California Marine Life Protection Act (MLPA) Initiative
Regional Profile of the Central Coast Study Region
(Pigeon Point to Point Conception, CA)

September 19, 2005 (v.3.0)

INSIDE COVER MEMO:

This Final Regional Profile of the Central Coast Study Region (Pigeon Point to Point Conception, CA) provides information to support the implementation of the Marine Life Protection Act in this region. In addition to this document, the Regional Profile includes spatial data layers posted on the MLPA Internet Mapping Service (IMS) site (http://maps.msi.ucsb.edu/mlpa) and maps posted on the MLPA website (http://www.dfg.ca.gov/mrd/mlpa/draftdocuments.html).

A draft of the Regional Profile was provided to the Central Coast Regional Stakeholder Group on June 1, 2005; a draft final version was provided to them on August 1, 2005. Verbal and written comments were received from the stakeholders and addressed to the extent possible in this final version. This final profile was reviewed by members of the MLPA Science Advisory Team.

The MLPA Initiative and CDFG staff are compiling and developing additional data layers and conducting GIS analyses. All of the spatial data layers will eventually be posted on the MLPA IMS site. In addition, new research contracts have been initiated to collect additional data. These include:

- An assessment of patterns of non-consumptive use in the Central California Coast (C. LaFranchi and M. Tamanaha; results provided in Appendix VI)
- A refinement of selected commercial fishing data through interviews to apportion historic effort to microblocks (Ecotrust; results pending and will be provided as Appendix VII)

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Executive Summary

In 1999, the Governor of California signed the Marine Life Protection Act (MLPA) mandating a statewide network of Marine Protected Areas (MPAs) by 2011. 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, which aims to resume implementation of the MLPA. Among other actions, the MLPA Initiative established the MLPA Blue Ribbon Task Force, a Science Advisory Team (SAT), a statewide stakeholder interest group, and an MLPA Initiative staff.

The MLPA will be implemented through a series of regional processes throughout the state, beginning with the Central Coast study region which extends from Pigeon Point (San Mateo County) south to Point Conception (Santa Barbara County), California.

The MLPA Central Coast Regional Profile provides background information and data on the biological, oceanographic, socioeconomic, and governance characteristics of the Central Coast study region. This profile is intended to assist the Central Coast Regional Stakeholder Group (CCRSG) in developing regional objectives, evaluating existing marine protected areas (MPA) within the central coast study region, and developing alternative proposals for MPAs.

The best readily available data is being compiled for use in the Central Coast MPA planning process. All data in spatial Geographic Information System (GIS) format is being housed in a new California Marine Geodatabase at the University of California, Santa Barbara (see the Internet Mapping Service site at http://maps.msi.ucsb.edu/mlpa). 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.

The CCRSG adopted Central Coast regional goals at its second meeting on July 7, 2005 in Morro Bay. The profile and associated information and spatial data provide a key link between the regional goals and the design of appropriate MPAs to meet those goals. The regional goals and sections of the profile that provide relevant information to address those goals and develop objectives are summarized in the table below and the following sections:

Regional Goal	**Sections of the Regional Profile**
Goal 1: To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems	Regional Description; Ecological Setting; Existing MPAs and Coastal Protected Areas; App. II – Regionally Important Species for the MLPA; Maps 1-5
Goal 2: To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted	Ecological Setting; Existing MPAs and Coastal Protected Areas; App. II-IV; Maps 1-5, 8-9
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	Regional Description; Land-Sea Interactions; Socioeconomic Setting; Academic Institutions, Research, Public Outreach, and Education; Existing MPAs and Coastal Protected Areas; Maps 2-3, 8-12
Goal 4: To protect marine natural heritage, including protection of representative and unique marine life habitats in central California waters for their intrinsic value	Regional Description; Ecological Setting; Existing MPAs and Coastal Protected Areas; Maps 1-4
Goal 5: To ensure that central California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines	Land-Sea Interactions; Jurisdiction and Management, Existing MPAs and Coastal Protected Areas; App. III-IV; Maps 1, 6, 7,12,13, 14
Goal 6: To ensure that the Central Coast's MPAs are designed and managed, to the extent possible, as a component of a statewide network	Existing MPAs and Coastal Protected Areas; Gap Analysis; App. II; Maps 1, 2,3,13

Regional Description: The study region encompasses approximately 860 square nautical miles and extends from the shoreline (mean high tide) to a maximum depth of approximately 1,475 meters (806 fm) in Monterey Submarine Canyon. The study region includes a broad array of habitats from intertidal to continental shelf and slope and submarine canyons that bisect the continental margin.

The Central Coast study region has many unique features (**relevant to Goals 1, 3, and 4**) including:

- Globally rare and significant upwelling-driven system that supports high marine biodiversity in open waters (plankton, invertebrates fish, marine mammals, seabirds).
- Globally unique giant kelp forests and associated fish assemblages (such as many species of rockfish).
- Unusual abundance of large submarine canyons in near-shore waters and high bathymetric complexity in the northern part of the region, which bring deep sea and near-shore assemblages in close proximity.
- Rare and regionally important estuaries (Elkhorn Slough and Morro Bay).
- Rich and productive fisheries that have supported coastal communities and provided fresh seafood to the region and the world.

- Renown as a diving, kayaking, fishing, and whale-watching destination; marine recreational activities help to support coastal tourism and coastal communities.
- An unusual abundance of marine research and educational institutions whose staff have explored and studied the region and helped to raise public awareness about marine biology.

Ecological Setting: The region is characterized as having high biodiversity, with 26 species of marine mammals, 94 species of seabirds, 345 species of fish, 4 species of sea turtles, 31 phyla (thousands of species) of invertebrates and more than 450 species of marine algae. The biodiversity of this marine region was one of the driving factors in the designation of the Monterey Bay National Marine Sanctuary in 1992, and for the founding of the Monterey Bay Aquarium in 1978.

All of the habitats listed in the MLPA (except seamounts) or recommended by the SAT for inclusion in MPA siting are found in the study region. For all of these habitats, there are some mapped data that will be available for identifying representative habitats and unique combinations of habitats (**Goals 1 and 4)**.

- Intertidal zones include sandy beaches, rocky shores, coastal marsh, and tidal flats. Some intertidal areas along the Big Sur coast are inaccessible.
- Estuaries, with their associated tidal flat, coastal marsh, eelgrass, and open water habitats are relatively rare in the study region. There are two larger estuaries: Morro Bay, which is a National Estuary Program site, and Elkhorn Slough, which is a National Estuarine Research Reserve. There are numerous small estuaries where coastal streams meet the sea; some of these are still populated by threatened coho salmon and steelhead trout.
- Eelgrass beds are found in Morro Bay and Elkhorn Slough and cover a relatively small area; however, eelgrass beds are very important as nursery grounds for fish and invertebrates and foraging areas for migratory shorebirds and waterfowl in the region. Surfgrass, which fringes the open coast, is found along more than a third of the study region in the shallow subtidal zone.
- Two types of kelp forests, dominated by giant kelp or bull kelp, are found in the Central Coast region in areas where rocky substrata allow them to attach; each type of kelp forest has different assemblages of species associated with it. Giant kelp forests dominate south of Davenport, while bull kelp dominates north of Davenport. Kelp beds have been mapped at a fine-scale resolution in 4 annual surveys (1989, 1999, 2002, 2003). Kelp beds are more persistent in some areas than others due to changes in climatic and environmental conditions over time.
- Hard substrata habitats (rocky reefs) are much less common than soft bottom habitats in the region in all depth zones (4-20% of the region for hard substrata in different depth zones versus 80-95% for soft substrata based on coarse-scale data). Coarse-scale extrapolated data for substratum type is available for the entire study region, but this data does not reflect actual mapping of many near-shore areas in state waters and tends to underestimate the amount of rocky habitat. Higher resolution (“fine-scale”)

substrata data is available for portions of the study region, and in those areas provides a much more accurate representation of the amount of hard and soft substrata.

- Underwater pinnacles are rocky cones or outcrops that can be important as areas where fish and other species aggregate. Underwater pinnacles have not been mapped, but an approximation of their location based on GIS analysis is available for parts of the study region where fine-scale seafloor habitat mapping has been completed.
- Biogenic habitats such as kelp forests, seagrass beds, and cold water corals and sponges provide important structure and habitat for many other species.
- Persistent oceanographic habitats are important pelagic habitats. Upwelling centers have been mapped and occur at major headlands (Davenport, Pt. Sur, along the Big Sur coast, and Point Conception). In the upwelling shadow or lee of those headlands, warmer water retention areas can develop; these retention areas have not been mapped. Freshwater plumes, also not mapped, are found near the mouths of major rivers such as the Pajaro, Salinas, and Santa Maria.

The following is a partial list of types of areas that have regional biodiversity significance **(Goals 1, 2 and 4**):

- Areas where numerous habitats are found in close proximity and areas with unique combinations of habitats
- Large estuaries (Elkhorn Slough and Morro Bay estuaries) with eelgrass beds, tidal flats, and coastal marsh (Map 2a and 2b)
- Small estuaries with presence of coho or steelhead populations (Maps 2a, 2b show estuaries; Maps 5a and b show salmonid outets)
- Submarine canyon heads and large submarine canyons, including those that are either soft or hard substrata-dominated (Map 3a, 3b, 3c, 3d)
- Marine areas off headlands with adjacent upwelling centers, epecially those with kelp forests and rocky reefs in retention areas in the lee of the upwelling center
- Persistent kelp beds (Map 2a and 2b) and nearshore rocky reefs (Map 3a, 3b, 3c, 3d)
- Areas of high bathymetric complexity which provide topographic relief and a variety of habitats in close proximity
- Shallow and deep pinnacles are areas where fish aggregate (Map 3c, 3d)
- Rocky subtrata in all depth zones, since rocky habitat is much less rare than soft-bottom habitat (Maps 3a, 3b, 3c, 3d)
- Shelf-slope break (100-200m) where the continental shelf slopes downward is an area with high biodiversity (Map 3a, 3b, 3c, 3d show depth contours)
- Rocky intertidal shores, especially wave-cut rocky platforms (which provide habitat at diverse tidal elevations) and rare sheltered rocky shores (Maps 2a and 2b)
- Seabird colonies and marine mammal rookeries and haulouts (Maps 5a and 5b)
- Areas of high fish or seabird diversity and/or density as identified by the NOAA Biogeographic Assessment (Maps 5a and 5b; Top 20th percentile diversity and density for fish and seabirds; NOAA 2004)

To identify species or populations important for MPA planning **(Goal 2**) the profile includes:

- Regionally important species that are likely to benefit from MPAs are listed in Appendix II (These are being reviewed by the Science Advisory Team).
- Depleted or over-fished species are described in Section 3.2.2 and include red and black abalone, 7 species of groundfish, and several other species that are of concern
- Special status species such as coho salmon, steelhead trout, sea otters, pinnipeds, cetaceans, and seabirds found in the region

Land – Sea Interaction: describes the ecological linkages between the terrestrial, aquatic, and marine environments that will help in the siting of MPAs and to identify areas with minimal disturbance **(Goal 3**) or to develop management strategies for existing or new MPAs (**Goal 5).** There are 11 major watersheds in the study region; coastal basins are categorized and a map showing percent urban area, percent agriculture, and percent road density (linear km of road/hectares) is provided to show the coastal areas with the greatest human "footprint." There is a section on areas of water quality concern including a map of impaired water bodies, permitted pollution discharge points, a list of beach advisories and closings, and a list of water quality programs in the region. Since there is so much water quality information available, web links were used to provide direct access to other resources.

Socioeconomic Setting: This section includes a description of the five coastal counties in the study region (San Mateo, Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara) and describes the economies that depend on healthy ocean resources. This section includes ocean industry data, tourism data, and commercial and recreational fishery information, as well as preliminary information on non-consumptive use. This general information will be useful in assessing potential impacts of MPA siting alternatives. Information on recreational use and access points will help to identify locations with recreational opportunities **(Goal 3**).

Academic Institutions, Research, Public Outreach, and Education: There are over 40 institutions with marine research or educational objectives in the region The locations of major research institutions, scientific collecting sites, educational sites, and monitoring stations from research programs (PISCO, LIMPET, MARINe, CRANE, and others) represent potential opportunities for future research and education associated with MPAs **(Goal 3**).

Jurisdiction and Management : There are numerous federal, state, and local agencies and programs that can be linked to MPAs for collaboration on effective management and enforcement (**Goal 5).**

Existing MPAs and Protected Areas: There are 12 existing state MPAs in the region, and a special invertebrate closure at Año Nuevo. Existing state MPAs vary in size and comprise 3.8% of the study region in their total area. A preliminary evaluation of each existing MPAs, included as Appendix V, will be refined to further evaluate the role of existing MPAs in meeting regional goals (**Goal 1-6**) and objectives.

Gap Analysis. A gap analysis will be conducted evaluate the approximate amount of each habitat present in existing state MPAs in the region. This information will be included in an "Eavaluation of Existing Central Coast MPA" and will help to identify their potential role in a regional network of MPAs (**Goal 6**).

Conclusions: The 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.

The Central Coast study region is the first region to begin implementation of the MLPA planning process. The regional profile summarizes and provides background information on the biological, oceanographic, socioeconomic and governance aspects and draws upon suggestions and information provided by regional stakeholders and the Science Advisory Team. The regional profile (and associated spatial database) provides key information for the development of regional objectives and alternative MPA siting designs. The best readily available data is being compiled for use in the Central Coast MPA planning process. This regional profile provides an overview of some of that data. All data in spatial Geographic Information System (GIS) format is being housed in a new 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.

