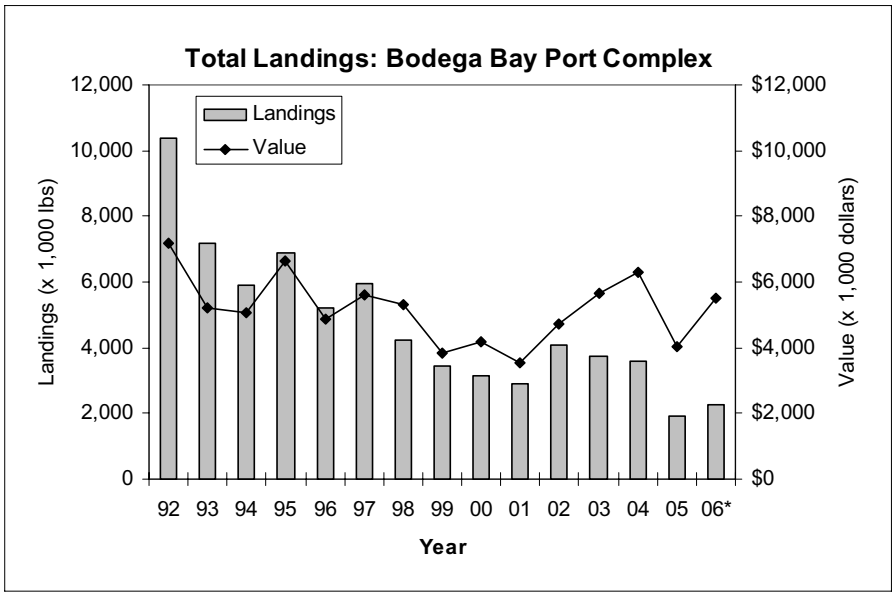
Source: Data were compiled from the Commercial Fishery Information System database (extraction date: 14 March 2007).
*Data for 2006 are preliminary.
Note: Values were adjusted for inflation (2006$).

Figure 14: Total Landings and Values from the San Francisco Port Complex, 1992-2006



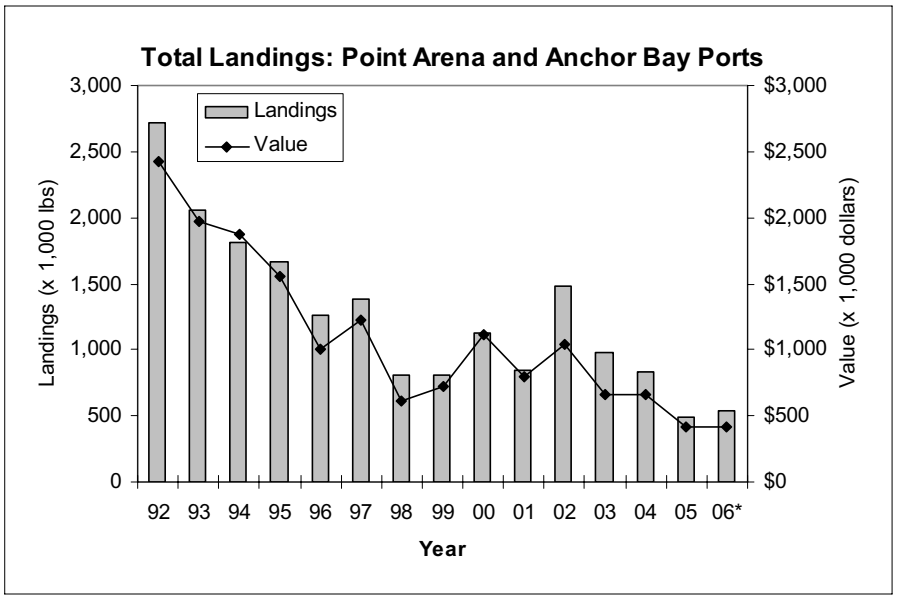
Source: Data were compiled from the Commercial Fishery Information System (CFIS) database (extraction date: 14 March 2007).
Note: Port complex delineations follow existing CFIS guidelines with the exception of the Princeton/Half Moon Bay Ports, which were analyzed separately. *Data for 2006 are preliminary. Values were not adjusted for inflation.

Figure 15: Total Landings and Values from the Bodega Bay Port Complex, 1992-2006



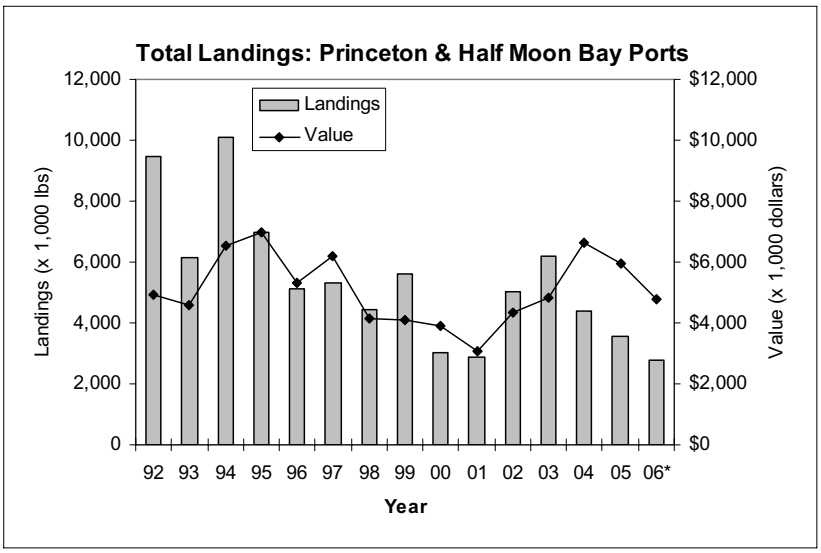
Source: Data were provided from the Commercial Fishery Information System (CFIS) database (extraction date: 14 March 2007).
Note: Port complex delineations follow existing CFIS guidelines. *Data for 2006 are preliminary. Values were adjusted for inflation (2006$).

Figure 16: Total Landings and Values from the Point Arena and Anchor Bay Ports, 1992-2006



Source: Data were provided from the Commercial Fishery Information System (CFIS) database (extraction date: 14 March 2007).
*Data for 2006 are preliminary.
Note: Values were adjusted for inflation (2006$).

Figure 17: Total Landings and Values from the Princeton / Half Moon Bay Ports, 1992-2006



Source: Data were provided from the Commercial Fishery Information System database (extraction date: 14 March 2007).
*Data for 2006 are preliminary.
Note: Values were adjusted for inflation (2006$).

5.5 Kelp and Aquaculture Leases

The presence of existing aquaculture leases or harvestable kelp bed leases can be a potential conflict with the establishment of state marine reserves or state marine parks that do not allow for commercial take. The presence of these types of leases may be consistent with the establishment of a state marine conservation area that explicitly allows for the activity and associated take of marine resources.

5.5.1 Synopsis of Kelp Bed Lease Status, Kelp Harvest Regulations, and Algae Harvest

Administrative kelp bed areas in California waters are numbered from north to south (see Title 14 California Code of Regulations Section 165.5 (j)(1)), are defined by compass bearings from known landmarks, and applicable commercial regulations pertain to the harvest of giant kelp or bull kelp (*Nereocystis lutkeana*) only. The entire coastline, including southern offshore islands, is numbered although not all areas contain kelp beds. The administrative kelp beds are classified as closed, leasable, leased (to the state), or open. Closed beds may not be harvested. Leased beds provide the exclusive privilege of harvesting to the lessee. Open beds may be harvested by anyone with a kelp harvesting license.

There are 8 administratively numbered kelp beds within the north central coast study region; all of these are closed to the leasing of kelp and no harvest is allowed.

Table 19: Kelp Bed Location and Lease Status in the North Central Coast Study Region

Kelp Administrative Bed Number	Geographic Extent	Lease Status of Bed
224	Point Ano Nuevo to Pescadero Point	Closed
225	Pescadero Point to Point Montara	Closed
226	Point Montara to Fort Point	Closed
301	Fort Point to Point Reyes	Closed
302	Point Reyes to Duncan's Point	Closed
303	Duncan's Point to Gualala Point	Closed
304	Gualala Point to Iverson Point	Closed
305	Iverson Point to Point Arena	Closed

Note: These data accurate as of October 19, 2006

No kelp or other aquatic plant may be harvested in a state marine reserve or state marine park. Between April 1 and July 31, a kelp harvester may not harvest bull kelp from a non-leased bed that lies partially or totally within the boundary of the Monterey Bay National Marine Sanctuary extending from Santa Rosa Creek, San Luis Obispo, northward to rocky Point, Marin County. However, bull kelp may be removed from beaches within the sanctuary during the seasonal closure.

At least one commercial harvester of non-kelp, edible seaweed exists in the study region (Tom Moore, pers. comm.). CDFG issues licenses for these activities.

There is a small but unknown amount of kelp harvest occurring within the study region by recreational fishermen. There is no closed season, closed hours, or minimum size limit, and the daily bag limit on all marine aquatic plants is 10 pounds wet weight. No eel grass (*Zostera* sp.), surf grass (*Phyllospadix* sp.), or sea palm (*Postelsia* sp.) may be cut or disturbed. In addition, permits for harvest of kelp by Native American groups are issued by CDFG.

5.5.2 Aquaculture Leases

Tomales Bay, Drakes Estero, and Pillar Point Harbor have active aquaculture leases where oysters, clams, mussels, and abalone are grown for commercial sale and consumption. There are 12 active leases in Tomales Bay covering 513 acres and 2 active leases in Drakes Estero covering 1060 acres (Table 20). The presence of active leases and commercial production is inconsistent with designation of state marine reserve or state marine park status; however may be consistent with state marine conservation area designation depending on allowable uses proposed. A spatial data layer showing location of these lease areas is available; lease areas are shown on maps 16a -16f.

An active state water bottom lease is one held by a currently registered aquaculturist who has 1) Fish and Game Commission approval in the form of a lease, 2) time remaining on the lease period, and 3) is currently meeting planting and harvesting requirements as set forth in Title 14, Section 237, (i) through (j). A lease defines the boundary and acreage of a specified state water bottom parcel and defines the terms and conditions of usage of that area for a specified time at an annual cost based on a rate per acre as a result of a competitive bidding in a lease auction. No changes to terms or conditions of the lease can be made without Fish and Game Commission approval (Tom Moore, CDFG Marine Region Aquaculture Coordinator, Tomales Bay and Drakes Estero Active State Water Bottom Lease Summary Information 2006.

Table 20: Summary of Active Tomales Bay and Drakes Estero Aquaculture Lessees, Lease Acreage, Acreage in Use, Approved Species, and Approved Culture Methods

Lessee	Lease Number	Lease Acreage	Acreage in Use (estimate)	Approved Species For Cultivation in Lease Agreement	Approved Culture Methods in Lease Agreement
TOMALES BAY					
Marin Oyster Company	M-430-02	5	5	Pacific, Kumomoto, Suminoe, Eastern, and Flat Oysters, Manila Clam, and Blue Mussels	Longline, Rafts, Rack and Bag, Longline on Stakes, Rack and Tray, Groundline and Bag, Bottom Culture, and Floats
Charles Friend	M-430-04	62	10	Pacific, Kumomoto, Suminoe, Eastern, and Flat Oysters, Manila Clam, and	Longline, Rafts, Rack and Bag, Stakes, Rack and Tray, Bottom Culture, and Floats

				Blue Mussels	
Marin Oyster Company	M-430-19	25	1	Pacific, Kumomoto, Suminoe, Eastern, and Flat Oysters, Manila Clam, and Blue Mussels	Longline, Rafts, Rack and Bag, Rack and Tray, Bottom Culture, and Floats
Cove Mussel Company	M-430-06	10	5	Bay Mussels, Pacific Oyster, Manila Clam	Longline, Rack and Bag
Hog Island Oyster Company	M-430-10	5	5	Pacific, European, Eastern, & Kumamoto Oysters, Manila Clam, and Bay Mussels	Raft, Longline, Rack and Bag, Groundline and Bag
Hog Island Oyster Company	M-430-11	5	5	Pacific, Eastern, and European Oysters, Bay Mussels, and Littleneck Clams	Longline, racks, stakes, and Modified Stakes
Hog Island Oyster Company	M-430-12	25	5	Pacific, Eastern, and European, Kumamoto Oysters, and Bay Mussels	Raft and Rack and Bag
Hog Island Oyster Company	M-430-15	128	40	Pacific, European, Eastern, & Kumamoto Oysters, Manila Clam, and Bay Mussels	Raft, Longline, Rack and Bag, Groundline and Bag
Point Reyes Oyster Company	M-430-14	5	<1	Pacific, Eastern, European, Suminoe, and Native Oysters, Bay Mussels, Manila and Quahog Clams, Rock and Japanese Scallops, and Red, Green, and Pink Abalone	Raft, and Longline
Point Reyes Oyster Company	M-430-13	25	<1	Pacific, Eastern, European, Suminoe, and Native Oysters, Bay and Sea	Raft, and Longline

				Mussels, Manila Clam	
Point Reyes Oyster Company	M-430-17	62	15	Pacific, Suminoe, Eastern, European, and Native Oysters, Manilla Clam, and Bay and Sea Mussels	Longline, Rafts, Floats, Stakes, Rack and Bag, Rack and Tray, Bottom Culture, and In-Ground Culture With Net Cover
Tomales Bay Shellfish Farms Inc.	M-430-05	156	60	Pacific & European Oysters, Bay Mussels	Raft, Rack and Bag, Stake and Bag
Tomales Bay Active Lease Totals	12	513	153		
DRAKES ESTERO					
Drakes Bay Oyster Company (formerly Johnson Oyster Company)	M-438-01	1, 059		Pacific (C. gigas) and European Flat (O. edulis) Oysters	
Drakes Bay Oyster Company (formerly Johnson Oyster Company)	M-438-02.	1		Purple-hinged rock scallops (Crassodoma gigantea) and Manila clam (Venerupis phillipinarum).	
Drakes Estero Active Lease Totals	2	1,060			
TOTAL					
Active Aquaculture Lease Totals in Region	15	1, 573			

Source: Tom Moore, CDFG Marine Region Aquaculture Coordinator, Tomales Bay and Drakes Estero Active State Water Bottom Lease Summary Information 2006.
Note: A previous lease for abalone in submerged cages in Pillar Point harbor was due to expire at the time of publication.

5.6 Recreational Fisheries

Various forms of recreational fishing occur throughout the north central coast study region. According to data provided by the Pacific States Marine Fisheries Commission, more than 109

species of finfishes were caught by recreational anglers from 2004 to 2006 within the study region, although many of these were seen infrequently in sampled catches.

In January 2004, California began an integrated recreational fishery sampling and assessment program called the California Recreational Fisheries Survey (CRFS). CRFS was implemented through the Recreational Fisheries Information Network program at the Pacific States Marine Fisheries Commission using federal funds from the National Marine Fisheries Service and state funds from CDFG. This program represents an expansion and improvement within California of the previous national sampling program, the Marine Recreational Fisheries Statistics Survey. CRFS has combined the efforts of CDFG's Ocean Salmon Project with other modes of recreational finfish sampling, expanded the number of anglers contacted by samplers, and has provided a more accurate telephone-based survey for estimating private boat angler effort from marinas or from night fishing (not sampled in the field by CRFS).

Maps 11a-11c show commercial passenger fishing vessel (CPFV), also known as "party boat," data for the halibut, rockfish, and salmon fisheries. Maps 12a-12c show CRFS data for the halibut, rockfish, and salmon fisheries. Maps 13a-13c show recreational abalone information for the portions of the study region where abalone harvest is permitted and significant take exists.

5.6.1 Modes of Fishing

The distribution of recreational fishing effort varies by mode of fishing and availability of access. The CRFS program categorizes recreational fishing effort into four basic modes:

- Commercial passenger fishing vessels (CPFV)
- Private and rental skiffs
- Beach and bank
- Manmade structures

Other modes of fishing and fisheries that are not fully captured by the CRFS program include: consumptive diving (including dive charters and private shorebased or skiff diving), kayak angling, Dungeness crab, and the abalone and clam fisheries. Although the CRFS program does provide some information on recreational consumptive diving and kayak angling it is limited by sampling frequency and whether or not these activities occur at sites that are sampled. Although Dungeness crab are partially captured by the CRFS program logbook data provides the best measure of that fishery. The CRFS program does not collect data on recreational catch of abalone by shore-pickers or free-divers or catch of clams. See below for information on CDFG monitoring of the recreational abalone fishery.

CPFVs, also called party boats, carry recreational anglers to ocean fishing locations for a fee. CPFVs have the greatest range of any recreational fishing mode and are generally limited by travel time. CPFVs in the study region operate out of ports in Bodega Bay, Berkeley, Emeryville, Sausalito, San Francisco, and Princeton (Maps 14a-14f). CPFVs may carry up to 40-50 anglers, although a passenger load of 10-30 is more common; some small CPFVs are known as "six-packs" due to their reduced passenger-carrying ability. In general CPFVs north of

and including Bodega Bay operate in nearshore waters north to Fort Ross, while CPFVs from Bodega Bay and Tomales Bay may operate south to Point Reyes. Several CPFVs conduct single-day trips to the Farallon Islands. Additionally, many San Francisco Bay-based CPFV operators make ocean trips. CPFVs from Princeton and Half Moon Bay tend to fish in nearshore waters between Pillar Point and Pigeon Point.

Private and rental skiffs, with some exceptions, generally fish closer to port or launch ramp areas than CPFVs, although salmon and albacore anglers may travel considerable distances. The port areas for private and rental boats within the study region are generally the same as those for CPFVs. Additionally, various boat ramps and launch facilities are used; some of which include, Timber Cove, Westside Ramp, Doran Park, Lawson's Landing, Miller Park, Sausalito, Berkeley, Estuary Park, Oyster Point, and Princeton (see Maps 14a-14f).

The coastline near Bodega Bay, along the ocean side of Marin County, Half Moon Bay and Pescadero Point receive the majority of the private and rental skiff effort for rockfish. However some rockfish/lingcod fishermen often travel farther to find good fishing, and during fair weather or in larger boats anglers will venture well offshore, including to the Farallon Islands. Halibut fishermen fish around Bodega Bay, Tomales Bay, and Point Bonita. Albacore and salmon fishermen may travel to the Gulf of the Farallones or even outside the islands.

Boat-based anglers and divers generally have a target species or species group in mind when they head out to fish, although some anglers or divers fish for whatever happens to be available in their region. Primary target species/species groups in this region are Chinook salmon, rockfishes/lingcod/cabezon/kelp greenling, California halibut, sanddabs, and albacore. Additional effort (excluding divers) is directed towards the recreational harvest of Dungeness crab using traps, often in combination with trips for other target species.

The beach and bank mode consists of shore-based anglers but also includes divers or anglers entering the water in kayaks, royaks, or on other floatation devices directly from the shore. Primary target species/species groups in this region are surfperches, jacksmelt, anchovy, halibut, nearshore rockfishes, including greenlings, lingcod, and cabezon.

Some of the frequently used shore access areas in ocean and estuarine waters north of the San Francisco Bay entrance include Point Arena, Anchor Bay, Ocean Cove, Timber Cove, Fort Ross, Goat Rock, Doran, Lawson's Landing, and Point Reyes. South of the San Francisco Bay entrance shore access points include Baker Beach, Pillar Point, Princeton, and Half Moon Bay (Maps 14a-14f).

Manmade structures consist of piers, jetties and breakwaters; if these structures are public a fishing license is not required. These structures are relatively limited outside of San Francisco Bay within the north central coast study region. Some of these include; Doran, Lawson's pier, Fort Baker, Pacifica pier, and Princeton pier and jetty (Maps 14a-14f).

Primary target species/species groups in this region for anglers fishing from manmade structures are Pacific sardine, northern anchovy, jacksmelt, surfperches, white croaker, and several nearshore rockfishes.

5.6.2 Recreational Fishing Effort

Estimates of effort, in terms of angler days, are calculated differently for each of the fishing modes in the CRFS program, all of which differ from the way historical programs computed effort. Effort sampling at man-made structures is done by a unique "roving site cluster" method. Effort is determined by counting anglers on the structures during time intervals and interviewing them for average trip duration to account for angler turnover. The average fishing trip time, average interval count, and average daylight hours are used to calculate average daily angler trips for weekend days and weekdays. These data are then expanded to the number of days by day-type in the month and months are summed for the total effort for the year.

Recreational fishing effort in angler-days differs by fishing mode in the north central coast study region (Table 21). In 2006 shore-based angling, fishing from man-made structures and beach and bank, accounted for 64% of the fishing effort that is sampled by the CRFS program in the north central coast study region. Fishing from CPFVs or private and rental boats accounted for 36% of all fishing effort. Within each of those modes, man-made structures accounted for 47% of all fishing while fishing from CPFVs only comprised 11% of all fishing.

Table 21: 2006 Estimated Angler Days by Fishing Mode

Fishing Mode	Effort (angler days)
CPFVs[1]	66,584
Private and Rental Boats[1]	151,805
Beach and Bank[1]	100,815
Man-made structures[2]	280,917

[1] Estimate derived from CRFS database for all of San Francisco and Wine districts for ocean only trips
[2] Estimate derived from CRFS database and includes only ocean sites and only sites in Mendocino County within the study region, does not include Tomales Bay

One form of recreational fishing not sampled by the CRFS program is the consumptive dive charter industry. Within this study region only a few such boats operate; vessel owners are required to submit CDFG logbooks summarizing their activities. Additionally, shore based consumptive diving is not directly sampled by the CRFS program. There are no reporting requirements for this group, except that abalone is reported through CDFG's abalone report card program as described below. Stakeholder input during the MLPA initiative process will be needed to describe these modes of fishing.

Kayak fishing effort and catch data may be captured by the CRFS program where launch sites overlap with sample sites. Kayak fishing generally has a range of 5 miles from any publicly accessible beach or other launch site. Furthermore, kayakers also require calm bays or beaches to launch from. A 46-page report compiled by the Kayak Fishing Association of Southern California lists the most frequently used launch sites from Point Conception to Point Arena (http://www.dfg.ca.gov/mrd/mlpa/pdfs/comments/kfasc_030805.pdf). Additionally, stakeholders have identified several launch sites that are of particular importance and the target species generally sought at each location (see Appendix IV, f). Kayaks are often used for

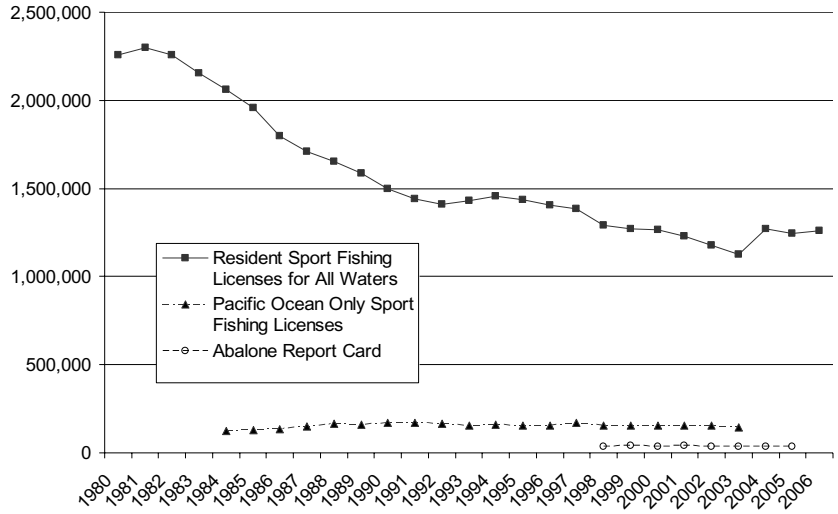
multiple fishing modes, including angling and consumptive diving (spear fishing and abalone). Due to the multiple-use nature of kayak fishing it is difficult to quantify the importance of the various fisheries.