1.0 Introduction

In 1999 the Governor of California signed the Marine Life Protection Act (MLPA). The MLPA mandates establishment of a statewide network of marine protected areas (MPAs). 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, which aims to resume implementation of the MLPA. Among other actions, the MLPA Initiative established the MLPA Blue Ribbon Task Force, a Science Advisory Team (SAT), a statewide stakeholder interest group, and an MLPA Initiative staff.

Between August 2004 and December 2006 five key objectives must be achieved by the MLPA Initiative: (1) develop a draft Master Plan Framework developed, (2) develop alternative proposals for MPAs in the Central Coast study region, (3) draft recommendations on long-term funding sources for MPA implementation and management, (4) draft recommendations to increase the coordination between state and federal agencies with the authority to manage marine resources, and (5) secure agreement among state agencies to complete implementation of the Master Plan by 2011 (Memorandum of Understanding, August 2004). The draft Master Plan Framework is complete and being reviewed by the Fish and Game Commission (CDFG 2005a). The process for the regional MPA planning has begun in the Central Coast study region. A Central Coast Regional Stakeholder Group (CCRSG) was assembled and convened their first meetings on June 8-9, 2005 in Monterey and July 7-8, 2005 in Morro Bay. This regional profile is being prepared to facilitate the regional MPA planning process.

The Central Coast Regional Profile provides background information on the biological, oceanographic, socioeconomic, and governance setting for the Central Coast study region. The Central Coast study region extends from Pigeon Point (San Mateo County) to Point Conception (Santa Barbara County), California. This regional profile consists of background information spanning a wide variety of disciplines and is intended to assist the Regional Stakeholder Group in developing regional goals and objectives, evaluating existing marine protected areas (MPA) within the Central Coast study region, and developing alternative proposals for MPAs. The information is provided in the form of text summaries, tables, selected maps (with links to other computer-accessible maps), and technical appendices.

The Master Plan Framework (CDFG, 2005a) requires the identification of regional goals and objectives; the regional profile helps to provide the context to develop those goals and objectives. The Central Coast regional goals (based on the statewide MLPA goals) adopted by the CCRSG on July 7, 2005 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 central California waters for their intrinsic value.
- Goal 5: To ensure that central 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 Central Coast's MPAs are designed and managed, to the extent possible, as a component of a statewide network.

The best readily available data is being compiled for use in the Central Coast MPA planning process. This regional profile provides an overview of some of that data. All data in a spatial Geographic Information System (GIS) format is being housed in a new 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 Description of the Study Region

The Central Coast study region covers the state waters extending from a line due west of Pigeon Point to a line extending due west from Pt. Conception (see Map 1). The coastline covers a straight-line distance of 210 nautical miles (nmi), but it is actually much longer due to the undulations of the coastline (over 300 nmi). In general, state waters extend from the high tide line 3 nmi seaward. However, in Monterey Bay, by definition, state waters extend 3 nmi seaward of a line from Pt. Santa Cruz (Santa Cruz County) to Pt. Pinos (Monterey County). This line administratively defines Monterey Bay; in this area, state waters extend as far as 12.4 nmi from shore.

The study region encompasses approximately 866 square nmi and extends from the shoreline (mean high tide) to a maximum depth of approximately 1475 m (806 fm) in Monterey Submarine Canyon. The study region includes a broad array of habitats from intertidal to continental shelf and slope, and submarine canyons that bisect the continental margin. The edge of the continental shelf is called the shelf-slope break where it transitions downward to become the continental slope, which occurs at approximately 200 m. The continental shelf varies in width along the study region from 0.8 nmi at its narrowest location to 24 nmi at its widest location (where it extends beyond state waters). State waters within the study region are dominated by shelf habitat (771 nmi^2), with a lesser amount of slope habitat (88 nmi^2). While much of the marine substratum in the region is soft (sand or mud) there are rocky reefs, pinnacles, and outcrops that are very important for marine biodiversity. The assemblages on rocky substrata differ based on the underlying geology and there are unique granitic outcrops which, within state waters, occur only from the Monterey Peninsula to Pt. Sur.

Another unique feature of the region is the presence within state waters of large submarine canyons which extend into the near-shore, resulting in deep sea communities coming in close proximity to near-shore communities. These near-shore canyon heads occur in the Monterey Bay area and further south along the Big Sur coast, but not in the southern portion of the study region. The submarine canyons along the Central Coast Study Region are geologically active and the high pressure under the sea floor may force fluids and gases through the seabed, creating cold seeps which support highly productive communities of bacteria, chemosynthetic clams and worms. The canyons create large areas of high bathymetric complexity that support high biodiversity. South of Monterey Peninsula, the Big Sur Coast is world renowned for its steep cliffs and rocky headlands. The continental shelf off Big Sur is narrow and highly dissected. Farther south, from Morro Bay to Point Conception, the continental shelf is broader and characterized by extensive soft-bottom habitats.

The Central Coast study region is a portion of the larger California Current marine ecosystem. The California Current is considered globally important for biodiversity because of its high productivity and the large numbers of species it supports (WWF, 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

these Eastern Boundary Currents and is characterized by seasonal upwelling of cold nutrient rich water, periodic El Niño - Southern Oscillation (ENSO) climatic events, and decadal climatic shifts (US GLOBEC, 1994). The waters are rich in nutrients that fuel highly productive and diverse ecosystems, such as the globally significant giant kelp forests, with large numbers of invertebrates, fish, seabirds, and marine mammals that are dependent on this seasonal abundance of prey resources. Giant kelp forests, such as those found along the coast of California, are not found anywhere else in the world; the Central Coast has some of the most extensive giant kelp forests in California. At the southern end of the study region, the large upwelling center and convergence of currents at Point Conception mark an important biogeographic boundary along the West Coast.

The study region has several large rivers (Salinas, Santa Maria, and Santa Ynez) and numerous small coastal streams. Monterey Bay, at 23 nmi across, is the largest embayment in the study region. Estuaries are relatively rare in the region; Morro Bay and Elkhorn Slough are the largest estuaries in the study region. Elkhorn Slough supports a diverse and abundant biota, with over 70 species of fish, and at least 265 bird species, as well as many invertebrates, sea otters, sea lions, and harbor porpoises. Morro Bay is located on the Pacific Flyway and supports numerous migrating bird species. The unique shallow water eelgrass beds and wetlands in large and small estuaries are nursery grounds for many invertebrates and fish.

The study region abuts five coastal California counties: San Mateo, Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara. The marine resources of the region support commercial and recreational fisheries and many non-consumptive economic activities such as coastal tourism and recreation. The Monterey Bay is renowned as a dive destination and people come from all over the world to visit the Monterey Bay Aquarium. There are more than 40 institutions that conduct marine research or education in the study region.

Oblique photos taken in a helicopter of the entire Central California coastline are available through the California Coastal Records Project (http:www.californiacoastline.org). This photographic database documents the California coastline and shows intertidal habitats and coastal development.

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 not overlapping exactly with 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. One indicator of the high level of biodiversity along the central California coast is that 80% of the seaweed species found between Alaska and Baja California occur on the Monterey Peninsula (Monterey Bay Aquarium Foundation 1999). The biodiversity of this marine region was one of the driving factors in the designation of the Monterey Bay National Marine Sanctuary in 1992, and for the founding of the Monterey Bay Aquarium in 1978.

The study region, particularly the area included in the MBNMS, has been relatively well studied and its biodiversity and ecological components described in many documents. This profile drew from those extensive efforts, and they should be used to complement and expand upon the information in this regional profile. The following is a partial list of documents characterizing the region's ecology and summarizing relevant scientific research from a variety of orignial sources:

- *The Natural History of the Monterey Bay* (1999). Monterey Bay National Marine Sanctuary and the Monterey Bay Aquarium Foundation.
- *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).
- *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/).

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. Seamounts are not found in state

waters. The other seven habitats are found within the Central Coast study region. In addition, the Science Advisory Team (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). The SAT identified two different types of kelp forests that occur in the Central Coast region, *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 SAT also identified underlying geology (eg. granitic versus sandstone or shale substrata) as important in structuring the composition of communities on rocky reefs and rocky intertidal zones. Biogenic habitats such as kelp forests, seagrass beds, and cold water corals and sponges provide important structure and habitat for many other species.

Regional habitats are described below and have been mapped, to the extent possible, given readily available information (Maps 2, 3, and 4). 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; inclusion of S.F. 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 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
Shoreline[1] (Length, nmi)	371.8		1211.5		2134.4		NOAA-ESI 2002 / Does not include SF Bay
Intertidal: Rocky shores	181.8	48.9	468.6	38.7	712.8	33.4	NOAA-ESI 2002 / Does not include SF Bay
Intertidal: Sandy beaches	194.4	52.28	594.3	49.06	976.7	45.76	NOAA-ESI 2002 / Does not include SF Bay
Intertidal: Coastal marsh	31.7	8.54	185.8	15.3	241.8	11.3	NOAA-ESI 2002 / Does not include SF Bay
Intertidal: Tidal Flats	20.4	5.49	181.2	15.0	211.7	9.9	NOAA-ESI 2002 / Does not include SF Bay
Hard and Soft Bottom Habitats and Canyon (Area, nmi^2)	859.6		2180.9		3961.2		Total area includes all subtidal habitats mapped by Greene et al 2004
Coarse-scale Rocky Habitat 0-30m	35.2	4.1	88.9	4.1	119.2	3.0	Greene et al 2004 / Underestimates amount in state waters
Coarse-scale Rocky Habitat 30-100m	20.2	2.4	69.2	3.2	133.3	3.4	Greene et al 2004 / Underestimates amount in state waters
Coarse-scale Rocky Habitat 100-200m	10.5	1.2	10.5	0.5	79.4	2.0	Greene et al 2004 / Underestimates amount in state waters
Coarse-scale Rocky Habitat >200m	12.2	1.4	12.2	0.6	82.2	2.1	Greene et al 2004 / Underestimates amount in state waters
Total Coarse-	78.2	9.1	180.8	8.3	414.1	10.5	Greene et al

scale Rocky Habitat (all depths)							2004 / Underestimates amount in state waters
Coarse-scale Soft Bottom Habitat 0-30m	222.1	25.8	741.1	34.0	1153.7	29.1	Greene et al 2004 / Over estimates amount in state waters
Coarse-scale Soft Bottom Habitat 30-100m	434.8	50.6	1069.8	49.1	1729.8	43.7	Greene et al 2004 / Overestimates amount in state waters
Coarse-scale Soft Bottom Habitat 100-200m	44.1	5.1	103.5	4.7	219.7	5.6	2004 / Over estimates amount in state waters
Coarse-scale Soft Bottom Habitat >200m	79.7	9.3	83.0	3.8	338.5	8.6	2004 / Over estimates amount in state waters
Total Coarse-Scale Soft Bottom Habitat (all depths)	780.7	90.8	1997.4	91.6	3441.8	86.9	2004 / Over estimates amount in state waters
Canyon 0-30m	0.4	0.1	0.4	0.02	1.0	0.02	Greene et al 2004
Canyon 30-100m	3.3	0.4	3.6	0.2	6.4	0.2	Greene et al 2004
Canyon 100-200m	4.6	0.5	6.6	0.3	11.5	0.3	Greene et al 2004
Canyon >200m	32.3	3.8	35.4	1.6	51.6	1.3	Greene et al 2004
Total Canyon (all depths)	40.6	4.7	46.0	2.1	70.4	1.8	Greene et al 2004
Underwater Pinnacles	NA		NA		NA		
Estuarine and Nearshore Habitats (Area, nmi^2)	868.4		2191.9		3976.2		Total area includes subtidal area and estuaries
Kelp 2003	7.2	0.8	8.2	0.4	28.1	0.7	CDFG 2003 aerial survey
Kelp 2002	9.5	1.1	11.1	0.5	20.8	0.5	CDFG 2002 aerial survey
Kelp 1999	1.9	0.2	4.9	0.2	13.1	0.3	CDFG 1999 aerial survey
Kelp 1989	13.6	1.6	17.9	0.8	30.6	0.8	CDFG 1989 aerial survey

Estuary	6.9	0.8	53.22	2.4	84.61	2.1	National Wetlands Inventory; CNDDB; NOAA-ESI 2002; USGS Topos
Seagrass: Surfgrass (Length, nmi, % of shoreline)	140.0	37.7	NA		NA		
Seagrass: Eelgrass	0.8	0.1	10.2	0.5	23.8	0.6	Morro Bay NEP; Elkhorn Slough Foundation; CDFG Tomales Bay data; Humboldt GIS Atlas
Oceanographic Habitats							
Upwelling center[2]	3 major centers		6 major centers		6 major centers		NOAA Coastwatch Sea Surface Temperature
Retention area	NA		NA		NA		
Freshwater plume	NA		NA		NA		

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.

3.1.1 Depth Categories

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

- Intertidal
- Intertidal to 30 m (0 to 16 fm)
- 30 to 100 m (16 to 55 fm)
- 100 to 200 m (55 to 109 fm)
- 200 m and deeper (109 fm and deeper)

The intertidal zone includes habitats such as sandy beaches, rocky shores, tidal flats, some seagrasses, 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 extent and percentages of the subtidal depth ranges within the study region are provided in Table 2, based on CDFG 2005 creation of depth zones using Geodas 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 Central Coast Study Region

Depth Zone	Area (nmi^2)	Percentage of Study Region
Intertidal to 30 m (0 to 16 fm)	258.0	30.0%
30 to 100 m (16 to 55 fm)	455.0	52.9%
100 to 200 m (55 to 109 fm)	54.7	6.4%
200 m and deeper (109 fm and deeper)	91.9	10.7%

Bathymetric complexity (a measure of rugosity) is high in the portion of the study region where the large submarine canyon complexes enter state waters (Monterey Canyon, Soquel Canyon, Carmel Canyon, Mill Creek and Partington Canyon), and there are numerous rocky reefs and pinnacles. The continental shelf in the study region is relatively wide in the northern (Santa Cruz to Pigeon Point) and southern ends (Morro Bay to Pt. Conception) and relatively narrow along the Big Sur coast. Deep water habitats occur in state waters where there is a narrow continental shelf (such as along the Big Sur coast) and/or where canyon heads occur near shore (Soquel, Monterey, Carmel, Partington, Mill Creek, and others). In these areas, a wide range of depth zones (and associated species assemblages) can be found in close proximity (NOAA 2004).

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 (see Maps 2a and 2b). Much of the intertidal zone extending approximately 40 miles from Cooper Pt. (just south of the Big Sur River), to Ragged Point (north of Piedras Blancas) is inaccessible from shore due to the presence of steep, rugged cliffs.

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 effect the ecological communities present (Foster et al., 1988). The following rocky shore types have been mapped in the Central Coast study region by NOAA for the Environmental Sensitivity Index (ESI) program in 2002 (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**: Same as above but with boulders at base of cliff. Exposed rocky cliffs w/ talus boulder base are a relatively rare rocky intertidal habitat type in the Central Coast (Table 3).
- **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 very rare in central California (Table 3); they are typically found inside bays or estuaries.

Significant expanses of continuous sandy shores areas occur along Monterey Bay, Estero Bay, and San Luis Obispo Bay, with shorter stretches of sandy beaches and pocket beaches along the Big Sur coast. Sandy beach communities are structured in large part by grain size, 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 Salinas, Pajaro, and Santa Maria River mouths.

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 haulout on isolated beaches and sands spits. Sand dollars, worms, clams, crabs, surfperches, flatfishes, and other fishes live in the surf zone. Beach types in the Central Coast 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 Central California (Table 3).

Tidal flats and marshes occur primarily around the edges of bays and estuaries (e.g. Elkhorn Slough and Morro Bay). 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:

- **Coastal marsh**: 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. Exposed tidal flats are very rare in Central California (Table 3).
- **Sheltered tidal flats**: includes intertidal flats comprised of silt and clay (eg. 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, (371 nmi 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 (2002). Rocky shores and sandy beaches dominate the shoreline; marsh and tidal flat habitats are rare on the Central Coast. In addition, the Central Coast study region has a higher percentage of rocky shores and sandy beaches, and a lower percentage of coastal marsh and tidal flats, than the rest of the bioregion or the state (Table 1).

Table 3: Summary of the Linear Length and Percentage of Total Shoreline

Shore Type	Length in Region (nmi)	Percentage of Total Shoreline in Region
Exposed Rocky Cliffs	31.5	8.5
Exposed Rocky Cliff w/ Talus Boulder Base	19.5	5.2
Exposed Wavecut Rocky Platform	130.3	35.1
Sheltered Rocky Shore	0.5	0.1
Gravel Beach	27.2	7.3
Mixed Sand and Gravel Beach	30.4	8.2
Coarse-grained Sand Beach	25.9	7.0
Fine-Medium Grained Sand Beach	110.9	29.8
Coastal Marsh	31.7	8.5
Exposed Tidal Flats	3.0	0.8
Sheltered Tidal Flats	17.4	4.7
Riprap (man-made)	14.0	3.8
Seawall (man-made)	2.6	0.7
Total Shoreline Length in Study Region[1]	371.8	

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

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. Generally salinities in Central Coast estuaries are around 25 parts per thousand due to relatively low freshwater inputs in the region. 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 two relatively large permanent estuaries, Elkhorn Slough and Morro Bay, and many small estuaries or lagoons at the mouths of coastal rivers: San Lorenzo, Pajaro, Salinas, Carmel, Little Sur, Big Sur, Arroyo de la Cruz, Santa Ynez, and many others (Maps 2a and 2b). The aerial extent of estuaries in the Central Coast study region totals 6.9 nmi^2 or only 0.8% 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 (especially Monterey Bay / Elkhorn Slough, and Morro Bay) are an important part of the Pacific Flyway and host thousands of shorebirds and waterfowl on their migrations (Ramer, 1991). Anadramous species such as salmonids and lampreys must pass through estuaries on their migration pathways (Boesch and Turner, 1984). Steelhead in the 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.

Elkhorn Slough is an estuary of very high species richness and habitat (Caffrey et al. 2002). The combined marshes of Elkhorn and Moro Cojo Slough are the largest between San Francisco and Morro Bays at 4,182 acres (Elkhorn Slough Foundation, 2002). Elkhorn Slough is home to over 270 species of resident and migratory birds (Elkhorn Slough Foundation, 2002). Its communities include tidal sloughs, mudflats, salt and brackish marshes. The marsh provides important feeding and roosting habitat for la variety of migrant and resident birds, including two heron rookeries, a small breeding population of western snowy plovers, nesting pairs of golden eagles, white-tailed kites, and other species of raptors. Elkhorn Slough also serves as an important fish nursery and fish habitat (Barry et al 1996; Yoklavich et al. 2002; Allen et al. in press). The estuary functions as a filter and sponge for sediment and pollution from surrounding farms and other land uses and. This function is significant, because the mouth of Elkhorn Slough opens into the Monterey Submarine Canyon.

Morro Bay Estuary encompasses approximately 2300 acres of mudflats, open water habitat, and tidal wetlands (MBNEP, 2000). This estuary supports a unique ecosystem containing numerous plants and animals and habitats including open water and channels, subtidal and intertidal eelgrass, mudflats, coastal salt marsh, brackish marsh, freshwater marsh, and riparian woodland. These habitats support a number of special status species. The role of the estuary as a fish nursery is significant, particularly for flatfishes.

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 have been mapped in Morro Bay (Morro Bay National Estuary Program) and Elkhorn Slough (Elkhorn Slough National Estuarine Research Reserve) and cover less than 0.1% of the study region (Table 1). Total coverage of eelgrass beds in Morro Bay is approximately 0.8 nmi^2 and Elkhorn Slough is 0.025 nmi^2. (see Maps 2a and b). There is an extensive seagrass bed on the shale reef off Del Monte Beach, Monterey, but the current condition of this bed is not known and it has not been mapped (J.Pearse, pers.comm).

The eelgrass beds in Morro Bay are known as the largest and least impacted of any in central and southern California (MBNEP, 2000). These unique beds are productive and complex environments. The beds serve as spawning and nursery grounds for many species of fish, including English sole and California halibut. The density and diversity of benthic fauna are several times greater within the eelgrass beds than in other Morro Bay habitats (MBNEP, 2000). A vital community of epiphytic flora and fauna lives upon the thick foliage of the beds.

The beds function as a filter, which decontaminates the bay's water by providing a microbial environment. Furthermore, the beds moderate current and wave action, improving the water clarity and quality of Morro Bay by moderating suspended sediments and organic particles to settle.

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. In some areas, such as Soquel Point, surfgrass forms extensive beds (J.Pearse, pers.comm). The distribution of surfgrass along the Central Coast study region has been mapped as linear segments that total 141 nmi or 38% of the shoreline.

3.1.5 Kelp Forests

Kelp forests (also called kelp beds) within the study region are formed by two predominant canopy-forming brown macro-algae species: giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nereocystis lutkeana*). These two types of kelp forests differ in their biological productivity (giant kelp forests are more productive) and in their species assemblages and should be considered separate habitats (CDFG 2005a). 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 along much of the Central Coast study region where hard substrata is available in the nearshore. Extensive kelp beds are found around Point Sur and Lopez Point. The kelp forests in the study region were well mapped at fine-scale resolution in 1989, 1999, 2002, and 2003 based on aerial surveys by CDFG. Kelp abundance in the study region over the 4 survey years has ranged from 1.9 to 13.6 nmi^2 ; in some years, the Central Coast study region has almost half of the total statewide kelp amount (Table 1). In 2003, there were 7.2 nmi^2 of kelp bed in the Central Coast study region (see Maps 2a and 2b).

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 et al. 1985). California's giant kelp forests are globally unique and significant. Kelp forests, dominated by giant kelp, occur from Baja California (Mexico) up through central California (approximately Sand Hill Bluff area near Davenport) in near-shore waters with hard substrata where the kelp can attach. North of Davenport, bull kelp (*Nereocystis luetkeana*) becomes the dominant kelp. These two types of kelp beds harbor distinct ecological assemblages. In many parts of the Central Coast, especially exposed areas, mixed beds of giant kelp and bull kelp are found. Kelp beds are characterized by a high degree of spatial and temporal variability. Studies have shown that distribution and abundance of kelp beds and successional processes are effected 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, as well as juvenile bocaccio and yellowtail rockfish occur in the midwater kelp canopy (Allen et al, in press). 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, in press). The sea otter occurs throughout the study region and is considered a keystone species for its role in structuring kelp forest communities by preying on sea urchins and other macro invertebrates, including other herbivores.

Both giant kelp and bull kelp are included in the lists of species which may benefit from MPAs (Appendix I). However, the benefits are somewhat different than those afforded to fishes and invertebrates, and relate more to the role of kelp as a key component in the structure, function, and integrity of the nearshore rocky subtidal ecosystem, which occurs in many areas of the Central Coast. Unlike marine fishes and invertebrates, 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 (DFG 2001).

Inclusion of kelp beds within MPAs may not result in an increase in abundance of kelp adjacent to the MPAs. The rapid growth of kelp and existing regulations which limit the harvest of kelp to the upper fronds within 4 feet of the surface ensure rapid replenishment of the canopy if harvested. The harvest of kelp is prohibited within state marine reserves and state marine parks, but may be allowed within state marine conservation areas.

3.1.6 Sandy/Soft Bottoms

Soft bottom habitats are found in estuaries, along sand beaches, and on the continental shelf and slope throughout the region (Eittreim, 2002). The continental shelf and slope environments include soft bottom habitats in areas that range from flat expanses to slopes to deep submarine canyons. Soft bottom habitats lack the structural complexity and relief of hard-bottom substrata and are generally dominated by bottom dwelling invertebrates and fishes; assemblages differ with depth (Allen et al., in press; Johnson et al 2001). Squid spawning grounds occur in many of the near-shore sandy bottoms of the Central Coast study region; major spawning grounds occur in Monterey Bay and in the San Luis Obispo Bay area.

Soft bottom habitats can be highly dynamic in nature as sediments shift due to wave action, bottom currents, and geological processes. Many parts of the Big Sur coast are erosional, and landslides and slumps extend offshore in the nearshore waters. Many canyon heads are also alluvial in nature and dominated by shifting soft sediments.

Soft bottom habitats predominate over hard bottom habitats in all depth zones (Table 4, Maps 3a and 3b). 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, pers.comm). Soft-bottom habitats in different depth zones should be considered separate habitats (CDFG 2005a).

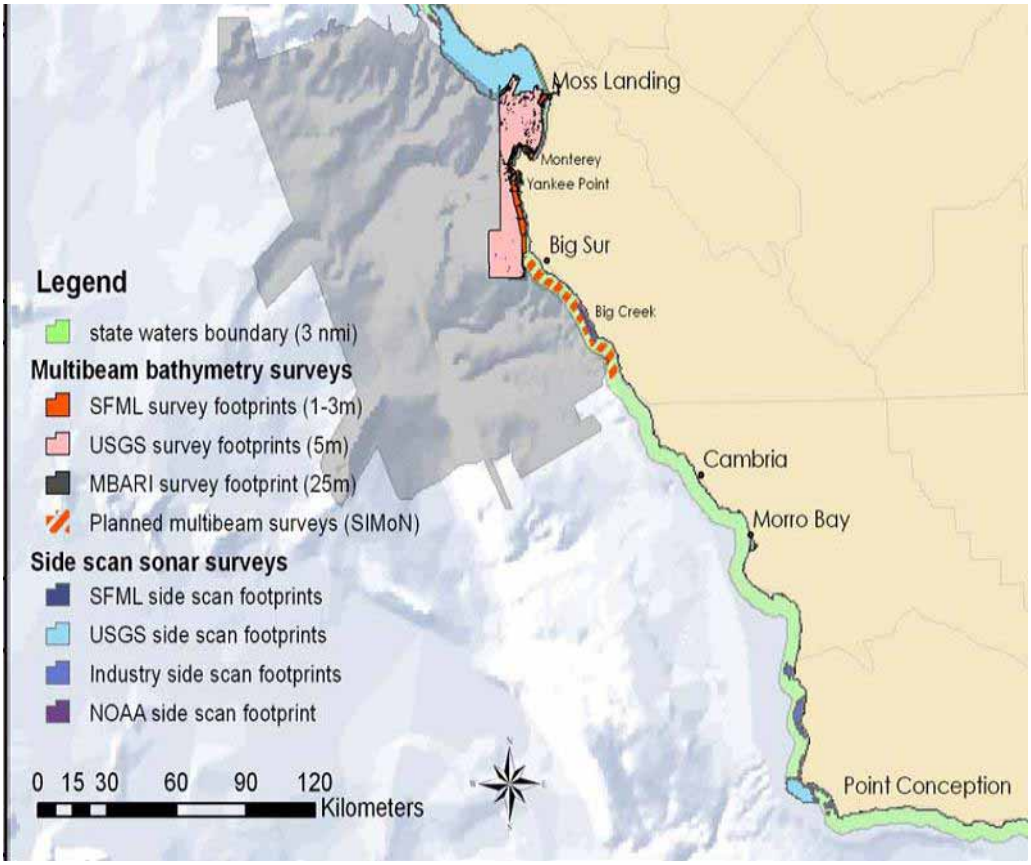
Spatial mapped data on hard and soft substrata are available for the entire study region at a coarse scale (1:250,000) based on data compiled by Greene et al (2004) for the *Fisheries Habitat Characterization of the California Continental Margin*. It is important to note that this coarse-scale habitat mapping includes very little data in near-shore state waters. Almost almost all of the substrata in state waters is represented as soft-bottom habitat, which is an over-representation of this habitat type, as rocky habitats are generally missed by this data set. Table 3 shows hard and soft bottom habitats by depth zone in the study region based on Greene et al. 2004 coarse scale data. These habitat amounts should be considered very approximate, as this coarse-scale data underestimates rocky habitat in state waters.