The recreational red abalone fishery is another fishery not sampled by the CRFS program. Instead, red abalone catch is reported through a report card system. Anglers wishing to collect abalone are required to purchase an abalone report card. On the report card abalone catches must be reported for every fishing day as well as the general location from which they were harvested. CDFG summarizes annual catch and effort data from returned cards.

It is legal to harvest red abalone north of a line drawn due west magnetic from the center of the mouth of san Francisco Bay. Abalone are either harvested in intertidal areas during negative low tides or while free diving. Free divers either swim out from shore, or use boats or kayaks to reach the dive sites. Important sites include Fort Ross, Fort Ross Reef Camp, Salt Point, Sea Ranch, Arena Cove, Point Reyes, Tomales Point, and Bodega Head (Maps 13a-13c). However, during abalone season nearly every accessible cove in Sonoma and Mendocino counties, where effort is greatest, may experience harvesting. An estimated 97,000 abalone trips were made in 2002, 110,000 trips in 2003, and 104,000 trips in 2004.

Trends in recreational fishing license sales and boat registrations for CPFVs have not mirrored the trend of an ever-increasing human population in California. Recreational resident fishing license sales for all waters (inland and ocean) declined steadily from approximately 2.25 million in 1980 to approximately 1.27 million in 2000. This represents a 44% decrease in a 20-year period. However, a small but sharp increase occurred from 2003 to 2004 and in the last 3 years sales have remained fairly stable (Figure 18).

Figure 18: Resident Sport Fishing Licenses for All Waters; Pacific Ocean Only Sport Fishing Licenses; and Abalone Stamps: 1980-2006



The trend in the sale of Pacific Ocean only sport fishing licenses is quite different (Figure 18); CDFG issued this type of license from 1984 to 2003. From 1984 to 1991 license sales

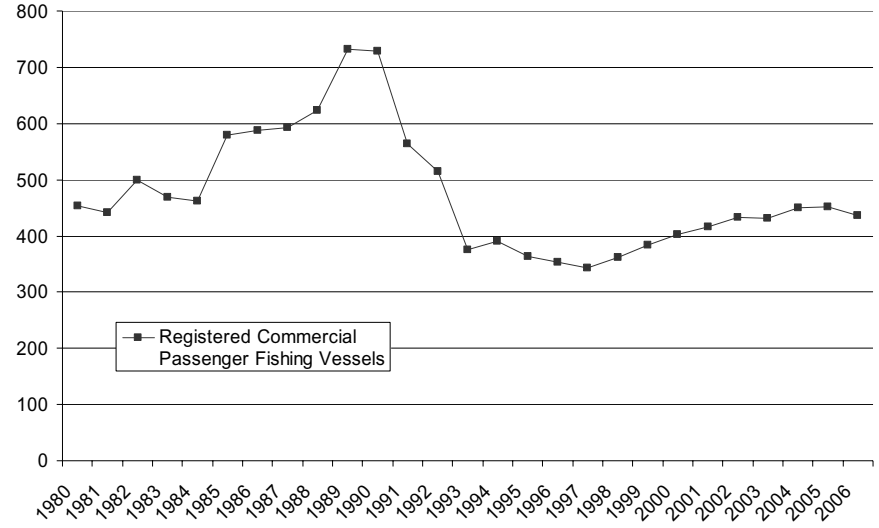
increased by 37%, then gradually declined by 16% during the next 12 years to a level higher than that in 1984. The sharp rise in resident sport fishing licenses for all waters in 2004 is likely due to the halt of sales of Pacific Ocean only licenses after 2003.

CDFG began selling abalone report cards in 1998. Abalone report card sales from 1998 to 2005 have remained fairly stable, ranging from 35,180 to 40,841, respectively (Figure 18). The proportion of all sport fishing license buyers who also purchased abalone stamps ranged from 28% to 33% between 1998 and 2005.

Statewide registration of CPFVs demonstrates a trend different from recreational license sales (Figure 19). The number of registered CPFVs increased by more than 60% from 1980 to 1989, declined by almost 50% during the next 4 years, and after a modest increase from the late 1990's appear relatively stable over the last 5 years.

Data are not available for the number of CPFV registrations in the MLPA North Central Coast Study Region. However, as a proxy, data are available that show the number of registered CPFVs in the study region that have submitted logbooks; this is representative of the active CPFVs in the region. The number of CPFVs in the study region that submitted logbooks annually from 2004 to 2006 were 106, 100, and 78 respectively. These represent 24%, 22%, and 18% of the logbooks submitted for the entire state for those years.

Figure 19: Statewide Registered Commercial Passenger Fishing Vessel Licenses: 1980-2006



5.6.3 Distribution of Recreational Fishing Effort

Recreational fisheries within the study region that have the greatest potential to be impacted by the implementation of new or expanded MPAs are those that target primarily residential, non-

migratory species, including nearshore and shelf rockfishes, lingcod, cabezon, kelp greenling, California halibut, jacksmelt, surfperches, Dungeness crab, and red abalone.

Spatially explicit data on recreational fishing effort are provided from these primary sources:

1. For CPFV fishing targeting rockfish, California halibut, and salmon, CDFG has compiled landing data (for the sampled trips by microblock) from 2004 thru 2006. This provides an estimate of the relative number of fish landed in discrete locations, which is in turn an estimate of the relative value of particular locations to the CPFV industry. The data are available as a series of maps panning the north central coast study region, with the number of landed California halibut, rockfish, and salmon by different colors (Maps 11a-11c).
2. For private and rental boat recreational fishing, CDFG has compiled spatially-explicit data within the study region from 2004, the first year of the California Recreational Fisheries Survey program thru 2006. While these data are depth-limited in scope for bottom-oriented fishes due to regulations, they are the only data available with this degree of resolution for private and rental boat fishing. Data are presented on microblock (one minute of latitude by one minute of longitude) maps with colors representing the total number of sampled trips targeting the California halibut, rockfish complex, and salmon to each microblock (Maps 12a-12c). It is important to note that these data include fishing trips in which no catch occurred. The microblocks compiled in this data set are those reported by the fishermen to the samplers.
3. For red abalone CDFG has summarized landings from submitted abalone report cards. These data are available as summary data for the nearest access points (Maps 13a-13c). Since 2002 regulation changes further limited the daily and annual take of red abalone. Nevertheless, summary data indicate the importance of particular sites to abalone fishermen. Areas with high abalone catches are either representative of easy access and therefore high use and/or are more productive areas and experience a higher catch per unit effort.

5.6.4 Recreational fishery profiles

Seven profiles are provided in Appendix IV for recreational fishing in the study region:

1. Commercial passenger fishing vessels (CPFVs)
2. Private and rental skiffs
3. Beach and bank fishing
4. Fishing from manmade structures
5. Consumptive diving (charter and private/ shorebased)
6. Kayak fishing
7. Red abalone

Each of the recreational fishery profiles in Appendix IV is organized as follows:

- Port area
- Fishing mode
- Species targeted
- Estimated number of fishing trips from 2004 to 2006 in study region by target species
- 2004 to 2006 estimated catch (number of fish)
- 2004 to 2006 estimated catch (weight of fish)
- Comments
- Primary depth range in which fishing occurs
- Primary habitat(s) in which the fishery occurs
- Primary area of fishery (state waters and/or federal waters)
- Synopsis of regulations applicable to the MLPA North Central Coast Study Region

5.6.5 Commercial and Recreational Fisheries

Relative importance. Many species are harvested by both commercial and recreational fisheries. The market categories with measured landings from both commercial and recreational fisheries are provided below in Table 22. Unfortunately, due to changes in sampling protocol recreational landings (for species other than Chinook salmon) are not comparable for years before 2004, so average annual landings for 2005 and 2006 are provided to show the relative importance of the commercial and recreational sectors. Dover sole, grenadier, sablefish, and thornyheads had no recreational landings in 2005 or 2006 so were not included in Table 22.

Table 22: Average Annual Landings (2005–2006) for Commercial and Recreational Fisheries within the North Central Coast Study Region.

Market Category	Commercial[1]		Recreational[2]	
	Average of 2005 & 2006 Landings (lbs)	% of Total	Average of 2005 & 2006 Landings (lbs)[1]	% of Total
Nearshore Rockfish	TBD[3]		664,655	
Shelf Rockfish	45,699	56.0	35,910	44.0
Flatfish Other	568,317	99.9	209	0.1
Cabezon	TBD[3]		52,872	
California Halibut	517,260	85.4	88,707	14.6
Coastal Pelagics[4]	364,684	91.7	10,937	2.9
Lingcod	27,018	6.1	412,463	93.9
Greenling (rock & kelp)	TBD[3]		120,956	
Chinook Salmon[5]	108,850	64.1	61,050	35.9
Sanddabs	131,677	94.1	8,319	5.9
Tuna	23,217		-NO DATA-	

Surfperch	10,008	15.2	55,799	84.8
Sharks, Skates & Rays	35,757	50.6	34,954	49.4
Croaker	12,069	43.7	15,568	56.3
Dungeness Crab[6]	5,194,651		1,774	
Smelt	5,418	72.0	2,106	28.0

[1]Commercial fishery information is from the CFIS database (extraction date: March 14, 2007) estimates include landings from Point Arena and Anchor Bay ports, Bodega Bay port complex and San Francisco Bay port complex and includes both state and federal waters.
[2]Estimates derived from Recreation Fisheries Information Network database, includes all ocean waters in the San Francisco and Wine districts except for waters of the San Francisco Bay. The Wine district includes Sonoma and Mendocino counties with portions of Mendocino outside the study region (these are draft and will be updated to include only those portions with-in the study region when available).
[3]TBD – To be determined; data exists but is not yet available.
[4]Coastal pelagics include Pacific sardines, Pacific anchovy and Jack mackerel.
[5]Salmon reported in numbers of fish not pounds.
[6]Recreational Dungeness crab landings are reported in numbers not pounds

Ocean Salmon Project*:* CDFG's Ocean Salmon Project has surveyed both commercial and recreational salmon fisheries since 1986. Consequently, a longer time series of commercial and recreational data for Chinook salmon can be provided (Table 23). From 1989-2006, the number of commercial salmon vessel permits issued by CDFG decreased from 5,429 to 1,554. Although the data does not show a steady increase in the proportion of salmon harvested by the recreational sector during this period, 2006 had the highest recreational proportion of harvest during the 15-year period, and 1986-90 had the lowest. In general, the proportion of harvest by the recreational sector is increasing in this region.

Table 23: Estimated Chinook Salmon Harvest in the North Central Coast Study Region* from 1986 to 2006

Year	Commercial		Recreational		Total (1000s of fish)	No. Commercial Permits
	1000s of fish	% of Total	1000s of fish	% of Total		
1986-90	1,755.6	94.7%	98.3	5.3%	1,853.9	5,429 (1989)
1991	174.8	82.4%	37.3	17.6%	212.1	4,705
1992	95.8	67.0%	47.2	33.0%	143	3,444
1993	155	66.3%	78.7	33.7%	233.7	3,455
1994	219.9	60.9%	141	39.1%	360.9	3,056
1995	357.5	69.7%	155.7	30.3%	513.2	3,224
1996	167.4	66.5%	84.5	33.5%	251.9	2,435
1997	253.5	67.2%	124	32.8%	377.5	2,273
1998	126.1	64.0%	71	36.0%	197.1	1,986
1999	181	72.3%	69.3	27.7%	250.3	1,957
2000	250.4	79.5%	64.7	20.5%	315.1	1,944
2001	136.6	77.4%	39.9	22.6%	176.5	1,839
2002	242.9	73.6%	87	26.4%	329.9	1,865
2003	202.9	78.2%	56.6	21.8%	259.5	1,720
2004	298.2	69.6%	130.2	30.4%	428.4	1,764
2005	170.5	70.1%	72.8	29.9%	243.3	1,697
2006	47.2	48.9%	49.3	51.1%	96.5	1,554
1991-2006 Average	**192.5**	**69.6%**	**81.8**	**30.4%**	**274.3**	**2,432.4**

*North Central study region includes ports of Bodega Bay, Sausalito, Berkeley, Emeryville, San Francisco and Princeton (Half Moon Bay).

5.7 Scientific Collecting

Title 14, Section 650 of the California Code of Regulations, authorizes the take or possession of marine plants or animals for scientific, educational, or propagation purposes with a permit issued by CDFG. Permits may be issued to:

1. Employees of local, state and federal agencies who take specimens in connection with their official duties.
2. Faculty, professional staff, college level students of, or individuals hired by public or private companies, educational institutions, zoological gardens or aquariums, in or out of state.
3. Individuals who take wildlife or marine plants for other permittees or pursuant to environmental protection documents required by law.
4. Individuals who possess a valid federal Bird Marking and Salvage Permit. Holders of this federal permit are not required to obtain a state permit to take migratory birds, other than raptorial birds.

There are three types of permits: resident, non-resident, and student. Resident and non-resident permits are valid for two years, and student permits are valid for one year. Each permit is reviewed and approved on a case-by-case basis. In some areas, such as in marine protected areas, additional specific restrictions may be applied, however, scientific collecting may be allowed on a case-by-case basis in all three classifications of state MPAs. There are standard exceptions to the scientific collecting permit, including state- and federally-listed species, for which additional state and/or federal authorizations must be obtained.

Permit requestors must indicate on their application the following components:

1. species and numbers to be collected
2. collection locations
3. methods/techniques
4. purpose for collecting
5. disposition of specimens

CDFG has an electronic database for processing scientific collecting permit applications, which is recorded on a statewide basis. The total number of permits issued in California from 1989 through 2006 is shown in Table 24. The trend in the number of permits issued clearly reflects the bi-annual permit cycle from 1989 through 2001, with a relatively constant trend in number of permits issued. From 2002 forward, an annual cycle emerged. From 1991 to 2001 the number of permits issued was relatively constant every other year, until 2002 when this pattern is no longer apparent. The highest numbers of permits issued since the database began were in 2004 and 2005.

Scientific collecting permits are authorized by type of organism to be collected (e.g. marine fishes, freshwater fishes, amphibians, mammals, birds). Authorization categories for marine organisms are marine fishes, marine aquatic plants, and marine invertebrates. Table 25 shows number of permits issued in California for marine authorizations in 2005 and 2006.

One condition of the scientific collecting permit is that the holder must submit a Report of Specimens Collected or Salvaged within 30 days of permit expiration. To determine the types of organisms and locations collected within the north central coast study region, reports submitted during the past year-and-a-half were reviewed. There were 65 reports filed during this period for the north central coast study region, reflecting collections made from 1999 through 2006, although it must be noted that compliance with report submission is not 100 percent. Of these reports, 94 percent of permits were for marine invertebrates, 49 percent were for marine fishes, and 32 percent were for marine plants (note that multiple species can be authorized on a single permit, so that these numbers do not total 100%). In addition, one leatherback turtle was captured and salvaged in 2004 off of San Francisco. See Table 26 for a breakdown of reports submitted by subregion in the north central coast study region. By far, the highest number of collections were reported in subregion 3, due to the high incidence of collections within and around Bodega Bay. Table 27 lists the reported methods of capture identified in the 65 analyzed reports.

Table 24: Number of scientific collecting permits issued by DFG statewide from 1989-2006

Year	Number of Permits
1989	1,654
1990	455
1991	1,347
1992	812
1993	1,229
1994	931
1995	1,207
1996	989
1997	1,212
1998	913
1999	1,169
2000	975
2001	1,078
2002	1,218
2003	1,306
2004	1,740
2005	1,717
2006	1,492

Table 25: Number of scientific collecting permits with marine organism authorizations issued by CDFG statewide in 2005 and 2006

Year	Number of Unique Scientific Collection Permits			
	Marine Fishes	Marine Aquatic Plants	Marine Invertebrates	Marine Fishes, Aquatic Plants and Invertebrates*
2005	542	473	700	830
2006	592	470	674	805

* Each permit may have multiple authorizations, and therefore the numbers are not additive.

Table 26: Percent Scientific Collecting Permit reports filed in each subregion of total submitted for North Central Coast Study Region (65), over 1-1/2 year period

Subregion No.	Subregion Name	Percent of Scientific Collecting Permits for which Reports were Filed*
1	Alder Creek/Point Arena to Horseshoe Point	12%
2	Horseshoe Point to Bodega Head	18%
3	Bodega Head to Double Point	62%
4	Double Point to Point San Pedro	12%
5	Point San Pedro to Pigeon Point	23%
6	Farallon Islands	3%

*Each report may cover multiple subregions

Table 27: Methods of capture used for scientific collecting permits within the North Central Coast study region, and number of times the method was used

Capture method	Number of times used* (sorted by most common method)
Hand	39
Seine net	10
Hook & line	5
Dip net	4
Traps	3
Scuba	3
Hand net	3
Core	2
Crab net	2
Trawl net	2
Minnow trap	2
Shore picking	1
Intertidal	1
Knife	1
Shovel	1
Hammer/chisel	1
Gill net	1
Box trap	1
Slurp gun	1
Fouling panel	1
Settlement plate	1
Free diving	1
Electrofish	1

*Tallied by permit

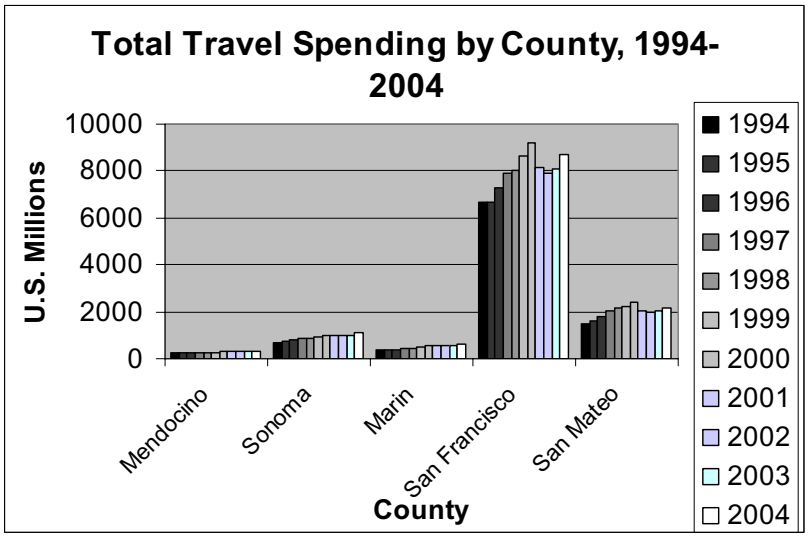
5.8 Coastal Tourism

California is the most visited state in the United States, and travel and tourism comprise the fourth largest industry and employer in the state. Total direct travel spending in California was $88.1 billion in 2005, a 7.6 percent increase over the preceding year. The year 2005 was the third straight year of positive growth and the greatest increase since 2000. During 2005, travel spending in California directly supported nearly 912,000 jobs, up 5.4 percent from 2004 figures. Travel spending generated the greatest number of jobs in food service (263,300); arts, entertainment and recreation (229,100); and accommodations (202,900). Californians account for 83% of all domestic visitors to the state (California Travel and Tourism Commission 2006).

Coastal tourism alone in California generates $9.9 billion in revenue annually (Gulf of the Farallones National Marine Sanctuary 2006). Visits to the beach and waterfront activities are the fourth most popular expenditure-based activities after “dining, shopping and entertainment”, “sightseeing”, and “theme and amusement parks” (California Travel and Tourism Commission 2006).

Tourism and recreation are economic drivers in the MLPA North Central Coast Study Region. Within the study region, San Francisco County has the highest travel spending, varying between $6.6 and $9.2 billion between 1994 and 2004. San Mateo, Sonoma, Marin, and Mendocino fall significantly below the travel spending in San Francisco County (see Figure 20).

Figure 20: Total Travel Spending by County, 1994-2004



Source: California Travel and Tourism Commission 2006

The counties within the study region boast the first, forth and fifth most popular national parks in the state, including the Golden Gate National Recreation Area (13,602,629 visitors in 2005), Point Reyes National Seashore (1,988,585), and the Fort Point National Historic Site (1,682,041) (California Travel and Tourism Commission 2006).

The Sonoma Coast State Beach is overwhelmingly the most popular state park adjacent to the shore within the study region with approximately 3 million visitors annually and is the third most visited state park in the entire state (see Table 28).

Table 28: Ten Most Frequently Visited California State Parks Adjacent to the Shore in Study Region

Park Name	County	Total Attendance (Fiscal Year 2004/2005)
Sonoma Coast State Beach	Sonoma	3,059,141

Half Moon Bay State Beach	San Mateo	838,872
Mount Tamalpais State Park	Marin	411,907
San Gregorio State Beach	San Mateo	392,582
Pescadero State Beach	San Mateo	383,480
Bean Hollow State Beach	San Mateo	284,763
Salt Point State Park	Sonoma	281,983
Pomponio State Beach	San Mateo	184,317
Fort Ross State Historic Park	Sonoma	135,596
Ano Nuevo State Reserve	San Mateo	126,816

Source: California Department of Parks and Recreation 2006

5.9 Non-consumptive Uses

Non-consumptive uses include beach-going, swimming, surfing, kayaking, diving, wildlife viewing, photography, and other activities that do not involve the take or extraction of marine resources. In 1999 and 2000, more than 43% of all U.S. residents participated in some form of marine recreation. U.S. residents flock to beaches and shores to swim, fish, boat, and view the natural scenery. In coming years, populations in the coastal zone are expected to grow and the total number of people participating in all forms of marine recreation is expected to increase with the largest increases expected for beach going activities. Despite this expected increase in the total number of residents participating in marine recreation, the percentage of all residents engaged in marine recreation is expected to decrease (Leeworthy et al. 2005). California ranks second to only Florida in the number of participants in coastal recreation nationwide with nearly 18 million participants, most of whom participate in one of the 17 non-consumptive activities listed in table 29 (Leeworthy 2001).

Table 29: Participation in Coastal Recreation in California

Coastal Activity	Estimated Numbers Statewide for California
Visit Beaches	12,598,069
Visit Waterside Besides Beaches	1,500,965
Swimming	8,398,997
Snorkeling	706,998
Scuba Diving	288,023
Surfing	1,114,372
Wind Surfing	82,201
Motorboating	1,549,289
Sailing	1,087,755
Personal Watercraft Use	680,309
Canoeing	190,948
Kayaking	433,209
Rowing	280,265
Water-skiing	265,533

Bird Watching in Saltwater Surroundings	2,581,958
Viewing Other Wildlife in Saltwater Surroundings	2,551,711
Viewing or Photographing Scenery in Saltwater Surroundings	4,175,372

Source: Leeworthy 2001
Note: Data includes civilian non-institutionalized population 16 years and older as sampled Sept. 1999. Extrapolated from a sample of 27,854 households.

5.9.1 Recreational Beach Use

The study region's approximately 367.6 miles of coastline provide not only these intrinsic natural and aesthetic values, but also recreational opportunities for its users and great economic benefits to the local, regional, and state economies. In 1998, California's beaches statewide generated $14 billion in direct revenue ($73 billion including indirect and induced benefits), $2.6 billion in federal tax revenue, and 883,000 jobs (King 1999). A more recent study by Kildow and Colgan estimates that direct expenditures by beach goers in California average roughly $25 per person per day and total spending by beach goers in the state is approximately $3.75 billion (Kildow and Colgan 2005). Revenues at state beaches in the study region from user fees and concessions were approximately $2.5 million during the 2004/2005 fiscal year (Table 30) (California Department of Parks and Recreation 2006).