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

Depth Zone	Hard Substrata, nmi^2 (% of depth zone area)	Soft Substrata nmi^2 (% of depth zone area)
0-30m	35.2 (14%)	222.1 (86.1%)
30-100m	20.2 (4.4%)	434.8 (95.6%)
100-200m	10.5 (19.2%)	44.1 (80.1%)
>200m	12.2 (13.2%)	79.7 (86.7%)
Total	78.2 (9.1% of study region)	780.7 (90.8% of study region)

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

Figure 1: Map of areas within study region with fine-scale seafloor habitat mapping data available (R.Kvitek et al, CSUMB Seafloor Mapping Lab)



3.1.7 Rocky Reefs

The MLPA identifies rocky reefs as a habitat for MPA site; all hard bottom substrata are included as “rocky reefs.” Coarse-scale maps of hard and soft substrata are available for the entire study region (Map 3a and 3b); however, these data do not provide much detail, especially in near-shore waters, and greatly under-represent the amount of hard substrate in state waters. Figure 1 shows the portions of the Central Coast study region that have been subject to more accurate seafloor habitat mapping using side-scan and multibeam sonar technologies. More refined data from these hydroacoustic mapping efforts in the study region are available for the area north of Pt. Sur and into Monterey Bay, in the area north of Santa Cruz to Pt. Ano Nuevo, and several areas south of Pt Sur, such as in and adjacent to Big Creek State Marine Reserve. More accurate representations of soft and hard bottom substrata are available for these areas, shown as “fine-scale” substrata data on Maps 3c and 3d. Rocky reefs within the study region are also well known to commercial and recreational fishermen, as well as other mariners and researchers (Yoklavich et al 1997; Love and Yoklavich, in press). In areas not well mapped at a fine-scale resolution, nearshore rocky reefs can potentially be inferred by the presence of kelp beds.

The species that associate with hard substrata differ greatly with depth and type of substratum (Cross and Allen, 1993). Rocky substrata are much less common than soft substrata in the region at all depth zones (Table 4). Rocky reefs provide hard substrata 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 substrate for attachment and are found only on hard substrata in deeper waters (Engle and Coyer, 1981). In addtion to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish (Carr, 1991; CDFG, 2001). The fauna of rocky reefs differs by depth zone and substratum type (i.e., the amount of relief changes with gravel, cobble, boulders, and smooth rock outcrop). Rocky reefs in each depth zone should therefore 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). A unique natural feature of the Central Coast study region is an expanse of granitic outcrops in state waters from southern Monterey Bay (Pt. Pinos) to Point Sur (G. Greene, pers. comm.). The northern half of Monterey Bay to Pigeon Point is characterized by sandstone and shale beds. South of Pt. Sur, the Franciscan Complex dominates (greenstone, serpentinite, argillite, and greywacke). 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 (G.Greene, pers.comm). Pinnacles are scattered in state waters along the entire Big Sur coast and can be important bathymetric features that attract certain fish and invertebrate species (Carr, 1991; CDFG, 2001). Pinnacles have been provisionally identified using bathymetric and fine-scale substratum data in a GIS analysis for area where fine-scale mapping is available; their area has not been calculated as the coverage is not complete.

3.1.9 Submarine Canyons

Submarine canyon habitat is represented in several areas within the study region. The Monterey Submarine Canyon (Monterey Canyon) is the most prominent topographical feature in central California waters and a significant portion is contained within the study region. Soquel Canyon is an extension to the north of the main channel of the Monterey Canyon. Carmel Canyon, extending seaward from the mouth of the Carmel River, is a southern extension of the Monterey Canyon complex. The upper reaches of Partington Canyon, approximately 12 miles south of Pt. Sur, bring deep water habitats close to shore along the Big Sur coast. Mill Creek Canyon is another large canyon offshore of the Big Sur coast. In addition,

there are other smalller canyons with their heads in state waters in the northern half of the study region (Map 3a).

Canyons in state waters are rare and the Central Coast study region has more canyons than other parts of the state. Of the 70 nmi2 of canyons mapped to date in state waters, 41 nmi2 are in the Central Coast study region (Table 1).

Submarine canyons provide areas of high bathymetric complexity, bring deep water communities close to shore, and effect local and regional circulation patterns. The south side of Monterey Canyon is very productive because prey organisms migrate up from the canyon depths to feed and are transported by currents southward to be trapped in shallow shelf waters, where they are then preyed upon by fish, birds, and marine mammals. In addition to the canyons themselves, the canyon heads that occur in near-shore water are considered areas of high biodiversity importance because of the presence of a steep elevation gradient, variation in benthic topography, and other factors that support biological richness. Canyon heads vary in their structure from steep rocky relief to flat alluvial forms. Steep and rocky canyon walls provide shelter for many species of benthic fishes, including rockfishes and thornyheads; sedimentary canyon heads provide habitat for species such as flatfishes (Yoklavich et al., 2000; Yoklavich et al. 2002).

3.1.10 Oceanographic Habitats

The SAT recommended that habitat definitions in the MLPA be expanded to include oceanographic features that significantly effect 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 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 warmwater 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. These currents converge at Point Conception creating a major biogeographic boundary that many species do not cross. North of Pt. Conception, the countercurrent may surface as a nearshore northward flowing current, especially in fall and winter. Ocean circulation patterns are effected 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).

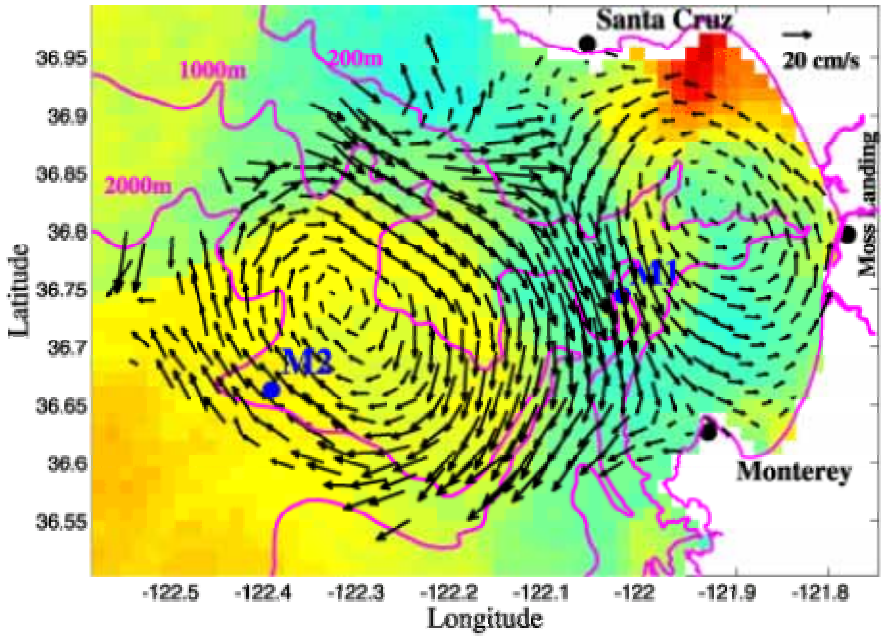
Table 5: Oceanic Seasons in Central California

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 (ENSO) is a large-scale change in atmospheric pressure, trade winds, and sea surface temperatures (SST) of the tropical Pacific that occurs every few years and has significant effects on the California Current System. During ENSO events, there is a reduction in upwelling of cold nutrient rich waters, increased onshore and northward flow, increased SST, and increased northward advection of warm subtropical waters. ENSO events generally result in a decline in zooplankton and reductions in productivity that can effect fish, seabird, and marine mammal populations (Benson et al., unpublished; Marinovic et al., in press). Longer term decadal and multi-decade climatic cycles also effect 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 SST 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.

Near-shore current patterns for the region are variable in time and space depending on a variety of factors. An example of some near-shore current patterns in Monterey Bay is shown in Figure 2 based on surface velocity vectors for August 6, 1994 measured by high frequency (HF) radar installations around Monterey Bay (arrows). The data show alongshore movement toward the south across the mouth of Monterey Bay and a counterclockwise circulation within Monterey Bay, which is typical of the region during upwelling favorable wind conditions (winds from the northwest). Colors indicate satellite-derived sea surface temperatures ranging from cool 52 deg F values representing upwelled waters north of Santa Cruz (light blue) and warm 62 deg F values in the northeast corner of Monterey Bay. Depth contours and the position of long-term mooring sites M1 and M2 are also shown. (Adapted from Paduan and Rosenfeld, 1996.)

Figure 2: Nearshore current patterns and sea-surface temperatures in Monterey Bay, August 6, 1994 (adapated from Paduan and Rosenfield, 1996).



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). In addition, oceanographic processes and cross-shelf transport can significantly effect recruitment patterns of fish and invertebrates in intertidal and nearshore communities (Farrell et al 1991; Roughgarden et al 1991). 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 and therefore difficult to capture in a static map; maps of the frequency of upwelled water in a portion of the study region are shown in Map 4.

- **Upwelling zones**: Major upwelling cells are typically found during the upwelling season at Davenport, Point Sur, and Point Conception; in addition there is often upwelling along the Big Sur coast. The Central Coast study region has 3 of the 6 major upwelling centers in California.
- The presence of upwelled water was assessed by the Pacific Fisheries Environmental Laboratory (PFEL) using sea surface temperature data (1985-2001) from satellite imagery from NOAA's Coast Watch Program. Mean seasonal maps depicting the occurrence and spatial extent of surface water classified as due to upwelled water, frontal water, and offshore warm water present in the study region for 50% or more of the time during 1985 – 2004. Frontal water was classified as areas with temperature changes of greater than 0.05 deg C/km. Upwelled water was classified as areas where the temperature was less than 12 deg C. Offshore warm water was classified as areas

where the temperature was greater than 15 deg C." Map 4 shows upwelled waters – areas with cooler temperatures- off of Santa Cruz/Davenport, Point Sur and along the Big Sur coast. Point Conception is also a major upwelling center. 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 et. al., in press; Wing et. al. 1998). Maps of retention areas are not available for the region.
- **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 reach hundreds of kilometers offshore following El Niño storm events (Kudela and Chavez, 2004). Maps of rivers plumes are not available. Large rivers in the region, including the Salinas, Santa Maria, and Santa Ynez, probably have relatively large plumes especially during the winter rainy season.

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. CDFG drafted a list of species likely to benefit from MPAs and is working with the SAT to refine the list for the study region (see Appendix II for the full list, with information on life history).

Species are included in this list if they meet one or more of these conditions:

- They occur in the Central Coast study region.
- They are taken directly or indirectly in commercial and/or recreational fisheries.
- They have life history characteristics that make them more condusive 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. While there is no formal definition for this term as related to 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, indicates 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.

The National Marine Fisheries Service (NMFS) has 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” (http://www.pcoucil.org/facts/acronyms.pdf). The term generally describes any stock or stock complex determined to be below its overfished/rebuilding threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized. The rebuild target is 40% of unfished levels.

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) at

http://www.dfg.ca.gov/mrd/status/. In addition, information on groundfish managed by the PFMC can be found at http://www.pcouncil.org/groundfish.

***Abalone*:** Currently, all five major species of ablone in central and southern California are depleted, a result of cumulative impacts from commercial harvest, increased market demand, sport 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 occur within the Central Coast study region, and their populations within the region do not occur at levels that support commercial or recreational fishing.

The draft Abalone Recovery Management Plan (CDFG 2002a or b) has recommendations on the use of MPAs for abalone management and recovery. The plan advises that 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 in the Central Coast has resulted in suppressed populations of abalone in this region (Hines and Pearse, 1982). Present low populations of abalone in the Central Coast are probably the same level as prior to human exploitation of sea otters. The 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.

***Other invertebrates*:** In addition to abalone, several other macro-invertebrate species (brown rock crab populations in shallow water, red sea urchin, and Pismo clam) within the study region are also preferred prey of the sea otter. These species are not considered to be depleted; however, the otter's presence is a major factor in limiting recreational and/or commercial fisheries for them in this region. Along with abalone, it is unlikely that regional objectives, related to the enhancement or recovery of these invertebrate populations by the establishment of additional MPAs, would be achieved; however, MPAs would allow the comparison of the status of these stocks within and outside of fished areas and assist in the evaluation of traditional management measures (Rogers-Bennett and Pearse, 2000).

Groundfish (rockfishes, flatfishes, etc): There are eight groundfish species (lingcod and seven rockfishes) which NMFS has formally declared to be overfished. Seven of the eight species occur within the Central Coast study region:

- lingcod
- bocaccio
- canary rockfish
- cowcod
- darkblotched rockfish
- widow rockfish
- yelloweye rockfish

The eighth, Pacific Ocean perch, is uncommon within the study region. Based on their life history traits and habitat requirements (Yoklavich 1998; Parker et al 2000; Parrish et al. 2000), the first seven species would benefit from the establishment of MPAs, including MPAs in which the primary goal is not related to fishery management within the Central Coast study region, if appropriate habitats are protected. 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 (with the possible exception of lingcod) will take considerable time (decades) to achieve success; until then, these species continue to be considered as overfished. In addition, thornyheads are considered by NMFS to be in the "precautionary zone"—a population level that is below the level capable of producing Maximum Sustainable Yield.

Copper rockfish is considered a potential candidate for local depletion (CDFG 2001). This species occurs within the study region and is a good candidate for receiving additional protection through the establishment of MPAs.

Scientists have also raised concerns about a number of rockfish species in the Monterey Bay area specifically based on the reduced mean size of fish in sport landings. From 1960 to 1994, the mean size of the top ten rockfish species caught recreationally in this area declined by factors ranging from 1% to 27% (Mason 1998) Those species include blue, canary, greenspotted, greenstriped, olive, bocaccio, chilipepper, yellowtail, and widow; the latter four species each declined by more than 10% in mean size, and three of these are now considered to be overfished. Strong recruitment may lower the mean size of harvested fish when that year class reachs a harvestable size, and a periodic reduction in mean length is a natural phenomenon. However, mean length becomes a concern when it remains depressed and is coupled with an overall decline in abundance.

The concern over shelf rockfish species is evidenced by the establishment of significant recreational and commercial fishery closures in 2002 in the form of the Rockfish Conservation Areas (RCA). Within the study region, the RCAs covers approximately 4% of the area with full-time closures. In addition, the Nearshore Fishery Management Plan (NFMP) has identified MPAs as a management strategy and deferred implementation to the MLPA of any new MPAs for meeting NFMP objectives. The 19 species covered by the NFMP are:. black rockfish, black-and-yellow rockfish, blue rockfish, brown rockfish, cabezon, calico rockfish, California scorpionfish (not found within study region), California sheephead, 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 (top 20th percentile), as mapped by the NOAA Biogeographic Assessment of the MBNMS, are shown on Maps 5a and b. 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 National Marine Fisheries Service (NMFS) shelf, slope, and midwater trawl data (NOAA 2004).

3.2.3 Special Status Species

Some fish, marine mammals and seabirds of the Central Coast region, whose populations have declined, receive special protections under the Endangered Species Act. 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.

While it is not expected that MPAs in state waters will directly effect the populations of wide-ranging species, the presence of an integrated network component of MPAs along the 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 nesting and rookery sites, juvenile habitat (such as estuaries for salmonids), 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. Seabird nesting sites (eg. California Least Tern and Western Snowy Plover nesting sites along Central Coast beaches), seabird colonies, and pinniped rookeries are found along the central California shoreline.

A list of special status species expected to occur in the region compiled by the MBNMS is provided in Appendix II. A brief description of selected species follows:

Central Coast coho salmon and steelhead trout: Populations of the Central California Coast Coho salmon (*Oncorhynchus kisutch*) Evolutionarily Significant Unit (ESU) occurring within the Central Coast study region are listed as threatened under the federal Endangered Species Act. In the study region, there are 5 coastal rivers or streams with current coho presence: Gazos Creek, Waddell Creek, San Vicente Creek, San Lorenzo River, Scott Creek (Adams et al 1999). The Scott Creek population in the Big Basin hydrologic unit is considered a key population to maintain or improve (CDFG 2004).

There are three steelhead (*Oncorhynchus mykiss*) ESUs in the Central Coast study region with federal status under the Endangered Species Act. The Central California Coast steelhead ESU range extends from north of San Francisco Bay (Russian River watershed) down to the Santa Cruz area (just below Aptos Creek) and is listed as threatened. The South-Central California Coast steelhead ESU extends from the Pajaro basin north of Monterey down to the Santa Maria River and is listed as threatened. The Southern California steelhead ESU, listed as endangered, extends from the Santa Maria River south beyond the study region boundary. There are at least 47 coastal streams or rivers with current steelhead presence in the study region (Jigour et al 2004, Busby et al 1996; Titus et al 2000).

These two species 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 two salmonid species has been mapped (Maps 5a and b) based on a variety of sources (Adams et al 1999; Jigour et al 2004; Busby et al, 1996; Titus et al 2000).

Sea otters: Once ranging from northern California to Japan to Punta Abreojos in Baja California Sur, with few exceptions, southern sea otters (*Enhydra lutris*) are now found from Pt Año Nuevo in Santa Cruz County to Purisima Pt in Santa Barbara County, and occasionally north to Half Moon Bay and south to Santa Barbara (USFWS 1995, 2003). Historically, sea otters numbered approximately 15,000 in California, but commercial hunting severely reduced their population in the 18th and 19th century. By 1914, the California population of sea otters may have numbered as few as 50 animals. Between 1983 and 1994, the sea otter population grew at an average annual rate of 5-6%, and reached a maximum observed population size of 2,377 individuals in the spring of 1995. Sea otter numbers have fluctuated since then. Since 1998, the population has increased at a rate of 0.9%, based on the three-year running average. Though recent estimates indicate that the population is growing, recovery is still inhibited by a variety of factors that contribute to otter mortality including: incidental drowning in gill and trammel nets, along with oil spills, toxic contaminants, other human impacts, and disease (Hanni *et al.* 2003, Miller *et al.* 2004, USFWS 2003). The most recent statewide population count is 2735 otters based on surveys by the USGS (http://www.werc.usgs.gov/otters/ca-surveydata.html); this is well below their historic statewide abundance and sea otters are still listed as federally threatened. Their current distribution includes almost the entire Central Coast study region.

Otters have been shown to be a keystone species, exerting strong top-down control on their prey species (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 kelp forests and associated species (Estes and Palmisano 1974, Estes and Duggins 1995). Sea otters have a varied diet consisting of benthic invertebrates such as red sea urchins (*Strongylocentrotus franciscanus*), red (*Haliotis rufescens*) and black abalone (*H. cracherodii*), kelp crabs (*Pugettia producta*), clams (*Gari californica*), and cancer crabs (*Cancer spp.*) (Ostfeld 1982). Sea otters use many near-shore habitats along the coast, from estuaries to kelp forests and rocky habitats; typically sea otters are found near-shore but sometimes as much as 10km from shore. Mapped data on the density of otters in linear segments along the Central Coast have been compiled (NOAA, 2004) and are shown in Maps 5a and b.

Expansion of sea otter populations, following protection from harvest, resulted in conflicts with commercial and recreational abalone fisheries that had developed when otter numbers were depressed and abalone were abundant (Estes and VanBlaricom 1985). In some locations in Northern California, predation by otters may have a larger effect on red abalone populations than current human harvest rates (Fanshawe *et al.* 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. Four species of pinnipeds have either colonial rookeries or haulout sites in central California based on data collected and compiled by NOAA (Mark Lowry, pers. comm.; Lowry 2002; Lowry and Carretta 2003) and summarized in Maps 5a and b. Little to no information on historical abundances was available for California sea lions, harbor seals, and southern sea otters, 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 (MMPA) 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). Based on this research, Weise and Harvey estimated sea lions in central California consumed 8,406 - 8,447 tons of prey species in 2001-2002, of which 450 - 1,525 tons were salmonids. A study in southern California found that market squid were determined to be the most important prey type (Lowry and Carretta, 1999).

  In recent years, salmon fishermen have increasingly complained about damage to gear and catches by California sea lions. Between 1997 and 1999, Monterey Bay commercial fishermen suffered estimated losses that ranged from $18,031 to $60,570 for gear and $225,833 to $498,076 in salmon (Weise and Harvey *in press*). For the same period, Weise and Harvey estimated that sea lions fed upon hooked salmon at rates that ranged from 8.5% to 28.6% in the commercial fishery, 2.2% to 18.36% in the CPFV fishery, and 4.0% to 17.5% in the personal skiff fishery. Predation rates were highest in the El Niño year of 1998 when the abundance of other prey was reduced.
- ***Steller sea lion:*** Central California is the southern extent of the range of the Stellar sea lion, Eumatopias jubatus, also known as the Northern Sea Lion. The diet of Stellar sea lions is dominated by a variety of fish (especially demersal roundfish) and squid (Pauly et al 1998).
- ***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, Point Año Nuevo, Piedras Blancas, and Cape San Martin. 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 MMPA 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.

While not colonial, harbor seals are gregarious while molting and resting and haul out in groups on sandbars and rock ledges along the Central Coast. 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).

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 whales (blue, gray, humpback, and fin) can be seen seasonally in the Monterey Bay area and throughout the Central Coast study region.

Seabird colonies: The region supports a diverse assemblage of seabirds, many of whom aggregate into colonies, especially during the breeding season. 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 Monterey Bay are all important foraging areas for seabirds in the region. Some important breeding sites include Año Nuevo Island and numerous offshore rocks and pinnacles along the central California coast. Some seabird species with colonies in the Central Coast study region include common murres, pigeon guillemot, least tern, black oystercatcher, pelagic cormorant, and Brandt's cormorant. Sea bird colony locations in the Central Coast study region are shown on Maps 5a and b, 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 and b.

There are 28 birds on the list of special status species present in the Monterey Bay National Sanctuary (Appendix II); many are dependent on coastal beaches, estuaries, and near-shore marine environments.,

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 IMS, 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 (Elkhorn Slough and Morro Bay estuaries) with eelgrass beds, tidal flats, and coastal marsh (Map 2a and 2b)
- Small estuaries with presence of coho or steelhead populations (Maps 2a, 2b show estuaries; Maps 5a and b show salmonid outets)
- Submarine canyon heads and large submarine canyons, including those that are either soft or hard substrata-dominated (Map 3a, 3b, 3c, 3d)
- Marine areas off headlands with adjacent upwelling centers, epecially those with kelp forests and rocky reefs in retention areas in the lee of the upwelling center
- Persistent kelp beds (Map 2a and 2b) and nearshore rocky reefs (Map 3a, 3b, 3c, 3d)
- Areas of high bathymetric complexity which provide topographic relief and a variety of habitats in close proximity
- Shallow and deep pinnacles are areas where fish aggregate (Map 3c, 3d)
- Rocky subtrata in all depth zones, since rocky habitat is much less rare than soft-bottom habitat (Maps 3a, 3b, 3c, 3d)
- Shelf-slope break (100-200m) where the continental shelf slopes downward is an area with high biodiversity (Map 3a, 3b, 3c, 3d show depth contours)
- Rocky intertidal shores, especially wave-cut rocky platforms (which provide habitat at diverse tidal elevations) and rare sheltered rocky shores (Maps 2a and 2b)
- Seabird colonies and marine mammal rookeries and haulouts (Maps 5a and 5b)
- Areas of high fish or seabird diversity and/or density as identified by the NOAA Biogeographic Assessment (Maps 5a and 5b show Top 20th percentile diversity and density for fish and seabirds; NOAA 2004)

4.0 Land-Sea Interactions

The Central Coast study region has both terrestrial and marine biodiversity of global significance. 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.

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 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 effect ecotourism and management of environments) (Coastal Reserves Working Group, 2005).

These four classes of land-sea interactions specifically effect 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. Effecting one area (i.e. a stream or estuary) has 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 the potential effects of coastal-watershed interactions on MPAs or potential MPAs.

Coastal-watershed linkages are important for many reasons, both ecological and human. Land use patterns, alteration of hydrologic regimes (quantity and timing of freshwater flow), and inputs of pollutants can all effect estuarine and near-shore habitats and species.

4.1 Ecological linkages

Watersheds and coastal waters have many complex ecological linkages. Watersheds carry freshwater and sediments to bays, estuaries, and the ocean. 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). While bays and esturaries along the Central Coast study region are small, they support thousands of birds during migration; numerous marine species use embayments, and estuaries as spawning and nursery grounds.

Watersheds and coastal waters support abundant and diverse marine species. These species, in turn, have linkages within and between marine ecosystems. The structure and function of these ecosystems depend upon complex biological and physical processes and interactions. Competition amongst species and natural and human disturbances add further complexity to these interactions and linkages. Some examples of critical ecological linkages along the Central Coast study region are described below for selected marine species (from Airamé et. al., 2003).

- **Anadromous fish**, such as coho salmon and steelhead trout, 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. Central Coast rivers once supported large numbers of steelhead trout and coho salmon. 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 in danger of extinction.
- **Shorebirds and waterfowl**, such as clapper rail, 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 perches, jacksmelt, and topsmelt mate and bear their young in estuarine habitats.

Many of the ecological linkages between watersheds and coastal waters, especially estuaries and bays, are particularly vulnerable to coastal development, pollution, and introduction of invasive species. Increases in sedimentation, diversion of freshwater, and channelization have effected the conditions in salt marshes, brackish water, and eelgrass meadows. Urban runoff transports nutrients, bacteria, viruses, and toxins that can cause harmful algal blooms, reduced oxygen concentrations, or acute and chronic toxicity to biota. Humans have modified and transformed about 90% of the wetlands in California by such activities as diking, mining, dredging, filling, and reclamation (Airamé et. al., 2003). Healthy coastal wetlands are critical to the existence of organisms that depend on these habitats for survival. Wetlands have been called “kidneys of the landscape” because they filter and transform contaminants before they enter aquatic habitats. They also prevent floods, protect shorelines, and recharge aquifers (Mitsch and Gosselink 2000). Understanding linkages between watershed 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 Central Coast study region extends for over 200 miles along the Californian coast, includes 866 square nautical miles of ocean, and drains 9,900 square miles of land from 11 major watersheds. The largest coastal watersheds of the region include the Pajaro, Salinas, and Santa Maria (Table 6).