Table 30: California State Park Revenue for Parks Located Adjacent to Shore in North Central Coast Study Region 2004/2005

California State Park	County	Total Revenue (Fiscal Year 2004/2005) [1]
Half Moon Bay State Beach	San Mateo	$605,049
Sonoma Coast State Beach	Sonoma	$578,847
Ano Nuevo State Reserve	San Mateo	$245,670
Salt Point State Park	Sonoma	$230,038
San Gregorio State Beach	San Mateo	$144,874
Fort Ross State Historic Park	Sonoma	$127,539
Tomales Bay State Park	Marin	$69,850
Manchester State Park	Mendocino	$47,221
Pomponio State Beach	San Mateo	$27,939
Pescadero State Beach	San Mateo	$4,356
Gray Whale Cove State Beach	San Mateo	$446
Bean Hollow State Beach	San Mateo	$0
Montara State Beach	San Mateo	$0
Schooner Gulch State Beach	Mendocino	$0
Pigeon Point Lighthouse State Historic Park	San Mateo	$0
Marconi Conference Center State Historic Park	Marin	$0
Point Montara Light Station	San Mateo	$0
Thornton State Beach	San Mateo	$0

California State Park	County	Total Revenue (Fiscal Year 2004/2005) [1]
Pacifica State Beach	San Mateo	$0

Source: California Department of Parks and Recreation 2006
1. Some state parks do not charge an entrance fee nor a parking fee. Therefore, there is no revenue listed for these parks.

California beaches are owned by the public, and as a result, one does not necessarily need to pay to visit the beach. Beach visitors may value the beach beyond their direct expenditures such as gas or parking fees. This value, known as consumer surplus, has been estimated to range from a low of $10.98 (in 2001 dollars) for visits to Cabrillo Beach in Los Angeles County to a high of over $70 (in 2001 dollars) per person per trip for visits to San Diego beaches. Using a fairly conservative estimate of $15/visit for the value of a beach day and a conservative estimate of beach attendance of 150 million beach days annually, Kildow and Colgan estimate the non-market value of beach visits in California to be approximately $2.5 million annually (Kildow and Colgan 2005).

The impact of California's beaches on the state and national economy continues to grow; in comparison to Delaware, which ranks just behind California in overall federal funding for shoreline preservation, California generates 20 times more economic activity per federal dollar (King 1999).

The study region's miles of beaches, from narrow cove beaches flanked by rocky cliffs and containing some rocky intertidal area, to long strips of sand, offer non-consumptive recreational activities such as swimming, sunbathing, boating, diving, sightseeing, hiking, surfing, kayaking, canoeing, whale watching, and tidepooling, to name a few.

Approximately 1.1 million surfers live in California, surfing at popular spots along the coast, many of which are in the study region (NOAA 2000). Table 31 lists some surf spots in the study region.

Table 31: Surfing Spots in the North Central Coast Study Region

Location in Region	Name of surfing location		
Mendocino County south of Alder Creek and Sonoma County	Manchester Point Arena Salmon Creek	Black Point Beach Doran Beach	Russian Rivermouth
Marin County	Dillon Beach Bolinas	Point Reyes (north) Stinson Beach	Point Reyes (south) Cronkite
San Francisco County	Potato Patch	Fort Point	Ocean Beach
San Mateo County north of Pigeon Point	Sharp Park Pedro Point Mavericks Martin's Beach	Rockaway Montara Princeton Jetty Tunitas Creek	Linda Mar Ross' Cove Half Moon Bay Pescadero

Source: www.surfline.com

The *California Coastal Access Guide* describes each coastal area along California's 1,100 miles of continent abutting the Pacific Ocean. There are dozens of coastal destinations between Point Arena in Mendocino County and Pigeon Point in San Mateo County, the region encompassed in this study (Table 32).

Table 32: Facilities at Beaches in the North Central Coast Study Region

County	# Campgrounds	# Stairways to Beach	# Paths to Beach	# Hiking Trails	# Boating Facilities	# Fishing Sites
Mendocino	1	1	9	0	1	8
Sonoma	8	6	20	13	2	15
Marin	9	0	26	29	4	7
San Francisco	1	1	7	8	0	1
San Mateo	4	8	14	14	1	13

(Source: California Coastal Commission, *California Coastal Access Guide*, 1997)

5.9.2 Boating

Boating is a popular as well as economically important activity in the north central coast study region. In 2000, over four million people in California were involved in activities related to marine boating (California Resources Agency 2005). The contribution of boating to the gross state product was $11 billion in 1995, representing 1.2% of the state economy (Rust and Potepan 1997).

The California Department of Boating and Waterways published a report titled "California Boating Facilities Needs Assessment" (California Department of Boating and Waterways, 2002) as a survey and assessment of boating and boating facilities needs in California. The California Boating Facilities Needs Assessment (BNA) breaks the state into regions, two of which encompass the MLPA North Central Coast Study Region. The BNA North Coast Region includes Del Norte, Humboldt, Mendocino, and Sonoma Counties. The BNA San Francisco Bay Area Region includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, and Solano Counties. The following statements provide an overview of information about boating in these two BNA regions.

The offshore waters in the BNA North Coast Region are cold and hazardous, and do not attract many pleasure cruising vessels. More boats are used for commercial fisheries than for recreational activities. This was the only region in the Department of Boating and Waterways report for which this was true. However, boat ownership within the BNA North Coast Region was found to be "relatively high for its small population," with almost 5 boats per 100 people. This is in spite of the fact that boating facilities in this region represent only 5 percent of facilities statewide. The "top ten waterways" for the BNA North Coast Region included the marine waterways of the Pacific Ocean, Bodega Bay, and Tomales Bay.

Boat ownership in the BNA San Francisco Bay Region was average for the state, with 2.45 boats per 100 people. With numerous launch ramps in the bay, most boating activity took

place within the San Francisco Bay and the Sacramento-San Joaquin Delta; however the Pacific Ocean was listed as one of the "top ten waterways." Table 33 summarizes some additional relevant information from the BNA.

Table 33: Boats and boaters information summarized from California Boating Facilities

BNA Region	Total Registered/ Documented Vessels	Mean # of Trips in 2000	Top 5 Reasons Identified for Using a Waterway	Marine Areas Identified in "Top 10 Waterways" LIst
North Coast	34,643	20.2	Good fishing, close to home, convenience, near vacation home or camps, large water area, good sailing	Pacific Ocean, Bodega Bay, Tomales Bay
San Francisco Bay	158,223	25.0	Close to home, good fishing, convenience, near vacation home or camp, pleasure	Pacific Ocean

Source: California Department of Boating and Waterways 2002

Non-Consumptive Boat Data from DFG recreational survey: The California Recreational Fisheries Survey (CRFS) is a cooperative program of the California Department of Fish and Game, the Pacific States Marine Fisheries Commission, and the National Marine Fisheries Service. CRFS staff conducts interviews of anglers returning to public launch ramps as part of the data collection for recreational fishing effort and catch estimates. Under the Primary Private Boat Survey, boaters are interviewed at primary launch ramps approximately eight days per month (Van Buskirk, Pacific States Marine Fisheries Commission 2007). "Primary" launch ramps are defined as "those where the majority of the managed species, in any particular month, are landed" (Pacific States Marine Fisheries Commission 2007). Supplemental data collected include the number of private and rental boats that are not recreationally fishing for finfish. Table 34 summarizes CRFS survey results of boat trip types from January through November 2006 for Bodega Bay and Pillar Point Harbor, which are the two "primary" launch ramps that occur within the north central coast study region. Data represent totals for survey days only (approximately 8 days per month, 11 months), not estimated totals for the year.

The CRFS program also surveys three primary launch ramps located around San Francisco Bay: Berkeley ramp, Grand Street ramp in Alameda County, and Clipper Launch ramp in Marin County. There were 763 boats that fished recreationally for finfish in the open ocean from these ramps during January through November 2006. CRFS does not note the location where non-fishing activities took place. Since activities taking place within the San Francisco Bay are not in the north central coast study region, and ocean trips could not be separated from bay trips, non-fishing data for primary ramps in San Francisco Bay are not presented here.

For the two primary launch ramps within the MLPA North Central Coast Study Region, CRFS samplers intercepted 4,317 private and rental boats upon return to port; almost 97 percent of the intercepted boats had fished or intended to fish recreationally. Less than one percent were

commercial fishing vessels. The remaining 2.7 percent were involved in nonconsumptive activities, including sightseeing, sailing, research, and vessel maintenance. These proportions should not be seen as representing the complete picture of boating activities within the north central coast study region, since primary ramps represent only a fraction of total launching facilities.

Table 34: Number of Trailored Private and Rental Boats surveyed by CRFS in the months January through November 2006.

	Number of Counted Vessels			
Type of Activity	**Bodega Bay**	**Pillar Point**	**Total**	**Percent of Total**
Fished recreationally for finfish	2,347	1,766	4,113	95.3
Fished recreationally for invertebrates	26	21	47	1.1
Intended to fish recreationally but no gear in water	6	7	13	0.3
Total recreational fishing	2,379	1,794	4,173	96.7
Fished commercially	19	10	29	0.7
Total Vessels Fishing	2,398	1,804	4,202	97.3
Sailing/sightseeing	12	13	25	0.6
Non-consumptive diving	0	0	0	0
Maintenance	5	11	16	0.4
Enforcement (public agency)	1	0	1	0.0
Research (public agency)	4	1	5	0.1
Personalized Watercraft	0	0	0	0
Removing boat from harbor	37	18	55	1.3
Unidentified/Other	0	13	13	0.3
Total Vessels Not Fishing	59	56	115	2.7
Totals All Boats	2,457	1,860	4,317	

Recreational boating is a popular activity within the north central coast study region. The number of registered boats increased by more than 50% in the state between 1978 and 1991, although it is not known what proportion of boats are used in marine waters. Jet skis (also known as motorized personal watercraft) comprise 11% of all recreational vehicles in 1994 (Guerrero and Kvitek 1996).

According to the Department of Motor Vehicles, there are approximately 51,000 registered recreational marine or aquatic vessels in the study region (Table 35).

Table 35: Number of registered recreational marine or aquatic vessels in the North Central Coast Study Region as of December 31, 2005

County	Number registered recreational vessels
Mendocino	5,231

Sonoma	19,641
Marin	9,338
San Francisco	4,089
San Mateo	12,636

Source: California Department of Motor Vehicles 2006

There are several marinas and boat launches in the study region, many of which are not sampled through the CRFS program. Some examples of these facilities are listed below (Tables 36 and 37).

Table 36: Marinas in or Adjacent to the North Central Coast Study Region

Marina [1, 2]	**City**	**County**
Spud Point, Porto Bodega, Mason's Marina	Bodega Bay	Sonoma
Golden Hinde Inn and Marina	Inverness	Marin
Marshall Anchorage (anchorage only)	Marshall	Marin
Pillar Point Harbor, Pillar Point Yacht Club	Princeton-by-the-Sea	San Mateo
Arques Shipyard and Marina, Clipper Yacht Harbor, Horseshoe Harbor & Presidio Yacht Club, Marina Plaza Harbor, Pelican Harbor, Richardson Bay Marina, Sausalito Cruising and Yacht Club, Sausalito Yacht Harbor Schoonmaker Point Marina, Ayala Cove, San Francisco Yacht Club, Corinthian Yacht Club, Paradise Cay Yacht Harbor	Sausalito/ Tiburon	Marin
Loch Lomond Marina and Yacht Club, Marin Yacht Harbor and Yacht Club, Lowrle Yacht Harbor, San Rafael Yacht Club	San Rafael	Marin
Point San Pablo Yacht Harbor, Brickyard Cove Marina, Channel Marina, Richmond Yacht Harbor, Marina Bay Yacht Harbor, Berkeley Marina, Emeryville City Marina, Emery Cove Marina	Richmond/ Berkeley	Contra Costa
Jack London Marina, Portobello Marina, 5th Ave Marina, North Basin, Embarcadero Cove Marina, Union Point Marina, Marina Village Yacht Harbor, Oakland Yacht Club, Encinal Yacht Club, Fortman Marina and Alameda Yacht Club, Grand Marina, Alameda Marina, Alameda Marina and Island Yacht Club, Ballena Isle Marina and Yacht Club	Oakland	Alameda
Brisbane Marina and Sirra Yacht Club, Oyster Cove Marina, Pyster Point Marina and Yacht Club, Coyote Point Marina and Yacht Club, Bair Island Marina, Pete's Harbor, Redwood City Yacht Harbor and Sequoia Yacht Club	So. SF to Redwood City	San Mateo
San Francisco Marina, Pier 39 Marina, Pier 38, Treasure Island Marina, South Beach Harbor	San Francisco	San Francisco

Source: Charternet.com; Marina Recreational Association; Boatharbors.com
1. Note that the marinas within San Francisco Bay are located outside of the study region, but that vessels using these marinas may travel into the study region under the Golden Gate Bridge.
2. This list of marinas is not comprehensive

Table 37: Boat Launch Locations within the North Central Coast Study Region

Boat Launch Locations	City	County
Point Arena	Point Arena	Mendocino
Doran Park	Bodega Bay	Sonoma
Lawson's Landing	Dillon Beach	Marin
Marshall	Marshall	Marin
Golden Hinde Inn and Marina	Inverness	Marin
Pillar Point Harbor	Princeton-by-the-Sea	San Mateo

Source: www.boatrampslocator.com

5.9.3 Recreational SCUBA Diving

SCUBA diving is a popular activity within the study region, especially within Sonoma and Mendocino counties.

User Base and Economic Contribution: About 20% of California's 1.5 million certified divers are "active," meaning they dove within the past 12 months and plan to dive within the next year. California, which comprises an estimated 12% total of the national revenue generated by recreational SCUBA diving, generates approximately $180 million annually in revenue from diving; in equipment sales it produces an additional $60 million (Hornsby 2005). Growth in the sector was estimated at 10-20% per year in the 1980s and 5-7% in the 1990s (Weinstein). Diving also fosters related business, such as underwater photography and art galleries, and produces direct and indirect revenue via services and facilities serving the region. There are at least thirteen dive shops in the coastal counties of the study region.

In addition to the local dive shops and dive boats, numerous local businesses in the study region are involved in the increasingly popular activity of underwater photography.

Specific Diving Areas: The majority of the SCUBA diving sites in the study region are found in Sonoma and Mendocino Counties. The portion of the study region south of Sonoma County is not as popular because of the relative scarcity of rocky habitat and the increase in shark sightings.

Table 38: Some SCUBA Diving Sites in the North Central Coast Study Region

SCUBA diving site	County	SCUBA diving site	County
Arena Rock	Mendocino	Timber Cove	Sonoma
Arena Cove	Mendocino	Windmere Point, Lomer Gulch	Sonoma
Arena Bay	Mendocino	Fort Ross Cove	Sonoma
Collins Landing	Mendocino	Fort Ross Reef	Sonoma
Stewarts Point	Sonoma	Red Barn, Pedotti's Ranch, Sheep	Sonoma

SCUBA diving site	County	SCUBA diving site	County
		Ranch	
Richardson	Sonoma	Russian Gulch	Sonoma
Horseshoe Cove	Sonoma	Tomales Point	Marin
Fisk Mill Cove	Sonoma	Abalone Point/Double Point	Marin
Stump Beach	Sonoma	San Agustin	Main
Gerste Cove	Sonoma	Noonday Rock	San Francisco
Gerstle Pinnacle	Sonoma	Isle of St. James	San Francisco
Ocean Cove	Sonoma	Middle Farallon	San Francisco
Stillwater Cove	Sonoma	Henry Bergh	San Francisco
Cemetery Reef	Sonoma		

Sources: www.jawsclub.org/coast.html, Watkins 2000

5.9.4 Other Recreational Activities

More than ½ million people participated in some form of kayaking in California in 1999, 2.5 million people participated in wildlife viewing, and more than 4 million people took photos at the beach (Leeworthy and Wiley 2001). Kayaking, whale watching, and nature observation have all increased in popularity (Weinstein). There are at least eleven kayak rental shops in the coastal counties in study region and some popular kayak sites are listed in Table 39.

Table 39: Partial List of Popular Kayak Sites in the North Central Coast Study Region

Popular kayak sites	County
Russian River	Sonoma
Bodega Bay	Sonoma
Tomales Bay	Marin
Drakes Estero	Marin
Estero Americano	Marin
Limantour Estero	Marin
Bolinas	Marin
Muir Beach	Marin
Fitzgerald Marine Reserve	San Mateo
Pillar Point Harbor	San Mateo

Whalewatching and wildlife viewing is also very popular in the study region. There are at least 15 boats that participate in whale watching activities within the study region, many of which participate in both whalewatching and sportfishing depending upon the season.

5.9.5 Tidepool Visitors and Wildlife Watching From Shore

Tidepool visitation is a popular recreational activity within the study region. Tidepool locations in the study region were taken from “Pacific Intertidal Life” by Russo and Olhausen and are listed in Table 40. It was also noted which of these locations are monitoring sites for the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and Multi-Agency Rocky Intertidal Network.

Table 40: Tidepooling Sites in the North Central Coast Study Region

County	Site	PISCO / Multi-Agency Rocky Intertidal Network Monitoring Site
Mendocino	Stornetta Ranch	Yes
Sonoma	Sea Ranch	Yes
Sonoma	Russian Gulch	Yes
Sonoma	Duncans Landing	Yes
Sonoma	Horseshoe Cove	Yes
Sonoma	Mussel Point	Yes
Sonoma	Bodega (head?)	Yes
Marin	Santa Maria Creek	Yes
Marin	Bolinas Point	Yes
San Mateo	Fitzgeald Marine Reserve	Yes
San Mateo	Pigeon Point	Yes

5.10 Navigation

5.10.1 Lighthouses

The area within the study region has a rich maritime heritage including several lighthouses which are still active today. These active lighthouses not only serve their function as navigational aids, but are also popular tourist destinations.

Table 41: Active Lighthouses in Study Region

Active Lighthouse	Closest city	County
Point Arena	Point Arena	Mendocino
Point Reyes	Inverness	Marin
Point Bonita	Sausalito	Marin
Point Diablo	Sausalito	Marin
Farallon Island	San Francisco	San Francisco
Mile Rock Lighthouse	San Francisco	San Francisco
Point Montara	Montara	San Mateo
Pigeon Point	Pescadero	San Mateo

5.10.2 Vessel Traffic

The area west of the Golden Gate Bridge contains some of the busiest shipping lanes in the state. Over 6,000 commercial vessels (excluding domestic fishing vessels) enter and exit the San Francisco Bay each year. Less than 25% of the vessels are of intermediate size (draft <50 feet) and about 5% are large vessels (draft greater than 50 feet) (GFNMS 2006).

The Ports and Waterways Act authorizes the US Coast Guard to establish shipping lanes in order to promote navigation, vessel safety, and the protection of the marine environment. The San Francisco Vessel Traffic Separation Schemes consists of two mile-wide inbound and outbound vessel traffic lanes with separation zones located between (GFNMS 2006) (see Map 14d).

6.0 Academic Institutions, Research, Public Outreach, and Education

Academic institutions, government agencies, and non-governmental organizations in the San Francisco Bay area and surrounding region contribute to marine research, education and public outreach in the north central coast study region. Locations of research institutions and long-term monitoring sites are shown on Maps 15a and 15f.

6.1 Major Marine Institutions in the North Central Coast Study Region

Major academic institutions that conduct research in coastal and marine ecosystems in north central California include University of California, Berkeley, San Francisco State University, University of California, Davis, through support for the Bodega Marine Lab, and Stanford University and University of California, Santa Cruz, whose PISCO intertidal and subtidal monitoring extends north through the region. Marine laboratories in the north central coast study region include Bodega Marine Lab, Romberg Tiburon Center, Point Reyes Bird Observatory, the Marine Mammal Center, and Southwest Fisheries Science Center. Several government agencies contribute to research in the north central coast study region, including California Department of Fish and Game, California Sea Grant, Cordell Bank, Gulf of the Farallones and Monterey Bay National Marine Sanctuaries, San Francisco Bay National Estuarine Research Reserve and U.S. Geological Survey. Some non-governmental organizations also contribute to research in the study region, including Oikonos-Ecosystem Knowledge.

6.2 Scientific Research and Collecting

The scientific research within the north central coast study region is diverse, ranging from intertidal ecology to studies of the pelagic zone and deep ocean. Much of the research in the north central coast study region is concentrated around marine laboratories. Research at the Bodega Marine Laboratory, affiliated with the University of California, Davis, includes marine ecology, coastal/nearshore oceanography, environmental toxicology biochemistry, molecular biology, physiology, and pathology. The Romberg Tiburon Center, operated by San Francisco State University, focuses on research to understand the San Francisco Bay and its surrounding wetland environments, and the open ocean.

Research conducted at Point Reyes Bird Observatory (PRBO), founded in 1965, focuses on four key areas: (1) Ocean predators as bio-indicators of climate change and habitat quality, (2) population dynamics, reproduction, and survival of seabird, marine mammal and white shark populations, (3) life history characteristics: diet, feeding ecology, and energetic needs of seabirds in relation to marine fisheries and pollution, and (4) creation of marine protected areas and marine reserves to protect ocean ecosystems. The Southwest Fisheries Science Center, adjacent to University of California Santa Cruz's Long Marine Laboratory, supports research on stock assessments, population dynamics, ecological linkages, and economics of Pacific coast groundfish and Pacific salmon. Research at The Marine Mammal Center focuses on marine mammal health in order to understand the causes of marine mammal strandings, and links to ocean health and veterinary techniques. PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans) is a large-scale interdisciplinary marine research program based at four

academic institutions on the U.S. west coast, including the University of California, Santa Cruz, and Stanford University. PISCO maintains an array of intertidal and subtidal monitoring sites in the north central coast study region.

Government agencies in the study region sponsor, coordinate, and collaborate in scientific research. CDFG monitors and assesses the distribution and abundance of priority species and habitats to assist decision-makers in managing California's marine region. California Sea Grant, administered by the University of California, focuses on research, conservation and use of coastal and marine resources. Three national marine sanctuaries, Monterey Bay, Gulf of the Farallones, and Cordell Bank, are engaged in research in the study region. The GFNMS supports several long-term monitoring in the Gulf of the Farallones region, including Beach Watch and Sanctuary Ecosystem Assessment Surveys for the Pelagic and Rocky Intertidal Habitats. The Cordell Bank National Marine Sanctuary, in partnership with the National Marine Fisheries Service Laboratory in Santa Cruz, U.S. Geological Survey, and CDFG, initiated a long-term study to classify habitats and monitor fishes and macro-invertebrates on and around Cordell Bank.

The San Francisco Bay National Estuarine Research Reserve (NERR) supports long-term research and monitoring by staff, visiting scientist, and graduate students. The U.S. Geological Survey is engaged in research and dissemination of information about marine ecosystems in central and northern California. The Monterey Bay National Marine Sanctuary coordinates the Sanctuary Integrated Monitoring Network, a group of more than forty institutions and organizations in the Monterey Bay area that are currently investigating various aspects of the sanctuary, including intertidal habitats, rocky reefs, kelp forests, sandy seafloor habitats, and oceanography.

Non-governmental organizations also contribute to research in the region. Oikonos-Ecosystem Knowledge is a non-profit 501© (3) organization working locally and internationally to study distributions and important areas for seabirds and marine mammals off north and central California.

Table 42: Research and Monitoring Programs in the North Central Coast Study Region

Beach Watch Beach Watch, established by Gulf of the Farallones National Marine Sanctuary in 1993, trains citizen-scientists to survey seabirds and marine mammals on coastal beaches from Point Año Nuevo to Bodega Head. Beach Watch volunteers conduct oil spill sampling and tar ball retrieval to assist the California Office of Spill Prevention and Response. (http://farallones.nos.noaa.gov)
Center for Integrative Coastal Observation, Research and Education The California State University CI-CORE is a distributed coastal observatory for applied coastal research and monitoring in the nearshore (<100 m water depth) along the entire California coastline.
Bodega Ocean Observing Node A coastal ocean observing system within the Central and Northern California Ocean Observing System (CeNCOOS) based at the Bodega Marine Laboratory. (www.bml.ucdavis.edu)
California Current Marine Conservation Initiative

The Point Reyes Bird Observatory is implementing this initiative with a primary goal of conserving the complex food webs of the California Current System, with an emphasis on central California. (www.prbo.org/)
California Sea Grant The statewide program works in partnership with scientists and engineers at public and private universities, and with industry, government, and the public to conduct research on water quality, aquaculture, fisheries, fish habitat, and non-indigenous species. (http://cemarin.ucdavis.edu/Agriculture_and_Natural_Resources123/Marine_Resources.htm)
Central California Ocean Observing System This new initiative is part of the national Integrated Ocean Observing System (IOOS). For more information: (www.cencos.org)
Coastal Oceans Currents Monitoring Program A state multi-institution, interagency collaboration at Bodega Marine Laboratory for monitoring coastal currents with high frequency (HF) radar units at Point Reyes, Bodega Marine Laboratory and Gerstle Cove, and as far north as Point Arena. (www.bml.ucdavis.edu)
Computational Assessments of Scenarios of Change for the Delta Ecosystem USGS researchers are adapting and developing hydrologic, hydrodynamic, and biological models of the Bay-Delta watershed and Sacramento-San Joaquin River Delta to explore scenarios of change induced by factors such as global warming, water and ecosystem management, land use, and earthquakes. (www.usgs.gov)
Cordell Bank Ocean Monitoring Program Research on variability in the pelagic ecosystem around Cordell Bank was initiated by the Cordell Bank National Marine Sanctuary and Point Reyes National Seashore in 2004. (www.cordellbank.noaa.gov)
Cooperative Research and Assessment of Nearshore Ecosystems The Cooperative Research and Assessment of Nearshore Ecosystems is a California statewide monitoring program developed by the California Department of Fish and Game in cooperation with other research scientists. The program was implemented in 2004 but has not continued at all sites. (www.dfg.ca.gov/regions/region3.html/)
Longterm Monitoring Program and Experiential Training for Students Monitoring key intertidal, sandy shore, and offshore areas in the five west coast National Marine Sanctuaries. Monitoring is conducted by students in middle and high schools, and other volunteer groups. (http://limpets.noaa.gov/)
Long-term Monitoring of Cordell Bank The Cordell Bank National Marine Sanctuary (CBNMS), in partnership with the National Marine Fisheries Service Laboratory in Santa Cruz, the U.S. Geological Survey, and the California Department of Fish and Game, initiated a long term study to classify habitats and monitor fishes and macro-invertebrates on and around Cordell Bank. (www.cordellbank.noaa.gov)
Oikonos-Ecosystem Knowledge The organization supports scientists to collect and assemble the data, develop maps, and assess spatial and temporal distributions of marine mammals and seabirds off the California coast. (www.oikonos.org)
Pacific Estuarine Ecosystem Indicator Research Center A collaborative effort at Bodega Marine Laboratory by 28 principal scientists, including ecotoxicologists, ecologists, biochemists, microbiologists, and remote sensing experts, at University of California Davis and University of California Santa Barbara with the goal of developing new indicators of estuarine wetland health in marsh plants and animals. (www.bml.ucdavis.edu)
Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) Interdisciplinary research focuses on three issues: (1) how currents, upwelling, and other

physical and ecological processes affect the plants and animals of coastal marine ecosystems, (2) how coastal ocean ecosystems respond to shifts in water temperature, currents, and other factors that may vary with global climate change, and (3) how ocean circulation affects the dispersal of marine organisms in their earliest larval stages. PISCO maintains an array of intertidal and subtidal monitoring sites in central northern California. (www.piscoweb.org)
Point Reyes Bird Observatory Conservation Science For over 30 years PRBO scientists have gathered year-round observations of seabirds and marine mammals on the Southeast Farallon Islands through a cooperative agreement with the U.S. Fish and Wildlife Service. Since the 1971 oil spill in San Francisco, PRBO scientists collected comprehensive information on beached birds in the Pacific (1971-1986) and documented oiled wildlife on the Farallon Islands daily since 1977. (www.prbo.org/)
Resource Assessment Program The California Department of Fish and Game is initiating program to inventory, monitor, and assess the distribution and abundance of priority species, habitats, and natural communities in California, bringing together many efforts to collect, compile, and disseminate information. (www.dfg.ca.gov/regions/region3.html/)
Rocky Intertidal Monitoring A long-term monitoring program designed by Gulf of the Farallones National Marine Sanctuary to track population dynamics of organisms in rocky intertidal habitats. (http://farallones.nos.noaa.gov)
San Francisco Bay National Estuarine Research Reserve The reserve supports a variety of research projects on nutrient loading, seagrass restoration, habitat mapping and change, channel geomorphology, and the impacts of invasive species and participates in a NERR System-wide Monitoring Program. (http://sfbaynerr.org/)
Sanctuary Education Awareness and Long Term Stewardship Since 1996, more than 65 volunteers have helped the Gulf of the Farallones National Marine Sanctuary protect pupping harbor seals in Tomales Bay and Bolinas Lagoon. (http://farallones.nos.noaa.gov)
Sanctuary Ecosystem Assessment Surveys of the Pelagic Habitat Surveys designed by Gulf of the Farallones National Marine Sanctuary to investigate the relationship between hydrographic conditions, physical features and the distribution and abundance of marine organisms (seabirds, marine mammals, sea turtles, krill, and phytoplankton) in the vicinity of the Gulf of the Farallones region and the coastal and pelagic region west of Sonoma County. (http://farallones.nos.noaa.gov)
Sanctuary Integrated Monitoring Network The Sanctuary Integrated Monitoring Network is composed of many institutions and agencies that perform monitoring activities in the Monterey Bay National Marine Sanctuary and share their summary information with the Sanctuary Integrated Monitoring Network. (www.mbnms-simon.org)
Southwest Fisheries Science Center Research is focused on population dynamics, ecological linkages, and economics of Pacific coast groundfish and Pacific salmon. Groundfish under study include rockfishes, flatfishes, Pacific whiting, sablefish, and lingcod; salmon include coho, chinook, and steelhead. (www.nmfs.noaa.gov/)
The Marine Mammal Center Research is focused on diseases carried by marine mammals, diagnostic tests and clinical procedures to improve care of marine mammals, and tagging studies to monitor rehabilitated marine mammals following their release. (www.tmcc.org)
United States Geological Survey The USGS maintains a website “Access San Francisco Bay and Delta”

(http://sfbay.wr.usgs.gov/), which contains information about the region. The Bay Area Regional Database (BARD, http://bard.wr.usgs.gov/index.html), supported by the U.S. Geological Survey, contains bathymetry for the San Francisco Bay and Suisun Bay and Delta, and other related information.

6.3 Public Education and Outreach

Local, state, and federal agencies and institutes throughout the MLPA North Central Coast Study Region offer public outreach and education about coastal and marine ecosystems. University and graduate education is available through numerous educational institutions including the University of California, Santa Cruz, Stanford University, University of California, Berkeley, San Francisco State University, and marine laboratories, including Bodega Marine Lab, Romberg Tiburon Center, and The Marine Mammal Center. Public education and student and teacher training are available through the aquariums, including the Steinhart Aquarium and the Aquarium of the Bay, and the Lawrence Hall of Science. State and federal agencies, including the California Coastal Commission, Cordell Bank, Gulf of the Farallones and Monterey Bay National Marine sanctuaries, Point Reyes National Seashore, and the San Francisco Bay National Estuarine Research Reserve, provide opportunities for public education, K-12 education and teacher training. Dedicated education programs, such as California Center for Ocean Sciences Education Excellence (COSEE) and Marine Activities Resources and Education develop and distribute curricula, linked to California state teaching standards, on ocean science.

Public education is the primary focus of aquariums. The California Academy of Science and the Steinhart Aquarium, which opened in 1923, provides docent-lead tours and class activities for students, grades 3-5, and teacher workshops on coral reefs and environmental sustainability, among other topics, and teacher resources. Aquarium of the Bay, which opened in 1996, features aquatic life of San Francisco Bay and the surrounding waters. Aquarium of the Bay offers free guided tours, classroom programs that can be adapted for K-12, and teacher workshops; programs developed there focus on fish, tidepools, plankton, sharks, wetlands, sloughs, and mudflats, and the food web in the San Francisco Bay.

Education centers are designed to connect students and teachers with scientists and current scientific information. The University of California, Berkeley, Lawrence Hall of Science offers residential summer camps about marine and coastal biology at Point Reyes and Bodega, with hands-on environmental education activities for K-12 students. Marine Activities Resources and Education, based at the Lawrence Hall of Science, is a K–8 science program that offers “Ocean Immersion” for students and professional development for educators through a series of workshops and on-site “Ocean Immersion” coaching. Marine Activities Resources and Education offers print, audiovisual and web-based educational materials, guest speakers and field trip ideas. The California Center for Ocean Sciences Education Excellence (COSEE), also based at the Lawrence Hall of Science, connects scientists with education and outreach institutions. COSEE is working to increase awareness of K-12 students and their communities about ocean issues by providing ocean-related educational materials for K-12 schools and opportunities for scientists to connect with the schools. COSEE also distributes an

undergraduate and graduate course, "Communicating Ocean Science." In addition, COSEE is creating a website on ocean science and technical careers.

Although education is usually a secondary focus, research institutions often develop educational opportunities for undergraduate and graduate students. The Bodega Marine Laboratory, affiliated with University of California, Davis, offers college students a range of educational opportunities from personal mentoring with resident scientists to Research Education for Undergraduates. Scientists at the Romberg Tiburon Center, San Francisco State University) train undergraduate and graduate students through courses on a variety of ocean-related topics. The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) offers two interdisciplinary summer courses for graduate students: "Physical Oceanography and Marine Ecosystems" at the University of California, Santa Cruz, and "Ecological Physiology and Genetics" at Hopkins Marine Station in Pacific Grove.

Some of research institutions expand education programs to include K-12 students and teachers. Graduate students from the Romberg Tiburon Center teach local 6 through 12 graders marine science on board the *Research Vessel* White Holly, departing from Sausalito. Romberg Tiburon Center and the Bay Area Discovery Museum collaborate to share science about San Francisco Bay with local children ages ten and younger and their families. Romberg Tiburon Center and the San Francisco Bay National Estuarine Research Reserve (NERR) offer free one-day workshops for middle and high school teachers to provide teachers with local scientific resources and ideas for classroom science projects. The Marine Mammal Center offers docent-led tours, educational programs for students, outreach to Bay Area schools through the Whale Bus, and annual volunteer training. PRBO Conservation Science (PRBO) works with children, interns, volunteers and the public to increase environmental stewardship. PRBO offers teaching tools and curriculum for educators, field trips to the Palomarin Field Station and the Bird Banding Laboratory and classroom visits in Marin and San Francisco counties. The Fisheries Ecology Division of the Southwest Fisheries Science Center sponsored an interactive educational exhibit at nearby Seymour Marine Discovery Center, a part of the University of California, Santa Cruz, Marine Science Campus.

Some state and federal agencies have developed education and outreach programs to increase public awareness about coast and ocean issues. The California Coastal Commission Public Education Program offers information on Coastal Cleanup Day (3rd Saturday in September), Coastweeks (annual 3-week celebrations of coastal and water resources), Boating Clean and Green, and educational materials for teachers and students, grades 3-12. The Coastal Commission offers three classroom activity guides: "Waves, Wetlands, and Watersheds," "Our Wetlands, Our World," and "Save Our Seas." California Sea Grant regularly conducts public workshops about water quality, fish habitat needs, and land use for both large and small agricultural landowners. Educators, students, and families can learn about coastal and marine ecology through hands-on experiences at Point Reyes National Seashore. The Point Reyes National Seashore offers interactive displays in the visitor centers, a Junior Ranger Program, a 4-6 day family summer camp, paid summer internships for high school students, and educational information on the Internet. The San Francisco Bay National Estuarine Research Reserve (NERR) education program shares the results of research from the reserve and the San Francisco Bay estuary. The NERR and Romberg Tiburon Center offer one day

workshops for teachers and science curriculum for middle and high school classes. NOAA's National Ocean Service offers "Discovery Kits" with curriculum about estuaries for classroom teachers. The NERR System began a Coastal Training Program to provide science, tools, and techniques to coastal residents.

Public education is a priority for the National Marine Sanctuary Program. As noted above, three sanctuaries are located within the study region. Cordell Bank National Marine Sanctuary (CBNMS) offers opportunities for the public to learn about the Sanctuary program through displays, brochures, classroom visits, student summits, outreach events, lecture series, outings, and teacher trainings. CBNMS provides curriculum materials for educational activities about Black-footed Albatross, benthic habitat, and the National Marine Sanctuaries. In collaboration with Point Reyes National Seashore Association's Field Seminars, CBNMS hosts an annual wildlife watching seminar to introduce participants to pelagic seabirds and marine mammals. GFNMS provides educational programs through a visitor center at the Presidio and the Sharkmobile, a traveling educational program for fourth, fifth or sixth grade classes in the San Franciso Bay Area. GFNMS and San Francisco's Recreation and Park Department offer the Sanctuary Explorers Summer Camp, free for inner city youth, ages 8-13 years. GFNMS Sanctuary Education Program provides curriculum guides, scripted slide shows, field trips for teachers, and web-based fact sheets about the sanctuary, oceanography, marine food webs, sandy beaches, oil spills, intertidal habitats, salmon, seabirds and shorebirds. High school students and adults can volunteer to learn how to conduct research with the sandy beach and rocky intertidal monitoring projects. MBNMS provides educational programs through visitor centers in San Simeon and Santa Cruz, and public events and programs (such as the Beach Coastal Ocean Mammal / Bird Education and Reseach Surveys, a sandy beach monitoring program). MBNMS provides curricula on a variety of ocean-related topics for teachers and teaching resources on the Internet. MBNMS participates in Multicultural Education for Resource Issues Threatening Oceans, a marine conservation outreach program to serve multicultural students, teachers, adults and families. In 2003, the Bay Watershed Education and Training Program, Monterey Bay, was established to improve the understanding of environmental stewardship of students and teachers by means of education.

Non-governmental organizations also contribute to education and outreach in the study region. The Bay Institute, founded in 1981, uses a combination of scientific research, political advocacy, and public education to restore the entire watershed which drains into San Francisco Bay. Oikonos Ecosystem Knowledge, a non-profit 501(c) (3) organization, encourages stewardship of ocean ecosystems through the participation of middle and high-school students in albatross tracking studies.

Table 43: Academic, Research, and Education Institutions with a Focus on Coastal and Marine Ecosystems in the North Central Coast Study Region

Aquarium of the Bay	PIER 39 Embarcadero at Beach St San Francisco, CA 94133 888-732-3483	www.aquariumofthebay.com
The Bay Institute	500 Palm Drive	www.bay.org

	Novato, CA 94949 415-506-0150	
Bodega Marine Lab University of California, Davis	P.O. Box 247 Bodega Bay, CA 94923 707-875-2211	www.bml.ucdavis.edu
California Academy of Science and The Steinhart Aquarium	875 Howard St San Francisco, CA 94103 415-321-8000	www.calacademy.org/aquarium/
California Center for Ocean Sciences Education Excellence (COSEE)	Lawrence Hall of Science University of California Berkeley, CA	http://cacosee.net/
California Coastal Commission	Public Education Program 45 Freemont St, Ste 2000 San Francisco, CA 94105 415-904-5400	http://www.coastal.ca.gov/publiced/
California Department of Fish and Game	Marine Region 7329 Silverado Trail Napa, CA 94558 707-944-5500	www.dfg.ca.gov/regions/region3.html/
California Sea Grant, University of California, Cooperative Extension	1682 Novato Boulevard Suite 150-B Novato, CA 94947 415-499-4204	http://cemarin.ucdavis.edu/Agriculture_and_Natural_Resources123/Marine_Resources.htm
Cordell Bank National Marine Sanctuary	1 Bear Valley Rd Point Reyes Station, CA 94956 415-663-0314	www.cordellbank.noaa.gov
Gulf of the Farallones National Marine Sanctuary	Fort Mason, Bldg 201 San Francisco, CA 94123 415-561-6622	http://farallones.nos.noaa.gov
Lawrence Hall of Science University of California, Berkeley	Centennial Drive Berkeley, CA 94720 510-642-5132	www.lawrencehallofscience.org
Marine Activities Resources and Education	Lawrence Hall of Science Centennial Drive Berkeley, CA 94720 510-642-5132	www.lawrencehallofscience.org/MARE/
Monterey Bay National Marine Sanctuary	299 Foam Street Monterey, CA 93940 831-647-4201	www.montereybay.noaa.gov/
The Marine Mammal Center	Marin Headlands 1065 Fort Cronkhite Sausalito, CA 94965-2609 415-289-7330	www.tmcc.org
Oikonos Ecosystem Knowledge	PO Box 1932 Benincia, CA 94510 415-868-1399	www.oikonos.org
PISCO	UCSC Long Marine Lab 110 Shaffer Road Santa Cruz, CA 95060;	www.piscoweb.org

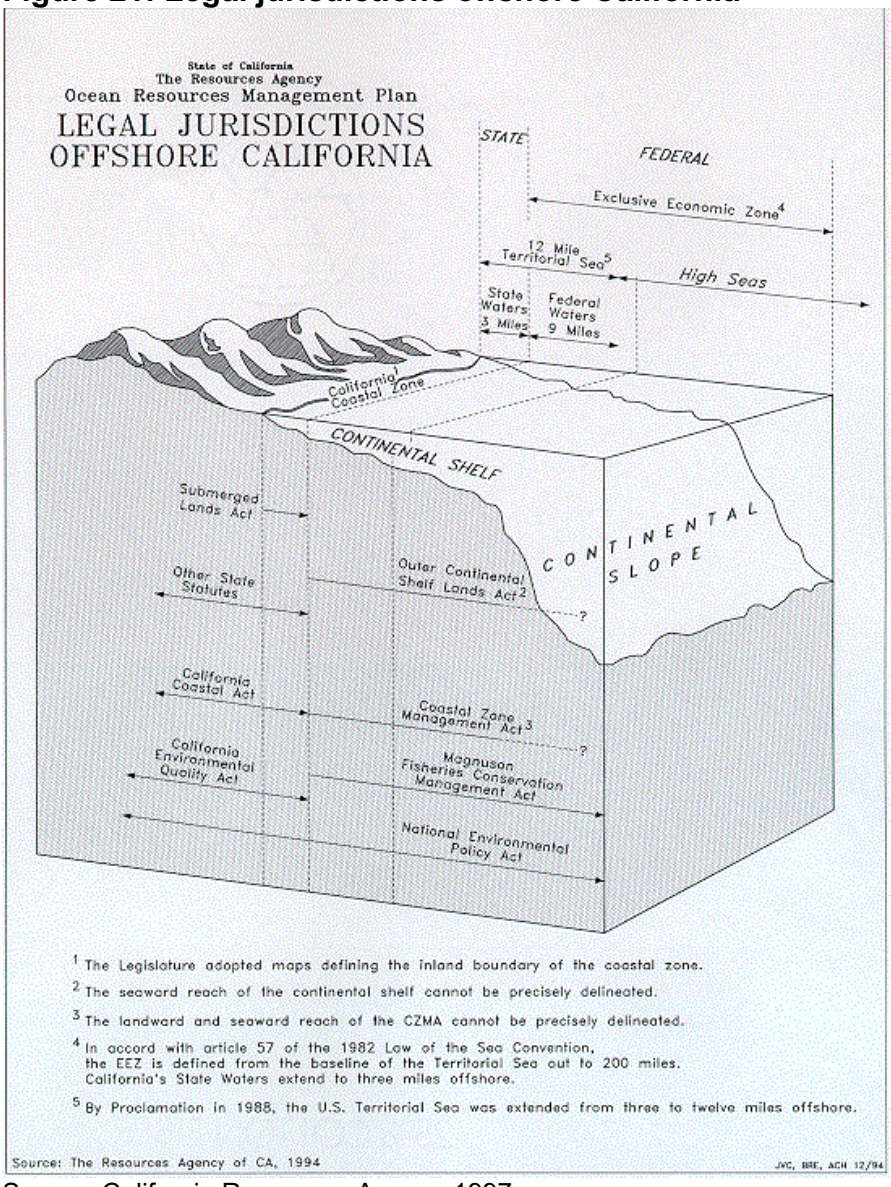
	Hopkins Marine Station Oceanview Boulevard Pacific Grove, CA 93950	
Point Reyes Bird Observatory	3820 Cypress Drive #11 Petaluma, CA 94954 707-781-2555	www.prbo.org/
Point Reyes National Seashore	1 Bear Valley Rd Point Reyes Station, CA 94956 415-464-5100 x2	www.nps.gov/pore
Romberg Tiburon Center	San Francisco State University 3152 Paradise Drive Tiburon, CA 94920 415-338-6063	http://rtc.sfsu.edu/
San Francisco Bay National Estuarine Research Reserve	San Francisco State U. 1600 Holloway Ave San Francisco, CA 94132 415-338-3707	http://sfbaynerr.org/
Southwest Fisheries Science Center	110 Shaffer Road Santa Cruz, CA 95060 Phone: (831) 420-3900 Fax: (831) 420-3980	www.nmfs.noaa.gov/
U.S. Geological Survey	345 Middlefield Rd Menlo Park, CA 94025 650-853-8300	www.usgs.gov

7.0 Jurisdiction and Management

7.1 Federal, State, Local and Native American Jurisdiction and Programs

No single federal, state or local agency has complete jurisdiction over the coastal and marine environment. Rather, jurisdiction varies spatially and with respect to the resource being managed. Figure 21 illustrates the division of jurisdictions between state and federal agencies offshore of California. The main federal, state, local, and Native American entities are highlighted below with a brief description of their role and responsibility.

Figure 21: Legal jurisdictions offshore California



Source: California Resources Agency 1997

7.1.1 Federal Agencies and Programs

The ***U.S. Department of Commerce*** has several agencies with responsibility for ocean and coastal resources, which are described below:

The ***National Oceanic and Atmospheric Administration (NOAA)*** conducts research and manages ocean resources through three units which have direct interest in MPA issues: the National MPA Center, the National Marine Sanctuary Program, and NOAA Fisheries. The NOAA Biogeographic Assessment Team has conducted an assessment of the region of the coast included within the three national marine sanctuaries of central and north central California (NOAA 2004).