Table 6: Major Watersheds in the Study Region

Hydrologic Unit Name	Area (square miles)	Area (hectares)
BIG BASIN	367.5	95,178
BOLSA NUEVA	51.0	13,213
CARMEL RIVER	255.7	66,230
ESTERO BAY	750.9	194,483
PAJARO RIVER	1310.9	339,525
SALINAS	3527.0	913,497
SAN ANTONIO	211.9	54,889
SANTA LUCIA	302.6	78,370
SANTA MARIA	1856.9	480,944
SANTA YNEZ	900.2	233,137
SOUTH COAST	375.2	97,168

Land use adjacent to the study region includes agriculture, timberlands, urban and rural developments, industrial uses, and parks and open space. Map 6 also shows 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 4.5.2, “Nonpoint Sources.”)

4.3 Coastal Water Quality

Chemical pollution, sedimentation, and eutrophication can alter the abundance and biodiversity of wildlife in coastal environments, especially bays and estuaries. The presence of pollution and the degree of its impact on water quality, habitats, and marine wildlife varies markedly along the state’s coastline. Because water pollution may effect marine species of concern or desirable human uses in an area, the presence and impacts of water pollution should be considered in siting and implementing MPAs. Where MPAs are located in polluted areas, efforts should be made to improve water quality. Information on trends in water quality over time along the Central Coast are not readily available.

An interdependency exists between watersheds and coastal areas with respect to monitoring and maintaining 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).

The Central Coast Regional Water Quality Control Board (RWQCB) has jurisdiction over a 300-mile long by 40-mile wide section of the State's Central Coast. Its geographic area encompasses all of Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara Counties as well as the southern one-third of Santa Clara County, and small portions of San

Mateo, Kern, and Ventura Counties. *The Regional Water Quality Control Plan* ("Basin Plan," available at http://www.swrcb.ca.gov/rwqcb3/WMI/Index.htm) contains three main types of information. First, it 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, it defines the water quality that must be maintained to support those beneficial uses. Last, the 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 this plan. Beneficial uses along with the numeric or narrative objectives established to protect those uses jointly constitute federal water quality standards. This Implementation Plan includes a description of the regional surveillance and monitoring programs, such as the Central Coast Ambient Monitoring Program.

Among the six types of managed areas described in the Marine Managed Areas Improvement Act (MMAIA), state water quality protection areas (SWQPAs) are "designated to protect marine species or biological communities from an undesirable alteration in natural water quality…" (Public Resources Code Section 36700[f]). These areas include "areas of biological significance" or ASBSs, which are established by the State Water Resources Control Board in the California Ocean Plan. Within SWQPAs waste discharges are prohibited or limited. In the Central Coast region, there are seven ASBSs: Ano Nuevo Point and Island, Point Lobos Ecological Reserve, Julia Pfeiffer Burns Underwater Park, Pacific Grove Marine Gardens Fish Refuge, Hopkins Marine Life Refuge, the ocean area around the mouth of Salmon Creek, and Carmel Bay. Individuals may nominate areas for designation as ASBS. Criteria include areas be "intrinsically valuable or have recognized value to man for scientific study, commercial use, recreational use, or esthetic reasons." Areas proposed for ASBS designation should be such that they would benefit from protection beyond that offered by standard waste discharge restrictions and other measures.

The California Coastal Commission operates the California Critical Coastal Areas program of coordination for efforts to protect coastal watershed from polluted runoff. Areas currently identified for the program include the San Lorenzo River, Soquel Lagoon, Watsonville Slough, Elkhorn Slough, Old Salinas River, Pacific Grove Marine Gardens, and San Luis Obispo Creek.

Offshore areas of the Central Coast have few documented water quality problems. However, 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 anadramous 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 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 study region are designated as impaired. (For a list of the water bodies, a description of the pollutant/stressor, potential sources, priority level, and area effected see http://www.waterboards.ca.gov/tmdl/docs/2002reg3303dlist.pdf.) Map 7 shows the impaired water bodies in the study region. High priority sites in the study region include, for example, Morro Bay and San Luis Obispo Creek.

Four categories of water quality stressors might play a causal role in these indicators of impairment: 1) persistent organic pollutants, 2) nutrients, 3) pathogens, and 4) suspended sediments in river discharges. Table 7 shows the relationships among the priority beneficial uses, their related indicators of impairment, and these water-quality stressors.

Table 7: Relationships between priority beneficial uses, important environmental issues, and possible causal water-quality constituents

Priority Beneficial Uses	Environmental Issue	Possible Water-Quality Stressors of Concern
Marine Habitat	Elevated tissue burdens of persistent organic pollutants in fish from Monterey Submarine Canyon and in otters	Persistent organic pollutants in water and sediment
	Bird and mammal mortality related to blooms of toxic phytoplankton	Nutrients
	Diseases in otters related to tissue burdens of persistent organic pollutants	Persistent organic pollutants in water and sediment Pathogens
Rare, Threatened, and Endangered Species	Sea otter deaths	Persistent organic pollutants in water and sediment Pathogens
Water-Contact Recreation	Beach closures	Pathogens
Wildlife Habitat	Elevated tissue burdens of persistent organic pollutants in fish from Monterey Submarine Canyon and in otters	Persistent organic pollutants in water and sediment
	Bird and mammal mortality related to blooms of toxic phytoplankton	Nutrients
	Diseases in otters related to tissue burdens of persistent organic pollutants	Persistent organic pollutants in water and sediment Pathogens
	Disturbance of benthic habitats	Suspended sediments in river discharges

(Source: Edited excerpt from regional document prepared by Applied Marine Sciences, Kris Lindstrom, July 14, 2005.)

Other processes may also impair water quality. Sedimentation, for example, may negatively effect marine habitats. The amount and type of sediment entering stream systems can greatly effect stream dynamics and has detrimental impacts on salmonid populations (FISRWG 1998). Sediment may disrupt communities; in the Rider Creek watershed in Santa Cruz County, for example, sand sediment has buried portions of downstream creeks; the sand load inundation, in turn, has destroyed steelhead rearing habitat in Corralitos Creek ("Rider Creek NPS Sediment Management Study," http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=581).

Eutrophication, water pollution caused by excessive plant nutrients, can also degrade water quality. Nutrients (primarily phosphorous and nitrogen) enter estuaries or streams in various ways: from agricultural runoff, urban lawns, golf courses, soil erosion, and untreated sewage. Eutrophication stimulates excessive algal growth (algal blooms) that can have far-reaching environmental effects. Algal blooms often lead to oxygen depletion and can cause the deaths of marine organisms.

Finally, trash and debris—anything from motor oil deposited in the gutter to toxic paints, household garbage, and pet waste—pose hazards to water quality, wildlife, and recreational users. Debris, if not properly disposed of, can deposit harmful materials into water bodies, including ammonia, chloride, copper, nitrate/nitrite, and sulfates, and can degrade water quality.

Between 1977 and 2003, the California State Mussel Watch Program (SMWP) collected transplanted and resident mussels and clams from the waters of California's bays, harbors, and estuaries to evaluate bioaccumulation of contaminants in tissues. Tissue concentrations provide a powerful monitoring tool because uptake of contaminants by biota integrates contaminant exposure over time; however, this method does not measure potential effects of contaminants. Samples collected were analyzed for trace elements, pesticides, and PCBs. The SMWP provided the State Water Resources Control Board (SWRCB) with a uniform statewide approach to the detection and evaluation of the occurrence of toxic substances in marine waters. 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 PCBs) and trace metals (Dugan, et. al. 2004).

4.3.2 Beach Closures

Beach closures are a direct indicator of the negative impacts to the water-contact-sport beneficial use. California has some of the most popular beaches in the country. Millions of residents and tourists each year visit them to swim, wade, surf, and dive. The State of California has mandated beachwater 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 stormdrains 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 8 lists the number of beach closures in days for each year from 2000-2003 by county within the study region. Table 9 lists all beach closures in the study region in 2003. 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. Rain advisories are automatically issued in Monterey and Santa Cruz counties for 72 hours when rainfall exceeds a pre-determined level regardless of bacterial monitoring levels. (For more information about these data, see http://www.nrdc.org/water/oceans/ttw/titinx.asp.)

Table 8: Beach Closings/Advisories by County: Year–to-Year Comparison

County	Number of Days 2003	Number of Days 2002	Number of Days 2001	Number of Days 2000
Monterey	104	92	210	69
San Luis Obispo	64	6	69	17
San Mateo	167	135	144	276
Santa Barbara	360	512	843	913
Santa Cruz	93	127	74	85

The data suggest that some counties, like Santa Barbara, have seen decreases in the number of days of beach closures per year. Other counties, San Mateo, Monterey, and Santa Cruz, have smaller changes in the number of closures.

Table 9: Beach Closing By County in the Study Region

County	Beach Name	Number of Closures in 2003
Monterey	Coral and Oceanview	1
Monterey	Del Monte Beach	1
Monterey	Lover's Point	1
Monterey	Maccabee Beach	1
Monterey	Seal Rock, Pebble Beach	1
Monterey	Stillwater Cove	4
Monterey	Sunset Drive at Arena/Asilomar	3
Monterey	All Beaches	3
San Luis Obispo	Avila Beach	4
San Luis Obispo	Cayucos Beach	2
San Luis Obispo	Morro Bay City Beach	2
San Luis Obispo	Pismo Beach	14
Santa Barbara	Guadalupe Dunes	1
Santa Barbara	Jalama Beach	5
Santa Barbara	Ocean Beach	1
Santa Cruz	Beercan Beach	1
Santa Cruz	Capitola State Beach	5
Santa Cruz	New Brighton State Beach	1
Santa Cruz	Rio Del Mar Beach	1
Santa Cruz	Seacliff Beach	2
Santa Cruz	Seascape Beach	1

4.4 How Land use and Watershed Modification Effect Rivers and Coastal Waters

Modification of natural watershed land cover and ecological processes can significantly effect downstream rivers and coastal waters. A variety of land use practices in watershed areas results in degraded quality of receiving waters. 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 (NPS). 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 Central Coast region, it is useful to begin with a consideration of how local geology plays a role in watershed processes.

4.4.1 Local Geology Can Impact Water Quality

Along the Big Sur Coastline (from Carmel River to San Carporforo) the Santa Lucia Mountains descend into the Pacific Ocean, creating one of the steepest coastal slopes in the United States. 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 effected by human disturbance within many coastal watersheds in the study region. The amount and type of sediment entering stream systems can greatly effect stream dynamics and has detrimental impacts on salmonid populations (FISRWG 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). Based on a study done by the USGS, the Big Sur Highway alone yields approximately 21,000 ± 3200 m3 of materials per kilometer per year (MBNMS, 2003). There is an investigation into the possibility of controlled disposal of landslide material to reduce the impact upon marine resources (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 (NPS) pollution. Runoff from NPS pollution sources is the primary cause of impairment for more than 76 percent of the water bodies where TMDLs are required in California (SWRCB, 2005 http://www.swrcb.ca.gov/nps/docs/npsfactsheet.pdf). The main sources of NPS pollution are:

- Agriculture
- Forestry
- Urban Areas
- Marinas and Recreational Boating
- Hydromodification

The NPS pollutants typically associated with **agriculture** include nutrients, animal waste, sediments, and pesticides. Agricultural NPS pollution enters receiving waters by direct runoff to surface waters or seepage into ground water. Runoff of nutrients can result from excessive application of fertilizers and animal waste to land, and from improper storage of animal waste. Farming activities can cause excessive erosion, which results in sediment entering receiving waters. Improper use and overapplication of pesticides cause pesticide pollution. Improper grazing management can cause erosion, soil compaction, and excessive nutrients. Sediment, pesticides, and excess nutrients all effect aquatic habitats by causing eutrophication, turbidity, temperature increases, toxicity, and decreased oxygen (SWRCB 2005 Nonpoint Source Encyclopedia http://www.swrcb.ca.gov/nps/docs/encyclopedia/encyclopedia.pdf).

Forestry operations can degrade the quality of receiving waters in a number of ways. The primary concern is that such operations 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 2005 Nonpoint Source Encyclopedia).

Major pollutants found in runoff from **urban areas** include sediment, nutrients, oxygen-demanding substances, heavy metals, petroleum hydrocarbons, pathogenic bacteria, viruses, trash, and plastics. Construction is a major source of sediment erosion. A number of pollutants originate from automobiles, such as petroleum hydrocarbons and a variety of metals. Runoff from urban areas tends to have high concentrations of nutrients and pathogens from garden fertilizers, leaves, grass clippings, pet wastes, and faulty septic tanks. As population densities increase, a corresponding increase occurs in pollutant loadings generated from human activities. Many of these pollutants enter surface waters via runoff without first undergoing treatment (SWRCB 2005 Nonpoint Source Encyclopedia).

Sources of pollution associated with **marinas and boating** include:

- Poorly-flushed waterways
- Pollutants discharged from boats (recreational boats, commercial boats, and "live-aboards")
- Physical alteration of wetlands and of shellfish and other benthic communities during construction of marinas, ramps, and related facilities
- Pollutants generated from boat maintenance activities on land and in the water

Pollution from marinas and recreational boating is a concern because they are located at the water's edge, and so are less likely to be buffered or filtered by natural processes (SWRCB 2005 Nonpoint Source Encyclopedia).

Hydromodification is the alteration of stream and river channels, installation of dams and water impoundments, and streambank and shoreline erosion. Channelization and channel modification activities can diminish the quality of aquatic habitats and streamside habitats by altering the instream pattern of water temperature and sediment type, as well as the rate of sediment erosion, transport, and deposition. Hardening the banks of streams and rivers with shoreline stabilization protection or armor can accelerate the movement of surface water (increasing erosion) and pollutants from upstream, degrading water quality. While erosion of streambanks and shorelines is a natural process that can be beneficial to downstream areas dependent on just the right amount of sediment and nutrients supplied from upstream sources, excessively high erosion can cause sediment to smother aquatic vegetation, cover shellfish beds and tidal flats, and contribute to increased turbidity and nutrients. Dams can adversely effect the hydrology and quality of surface waters and riparian habitat in the rivers and streams where they are located, as well as reduce downstream flows effecting water quality and habitat (SWRCB 2005 Nonpoint Source Encyclopedia).

4.4.3 Point Sources

There are also specific locations (point sources) where pollution enters coastal waters. More than 40 municipal wastewater treatment facilities discharge in the RWQCB Central Coast region, with many of these discharging directly into the ocean. More information about these facilities, including discharge location and volume, can be found in the Basin Plan (Chapter 4; http://www.waterboards.ca.gov /centralcoast/BasinPlan/BP_text/chapter_4/). In addition, other kinds of permitted pollution discharge points exist in the region; these point sources are shown on Map 7.

Thermal discharges (i.e. water drawn from the ocean or estuary used to cool generators, which is then released back to the ocean or estuary at temperatures above ambient) from power stations and industrial facilities can have a range of effects. Such discharges can change the speed of many chemical reactions and biological processes (including the solubility of oxygen and biological growth rates), because they effect the temperature at which reactions occur. In addition, temperature shifts may produce algal blooms and changed growth regimes for marine

plants and animals. The surrounding marine area may also become more susceptible to colonization by exotic species from warmer climates. There are three power plants in the study region that produce thermal waste: Diablo Canyon Power Plant, Morro Bay Power Plant, and Moss Landing Power Plant. Thermal pollution is regulated in California by the State Water Resources Control Board through the Thermal Plan (SWRCB, 1975).

4.5 Current Projects Along Central Coast Addressing Coastal-Watershed Linkages

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 Protection Program, Monterey Bay National Marine Sanctuary

The Monterey Bay National Marine Sanctuary (MBNMS) staff recognized that water quality was key to ensuring protection for all Sanctuary resources. As a result of an extensive outreach effort, a Memorandum of Agreement was signed in 1992 by eight federal, state, and local agencies agreeing to work together to develop a Water Quality Protection Program (WQPP) for the Sanctuary. Today the WQPP is a partnership of 25 federal, state and local agencies, public and private groups dedicated to protecting and enhancing water quality in the 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 (http://montereybay.noaa.gov/resourcepro/urban.html). This effort aims to provide an ecosystem-based water quality management process that integrates the mandates and expertise of existing coastal and ocean resource managers and protects the nationally significant resources, qualities, and compatible uses of the sanctuary.

4.5.2. U.S. Environmental Protection Agency Projects

Section 205(j) of the federal Clean Water Act allows EPA to provide funds to states that distribute the money to eligible candidates (i.e., governments and nonprofit organizations) in a competitive process for water quality management planning. These grants are intended to fund projects that address long-term growth management, impaired waters restoration, and public education. The State Water Resources Control Board, via the Regional Water Board, is managing a number of such 205(j) projects along the Central Coast. These projects address a wide range of water quality issues both in the receiving waters and the watersheds that drain to those waters. Many of the projects address contamination of aquifers or water supply wells as a result of seawater intrusion or improperly designed or maintained septic systems. Nitrate from on-site septic systems can also be a pollutant of concern in creeks and rivers. Another common theme addressed by the projects is increased sediment supply due to erosion. There

are projects that assess the impacts of this sediment delivery on fisheries in creeks and rivers, while other projects assess the water quality impacts due to erosion from timber harvest practices. There are also projects assessing the water quality impacts of abandoned metals mines in the region and projects addressing the impact of point and non-point sources on sensitive areas like shellfish growing beds, wetlands, and sloughs. Finally, a variety of projects are looking at developing management plans for managing storm water runoff and controlling non-point source pollution to coastal waters (Table 10).

Table 10: Some EPA Projects in Central Coast Watersheds

Project Name	Web Link
Salinas Valley Seawater Intrusion Study	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5603
San Lorenzo Valley Septic Management Study	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5602
Scotts Valley Ground Water Basin Nitrate Study	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=577
Soquel Creek Chronic Sediment Sources	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=578
Timber Harvest Water Quality Study	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=579
North Salinas Ground Water 3-D Model	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=580
Timber Harvest Erosion Control Workshop	http://www.epa.gov/region09/water/projects/reg_3.html#noreport
San Luis Obispo County Abandoned Mines Study	http://www.epa.gov/region09/water/projects/reg_3.html#noreport
Rider Creek NPS Sediment Management Study	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=581
San Lorenzo River Nitrate Study I	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=582
Elkhorn Slough Wetlands Water Quality Project	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=583
Santa Margarita Ground Water Management Study	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=584
Santa Barbara Channel Shellfish NPS Evaluation,	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5571
Carpinteria Salt Marsh Water Quality Monitoring	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5560
Monterey Bay Urban Runoff Water Quality Project	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5559
Reducing Nitrate Leaching in Irrigation and Fertilization	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5559
San Luis Obispo County Abandoned Mines Study	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5557
Schwan Lake Management Plan	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5556

San Lorenzo River Nitrate Study II	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5555
Stream Care and Water Quality Enforcement	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5554
McEnery Road Gully Treatment Project	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=458
Coastal and Marine Water Quality Information	http://www.epa.gov/region09/water/projects/reg_3.html#noreport
Salinas Basin Ground Water Quality Management Study	http://www.epa.gov/region09/water/projects/reg_3.html#noreport
Inactive Metal Mines in Four San Luis Obispo County Watersheds	http://www.epa.gov/region09/water/projects/reg_3.html#noreport
Watsonville Sloughs Resources Management Plan	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=3301
Reduce Overboard Discharge of Human and Solid Waste, Fuels, in Monterey Bay	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5258
State Morro Bay Watershed Management Plan	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5266
NPS Pollution in Coastal Harbors and Sloughs	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5266
San Lorenzo River Watershed Management Plan	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=3346
Santa Maria River Watershed Project	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=4990
San Benito County Water Quality Monitoring Plan	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=4990
Pajaro River Watershed Management Plan	http://endeavor.des.ucdavis.edu/nrpi/NRPIDescription.asp?ProjectPK=5549
Upper Salinas River Watershed Management Plan	

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 Central Coast RWQCB is responsible for five state water quality protection areas (SWQPA), formerly known as 'Areas of Special Biological Significance' (ASBS), in the Central Coast MLPA region These sites include state waters around: Ano Nuevo, Julia Pfeiffer Burns Underwater Park, Pacific Grove Marine Gardens, Salmon Creek, and Point Lobos Ecological Reserve. By law, point source waste and thermal discharges are prohibited or limited by special conditions, and nonpoint source pollution must be controlled to the extent practicable in these regions (Baggett, 2003).

The California Coastal Commission has designated ten Critical Coastal Areas (CCAs) in the MLPA Central Coast study region, specifically to organize multiple layers of governments' response to non-point source pollution issues (California Coastal Commission, 2002). In addition to looking at polluted rivers on the EPA's 303d list, streams which feed into waters

adjacent to SWQPAs and Marine Managed Areas were also considered for CCA designation. The ten Central Coast CCA sites include waters associated with: the San Lorenzo River, Soquel Lagoon, Watsonville Slough, Elkhorn Slough, Old Salinas River, Pacific Grove Marine Gardens, San Luis Obispo Creek, Goleta Slough, and Carpinteria Marsh.

The Central Coast Long-term Environmental Assessment Network (CCLEAN) is a program begun in 2001 that is designed to help municipal agencies and resource managers determine the sources, amounts, and effects of contaminants in nearshore waters of Monterey Bay.

On October 8, 1997, the Governor signed Executive Order W-162-97, which required that by October 1, 1998, the Secretary of the California Environmental Protection Agency (Cal/EPA) inventory existing ocean and coastal water quality monitoring programs and make recommendations for a comprehensive program for monitoring water quality and reducing pollution within coastal watersheds, bays, estuaries, lagoons, and near-shore ocean waters. The Governor also signed two companion bills—AB 1581 (Keeley), which provided funds to prepare the inventory and the monitoring plan, and AB 1429 (Shelley), which included provisions similar to those in the Executive Order, including a coastal monitoring Internet Web site. The State Water Resources Control Board (SWRCB) was assigned the responsibility of implementing the Cal/EPA aspects of the tasks of the Executive Order and these two bills.

With the assistance of the coastal Regional Water Quality Control Boards (RWQCB) and three contractors—Southern California Coastal Water Research Project (SCCWRP), San Francisco Estuary Institute (SFEI), and the California Department of Fish and Game (DFG)—the inventory of the coastal water quality monitoring programs has been completed, and a Web site for the inventory has been developed (www.sfei.org/camp). 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 analytes. Since the inventory itself is voluminous, it is not included in this report (it can be accessed electronically at http://www.sfei.org/camp/Coastal_Water_Quality_Monitoring_Strategy.html).

Today many programs monitor the region's beaches, rivers, and streams. The Central Coast Ambient Monitoring Program (CCAMP) is the Regional Board's regionally scaled water quality monitoring and assessment program. The purpose of the program is to provide scientific information to Regional Board staff and the public to protect, restore, and enhance the quality of the waters of central California.

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
- Elkhorn Slough Water Quality Monitoring Project (see 6.4, “Public Education and Outreach”)

Again, coastal water quality information and understanding of existing water quality and monitoring programs are important in MPA planning to ensure that any potential threats to marine resources in MPAs from water quality can be addressed through MPA design.

4.6 Effects of Coastal-Watershed Interactions on MPAs or Potential MPAs

The primary way in which coastal-watershed interactions could effect current or planned MPAs is through pollution either carried in runoff or discharged directly into the coastal waters. As discussed previously, watershed land uses like agriculture, silviculture, and urbanization result in the delivery of pollution (e.g. metals, pesticides, pathogens, sediment, nutrients, trash, and debris) to coastal waters. In addition, pollutants can be discharged directly into the water from wastewater treatment and industrial facilities and from marinas and boats. The effects of this pollution relevant to MPAs include direct toxicity to marine organisms, algal blooms, oxygen depletion, destruction of habitat, hazards from debris and trash, habitat loss due to sedimentation. From the human-use perspective, beach closings represent health hazards and loss of recreational opportunities. Contaminated seafood effects human health and seafood advisories effect the fishing and aquaculture industries.

The degree of impact from these stresses varies along California's coastline. Such impacts will tend to increase in coastal areas at the bottom of highly modified watersheds or those containing high concentrations of land use practices closely associated with pollution. Studying linkages between watersheds and coastal waters from multiple perspectives and beneficial uses, with a focus on water quality throughout all areas, will help managers understand how modification of these linkages may effect the ability of an MPA to meet its objectives.

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, effect marine resource use patterns, coastal livelihoods, and human activities. A brief overview of coastal counties, ocean economy, demographics, and resource use in the region is provided as regional context.

Data from the National Ocean Economics Program were compiled for each county and are discussed below. Data are from four ocean industry sectors, and include the number of people employed, wages paid, and gross state product[1]. The ocean industry sectors are:

- Coastal Construction (marine construction).
- Living Resources (aquaculture and seafood harvesting and processing).
- Tourism and Recreation (recreational fishing, amusement and recreation services, boat dealers, eating and drinking places, hotels and motels, marinas, recreational vehicle parks and campgrounds, sporting good retailers, zoos and aquaria).
- Transportation (deep sea freight transportation, marine transportation services, petroleum and natural gas pipelines, search and navigation equipment, warehousing).

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

Futhermore the MLPA Intiative is planning on to collect public documents (general plans, resolutions, etc,) related to marine uses from coastal public entities (counties, cities, special districts, parks).

1 Gross state product (GSP) is the final market value of goods and services produced by labor and property located in a state. It is the state counterpart to the nation's gross domestic product (GDP).

5.1 Coastal Counties

There are 5 coastal counties that abut the marine study region. They are briefly discussed below, in alphabetical order.

5.1.1 Monterey County

Monterey County includes approximately 100 miles of California's coast. The third-highest agricultural producing county in the state, Monterey is also a national leader in agriculture. Twenty-one percent of all county residents are employed in agriculture and it is the largest industry in the county. The fishing industry is present in Monterey and Moss Landing.

Population projections predict rapid growth with demographers estimating that by 2020 the population will be close to 600,000 (LMID, 2003). Job growth will be mainly in services, government, and retail trade sectors (LMID, 2003). Unemployment in 2002 was 10.4 % where the average in California was 6.7%. Seasonal jobs in agriculture and tourism, the mainstay of the economy, create seasonal unemployment.

In Monterey County, the ocean industry that employs the most people (11,950 in 2001) and pays the most wages ($238 million in 2001) is Tourism and Recreation (Table 11). Employment in Tourism and Recreation increased between 1990 to 2001 by 44% and wages increased by 78%. Coastal construction employment grew more than 168% between 1990 and 2001. Wages in Living Resources decreased by 52% between 1990 and 2001.