The National MPA Center was established by Executive Order 13158 of 2000 to oversee efforts to create a national system of MPAs and to assist government agencies in participating in this effort; the National MPA Science Center is located in Santa Cruz. The National MPA Center also supports the MPA Federal Advisory Committee established under the executive order as well as a Science Institute which provides scientific information and policy analysis to support the planning, management and evaluation of the nation's MPAs (California Marine Life Protection Act Initiative 2005).

The ***National Marine Sanctuary Program*** manages 14 marine protected areas that encompass more than 150,000 square miles of marine and Great Lakes waters from Washington State to the Florida Keys, and from Lake Huron to American Samoa. The system includes 13 national marine sanctuaries and the Northwestern Hawaiian Islands Marine National Monument. Since 1972, the National Marine Sanctuaries Program has worked cooperatively with the public and federal, state, and local officials to protect sanctuary resources while allowing compatible commercial and recreational activities. Increasing public awareness of marine heritage, scientific research, monitoring, exploration, educational programs, and outreach are the principal tools the National Marine Sanctuaries Program uses to fulfill its mandates. Sanctuaries have authority for establishing regulations under the National Marine Sanctuaries Act (Brookhart 2006). The Monterey Bay National Marine Sanctuary and the Gulf of the Farallones National Marine Sanctuary both lie within the north central coast study region. Cordell Bank National Marine Sanctuary lies westward in federal waters off of Point Reyes.

NOAA Fisheries (National Marine Fisheries Service or NMFS) has regulatory authority for marine finfishes, invertebrates, and marine mammals other than sea otters in waters 3-200 nautical miles from shore. NOAA Fisheries derives its authority from the Magnuson-Stevens Fisheries Conservation and Management Act of 1976 (Magnuson-Stevens Act), the Marine Mammal Protection Act and the federal Endangered Species Act. Under the Magnuson-Stevens Act, NOAA Fisheries manages any fishery that is the subject of a fishery management plan developed by regional fishery management councils (see below) as well as some non- fishery management plan species (California Marine Life Protection Act Initiative 2005).

The ***Pacific Fishery Management Council*** is one of eight regional fishery management organizations established by the Magnuson-Stevens Act. The councils develop fishery management plans for fisheries between 3 and 200 nautical miles of shore; these plans must be approved by the secretary of commerce and are implemented by NOAA Fisheries. The secretary of commerce, acting through NOAA Fisheries, has management authority for approximately 80 species of finfishes, primarily those associated with the bottom (groundfish), but also others such as highly migratory species (California Marine Life Protection Act Initiative 2005).

The ***National Estuarine Research Reserve System*** is a network of terrestrial and aquatic areas established for long-term research, education and stewardship. Within California, there are three national estuarine research reserves, one each in Elkhorn Slough, the Tijuana River, and San Francisco Bay. NOAA manages them jointly with CDFG, California Department of Parks and Recreation, and San Francisco State University, respectively. There are no national estuarine research reserves located in the north central coast study region. Long-term research, stewardship, and public education are the main objectives of the reserves. NOAA provides 70% of the sites' funding, while the state partner is required to provide the remaining 30%. Enforcement activities generally are the responsibility of the state partners (Goldfarb 2005).

The ***U.S. Department of Interior*** also has several agencies with responsibility for ocean and coastal-resources, which are described below.

The ***United States Fish and Wildlife Service (USFWS)*** conserves, protects and enhances populations of fish, other wildlife, and plants and manages the system of National Wildlife Refuges. The system includes the following coastal refuges in California: Castle Rock, Humboldt Bay, San Pablo Bay, Marin Islands, Farallon, Don Edwards San Francisco Bay, Salinas River, Guadelupe-Nipomo Dunes, Seal Beach, and the Tijuana Slough. The Farallon National Wildlife Refuge is the only refuge within the north central coast study region.

The ***National Park Service (NPS)*** has several park lands located along the California coast including Redwood National Park, Point Reyes National Seashore, Golden Gate National Recreation Area, Channel Islands National Park and the Cabrillo National Monument. The typical seaward boundary of coastal national park lands extends to 1000 feet offshore, with the exception of the Channel Islands National Park which has a seaward boundary that extends to 1 nautical mile. The National Park Service regulates the use of the seabed within these 1000 feet but there is ambiguity as to its authority to regulate the harvest of living marine resources (Neubacher 2006). Adjacent to the Golden Gate National Recreation Area, there are several underwater areas (mostly former military properties) that remain the property of the federal government (Ueber 2006).

Table 44: National Parks Adjacent to the North Central Coast Study Region

Name of National Park	County
Golden Gate National Recreation Area	Marin and San Francisco

Point Reyes National Seashore	Marin
Presidio of San Francisco*	San Francisco
Fort Point National Historic Site*	San Francisco

*encompassed within the Golden Gate National Recreation Area.

The ***U.S. Bureau of Land Management (BLM)*** has management responsibility for the California Coastal National Monument established in 2000, which extends from shore to twelve nautical miles seaward and is composed of thousands of small rocks and pinnacles above mean high tide, including many rocks and islets in the north central coast study region. The primary purpose of the monument is to protect geological values, including habitat. The BLM would need to work through the regulatory process of the California Fish and Game Commission to establish regulations affecting living marine resources in state waters adjacent to any part of the monument. The BLM manages living marine resources in cooperation with CDFG; a memorandum of understanding formalizes this agreement and includes the California Department of Parks and Recreation (California Marine Life Protection Act Initiative 2005; Hanks 2006).

The ***U.S. Minerals Management Service*** manages the nation's natural gas, oil and other mineral resources on the outer continental shelf.

The ***U.S. Geological Survey (USGS)*** is the earth science research and information agency and has conducted research on the continental shelf in the study region (California Marine Life Protection Act Initiative 2005).

The ***U.S. Department of Defense*** has installations along the California coast for which there may be a conflict between military activities and protection of natural resources offshore of the bases. The Department of Defense and the CDFG have made efforts in the past to allow for military activities within MPAs located offshore of military installations. Governor Schwarzenegger's *California's Action Strategy* of September 2004 declares that state agencies should coordinate ocean and coastal management activities that impact military facilities or operations with the Department of Defense (California Resources Agency and California Environmental Protection Agency 2004). There are several US Coast Guard facilities in the study region, but no military bases.

The ***U.S. Coast Guard*** is the primary maritime law enforcement agency (California Marine Life Protection Act Initiative 2005). The U.S. Coast Guard has a station in Bodega Harbor and eastward of the Golden Gate Bridge at Point Bonita.

The ***U.S. Army Corp of Engineers*** plans, designs, constructs, operates, and maintains a wide variety of water infrastructure to support U.S. national economic interests (navigation structures, channels, shore protection, and restoration projects) (California Marine Life Protection Act Initiative 2005).

The ***U.S. Environmental Protection Agency (USEPA)***, Office of Waters, is responsible for implementing the Clean Water Act and Safe Drinking Water Act, and other portions of laws focused upon pollution prevention and watershed management. The USEPA manages the

National Estuary Program which identifies, restores, and protects nationally significant estuaries. The San Francisco Bay falls under the jurisdiction of the National Estuary Program, however, the bay itself is not part of the north central coast study region (California Marine Life Protection Act Initiative 2005).

7.1.2 State Agencies and Programs

The ***California Department of Fish and Game (CDFG)*** has management authority over living marine resources within state waters (generally between 0 and 3 nautical miles from shore or around offshore islands and including estuarine areas) as well as authority to regulate fisheries that deliver catch to Californian ports. Thus, CDFG has some authority beyond state waters and often enforces regulations in this area. In addition, the CDFG regulates marine aquaculture within state waters, such as the leases for oyster mariculture that exist in Tomales Bay and Drakes Estero in the north central coast study region (California Fish and Game Code, section 15000-15007).

The ***California Department of Parks and Recreation*** is responsible for almost one-third of California's scenic coastline and manages coastal wetlands, estuaries, beaches, and dune systems within State Park System units. Through State Water Bottom Leases, the California Department of Parks and Recreation has management authority over fifteen underwater areas, though it does not have authority to restrict the take of living marine resources. The California Park and Recreation Commission has the authority to establish, modify, or delete state marine reserves, state marine parks, and state marine conservation areas, but must have the concurrence of the California Fish and Game Commission on any proposed restrictions to the extraction of living marine resources (California Public Resources Code, section 6725). Of the fifteen underwater areas, three can be found in the MLPA North Central Coast Study Region and are under lease from the State Lands Commission until 2029. Salt Point State Park, Fort Ross State Historic Park, and Sonoma Coast State Beach contain 940, 90 and 667 acres of underwater area, respectively.

See Table 45 for all state parks adjacent to the coast in the study region.

Table 45: California State Parks Located Adjacent to Shore in Study Region 2004/2005

Name of State Park	County
Manchester State Park	Mendocino
Schooner Gulch State Beach	Mendocino
Salt Point State Park	Sonoma
Fort Ross State Historic Park	Sonoma
Sonoma Coast State Beach	Sonoma
Marconi Conference Center State Historic Park	Marin
Tomales Bay State Park	Marin
Thornton State Beach	San Mateo
Pacifica State Beach	San Mateo
Gray Whale Cove State Beach	San Mateo

Montara State Beach	San Mateo
Point Montara Light Station	San Mateo
Half Moon Bay State Beach	San Mateo
San Gregorio State Beach	San Mateo
Pomponio State Beach	San Mateo
Pescadero State Beach	San Mateo
Bean Hollow State Beach	San Mateo
Pigeon Point Lighthouse State Historic Park	San Mateo
Ano Nuevo State Reserve	San Mateo

Source: California Department of Parks and Recreation 2006

The ***California State Lands Commission*** has responsibility for leasing state lands, including submerged lands in state waters (excluding aquaculture which is regulated by the CDFG).

The ***California Coastal Commission*** regulates the use of land and water in a legislatively-designated coastal zone. Development in the San Francisco Bay is regulated by the San Francisco Bay Conservation and Development Commission. The coastal zone varies between several hundred feet above mean high tide in highly urbanized areas and up to five miles in rural areas and extends to the state water offshore boundary. The California Coastal Commission's jurisdiction extends into federal waters because of the federal consistency review responsibilities delegated to it under the Coastal Zone Management Act of 1972. Any proposed action by a federal agency that will have a reasonably foreseeable impact on resources within the coastal zone must be consistent with the policies of the state's federally-approved coastal zone management program. Activities proposed by nonfederal applicants for federal licenses or permits, and state agencies or local governments applying for federal funds are also subject to the federal consistency requirement. The establishment of MPAs may require a coastal development permit from the California Coastal Commission or the San Francisco Bay Conservation and Development Commission if public access is limited or if there is any physical development (such as signage) (California Coastal Commission 2005).

The ***California State Coastal Conservancy*** protects, restores, and improves coastal resources, and provides access to shore. The California State Coastal Conservancy manages the Critical Coastal Areas Program (CCA) which fosters collaboration among local stakeholders and government agencies to focus resources and efforts to reduce polluted runoff in coastal zone watersheds (California Marine Life Protection Act Initiative 2005). For a list of CCAs, please see section 4.3 of the present report.

The ***State Water Resources Control Board (SWRCB)*** has regulatory authority over discharges into marine waters from point and nonpoint sources, as well as other water-quality related aspects. SWRCB has authority to create state water quality protection areas and areas of special biological significance (ASBS). Regional water quality control boards are the units within the SWRCB that oversee local management issues throughout the state (California Marine Life Protection Act Initiative 2005). For a list of ASBSs, please see section 4.3 of the present report.

The ***California Department of Water Resources*** protects, conserves, develops, and manages California's water supplies in coordination with other agencies. These activities directly impact water quality and quantity in estuaries and nearshore ocean environments (California Marine Life Protection Act Initiative 2005).

The California Ocean Protection Act of 2004 created the ***California Ocean Protection Council***. The Ocean Protection Council is chaired by the Secretary of Resources and includes the State Lands Commission Chair, the Secretary for Environmental Protection, and two non-voting, ex-officio members of the California Legislature. The purpose of the Council is to:

- Coordinate activities of ocean-related state agencies to improve the effectiveness of state efforts to protect ocean resources within existing fiscal limitations.
- Establish policies to coordinate the collection and sharing of scientific data related to coastal and ocean resources between agencies.
- Identify and recommend to the Legislature changes in law.
- Identify and recommend changes in federal law and policy to the Governor and Legislature (California Ocean Protection Council)

The Ocean Protection Council approved a five-year strategic plan in June 2006 which calls for the creation of a State Agency Steering Committee composed of senior representatives of state agencies with responsibility for coastal- and ocean-management. The State Agency Steering Committee met for the first time in September 2006.

The purpose of the State Agency Steering Committee is to:

- Identify top priorities for each fiscal year
- Identify strategies and projects within and across agencies to address these top priorities
- Assess the capabilities of agencies to carry out their ocean and coastal protection responsibilities
- Identify necessary funding for priority actions-either through redeploying existing funds, developing cross-cutting budgets, or identifying new funding
- Recommend any necessary legislative action or regulatory changes to implement priority actions and strategies (California Ocean Protection Council)

In the fall of 2006, the Ocean Protection Council approved funding for seafloor mapping of the north central coast study region to support MPA planning under the MLPA.

7.1.3 Local Government Programs

7.1.3.1 Local Coastal Programs

The federal Coastal Zone Management Act passed in 1972 encouraged coastal states to develop polices to protect coastal resources. The California Coastal Act of 1976 established the California Coastal Commission as a permanent coastal management and regulatory agency. The California Coastal Commission retains permanent permit jurisdiction for proposed projects

within a designated coastal zone, ranging from several hundred feet to several miles from the coast.

However, local government may assume permit jurisdiction once the California Coastal Commission approves its local coastal plan (LCP). Each LCP includes a land use plan that prescribes land use classifications, types and densities of allowable development, and goals and policies concerning development; and zoning and other ordinances and administrative procedures needed to implement the plan.

After an LCP is approved, the commission's permitting authority is delegated to the local county/city government. The commission retains appeal authority over certain local government permit decisions. It also retains original permit jurisdiction over development on tidelands, submerged lands, and public trust lands. All amendments to approved LCPs must be submitted to the commission for review and approval.

Within the study region, there are nine LCP segments:

- Point Arena
- Sonoma County
- Marin County South (Unit I)
- Marin County North (Unit II)
- San Francisco City and County
- Olympic Club
- Daly City
- Half Moon Bay
- San Mateo County

The Olympic Club segment has failed to file an LCP while the remaining eight segments all have approved LCPs (California Coastal Commission 2005).

7.1.4 Native American jurisdiction/treaty rights

The United States Constitution recognizes Native American tribes as separate and independent political communities within the territorial boundaries of the United States. Tribes promulgate and administer their own laws and operate under their own constitutions.

There are 109 federally recognized Native American tribes in California, 15 of which lie within the 5 coastal counties of the study region. In addition, there are numerous tribes petitioning to be federally recognized. Federally recognized tribes in coastal counties in the study region include:

Mendocino County
Round Valley Indian Tribes of the Round Valley Reservation
Cahto Indian Tribe of the Laytonville Rancheria, California

Sherwood Valley Rancheria of Pomo Indians of California
Coyote Valley Band of Pomo Indians of California
Pinoleville Rancheria of Pomo Indians of California
Redwood Valley Rancheria of Pomo Indians of California
Manchester Band of Pomo Indians of the Manchester-Point Arena Rancheria
Hopland Band of Pomo Indians of the Hopland Rancheria
Guidiville Rancheria
Potter Valley Tribe

Sonoma County
Cloverdale Rancheria (recognized, but do not currently own land)
Dry Creek Rancheria of Pomo Indians of California
Federated Indians of Graton Rancheria
Kashia Band of Pomo Indians of the Stewarts Point Rancheria
Lytton Rancheria (recognized, but do not currently own land)

The California Fish and Game Code is not applicable to recognized members of Native American tribes within the boundaries of the reservation or rancheria, although the sale of bird, mammal, fish, or amphibia is still prohibited (Fish and Game code §12300). However, outside reservation or rancheria property, Native American citizens are subject to the California Fish and Game Code. CDFG grants permits to Native American citizens for the collection of seaweed for religious or ceremonial purposes.

7.2 Non-governmental Organizations and Programs

Dozens of local, community-based voluntary organizations participate in efforts to address issues in coastal watersheds in the five counties of the north central coast study region. Many such organizations also support volunteer water-quality monitoring programs in harbors and along beaches.

8.0 Existing MPAs and Coastal Protected Areas

8.1 Existing State Marine Protected Areas in the Study Region

A marine protected area, according to California law, is a discrete geographic area that has been designated by law, administrative action, or voter initiative to protect or conserve marine habitat and life. Estuarine protected areas are considered MPAs. The MLPA requires an analysis of the regions' existing MPAs to assess the need for changing existing MPAs or adding new ones in order to fulfill the requirements of the MLPA.

Preliminary site characterizations and evaluations of existing MPAs in the entire state were completed by CDFG (CDFG 2004b, Appendix V) and provide good background information on these MPAs. A more formal evaluation of existing state MPAs, based on guidelines in the draft Master Plan for MPAs, is provided in Section 9.0.

There are 13 MPAs that are in the MLPA North Central Coast Study Region (Maps 16a-16f) that together encompass 3.25% of the total study region area (Table 46). The majority of these protected areas were established in the 1960's and 1970's, however quantitative baseline studies and monitoring have occurred in only a few, including Sonoma Coast SMCA, Bodega SMR, and Duxbury Reef SMCA. In general, these MPAs are approximately one square mile or less in area, with the exceptions of Manchester and Arena Rock SMCA (6.77 mi^2), Salt Point SMCA (1.75 mi^2) and Farallon Islands SMCA (13.51 mi^2), and do not extend to deeper offshore waters. Studies of MPAs in California's central coast (Starr et al 2002b; Starr et al 2002c) suggest that MPAs of this size are generally not large enough to achieve the goals of conserving biodiversity and protecting representative and unique habitats.

There are several MPAs with overlapping boundaries that potentially present management or enforcement difficulties. For instance, Gerstle Cove SMCA is located within Salt Point SMCA, but has different regulations. In addition, the northern part of Bodega SMR overlaps with the southern end of Sonoma Coast SMCA.

Table 46: Existing State MPAs in the North Central Coast Study Region

MPA Name	Allowed Take	Area (mi^2)	% of Total Region
Manchester and Arena Rock SMCA	Allows recreational and commercial take of finfish and some invertebrates. Allows commercial take of some algae.	6.68	0.87%
Del Mar Landing SMP	Take of all living marine resources is prohibited except the recreational take of finfish by hook and line or spear.	0.09	0.01%
Salt Point SMCA	Only the following species may be taken recreationally: finfish, red abalone, chiones, clams, cockles, rock scallops, native oysters, crabs, lobsters, ghost shrimp, sea urchins, mussels and marine worms except that no worms may be taken in any mussel bed unless taken incidentally to the take of mussels.	1.63	0.21%

MPA Name	Allowed Take	Area (mi^2)	% of Total Region
	Only the following species may be taken commercially: finfish, crabs, ghost shrimp, jackknife clams, sea urchins, algae (except giant kelp and bull kelp) and worms except that no worms may be taken in any mussel bed, nor may any person pick up, remove, detach from the substrate any other organisms, or break up, move or destroy any rocks or other substrate or surfaces to which organisms are attached.		
Gerstle Cove SMCA	Take of all living marine resources is prohibited except the commercial take of finfish and algae (except giant kelp and bull kelp).	0.01	0.00%
Fort Ross SMCA	No recreational take of living or non-living marine resources is allowed except: finfish, red abalone, chiones, clams, cockles, rock scallops, native oysters, crabs, lobsters, ghost shrimp, sea urchins, mussels and marine worms except that no worms may be taken in any mussel bed unless taken incidentally to the take of mussels. Commercial take of species other than giant kelp and bull kelp is allowed.	0.11	0.01%
Sonoma Coast SMCA	No recreational take of living or non-living marine resources is allowed except: finfish, red abalone, chiones, clams, cockles crabs, ghost shrimp, mussels, native oysters, rock scallops, sea urchins and marine worms except that no worms may be taken in any mussel bed unless taken incidentally to the take of mussels. Commercial take of species other than giant kelp and bull kelp is allowed.	0.87	0.11%
Bodega SMR	All commercial and recreational take prohibited.	0.28	0.04%
Tomales Bay SMP	Take of all living marine resources is prohibited except the recreational hook and line take of species other than marine aquatic plants. Only lightweight, hand-carried boats may be launched or operated within the Park.	0.63	0.08%
Point Reyes Headlands SMCA	Take of all living marine resources is prohibited except the commercial take of finfish and algae other than giant kelp and bull kelp.	0.79	0.10%
Estero de Limantour SMCA	Take of all living marine resources is prohibited except the commercial take of finfish and algae other than giant kelp and bull kelp.	0.86	0.11%
Duxbury Reef SMCA	Only the following species may be taken recreationally: red abalone, Dungeness crab, rock crabs, rockfish (family Scorpaenidae), lingcod, cabezon, surfperch (family Embiotocidae), halibut, flounder, sole, turbot, salmon, kelp greenling, striped bass, steelhead, monkeyface-eel, wolf-eel, smelt, and silversides. Commercial take of species other than giant kelp and bull kelp is allowed.	0.66	0.09%
James V. Fitzgerald	Take of all living marine resources is prohibited except the recreational take by hook and line or spear of: rockfish (family	0.76	0.10%

MPA Name	Allowed Take	Area (mi^2)	% of Total Region
SMP	Scorpaenidae), lingcod, surfperch (family Embiotocidae), monkeyface eel, rock eel, white croaker, halibut, cabezon, kelp greenling, and smelt (Families Osmeridae and Atherinidae).		
Farallon Islands SMCA	Area closures prevent take in certain nearshore locations from March 15 through August 15 of each year. Otherwise all take is allowed.	13.51	1.77%
Total Area of State Marine Reserves		0.28	0.04%
Total Area of State Marine Parks		1.49	0.19%
Total Area of State Marine Conservation Areas		25.12	3.29%
Total Area of State MPAs in North Central Coast Study Region		26.88	3.52%
Total Area of North Central Coast Study Region		763.5	

8.2 Marine Managed Areas and Other Fishery Closures

The study region has several existing marine managed areas where marine resource use is restricted.

8.2.1 National Marine Sanctuaries

Portions of two national marine sanctuaries (NMS) are located within the study region: MBNMS and GFNMS. Cordell Bank NMS also exists in close proximity to the study region, but in federal waters. These sanctuaries, established in 1992, 1981, and 1989, respectively, primarily regulate oil and gas extraction, vessel discharge, and seabed construction, though there are some restrictions on the extraction of historic/cultural resources and use of motorized personalized water craft.

MBNMS covers a total of 5,322 square miles and has a shoreline extent of 276 miles, stretching from Cambria in San Luis Obispo County in the south to Rocky Point in Marin County in the north. On average, MBNMS extends 30 miles from shore and reaches to a depth of over two miles at its deepest point. The San Francisco exclusion zone, an area from rocky point, north of the Golden Gate Bridge, to Point San Pedro, near Pacifica, is not included in the sanctuary. The sanctuary covers many diverse oceanographic habitats, including Monterey submarine canyon (located outside of the study region), and hosts at least 33 species of marine mammals, 94 species of marine birds, and 345 species of fish. MBNMS has a large number of research and monitoring programs, as well as programs for education and outreach. The sanctuary also regulates some activities, including: oil, gas, and mineral exploration, vessel discharge, seabed construction, seabird, marine mammal, and sea turtle protection, use of historical resources, and use of personalized water craft.

GFNMS is contiguous with the MBNMS and extends from the MBNMS northern boundary, Rocky Point, to Bodega Head. GFNMS covers a total area of 1,255 square miles and covers many important coastal features in the study region, including Bolinas Lagoon, Drakes Estero, Point Reyes, Tomales Bay, Estero Americano, Estero de San Antonio, Bodega Bay, and the Farallon Islands. This biologically rich area hosts 36 marine mammals, 52 species of rockfish,

27 endangered or threatened species, and the largest breeding concentration of seabirds in the contiguous United States. In addition to significant research, monitoring, education, and outreach activities, GFNMS regulates oil, gas, and mineral exploration, vessel discharge, seabed construction, protection of biologically significant areas, use of historical resources, and use of personalized water craft.

CBNMS is contiguous with GFNMS and includes the offshore area north of GFNMS, approximately 20 miles west of Point Reyes, to Bodega Head, covering 526 square miles. Though this sanctuary is located outside of the study region, it covers rocky submerged islands and pinnacles that are important for both marine species and human-use activities in close proximity to the study region.

In an effort to better coordinate their activities, the three sanctuaries have recently conducted a joint management plan review process, including public review. More information on the joint management plan review can be found at: http://www.sanctuaries.nos.noaa.gov/jointplan. The revised management plans for each sanctuary can be found at: http://www.sanctuaries.nos.noaa.gov/jointplan/drafts/mp.html.

8.2.2 Fishery Closures Within or Adjacent to the North Central Coast Study Region

Several areas in the north central coast study region and adjacent offshore waters are closed to fishing by other regulations. These areas are important to consider when establishing MPAs. Such fishery closures include:

Year-round closures for all fishing by all gear types

- Waters of Cordell Bank less than 100 fathoms (fms) in depth, except for pacific sanddab and “other flatfishes”

Year-round closures to specified commercial gear types

- All waters within 3 miles of shore are closed to use of trawl gear.
- Within the Rockfish Conservation Area* (RCA), take and possession of rockfish, lingcod, California scorpionfish (not found within north central coast study region), and ocean whitefish is prohibited with the following gear types: trawl nets, traps, hook and line gear with more than one hook and six ounces of weight attached, and set gill and trammel nets with mesh size less than 6 inches.
- In waters shoreward of the RCA but outside 3 miles from shore, small footrope gear is required on trawl nets.
- Within state waters, the use of gill nets and trammel nets to take rockfish is prohibited.
- Gill nets and trammel nets may not be used within 3 miles of the mainland shore.
- Waters of Cordell Bank less than 100 fm in depth, except Pacific sanddab and “other flatfishes”.

- Essential Fish Habitat Closures: Recently established essential fish habitat conservation areas are spatial closures for specific gear types implemented by the Pacific Fishery Management Council. Though these areas primarily exist outside of state waters, essential fish habitat conservation areas do exist within state waters in the vicinity of the Farallone Islands. These areas can be seen in Maps 17a and 17b.

* The RCA, defined by depth zones, is different for trawl and non-trawl fisheries and may change within a year. For trawl fisheries, the RCA is 100-150 fm within the north central coast study region. In latitudes between 40°10' N and 38°N the RCA is 100-200 fm January, February, November, and December, and 100-150 fm the rest of the year. For non-trawl fisheries, the portion of the RCA that is closed year round lies between 30 to 150 fms. In the north central coast study region the RCA effectively only covers depths between 30-69 fm (69 fm is the greatest depth within the north central coast study region). Therefore, the RCA depth zone accounts for approximately 31.5% of the study region area.

Year-round closures to recreational fishing for groundfish species (includes rockfish, lingcod, cabezon, and kelp greenling)

- Waters within the recreational RCA. In the north central coast study region this area is from the shoreline to the Exclusive Economic Zone (EEZ) January-May and December, and from 30 fm to the EEZ the rest of the year.
- Waters less than 10 fms around the Farallon Islands and Noonday Rock. Waters of Cordell Bank less than 100 fms in depth are closed to ground-fishing at all times, except Pacific sanddab and "other flatfishes".

In addition to the above year-round closures, seasonal closures exist for many commercial and recreational fisheries within the north central coast study region. While these seasonal closures provide benefits by helping to sustain those fisheries, unlike year-round closures, they do not allow populations of fished species to achieve the same size and age structure. See the appendices for summaries of fishing regulations including seasonal closures for each profiled commercial and recreational fishery. For RCA seasonal coordinate data go to: http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Groundfish-Closed-Areas/Index.cfm#CP_JUMP_30272

The MLPA North Central Coast Study Region differs from the MLPA Central Coast Study Region in that the maximum depth zone is only 60-69 fathoms while the central coast had much greater maximum depths in Monterey Canyon. Thus, this study region only contains portions of depth-related regional fishery closures, such as the RCA, while the central coast contained entire depth zones identified by these types of closures.

8.3 Military, and Power Plant Closures

Three military establishments exist within the north central coast study region: a US Coast Guard training center in Petaluma, a US Coast Guard Station in Bodega Bay, and a US Coast

Guard Station at Point Arena. None of these establishments has associated spatial closures in the marine environment.

Currently, there are no coastal power plants or associated spatial closures that operate within the study region. The city of San Francisco, however, is considering both tidal and wave energy projects in the future.

8.4 Terrestrial Protected Areas in Coastal Watersheds

In addition to state MPAs, there are also a variety of terrestrial protected areas within coastal watersheds of the region (Maps 16a-16f). These include many state parks, state beaches, national wilderness areas, and military lands along the coast which provide some protection for shoreline and estuarine habitats. Agencies managing terrestrial protected areas may make good partners for research, monitoring, and enforcement. Furthermore, the presence of terrestrial protected areas can help to minimize impacts from land use in the adjacent watershed.

Table 47: Summary of Terrestrial Protected Areas

Type of Protected Area	Locations	Number
National Monuments	Muir Woods, California Coastal	2
National Recreation Areas	Golden Gate	1
National Seashores	Point Reyes	1
National Wildlife Refuges	Farallon Islands	1
State Beaches	Manchester, Schooner Gulch, Sonoma, Thornton, Pacifica, Gray Whale Cove, Montara, Half Moon Bay, San Gregorio, Pomponio, Pescadero, Bean Hollow	12
State Parks	Manchester, Salt Point, Tomales Bay, California, Samuel P Taylor, Mt Tamalpais, Portola, Butano	8
State Historic Parks	Fort Ross, Marconi Conference Center, Pigeon Point Lighthouse	3
Game Refuges	Mt Tamalpais, Farallon Islands, San Francisco	3
State Reserves	Kruse Rhododendron, Año Nuevo	2
County Parks	Stillwater Cove, Doran, San Pedro Valley, Pescadero Creek, Bolinas Lagoon	5
Other Parks	Lincoln, Golden Gate, Sharp, Harding	4
Other Terrestrial Protected Areas	Austin Creek State Recreation Area, Stornette Ranch Property (BLM), Gualala Point Regional Park, Tomales Bay Ecological Reserve, Limantour Estero Reserve, Point Reyes Bird Observatory, Bolinas Lagoon Nature Reserve, Audubon Canyon Ranch, Slide Ranch, Fort Baker Military Reserve, Fort Point National Historic Site, Presidio of San Francisco, San Francisco Zoological Gardens, Fort Funston, Pescadero Marsh Natural Preserve	15

9.0 Evaluation of Existing MPAs

During the MLPA Central Coast Project, the SAT and MLPA staff developed a process for evaluating proposed MPA packages against the scientific guidelines defined in the draft Master Plan for MPAs, which are based on the goals of the MLPA. For the purposes of the MLPA Central Coast Project evaluation, the MLPA goals were divided into four groups:

- Goals pertaining to protection of habitats (MLPA goals 1 and 4)
- Goals pertaining to connectivity among MPAs in a network (MLPA goals 2 and 6)
- Goals pertaining to recreational, educational, and study opportunities provided by MPAs (MLPA goal 3)
- Goals not requiring scientific evaluation (MLPA goal 5)

The existing MPAs in the study region have been preliminarily evaluated by MLPA staff using the same framework that was used for the central coast. This preliminary evaluation will be reviewed and refined by the SAT that is convened for the MLPA North Central Coast Ctudy Region. The existing state MPAs in the study region represent the “no action alternative” in this portion of the MLPA planning process, and constitute a baseline package of MPAs to which future packages developed through the MLPA process can be compared.

An earlier evaluation of all existing state MPAs in California, including the thirteen MPAs in the study region, was conducted by CDFG in 2004 and has been included as a reference in Appendix V. The 2004 document is dated and has some errors, but provides some background information on the existing MPAs.

The three tables below (Tables 48, 49, and 50) summarize the key characteristics of the existing state MPAs in the study region, including area covered, alongshore span, depth range, and habitats represented.

Table 48: Overall Summary for Existing State MPAs in the North Central Coast Study Region

Type of MPA	# MPA	Area (mi^2)	% of Study Region
State Marine Reserve (SMR)	1	0.28 mi^2	0.04%
State Marine Park (SMP)	3	1.49 mi^2	0.19%
State Marine Conservation Area (SMCA)	9	25.12 mi^2	3.29%
All MPAs combined	13	26.88 mi^2	3.52%

Table 49: Individual Existing State MPAs in the North Central Coast Study Region (from North to South)

MPA Name	Size (mi^2)	Along-shore span (mi)[A]	Depth range (ft)
Manchester and Arena Rock SMCA	6.68 mi^2	3.0 mi	0-141 ft

Del Mar Landing SMP	0.09 mi^2	0.3 mi	0-55 ft
Salt Point SMCA	1.63 mi^2	2.2 mi	0-182 ft
Gerstle Cove SMCA	0.01 mi^2	0.1 mi	0-3 ft
Fort Ross SMCA	0.11 mi^2	0.9 mi	0-32 ft
Sonoma Coast SMCA	0.89 mi^2	3.3 mi	0-14 ft
Bodega SMR	0.28 mi^2	1.1 mi	0-30 ft
Tomales Bay SMP	0.63 mi^2	1.2 mi	0-3 ft
Point Reyes Headlands SMCA	0.79 mi^2	3.1 mi	0-80 ft
Estero de Limantour SMCA	0.86 mi^2	3.1 mi	0-3 ft
Duxbury Reef SMCA	0.66 mi^2	3.0 mi	0-6 ft
James V. Fitzgerald SMP	0.76 mi^2	3.4 mi	0-31 ft
Farallon Islands SMCA	13.51 mi^2	5.1 mi	0-244 ft

A. Alongshore span measured as direct line from one end of the MPA to the other.

Table 50: Habitat Representation in Existing State MPAs

	Percentage of habitats in the study region within existing MPA designations [A]			
Habitat Type	**SMR**	**SMP**	**SMCA**	**Total, all MPAs**
Intertidal				
Sandy or gravel beaches	0.12%	1.44%	8.38%	9.93%
Rocky intertidal and cliff	0.89%	2.46%	12.82%	16.17%
Coastal marsh	0.00%	11.82%	10.99%	22.81%
Tidal flats	0.00%	4.56%	12.71%	17.27%
Seagrass beds (0-30m): Surfgrass	1.80%	5.46%	14.83%	22.09%
Seagrass beds (0-30m): Eelgrass	0.00%	0.00%	12.70%	12.70%
Estuary	0.00%	3.24%	3.88%	7.12%
Soft bottom				
0-30 meters	0.09%	0.30%	3.40%	3.79%
30-100 meters	0.00%	0.00%	2.07%	2.07%
100-200 meters	0.00%	0.00%	0.00%	0.00%
>200 meters	NP	NP	NP	NP
Hard bottom				
0-30 meters	0.17%	1.42%	5.69%	7.27%
30-100 meters	0.00%	0.00%	10.01%	10.01%
100-200m	NP	NP	NP	NP
>200 meters	NP	NP	NP	NP
Kelp forest				
Average kelp (‘89, ‘99, ‘02, ‘03)	0.00%	0.08%	5.28%	5.36%
Submarine canyon				
0-30 meters	NP	NP	NP	NP
30-100 meters	NP	NP	NP	NP
100-200 meters	NP	NP	NP	NP
>200 meters	NP	NP	NP	NP

A: Based on currently available mapping data
NP = habitat not present in study region

9.1 Protection Levels of Existing MPAs

The level of protection afforded by an MPA varies according to its specific regulations, particularly on allowed take of marine resources. Preliminary levels of protection for existing MPAs have been assigned, based on the criteria established in the central coast process (Table 51) into the following categories: SMR, SMCA high, SMCA moderate, SMCA low, and SMP low.

The highest SAT protection level is "SMR" and corresponds to those MPAs that do not allow any take of marine life. "SMCA high" is the next highest protection level and generally includes MPAs that only allow take of pelagic finfish and prohibit bottom contact of any fishing gear. MPAs that are "SMCA moderate" may allow some bottom contact, such spot prawn traps, and may also allow some small scale hand harvest of kelp. The remaining categories, "SMCA low" and "SMP low," are the lowest levels of protection and may allow take of groundfish, larger-scale kelp harvest, or other activities that may have significant effects on marine ecosystems.

Table 51: Names, Regulations, and SAT Protection Level for Existing MPAs in the North Central Coast Study Region (from North to South)

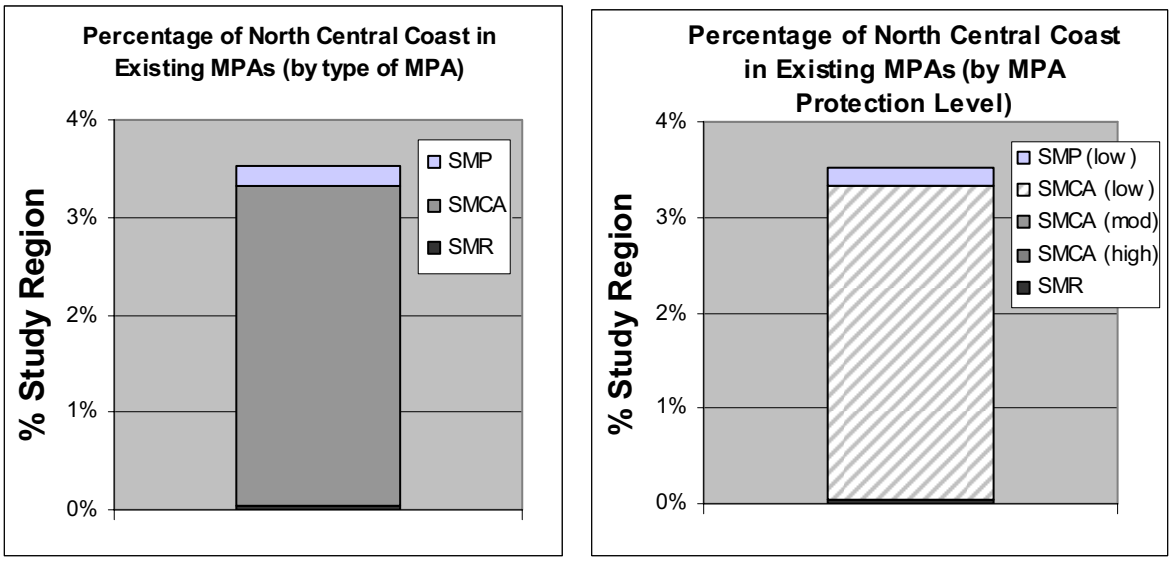
MPA Name	Allowed Take	SAT Protection Level
Manchester and Arena Rock SMCA	Allows recreational and commercial take of finfish and some invertebrates including red abalone, chiones, clams, cockles, rock scallops, native oysters, crabs, lobsters, ghost shrimp, sea urchins, mussels, and worms. Allows commercial take of some algae.	SMCA Low
Del Mar Landing SMP	Take of all living marine resources is prohibited except the recreational take of finfish by hook and line or spear.	SMP Low
Salt Point SMCA	Only the following species may be taken recreationally: finfish, red abalone, chiones, clams, cockles, rock scallops, native oysters, crabs, lobsters, ghost shrimp, sea urchins, mussels and marine worms except that no worms may be taken in any mussel bed unless taken incidentally to the take of mussels. Only the following species may be taken commercially: finfish, crabs, ghost shrimp, jackknife clams, sea urchins, algae (except giant kelp and bull kelp) and worms except that no worms may be taken in any mussel bed, nor may any person pick up, remove, detach from the substrate any other organisms, or break up, move or destroy any rocks or other substrate or surfaces to which organisms are attached.	SMCA Low
Gerstle Cove SMCA	Take of all living marine resources is prohibited except the commercial take of finfish and algae (except giant kelp and bull kelp).[A]	SMCA Low
Fort Ross SMCA	No recreational take of living or non-living marine resources is allowed except: finfish, red abalone, chiones, clams, cockles, rock scallops, native oysters, crabs, lobsters, ghost shrimp, sea	SMCA Low

MPA Name	Allowed Take	SAT Protection Level
	urchins, mussels and marine worms except that no worms may be taken in any mussel bed unless taken incidentally to the take of mussels. Commercial take of species other than giant kelp and bull kelp is allowed.	
Sonoma Coast SMCA	No recreational take of living or non-living marine resources is allowed except: finfish, red abalone, chiones, clams, cockles crabs, ghost shrimp, mussels, native oysters, rock scallops, sea urchins and marine worms except that no worms may be taken in any mussel bed unless taken incidentally to the take of mussels. Commercial take of species other than giant kelp and bull kelp is allowed.	SMCA Low
Bodega SMR	All commercial and recreational take prohibited.	SMR
Tomales Bay SMP	Take of all living marine resources is prohibited except the recreational hook and line take of species other than marine aquatic plants. Only lightweight, hand-carried boats may be launched or operated within the Park.	SMP Low
Point Reyes Headlands SMCA	Take of all living marine resources is prohibited except the commercial take of finfish and algae other than giant kelp and bull kelp.	SMCA Low
Estero de Limantour SMCA	Take of all living marine resources is prohibited except the commercial take of finfish and algae other than giant kelp and bull kelp.	SMCA Low
Duxbury Reef SMCA	Only the following species may be taken recreationally: red abalone, Dungeness crab, rock crabs, rockfish (family Scorpaenidae), lingcod, cabezon, surfperch (family Embiotocidae), halibut, flounder, sole, turbot, salmon, kelp greenling, striped bass, steelhead, monkeyface-eel, wolf-eel, smelt, and silversides. Commercial take of species other than giant kelp and bull kelp is allowed.	SMCA Low
Farallon Islands SMCA	Area closures prevent take in certain nearshore locations from March 15 through August 15 of each year. Otherwise all take is allowed.	SMCA Low
James V. Fitzgerald SMP	Take of all living marine resources is prohibited except the recreational take by hook and line or spear of: rockfish (family Scorpaenidae), lingcod, surfperch (family Embiotocidae), monkeyface eel, rock eel, white croaker, halibut, cabezon, kelp greenling, and smelt (Families Osmeridae and Atherinidae).	SMP Low

A: State Park regulations in Gerstle Cove have made this area an unofficial no-take reserve.

Using these protection levels, it is possible to compare the percentage of the study region area within existing MPAs as grouped by the three MPA designations and as grouped by SAT protection levels (Figure 22).

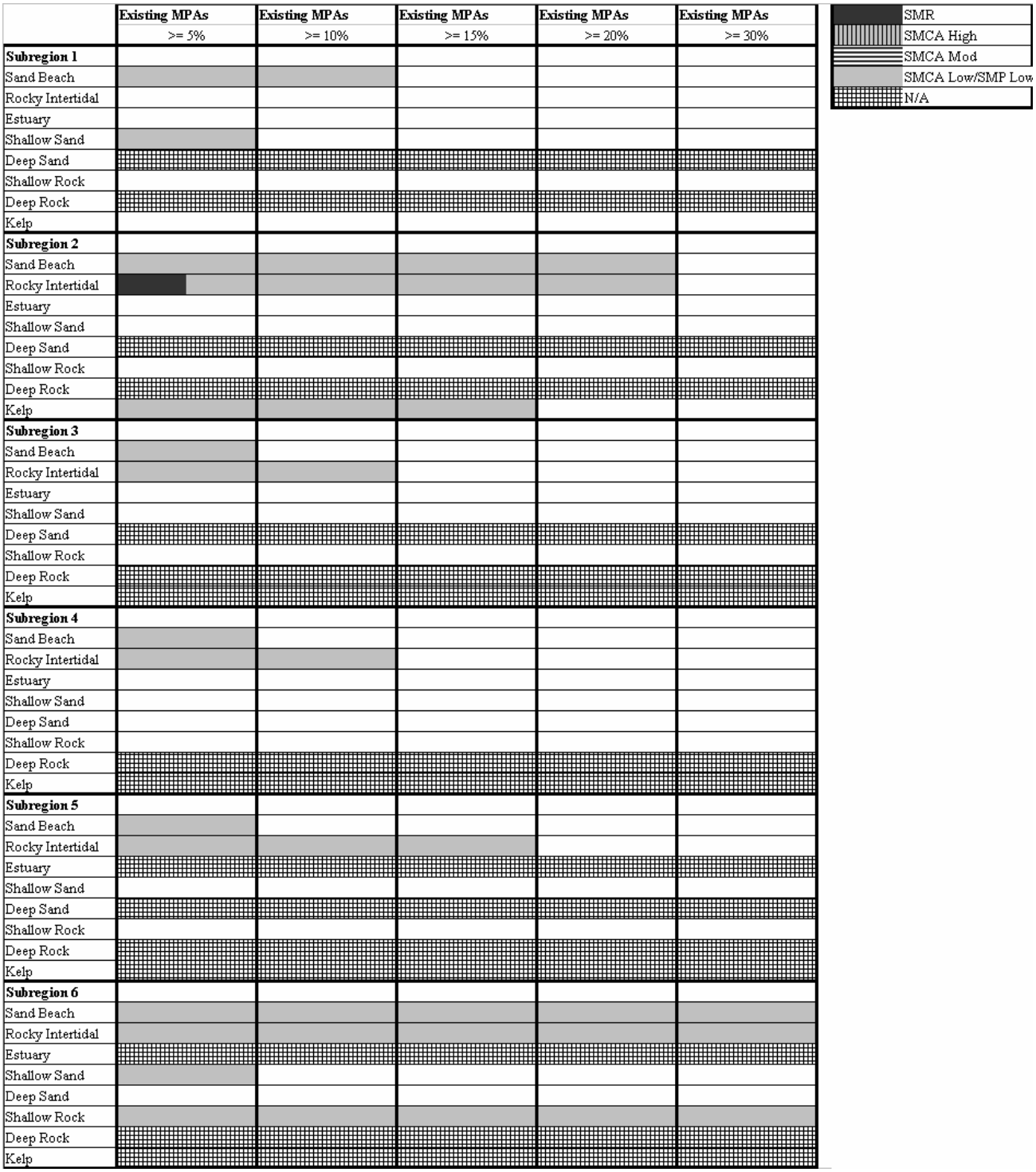
Figure 22: Area Covered by Existing MPAs by Designation and Protection Level



9.2 Habitat Protection of Existing MPAs (Goals 1 and 4)

The degree to which the existing MPAs include representative habitats within the north central coast was evaluated by determining the percentage of available habitat in the region and each subregion and evaluating how much of available habitat is included in MPAs. Coverage of habitats within various levels of protection is assessed for thresholds between 5% and 30% (figure 23). Each column represents a different threshold, with the threshold amount increasing from left to right. More filled boxes in each column represents more habitats protected to a level of at least that threshold percentage of the total amount available.

Figure 23: Analysis of Habitat Protection in Existing MPAs by Subregion



9.3 Size and Spacing of Existing MPAs (Goals 2 and 6)

Size and spacing of MPAs will influence the degree of connectivity among MPAs. Size and spacing guidelines were established by the SAT for the central coast process. In general terms, larger MPAs are more likely to protect a greater proportion of the home-range of species of interest and thus create areas where individuals can produce larvae that might be exported outside of the MPA. The distance between MPAs helps to determine whether these exported larvae are likely to travel to another MPA. Considering the known home-ranges and larval dispersal distances of all species of interest, the central coast SAT determined guidelines for size and spacing of MPAs:

"For an objective of protecting the diversity of species that live at different depths and to accommodate the ontogenetic movement of individuals to and from nursery or spawning grounds to adult habitats, MPAs should extend from the intertidal zone to deep waters offshore. For an objective of protecting adult populations, based on adult neighborhood sizes and movement patterns, MPAs should have an alongshore span of 5-10 km (3-6 mi or 2.5- 5.4 nmi) of coastline, and preferably 10-20 km (6-12.5 mi or 5.4-11 nmi). Larger MPAs would be required to fully protect marine birds, mammals, and migratory fish.
For an objective of facilitating dispersal and connectedness of important bottomdwelling fish and invertebrate groups among MPAs, based on currently known scales of larval dispersal, MPAs should be placed within 50-100 km (31-62 mi or 27-54 nmi) of each other."
(See “Considerations in the Design of MPAs” in CDFG 2006)

Evaluation of the size of the existing MPAs according to these criteria appears in figure 24. Note that by using the SAT recommended offshore extent of 3 miles and the minimum alongshore span of 3 miles, one gets a minimum MPA area of 9 mi^2 (or a minimum preferred size of 18 mi^2 using a 6 mile minimum preferred alongshore span). MPAs that are adjacent to one another are evaluated together as an MPA “cluster.” In some cases, existing MPAs were created with overlapping boundaries. Gerstle Cove SMCA and Salt Point SMCA, as well as Sonoma Coast SMCA and Bodega SMR have boundaries that overlap, in which case the more stringent regulations were assumed to apply in the overlapping area.

Table 52 displays the distance between each MPA in the study region, so that distances between any two MPAs can be compared to recommendations of the SAT (described above). The SAT recommendations for spacing need to be considered on a habitat basis; this evaluation has not yet been done in part because there is only 1 existing MPA (Bodega SMR) that is considered high protection and the guidelines were designed in large part to evaluate spacing between high protection MPAs. Distances in Table 52 were calculated using the straight Euclidian distance between the centroids of each MPA. Distance around headlands was calculated using points offshore of each headland.

Figure 24: Size Analysis for Existing MPAs in the North Central Coast Study Region

Size Category	# of MPA Clusters	Below Minimum	At Minimum	Above Minimum
Length (all MPA clusters)	11	36%	64%	0%
Length (high protection clusters)	1	100%	0%	0%
Area (all MPA clusters)	11	91%	9%	0%
Area (high protection clusters)	1	100%	0%	0%

Table 52: Distance Between North Central Coast MPAs (mi)

MPA	Manchester and Arena Rock	Del Mar Landing	Salt Point	Gerstle Cove	Fort Ross	Sonoma Coast	Bodega	Tomales Bay	Point Reyes Headlands	Estero de Limantour	Duxbury Reef	James V Fitzgerald	Farallon Islands *
Manchester and Arena Rock	0.0	22.4	38.0	37.8	43.0	59.2	59.0	80.3	81.9	88.1	98.1	123.3	92.1
Del Mar Landing	22.4	0.0	15.3	15.4	21.3	36.6	37.5	58.1	60.1	67.5	76.3	101.6	76.9
Salt Point	59.2	15.3	0.0	0.4	6.1	21.3	22.1	42.7	45.0	51.0	61.5	86.5	56.4
Gerstle Cove	37.8	15.4	0.4	0.0	5.9	21.2	22.0	42.7	45.1	50.9	61.4	86.7	56.4
Fort Ross	43.0	21.3	6.1	5.9	0.0	15.4	16.3	36.9	40.1	46.1	55.8	82.2	51.8
Sonoma Coast	59.2	36.6	21.3	21.2	15.4	0.0	1.2	21.8	26.3	32.0	42.8	67.8	39.1
Bodega	59.0	37.5	22.1	22.0	16.3	1.2	0.0	20.6	25.1	32.2	41.4	67.1	38.2
Tomales Bay	80.3	58.1	42.7	42.7	36.9	21.8	20.6	0.0	35.2	40.5	51.7	76.8	48.3
Point Reyes Headlands	81.9	60.1	45.0	45.1	40.1	26.3	25.1	35.2	0.0	5.7	16.3	42.5	16.5
Estero de Limantour	88.1	67.5	51.0	50.9	46.1	32.0	32.2	40.5	5.7	0.0	14.3	42.7	21.8
Duxbury Reef	98.1	76.3	61.5	61.4	55.8	42.8	41.4	51.7	16.3	14.3	0.0	29.2	21.0
James V. Fitzgerald	123.3	101.6	86.5	86.7	82.2	67.8	67.1	76.8	42.5	42.7	29.2	0.0	30.1
Farallon Islands *	92.1	70.5	56.4	56.4	51.8	39.1	38.2	48.3	16.5	21.8	21.0	30.1	7.3 *

* The Farallon Islands SMCA has two distinct sections. Distances between the Farallon Islands and MPAs north of Point Reyes were measured from the northern Farallon Islands section. Likewise, distances between the Farallon Islands and MPAs south of Point Reyes were measured from the southern Farallon Islands section. The distance between these two sections, 7.3 mi, is listed as the distance from the North Farallon Islands to the South Farallon Islands.

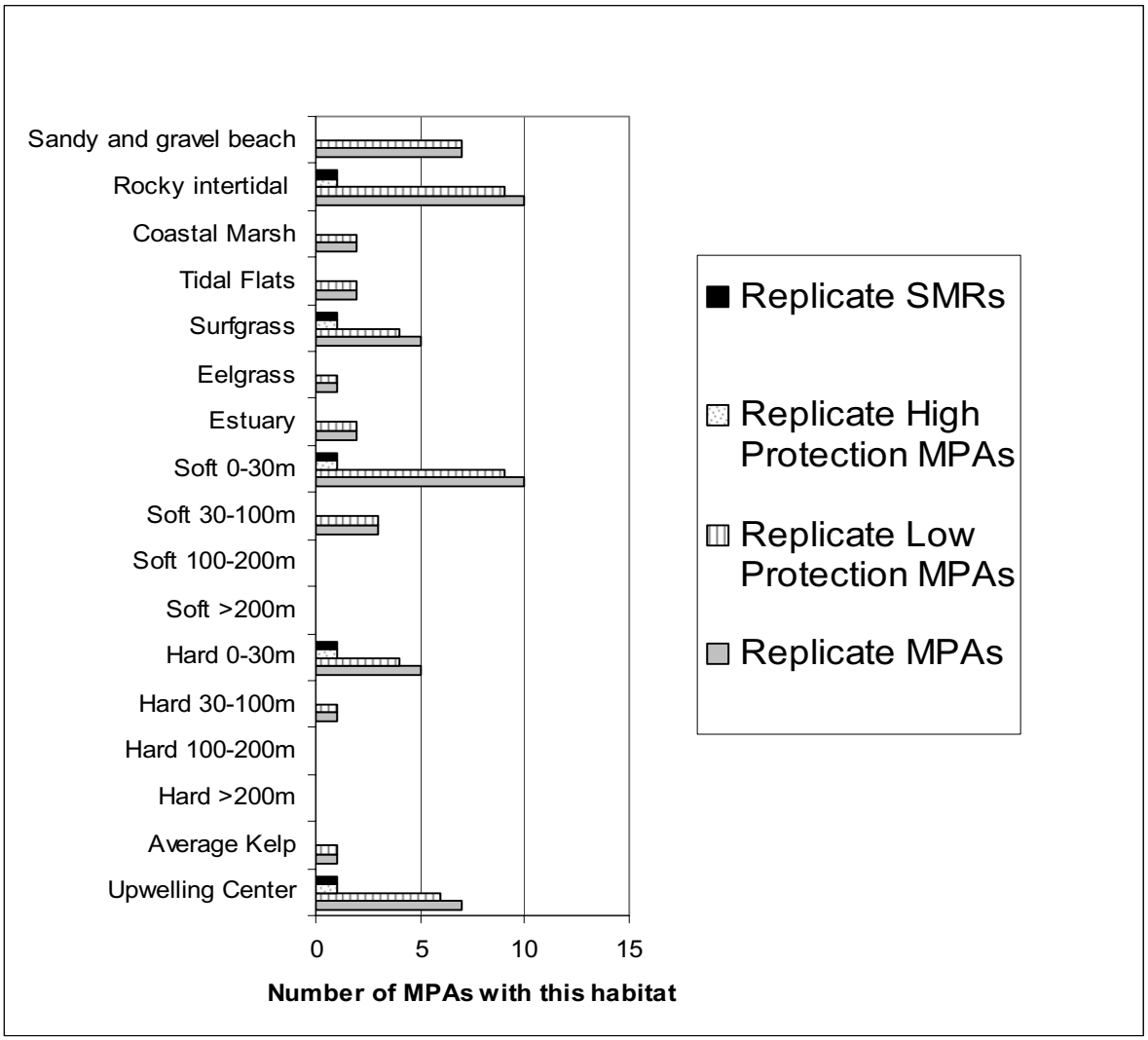
9.4 Replication of Habitats in Existing MPAs

The SAT also recommended that habitats be replicated within MPAs:

"For an objective of providing analytical power for management comparisons and to buffer against catastrophic loss of an MPA, at least three to five replicate MPAs should be designed for each habitat type … within a biogeographical region."
(See "Considerations in the Design of MPAs" in CDFG 2006)

Note that the north central coast study region is only part (approximately one-third) of the biogeographical region which extends from Oregon border to Point Conception. Figure 25 shows the replication of habitats within existing MPAs in the north central coast study region.

Figure 25: Replicate Habitats in Existing MPAs



9.5 Recreational, Educational, and Study Opportunities (Goal 3)

The creation of recreational, educational, and study opportunities is difficult to directly assess, but can be approximated by considering how close MPAs are to ports, population centers, and research institutions as well as whether they include existing monitoring sites. The staff and science advisory team will analyze how many MPAs are close to the ports, population centers, and research institutions as well as to what degree existing MPAs encompass exiting monitoring sites. These data are currently being collected and figures displaying this information have not yet been generated.

9.6 Summary Evaluation of Existing MPAs

The SAT that is assembled for the MLPA North Central Coast Study Region will review and interpret the evaluation of existing MPAs for the next draft of the regional profile.

10.0 Summary by Subregion

Highlights and basic information on the ecological and socioeconomic setting and existing managed areas in each of the six subregions are summarized in the following draft sections. Information provided by the regional stakeholders and SAT during group "fact finding sessions" will be added to these sections to make them more complete.

Table 53: Subregional Summary of Habitats for the North Central Coast Study Region
[square miles (% of total in study region)]

Habitat	Subregion 1	Subregion 2	Subregion 3	Subregion 4	Subregion 5	Subregion 6	Total Region
Total Area	135.0 (17.7%)	105.7 (13.8%)	178.7 (23.4%)	133.5 (17.5%)	116.4 (15.2%)	94.3 (12.3%)	763.5 (100%)
Total Shoreline Length^	64.5 (17.6%)	45.7 (12.4%)	141.2 (38.4%)	58.8 (16.0%)	50.2 (13.7%)	7.1 (1.9%)	367.6 (100%)
Intertidal Rock	50.1 (29.6%)	29.0 (17.1%)	37.7 (22.2%)	24.8 (14.7%)	20.5 (12.1%)	7.1 (4.2%)	169.5 (100%)
Intertidal Sand	24.0 (12.8%)	24.8 (13.2%)	74.6 (39.6%)	36.1 (19.2%)	28.7 (15.2%)	0.1 (<0.1%)	188.3 (100%)
Intertidal Coastal Marsh	1.2 (2.4%)	2.3 (4.4%)	35.9 (69.3%)	7.5 (14.5%)	4.9 (9.4%)	0.0 (0.0%)	51.8 (100%)
Intertidal Tidal Flats	0.4 (0.7%)	0.0 (0.0%)	46.8 (77.2%)	9.9 (16.4%)	3.5 (5.7%)	0.0 (0.0%)	60.6 (100%)
Hard 0-30 m	1.0 (1.7%)	1.5 (2.4%)	12.0 (18.9%)	17.6 (27.7%)	28.7 (45.2%)	2.7 (4.2%)	63.5 (100%)
Hard 30-100 m	1.7 (3.2%)	2.1 (3.8%)	27.0 (50.2%)	2.6 (4.8%)	10.0 (18.6%)	10.4 (19.4%)	53.8 (100%)
Hard 100-200 m	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (100%)
Hard >200 m	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (100%)
Soft 0-30 m	26.1 (11.0%)	23.8 (10.0%)	56.9 (24.0%)	93.7 (39.5%)	36.5 (15.4%)	0.2 (0.1%)	237.2 (100%)
Soft 30-100 m	105.9 (26.4%)	77.9 (19.4%)	81.2 (20.2%)	19.4 (4.8%)	41.2 (10.3%)	75.8 (18.9%)	401.3 (100%)
Soft 100-200 m	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	< 0.1 (0.8%)	0.00 (0.00%)	4.9 (99.2%)	5.0 (100%)
Soft >200 m	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.00 (100%)
Pinnacles	NA	NA	NA	NA	NA	NA	NA
Kelp ('05)	0.8 (88.4%)	0.1 (11.6%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.9 (100%)
Kelp ('04)	0.9 (65.2%)	0.4 (30.8%)	< 0.1 (0.9%)	< 0.1 (1.2%)	< 0.1 (1.9%)	0.00 (0.0%)	1.4 (100%)
Kelp ('03)	0.9 (78.4%)	0.2 (20.3%)	<0.1 (0.6%)	0.0 (0.0%)	<0.1 (0.7%)	0.0 (0.0%)	1.2 (100%)
Kelp ('02)	0.5 (26.4%)	1.2 (68.6%)	< 0.1 (1.0 %)	0.1 (3.5%)	< 0.1 (0.6%)	0.0 (0.0%)	1.7 (100%)
Kelp ('99)	2.1 (84.4%)	0.4 (15.6%)	0.0 (0.0%)	0.0 (000%)	0.0 (0.0%)	0.0 (0.0%)	2.5 (100%)

Habitat	Subregion 1	Subregion 2	Subregion 3	Subregion 4	Subregion 5	Subregion 6	Total Region
Kelp ('89)	2.7 (78.9%)	0.7 (20.9%)	0.0 (0.0%)	< 0.1 (0.2%)	0.0 (0.0%)	0.0 (0.0%)	3.4 (100%)
Average Kelp	1.3 (72.1%)	0.5 (27.9%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	1.8 (100%)
Estuary	0.1 (0.6%)	0.3 (1.7%)	17.1 (87.9%)	1.8 (9.4%)	0.1 (0.3%)	0.0 (0.0%)	19.5 (100%)
Seagrass (surfgrass)	0.0 (0.0%)	3.9 (5.6%)	28.6 (41.6%)	20.0 (29.1%)	15.9 (23.1%)	0.4 (0.6%)	68.8 (100%)
Seagrass (eelgrass)	0.0 (0.0%)	0.0 (0.0%)	6.0 (100%)	0.0 (0.0%)	0.0 (0.0%)	0.00 (0.00%)	6.1 (100%)
Oceanographic Habitats							
Upwelling Center	Point Arena		Point Reyes				
Retention Area							
Freshwater Plume							
Depth Zones							
Intertidal to 30m	27.2 (9.0%)	25.3 (8.4%)	68.8 (22.9%)	111.3 (37.0%)	65.2 (21.7%)	2.9 (1.0%)	300.9 (100%)
30m – 100m	107.6 (23.6%)	79.9 (17.6%)	108.2 (23.8%)	21.9 (4.8%)	51.1 (11.2%)	86.3 (19.0%)	455.1 (100%)
100m – 200m	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	< 0.0 (0.8%)	0.0 (0.0%)	4.9 (99.2%)	5.0 (100%)
Greater than 200m	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (NA)	0.0 (100%)

^Shoreline length is based on the Environmental Sensitivity Index (ESI) database.

10.1 Alder Creek/Point Arena to Horseshoe Point (Subregion 1)

Subregion 1 covers 135.0 mi^2, with 64.5 miles of coastline oriented northwest to southeast with Point Arena being the only major promontory. The continental shelf is relatively narrow. Prominent coastal features include: Point Arena, Point Arena Lighthouse, Sea Lion Rocks, Arena Cove, Iverson Point, Havens Neck, Fish Rocks, Havens Anchorage, Robinson Point, Gualala Point, Black Point, Fishermen Bay, Rocky Point, "The Football," Horseshoe Cove, and Horseshoe Point.

10.1.1 Ecological Setting

***Shoreline**:* Open, mostly rocky exposed coast in an upwelling region.
***Estuaries**:* Garcia and Gualala estuaries
***Seagrass**:* None mapped.
Kelp: Bull kelp along whole subregion length, biggest patches are located just south of Point Arena.
Depth Range: Mostly soft bottom in the 30-100 m range with some shallower areas near the coast (about a fifth of the subregional area). No areas deeper than 100 m.

Rock/Sand Bottom: Several rocky reefs including Saunders and Robinson reefs. Most mapped rocky reef is just south of Point Arena.
Oceanographic Habitats: Major upwelling center at Point Arena and significant upwelling all along the Sonoma coast, this area is in the lee (south of) of Point Arena.
Seabird Colonies: Fish Rocks (Leach's Storm Petrel, Brandt's Cormorant, Pelagic Cormorant, Western Gull, Pigeon Guillemont, Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin), Gualala Point Island (Brandt's Cormorant, Western Gull, Pigeon Guillemont), Pelagic Cormorant and Pigeon Guillemont at many sites throughout the subregion.
Marine Mammal Rookeries: Fish Rocks (Steller Sea Lion (minor))
Marine Mammal Haulouts: Largest haulouts are located at Fish Rocks, 5km south of Gualala Point, Stewarts Point, and 1.5km south of Point Arena.

10.1.2 Land-Sea Interactions

Coastal watersheds: Mendocino Coast
Major rivers: Garcia and Gualala Rivers
Anadramous fish streams: Gualala (steelhead); Garcia (steelhead, chinook, coho)
Hardened shoreline: Arena Cove (riprap)
Impaired water bodies: Garcia River (temperature), Gualala River (temperature, sediment)
Major point sources: Wastewater treatment facility at Anchor Bay.

10.1.3 Socioeconomic Setting

Counties: Mendocino, Sonoma
Coastal towns/ports/harbors: Point Arena, Fish Rock, Anchor Bay, Gualala, Stewarts Point
Public access areas, boat ramps, piers, etc: Manchester State Beach (campground, fishing, beach), Garcia River Access (fishing), Arena Cove (boating, fishing), Fish Rock Beach (campground, disabled access, fishing), Collins Landing (fishing), Gualala River Mouth (fishing), Gualala Point Regional Park (campground, disabled access, fishing), North Horseshoe Cove (fishing).
Important areas for commercial fisheries: To be determined.
Important areas for consumptive recreational use: To be determined.
Important areas for non-consumptive recreational use (diving, kayaking, wildlife viewing, beaches, etc): To be determined.

10.1.4 Research and Monitoring

***Research institutions*:** None
***Existing monitoring sites*:** Point Arena (CENCOOS, PISCO intertidal), Stornetta Ranch (PISCO intertidal), Arena Cove (CENCOOS), Gualala River (CENCOOS), Sea Ranch, south of Del Mar Point (PISCO intertidal).

10.1.5 Existing MPAs, Marine Managed Areas, and Coastal Protected Areas

***Existing state MPAs*:** Manchester and Arena Rock SMCA just north of Point Arena (Allows recreational finfish and some invertebrates and commercial take of some invertebrates); Del Mar Landing SMP (allows recreational finfish).
***RCAs and other fishery closures*:** No overlap with RCA
***Other marine managed areas*:** None
Coastal protected areas: Stornetta Ranch Property (BLM), Gualala Point Regional Park, Schooner Gulch State Beach, Manchester State Beach

10.1.6 Other Issues
To be determined.

10.2 Horseshoe Point to Bodega Head (Subregion 2)

Subregion 2 covers 105.7 mi^2 and 45.7 miles of coastline oriented northwest to southeast with major freshwater input from the Russian River. The continental shelf is relatively narrow. Prominent coastal features include: Horseshoe Point, Fisk Mill Cove, Gerstle Cove, Ocean Cove, Timber Cove, Northwest Cape, Goat Rock, Peaked Hill, Duncan's Point, Bodega Head.

10.2.1 Ecological Setting

Shoreline: Open, exposed coast in an upwelling region; mostly rocky shoreline in the north giving way to sandy beach backed by dunes in the south.
Estuaries: Russian River estuary
Seagrass: None mapped.
Kelp: Bull kelp along the northern portion, mostly concentrated between Stewarts Point and just south of Fort Ross.
Rock/Sand Bottom: Several rocky reefs including Fort Ross and Sunken reefs. Most mapped rocky reef is off of Bodega Head.
Depth Zones: Mostly soft bottom in the 30-100 m depth range with some shallower areas near the coast (about a quarter of the subregional area). No areas deeper than 100 m.
Oceanographic Habitats: Significant upwelling all along the Sonoma coast.
Seabird Colonies: Arched Rock (Brandt's Cormorant, Western Gull), Russian River Rocks (Double-Crested Cormorant, Brandt's Cormorant, Pelagic Cormorant, Western Gull), Russian Gulch (Pelagic Cormorant, Western Gull, Pigeon Guillemont), Gull Rock (Leach's Storm Petrel, Pelagic Cormorant, Western Gull)
Marine Mammal Rookeries: Northwest Cape Rocks (Steller Sea Lion), Bodega Rock (Steller Sea Lion)
Marine Mammal Haulouts: Largest 1.1 km north of salt point, Horseshoe Cove, Bodega Rock, and Fort Ross Cove.

10.2.2 Land-Sea Interactions

***Coastal watersheds**:* Mendocino Coast, Russian River, Bodega
***Major rivers**:* Russian River
***Anadramous fish streams**:* Russian River (coho, steelhead)

***Hardened shoreline**:* Russian River estuary (riprap) and ¾ mile south of Russian River Estuary (riprap).
***Impaired water bodies**:* Russian River (temperature, sediment, pathogens)
***Major point sources**:* Bodega Marine Lab at Bodega Head.

10.2.3 Socioeconomic Setting

Counties: Sonoma
Coastal towns/ports/harbors: Fort Ross, Oceanview, Sereno Del Mar, Carmet
Public access areas, boat ramps, piers, etc: Fisk Mill Cove (fishing), Ocean Cove Reserve (campground, fishing), Timber Cove Campground and Boat Landing (campground, boating, fishing), Fort Ross Historic State Park (disabled access, fishing), Rivers End (campground, fishing, boating), Jenner visitor center (disabled access, boating, fishing), Bridgehaven campground (campground, fishing), Fort Ross Reef Campground (campground, disabled access, fishing), North Jenner Beaches (fishing), Stump Beach (fishing), Salt Point State Park (campground, disabled access, boating, fishing), Goat Rock (disabled access, fishing), Shell Beach (disabled access, fishing), Duncans Mills Camping Club (campground, disabled access, fishing), Casini Ranch Family Campground (camping, boating, fishing), Wrights Beach (campground, disabled access, fishing), Duncans Cove and Landing (fishing), Salmon Creek Beach (fishing).
Important areas for commercial fisheries: To be determined.
Important areas for consumptive recreational use: To be determined.
***Important areas for non-consumptive recreational use (diving, kayaking, wildlife viewing, beaches, etc)*:** To be determined.

10.2.4 Research and Monitoring

***Research institutions**:* University of California Marine Laboratory (Bodega)
***Existing monitoring sites**:* Gerstle Cove (CENCOOS), Russian Gulch (PISCO intertidal), Russian River mouth (CENCOOS), Russian River near Moscow (CENCOOS), Duncans Landing (PISCO intertidal), Mussel Point (PISCO intertidal), Bodega Marine Lab (PISCO intertidal), Horseshoe Cove (PISCO intertidal), Bodega head (CENCOOS (x2))

10.2.5 Existing MPAs, Marine Managed Areas, and Coastal Protected Areas

***Existing state MPAs**:* Salt Point SMCA (allows recreational and commercial take of finfish and some invertebrates); Gerstle Cove SMCA (allows commercial take of finfish and some algae); Fort Ross SMCA (allows recreational take of finfish and some invertebrates and commercial take of finfish, invertebrates, and some algae); Sonoma Coast SMCA (allows recreational take of finfish and some invertebrates and commercial take of finfish, invertebrates, and some algae), Bodega SMR (no take).
***RCAs and other fishery closures*:** No overlap with RCA
Other marine managed areas: None
***Coastal protected areas**:* Kruse Rhododendron State Reserve, Salt Point State Park, Stillwater Cove County Park, Fort Ross State Historic Park, Sonoma Coast State Beach,

10.2.6 Other Issues
To be determined.

10.3 Bodega Head to Double Point (Subregion 3)

Subregion 3 is the largest of the subregions and covers 178.7 mi^2 and 141.2 miles of coastline dominated by the large coastal promontory of Point Reyes. The continental shelf widens as one moves from north to south in this subregion. Prominent coastal features include: Bodega Head, Bodega Harbor, Bodega Bay, Tomales Bay, Sand Point, Tomas Point, Preston Point, Pelican Point, Abbotts Lagoon, Hog Island, Tomales Point, Bird Rock, Point Reyes, Point Reyes Lighthouse, Drakes Bay, Drakes Estero, Bull Point, Schooner Bay, Home Bay, Drakes Head, Estero De Limantour, Point Resistance, Millers Point, Alamere Falls, Stormy Stack, and Double Point.

10.3.1 Ecological Setting

***Shoreline**:* Diverse shoreline types with several large promontories, bays, and estuaries in an upwelling region.
Estuaries: Estero Americano, Estero de San Antonio, Tomales Bay, Olema Marsh, Livermore Marsh. Marshall Marsh, Abbotts Lagoon, Drakes Estero, Estero de Limantour,
Seagrass: Eelgrass in Bodega Bay, Estero Americano, Tomales Bay, and Drakes Estero
Kelp: Very little kelp.
***Rock/Sand Bottom**:* Significant rocky reefs are located off Bodega Head, south of Tomales Point, and off Point Reyes.
***Depth Zones**:* About 60% soft and hard bottom in the 30-100 m depth range and 40% soft and hard bottom in the 0-30 m depth range. No areas deeper than 100 m.
***Oceanographic Habitats**:* Major upwelling center at Point Reyes.
***Seabird Colonies**:* Point Reyes (Common Murre, Ashy Storm Petrel, Brandt's Cormorant, Pigeon Guillemont, Pelagic Cormorant, Western Gull, Tufted Puffin), Double Point Rocks (Common Murre, Ashy Storm Petrel, Brandt's Cormorant), Point Resistence (Common Murre, Double-Crested Cormorant), Millers Point Rocks (Common Murre, Brandt's Cormorant, Pigeon Guillemont), Bird Rock (Ashy Storm Petrel, Western Gull, Pigeon Guillemont, Rhinoceros Auklet, Tufted Puffin).
***Marine Mammal Rookeries**:* Point Reyes (Steller Sea Lion, Elephant Seal)
***Marine Mammal Haulouts**:* Very large haulouts at Double Point, Drakes Estero, north of Tom's Point, Sea Lion Cove, and Bird Rock

10.3.2 Land-Sea Interactions

***Coastal watersheds**:* Bodega, Marin Coastal
***Major rivers**:* Estero Americano, Estero de San Antonio, Walker Creek, and Lagunitas Creek
***Anadramous fish streams**:* Coast Creek (steelhead), Walker Creek (steelhead), Lagunitas Creek (steelhead, coho), Drakes Estero (steelhead)
***Hardened shoreline**:* Bodega Harbor (riprap and seawalls), Tomales Bay, Nicks Cove (riprap), Tomales Bay, ½ mile south of Nick Cove (riprap), Tomales bay, South of Marshall (riprap, seawalls)

***Impaired water bodies**:* Estero Americano (nutrients, sediment), Americano Creek (nutrients), Estero de San Antonio (nutrients, sediment), Walker Creek (mercury, nutrients, sediment), Lagunitas Creek (pathogens, nutrients, sediment), Tomales Bay (pathogens, nutrients, sediment, mercury)
***Major point sources**:* Bodega Bay Fish Farm at Estero Americano

10.3.3 Socioeconomic Setting

***Counties**:* Sonoma, Marin
***Coastal towns/ports/harbors**:* Bodega Bay, Bodega Harbor, Dillon Beach, Ocean Roar, Hamlet, Marshall, Reynolds, Marconi, Millerton, Inverness, Inverness Park, Point Reyes Station, and Limantour
***Public access areas, boat ramps, piers, etc**:* Bodega Harbor, including Westside Regional Park, Spud Point Marina, Masons Marina, Porto Bodega, and Doran Beach Regional Park (camping, disabled access, boating, fishing), Dillon Beach (fishing, boating), Lawsons Landing (fishing, boating), Keys Creek Public Fishing Access (fishing), Tomales Bay State Park, Millerton Point (disabled access, fishing), Miller Park Launching Facility (boating, fishing).
***Important areas for commercial fisheries**:* To be determined.
***Important areas for consumptive recreational use**:* To be determined.
Important areas for non-consumptive recreational use (diving, kayaking, wildlife viewing, beaches, etc): To be determined.

10.3.4 Research and Monitoring

***Research institutions**:* University of the Pacific Marine Station
***Existing monitoring sites**:* Bodega Harbor (CENCOOS(x4)), Estero Americano (CENCOOS), Estero de San Antonio (CENCOOS), Tomales Bay (CENCOOS (x14)), Walker Creek (CENCOOS (x5), Lagunitas Creek (CENCOOS (x2)), Point Reyes (CENCOOS (x3)), Santa Maria Creek (PISCO intertidal)

10.3.5 Existing MPAs, Marine Managed Areas, and Coastal Protected Areas

***Existing state MPAs**:* Tomales Bay SMP (allows recreational take by hook and line), Point Reyes Headlands SMCA (allows commercial take of finfish and some algae), Estero de Limantour SMCA (allows commercial take of finfish and some algae)
***RCAs and other fishery closures*:** No overlap with RCA
***Other marine managed areas**:* Gulf of the Farallones NMS
***Coastal protected areas**:* Doran County Park, Point Reyes National Seashore, Tomales Bay Ecological Reserve, Tomales Bay State Park, Tomales Bay State Park - Alan Sieroty Beach, Limantour Estero Reserve, Samuel P. Taylor State Park

10.3.6 Other Issues

Bolinas Lagoon Ecosystem Restoration Project: Potential dredging of Bolinas Lagoon by the US Army Corps of Engineers to remove accumulated sediment.

10.4 Double Point to Point San Pedro (Subregion 4)

Subregion 4 covers 133.5 mi^2 and 58.8 miles of coastline dominated by the mouth of San Francisco Bay in the lee (south of) Point Reyes. The continental shelf is relatively wide as it stretches to the Farallon Islands. Prominent coastal features include: Double Point, Abalone Point, Bolinas Point, Duxbury Point, Bolinas Bay, Bolinas Lagoon, Kent Island, Rocky Point, Gull Rock, Pirates Cove, Tennessee Cove, Tennessee Point, Bolinas Channel, Rodeo Cove, Rodeo Lagoon, Bird Island, Point Bonita, Point Bonita Lighthouse, Mile Rocks Light/Horn, Lands End, Mori Point, Shelter Cove, San Pedro Rock, and Point San Pedro.

10.4.1 Ecological Setting

***Shoreline**:* Steep, rocky coastal topography with one significant estuary, Bolinas Lagoon, and the mouth of the largest estuary in California, San Francisco Bay (San Francisco Bay itself is not included in the study region). Mostly rocky shores north of San Francisco Bay and sandy beach south of it.
***Estuaries**:* Bolinas Lagoon, Rodeo Lagoon.
***Seagrass**:* None mapped.
Kelp: Very little kelp. Small patches north of Bolinas Point.
***Rock/Sand Bottom**:* Significant rock located in the vicinity of Bolinas Point and Point San Pedro. Sandy shoals located near the mouth of San Francisco Bay including the "potato-patch" and Four-fathom bank.
***Depth Zones**:* Mostly shallow (< 30 m) hard and soft bottom with some deeper, mostly soft, areas in the 30-100 m depth range and a very small amount of soft bottom in the 100-200 m depth range. No areas deeper than 200 m.
***Oceanographic Habitats**:* Major upwelling center at Point Reyes, this area is in the lee (south of) of Point Reyes.
***Seabird Colonies**:* Lobos Rock and Land's End (Brandt's Cormorant), Point Bonita (Pelagic Cormorant, Pigeon Guillemont)
***Marine Mammal Rookeries**:* None
***Marine Mammal Haulouts**:* Largest at Seal Rocks, Point Bonita, Bolinas Lagoon, and Duxbury Point.

10.4.2 Land-Sea Interactions

***Coastal watersheds**:* Marin Coastal, San Mateo, San Francisco Bay Drainage
***Major rivers**:* None
***Anadramous fish streams**:* Pine Gulch Creek (steelhead, coho), McKinnan Gulch (steelhead), Redwood Creek (steelhead, coho), San Pedro Creek (steelhead)
***Hardened shoreline**:* Mouth of Bolinas Lagoon (riprap), Rodeo Lagoon (riprap), Golden Gate Bridge (seawall), Mussel Rock Park (riprap), Pacifica, north of pier (riprap), Pacifica Pier.
***Impaired water bodies**:* Pacific Ocean at Rockaway State Beach (coliform), Pacific Ocean at Pacifica State Beach (coliform), San Pedro Creek (coliform)
***Major point sources**:* San Francisco Oceanside Wastewater Treatment Facility, North San Mateo County Wastewater Treatment Facility

10.4.3 Socioeconomic Setting

***Counties**:* Marin, San Francisco, San Mateo
***Coastal towns/ports/harbors**:* Bolinas, Stinson Beach, Muir Beach, San Francisco, Daly City, Pacifica.
***Public access areas, boat ramps, piers, etc**:* Duxbury Reef SMCA (fishing), Bolinas Beach (fishing), Golden Gate State Park (disabled access, boating, fishing), Baker Beach (disabled access, fishing), Mussel Rock City Park (disabled access, fishing), Sharp Park beach and Pacifica Pier (disabled access, fishing), Rockaway Beach (fishing), San Pedro Beach (disabled access, fishing), Phillip Burton Memorial Beach (fishing)
***Important areas for commercial fisheries**:* To be determined.
***Important areas for consumptive recreational use**:* To be determined.
***Important areas for non-consumptive recreational use**:* To be determined.

10.4.4 Research and Monitoring

***Research institutions**:* Point Reyes Bird Observatory Conservation Science, Audobon Canyon Ranch, Slide Ranch, Marine Mammal Center, San Francisco State University, Steinhart Aquarium
***Existing monitoring sites**:* Bolinas Point (PISCO intertidal (x2)), Bolinas Lagoon (CENCOOS), Offshore of rocky point (CENCOOS (x6)), Near Golden Gate Bridge (CENCOOS (x5)), San Francisco County Northwest Coast (CENOS (x6), Offshore Daly City (CENCOOS (x13)), Pacifica (CENCOOS (x2)), Offshore Pacifica (CENCOOS (x6)).

10.4.5 Existing MPAs, Marine Managed Areas, and Coastal Protected Areas

***Existing state MPAs**:* Duxbury Reef SMCA (allows recreational take of some finfish and invertebrates and commercial take of finfish, invertebrates, and some algae)
***RCAs and other fishery closures*:** No overlap with RCA
***Other marine managed areas**:* Gulf of the Farallones NMS, Monterey Bay NMS.
***Coastal protected areas**:* Point Reyes Bird Observatory, Point Reyes National Seashore, Golden Gate National Recreation Area, Bolinas Lagoon County Park, Bolinas Lagoon Nature Reserve, Audubon Canyon Ranch, Slide Ranch, Mt Tamalpais Game Refuge, Mt Tamalpais State Park, Muir Woods National Monument, Fort Baker Military Reserve, Fort Point National Historic Site, Presidio of San Francisco, Lincoln Park, Golden Gate Park, San Francisco Zoological Gardens, Harding Park, Fort Funston, Thornton State Beach, Sharp Park, San Pedro Valley County Park, San Francisco State Fish and Game Refuge.

10.4.6 Other Issues

***Construction of new pier at Pillar Point Harbor**:* The San Mateo County Harbor District is exploring the possibility of replacing Romeo pier at Pillar Point Harbor.

***Expansion of berths and construction of haulout facility at Pillar Point Harbor**:* **"**The San Mateo County Harbor District is beginning a new project to install 71 new boat berths in the Inner Harbor. The project will include dredging a basin for the berths, placing the sediment on

the perched beach behind a new bulkhead, installing the berths, constructing new access walkways, landscaping, and vehicle parking behind the bulkhead, and links to the new restrooms.

10.5 Point San Pedro to Pigeon Point (Subregion 5)

Subregion 5 covers 116.4 mi^2 and 50.2 miles of coastline oriented north to south with a promontory at Montara Mountain between Pacifica and Half Moon Bay. The continental shelf is relatively narrow. Prominent coastal features include: Point San Pedro, Devils Slide, Point Montara, Point Montara Lighthouse, Seal Cove, Pillar Point, Half Moon Bay, Miramontes Point, Eel Rock, Seal Rock, Pescadero Point, Bolsa Point, Pigeon Point Lighthouse, Pigeon Point.

10.5.1 Ecological Setting

***Shoreline**:* Steep rocky headlands in the north giving way to rolling river valleys in the south. Sandy beaches in Half Moon Bay and between Pescadero and San Gregorio Creeks.
***Estuaries**:* Pescadero Marsh.
***Seagrass**:* None mapped
***Kelp**:* Very little kelp.
***Rock/Sand Bottom**:* Significant rocky reef exists in this subregion from San Pedro Point to the outlet of San Gregorio Creek. The area south of Half Moon Bay has particularly broad rock coverage.
***Depth Zones**:* About half of the subregional area is hard and soft bottom in the 0-30 m range and half is hard and soft bottom in the 30-100m range. No areas deeper than 100 m.
***Oceanographic Habitats**:* Some upwelling south of Half Moon Bay.
***Seabird Colonies**:* Devil's Slide Rock (Common Murre, Pigeon Guillemont, Pelagic Cormorant, Western Gull), Seal Rock Cliffs (Pelagic Cormorant, Brandt's Cormorant), Martin's Beach (Pelagic Cormorant, Pigeon Guillemont), San Pedro Rock (Pigeon Guillemont).
***Marine Mammal Rookeries**:* None
***Marine Mammal Haulouts**:* Largest south of Miramontes Point, Bean Hollow State Beach, north of Bolsa Point, and reefs west of Half Moon Bay.

10.5.2 Land-Sea Interactions

***Coastal watersheds**:* San Mateo, Big Basin
***Major rivers**:* San Gregorio Creek, Pescadero Creek, Butano Creek,
***Anadramous fish streams**:* Denniston Creek (steelhead), Frenchman's Creek (steelhead), Tunitas Creek (steelhead), San Gregorio Creek (steelhead), Pomponio Creek (steelhead), Pescadero Creek (steelhead, coho), Butano Creek (steelhead).
***Hardened shoreline**:* Devils Slide (riprap), Half Moon Bay (extensive jetties, riprap, seawall), South of Pescadero Creek (riprap).
***Impaired water bodies**:* Pacific Ocean at Fitzgerald Marine Reserve (coliform), San Vicente Creek (coliform), Pacific Ocean at Pillar Point Beach (coliform), Pacific Ocean at Venice Beach (coliform), San Gregorio Creek (coliform, sediment), Pomponio Creek (coliform), Pescadero Creek (sediment), Butano Creek (sediment).
***Major point sources**:* Mid-Coastside Wastewater Treatment Facility

10.5.3 Socioeconomic Setting

***Counties**:* San Mateo
***Coastal towns/ports/harbors**:* Montara, Moss Beach, El Granada, Miramar, Half Moon Bay, Pillar Point Harbor, San Gregorio, Pescadero
***Public access areas, boat ramps, piers, etc**:* Montara State Beach (fishing), Pillar Point Harbor (disabled access, fishing, boating), East Breakwater (campground, fishing), Francis Beach (campground, disabled access, fishing), Martins Beach (fishing), San Gregorio State Beach (disabled access, fishing), Pomponio State Beach (disabled access, fishing), Pigeon Point Lighthouse Hostel (fishing).
***Important areas for commercial fisheries**:* To be determined.
***Important areas for consumptive recreational use**:* To be determined.
***Important areas for non-consumptive recreational use**:* To be determined.

10.5.4 Research and Monitoring

Research institutions: None
Existing monitoring sites: Fitzgerald Marine Reserve (PISCO intertidal), Pescadero Creek (CENCOOS), Pigeon Point (PISCO intertidal)

10.5.5 Existing MPAs, Marine Managed Areas, and Coastal Protected Areas

***Existing state MPAs**:* James V. Fitzgerald SMP (allows recreational take of some finfish and invertebrates)
***RCAs and other fish closures**:* No overlap with RCA
***Other marine managed areas**: Monterey Bay NMS*
***Coastal protected areas**:* Gray Whale Cove State Beach, Montara State Beach, San Francisco State Fish and Game Refuge, Half Moon Bay State Beach, San Gregorio State Beach, Pomponio State Beach, Pescadero State Beach, Pescadero Marsh Natural Preserve, Bean Hollow State Beach, Pescadero Creek County Park, Portola State Park, Butano State Park, Pigeon Point Light Station State Historic Park

10.5.6 Other Issues
To be determined.

10.6 Farallon Islands (Subregion 6)

Subregion 6 is the smallest of the subregions and covers 94.3 mi^2 and 7.4 miles of coastline surrounding the North, Middle, West End and Southeast Farallon Islands. The islands are located 28 miles west of the Golden Gate and 20 miles south of Point Reyes and oriented in a northwest to southeast, eight mile long line. The continental shelf is shallow to the east of the islands and drops steeply to the west of the islands. Prominent coastal features include Southeast Farallon Island, Maintop Island, Seal Rock, Middle Farallon, North Farallon, Noonday Rock, and the Farallon Lighthouse.

10.6.1 Ecological Setting

***Shoreline**:* Rocky Islands in an upwelling region.
***Estuaries**:* None.
***Seagrass**:* None mapped
Kelp: None mapped.
***Rock/Sand Bottom**:* Several rocky reefs including Fanny and Hurst Shoal. Most rock in this subregion is concentrated around the Southeast, Middle, and North Farallon Isalnds, as well as Noon Day Rock.
***Depth Zones**:* Mostly hard and soft bottom in the 30-100 m depth range with some mostly hard bottom in the 0-30 m range and the only significant, though still small, area of soft bottom in the 100-200 m range. No areas deeper than 200 m.
***Oceanographic Habitats**:* Major upwelling center at Point Reyes, with upwelled water advected south to the Gulf of the Farallones.
***Seabird Colonies**:* North Farallon Island (Common Murre, Brandt's Cormorant), Southeastern Farallon Island (Leach's Storm Petrel, Ashy Storm Petrel, Brandt's Cormorant, Double-Crested Cormorant, Pelagic Cormorant, Western Gull, Pigeon Guillemont, Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin, Fork-Tailed Storm Petrel)
***Marine Mammal Rookeries**:* North Farallon Island (Steller Sea Lion), Southeast Farallon Island (Steller Sea Lion (large), Northern Fur Seal, Elephant Seal)
***Marine Mammal Haulouts**:* Major haulouts on Southeastern Farallon and other haulouts on North Farallon.

10.6.2 Land-Sea Interactions

Coastal watersheds: Farallon Islands
***Major rivers**:* None
Anadramous fish streams: None
Hardened shoreline: None
Impaired water bodies: None.
Major Point Sources: None mapped.

10.6.3 Socioeconomic Setting

***Counties**:* San Francisco
***Coastal towns/ports/harbors**:* None
***Public access areas, boat ramps, piers, etc**:* None
***Important areas for commercial fisheries**:* To be determined.
***Important areas for consumptive recreational use**:* To be determined.
***Important areas for non-consumptive recreational use**:* To be determined.

10.6.4 Research and Monitoring

***Research institutions**:*
***Existing monitoring sites**:* Southeast Farallon (PISCO intertidal, CENCOOS)

10.6.5 Existing MPAs, Marine Managed Areas, and Coastal Protected Areas

***Existing state MPAs**:* Farallon Islands SMCA (some spatial closures from March to April)
***RCAs and other fish closures**:* Some overlap with RCA (60.1 sq mi)
***Other marine managed areas**:* Gulf of the Farallones NMS.
***Coastal protected areas**:* Farallon Islands National Wildlife Refuge, Farallon Islands State Game Refuge

10.6.6 Other Issues
To be determined.

11.0 Conclusion

The north central coast study region is the second region to begin implementation of the MLPA planning process and builds on lessons learned during the central coast pilot project. The draft regional profile summarizes and provides background information on the biological, oceanographic, socioeconomic and governance aspects of the region and draws upon suggestions and information provided by regional stakeholders and the SAT. The profile serves as a foundation for evaluating existing MPAs and describing alternatives of potential new MPAs, and identifying needs for additional data and information.

The MLPA has a number of goals that includes conservation of biodiversity and health of marine ecosystems, recovery of depleted marine populations, protection of representative and unique habitats for their intrinsic value, and improvement of recreational, educational, and study opportunities. The north central coast study region is one of the most biologically productive regions in the world. Furthermore, California's marine and coastal environments form part of the State's identity and support important economies that depend on healthy ocean resources, such as fisheries and coastal tourism.

In summary, the north central coast study region has many important and unique features including:

- Globally rare and significant upwelling-driven system that supports high marine biodiversity (plankton, invertebrates fish, marine mammals, seabirds) in open waters of the Gulf of the Farallones
- Important kelp forests and rocky reefs and associated fish assemblages (such as many species of rockfish)
- Regionally important estuaries (Tomales Bay, Drakes Estero, Bolinas Lagoon) and the mouth of the San Francisco Bay (the largest estuary on the west coast)
- Monterey Bay National Marine Sanctuary, Gulf of the Farallones National Marine Sanctuary, Point Reyes National Seashore, and the Golden Gate National Recreation Area
- Rich and productive fisheries that have supported coastal communities and provided fresh seafood to the region and the world
- Renown as a fishing, kayaking, and whale-watching and wildlife viewing destination where marine recreational activities help to support coastal tourism and coastal communities
- An abundance of marine research and educational institutions whose staff have explored and studied the region and helped to raise public awareness about marine biology

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