Table 11: Ocean Economic Data in Monterey County

County	Year	Sector	Employment	Wages	Gross State Product
Monterey	2001	Construction	531	$25,092,377	
Monterey	2001	Living Resources	74	$1,920,888	
Monterey	2001	Tourism & Recreation	11950	$238,280,718	
Monterey	2001	Transportation	849	$30,647,529	
Monterey	1990	Construction	198	$8,145,767	$15,384,686
Monterey	1990	Living Resources	281	$4,038,264	$1,1374,761
Monterey	1990	Tourism & Recreation	8271	$134,042,893	$283,508,971
Monterey	1990	Transportation	339	$11,284,332	$20,205,224

D = Disclosure issues prevent these data from being presented.
Note: All dollar values are converted to year 2000 equivalents.
(Source: National Ocean Economics Program. 2005. www.oceaneconomics.org)

There are two main commercial harbors and ports and one small landing facility in the Monterey County region. The commercial harbors are Moss Landing and Monterey, and the landing facility is at Mill Creek in the southern end of the county. Moss Landing and Monterey also have private recreational boating facilities as well as commercial passenger fishing vessels (CPFV). A small recreaqtional launch facility exists in Stillwater Cove, Pebble Beach.

In 2003 a socio-economic study of the Moss Landing commercial fishing industry showed that the commercial industry includes 125 residents and 175 non-resident fishing operations, 7 resident and dozens of non-resident fish buyers, and 9 local businesses and many more non-resident businesses (Pomeroy and Dalton, 2003). Ten people are harbor employees (Pomeroy and Dalton, 2003). The Harbor's average annual expenditures for 1999 – 2001 were about $10 million, bringing in approximately $10.1 million per year (Pomeroy and Dalton, 2003). The Moss Landing Harbor provides goods and services to the commercial fishing industry and research and tourism communities. It provides dredging services, as well as berths and other amenities.

5.1.2 San Luis Obispo County

San Luis Obispo County has a small population compared with other counties in the region, but cities such as Paso Robles are growing rapidly at an annual of rate of 4.3%. Unemployment was only 3.4% in 2002, compared with the state average of 6.7%. Tourism and education are the basis of the economy. The government is the largest employer in the county providing more than 23,000 jobs. Trade, transportation and utilities are the second largest industry, and leisure and hospitality is the third largest industry in the county. Natural resources, mining and construction, information, and other service are the fastest growing industries in the county. The county continues record job growth with the service sector expected to grow almost 20% between 1999-2006 (LMID 2003).

In San Luis Obispo County ocean industry data are incomplete (Table 12). Employment in Tourism and Recreation increased between 1990 to 2001 by 94% and wages increased by 120%. Coastal construction employment grew by 4%.

Table 12: Ocean Economic Data in San Luis Obispo County

County	Year	Sector	Employment	Wages	Gross State Product
San Luis Obispo	2001	Construction	518	$20,542,408	
San Luis Obispo	2001	Living Resources	N/A	N/A	
San Luis Obispo	2001	Ship & Boat Building	N/A	N/A	
San Luis Obispo	2001	Tourism & Recreation	6337	$83,043,055	
San Luis Obispo	2001	Transportation	170	$5,212,833	
San Luis Obispo	1990	Construction	498	$18,559,034	$35,051,939
San Luis Obispo	1990	Living Resources	D	D	D
San Luis Obispo	1990	Tourism & Recreation	3263	$37,690,456	$81,695,765
San Luis Obispo	1990	Transportation	D	D	D

D = Disclosure issues prevent these data from being presented.
Note: All dollar values are converted to year 2000 equivalents.
(Source: National Ocean Economics Program. 2005. www.oceaneconomics.org)

There are three main commercial harbors and ports in the Morro Bay region. They are Morro Bay, Avila, and Port San Luis. Cambria (Leffingwell's), Morro Bay, and Port San Luis have private recreational boating facilities. Morro Bay and Port San Luis have CPFVs.

5.1.3 San Mateo County

A small portion of the northern part of the study region borders San Mateo County. San Mateo County is the 13th most populous county in the state. Population density is high, particularly in the eastern half of the county. The coastal Santa Cruz Mountains divide the county, with the western, coastal side having more rural uses such as farming, game preserves, watersheds, parks, and undeveloped lands. Industry projections from 1999-2006, show that the three largest growth industries are service, retail trade, and manufacturing (LMID, 2003).

Ocean industry data are presented below are for all of San Mateo County; howerver, as stated above the study region includes only the southern most part of the county. The construction industry decreased between 1990 and 2001 by 27% in employment and 44% in wages. Both Transportation and Tourism and Recreation employment and wages increased between 1990 and 2001 (Table 13).

Table 13: Ocean Economic Data in San Mateo County

County	Year	Sector	Employment	Wages	Gross State Product
San Mateo	2001	Construction	500	$24,152,973	
San Mateo	2001	Living Resources	N/A	N/A	
San Mateo	2001	Ship & Boat Building	N/A	N/A	
San Mateo	2001	Tourism & Recreation	25216	$488,205,469	
San Mateo	2001	Transportation	3973	$290,205,144	
San Mateo	1990	Construction	689	$43,031,684	$81,272,761
San Mateo	1990	Living Resources	D	D	D
San Mateo	1990	Ship & Boat Building	D	D	D
San Mateo	1990	Tourism & Recreation	16290	$265,080,937	$563,453,079
San Mateo	1990	Transportation	1709	$92,601,868	$114,455,006

D = Disclosure issues prevent these data from being presented.
Note: All dollar values are converted to year 2000 equivalents.
(Source: National Ocean Economics Program. 2005. www.oceaneconomics.org)

5.1.4 Santa Barbara County

Government, trade, transportation and utilities, and leisure and hospitality are significant industries in the county. The largest employer is the government, providing close to 20% of all employment due to the University of California Santa Barbara, federal prison, and Vandenberg Air Force Base. Services, retail trade, and government are the largest projected growth industries.

Ocean industry data presented below are for all of Santa Barbara County; however, the study region includes only the northern most part of the county. Construction industry and Living Resources employment and wages decreased between 1990 and 2001, while Transportation and Tourism and Recreation sectors expanded (Table 14).

Table 14: Ocean Economic Data in Santa Barbara County

County	Year	Sector	Employment	Wages	Gross State Product
Santa Barbara	2001	Construction	216	$12,077,178	
Santa Barbara	2001	Living Resources	15	$357,587	
Santa Barbara	2001	Ship & Boat Building	N/A	N/A	
Santa Barbara	2001	Tourism & Recreation	13915	$229,331,940	
Santa Barbara	2001	Transportation	2546	$147,835,455	
Santa Barbara	1990	Construction	227	$9,605,311	$18,141,287
Santa Barbara	1990	Living Resources	11	$202,858	$593,668
Santa Barbara	1990	Ship & Boat Building	12	$315,663	$376,981
Santa Barbara	1990	Tourism & Recreation	8889	$119,728,107	$260,033,094
Santa Barbara	1990	Transportation	2393	$122,402,300	$150,786,526

D = Disclosure issues prevent these data from being presented.
Note: All dollar values are converted to year 2000 equivalents.
(Source: National Ocean Economics Program. 2005. www.oceaneconomics.org)

5.1.5 Santa Cruz County

Santa Cruz is the second smallest county in California with just 440 square miles of land. The county expects population growth rate in the next few years to be at approximately 1.3 - 1.6% annually (LMID, 2003). Unemployment is higher in this county than other counties due to the seasonal variations of employment in the main industries of agriculture, recreation, and tourism (LMID, 2003). Government, including federal, state, and local, is the largest area of growth at 17.6%. The service sector is expected to grow at 17.5%, between 1999-2006 and, retail trade is the third largest industry of growth. The southern part of the county incorporates more fertile lands of Pajaro Valley which is a productive agricultural community producing strawberries, raspberries, landscape plants, lettuce, and flowers among other crops. Between 1999-2001 there were three years of decline in the agricultural industry, however 2002 saw an increase of 8%. Watsonville is the major agricultural community in the region where many food processing firms are based.

In Santa Cruz County the ocean industry that employs the most people (8527 in 2001) and pays the most wages ($135 million in 2001) is Tourism and Recreation (Table 15). Employment in Tourism and Recreation increased between 1990 to 2001 by 53% and wages increased by 97%. Transportation employment grew more than 2622% between 1990 and 2001. Employment in Ship and Boat Building remained stable at 42 between 1990 and 2001, although wages increased.

Table 15: Ocean Economic Data in Santa Cruz County

County	Year	Sector	Employment	Wages	Gross State Product
Santa Cruz	2001	Construction	104	$3,187,144	
Santa Cruz	2001	Living Resources	N/A	N/A	
Santa Cruz	2001	Ship & Boat Building	42	$1,425,326	
Santa Cruz	2001	Tourism & Recreation	8527	$134,935,909	
Santa Cruz	2001	Transportation	844	$44,271,712	
Santa Cruz	1990	Construction	92	$3,190,236	$6,025,311
Santa Cruz	1990	Living Resources	D	D	D
Santa Cruz	1990	Ship & Boat Building	42	$1,037,273	$1,238,764
Santa Cruz	1990	Tourism & Recreation	5585	$68,447,705	$145,754,172
Santa Cruz	1990	Transportation	31	$313,335	$561,043

D = Disclosure issues prevent these data from being presented.
Note: All dollar values are converted to year 2000 equivalents.
(Source: National Ocean Economics Program. 2005. www.oceaneconomics.org)

There is one main commercial harbor in the county, Santa Cruz Harbor. It also has private recreational boating facilities, as well as rental boats and CPFVs. Capitola Pier also has private and rental boat facilities.

5.2 Population Projections

Most of the population of California lives near the coast. Population growth trends in coastal counties will result in increasing pressure on and impacts to coastal and marine resources and habitats. San Luis Obispo County has the highest percent change in population growth (+29.3) among counties along the Central Coast study region (Table 16). Population centers include the largely urbanized cities of Salinas, Santa Cruz, the Monterey Peninsula, and Santa Maria.

Table 16: Total Population, Population Change, and Projected Growth in Coastal Counties in the Central Coast

Coastal County	Total Population (2003)*	% Population change 1990-2000	% Projected population change 2000-2010	% Projected Population Change 2000-2050	Projected Population 2050	People Per Square Mile (2002)*
San Mateo	697,456	+ 10.5	+ 10.7	16.3	826,342	1574.7
Santa Cruz	251,584	+ 12.9	+ 20.3	14.2	293,350	445
Monterey	414,449	+ 14.9	+ 20.7	62.2	654,847	120
San Luis Obispo	253,118	+ 15.1	+ 29.3	38.3	343,548	74.7
Santa Barbara	403,134	+ 9.9	+ 15.2	20.2	481,840	574.1

(Source: *US Census Bureau Quickfacts, quickfacts.census.gov; California Institute for County Government, www.cicg.org)

Populations of all coastal counties are expected to grow, though at markedly different rates. Based on census data, populations in all coastal counties grew during the period between 1990 and 2000. All of the counties in the region, except Santa Cruz, had rates of growth greater than 15% in that period (Table 16). Based on a demographic model that incorporates

fertility, migration, and survival rates, population projections for the year 2050 indicate that Monterey County will have population increases greater than 50% and San Luis Obispo county close to 40% (Table 16). Rapid growth is occurring in the counties where the average population density is currently the lowest.

5.3 Coastal Tourism

California is the most visited state in the U.S., and travel and tourism comprise the fourth largest industry and employer in the state. In 2003 total travel and tourism expenditures totaled $78.2 billion and provided jobs for 894,000 Californians. Californians love to travel around their own state, accounting for 86% of all visitors (CTTC, 2004).

Tourism and recreation are economic drivers in Central Coast counties. These counties boast some of the "Top Ten" most popular destinations in the state, including the Monterey Bay Aquarium and the Santa Cruz Beach and Boardwalk (Table 17). The Central Coast, with its numerous coastal parks and beaches, five state marine reserves, and seven state marine conservation areas, also attracts visitors to swim, dive, birdwatch, whalewatch, tidepool, and hike the magnificent coastal environments.

Table 17: Park Attendance in Selected Coastal Parks & Marine Attractions

Site	County	# visitors (2003)
Asilomar State Beach and Conference Center	Monterey	647,169
Marina State Beach	Monterey	850,539
Monterey Bay Aquarium	Monterey	1,678,929
Monterey State Beach	Monterey	788,817
Pfeiffer Big Sur State Park	Monterey	379,562
Point Lobos State Reserve	Monterey	285,032
Salinas River State Beach	Monterey	505,221
Hearst Castle	San Luis Obispo	767,816
Monta*ñ*a De Oro State Park	San Luis Obispo	776,651
Morro Bay State Park	San Luis Obispo	1,515,506
Pismo State Beach	San Luis Obispo	1,177,518
Point Sal State Beach	Santa Barbara	8800
Natural Bridges State Beach	Santa Cruz	917,861
New Brighton State Beach	Santa Cruz	1,546,308
Seacliff State Beach	Santa Cruz	2,503,230
Santa Cruz Beach Boardwalk	Santa Cruz	3,000,000

(Source: California Travel and Tourism Commission – Fast Facts 2004; http://visitcalifornia.com; Department of Parks and Recreation, 2004. California State Park System Statistical Report. Sacramento, CA)

Coastal tourism contributes significantly to each county (presented in alphabetical order) involved in this profile:

***Monterey County*:** Tourism in many Central Coast counties continues to grow, particularly in Monterey County. Within northern California, Monterey County is the number one destination, followed by San Francisco and Napa/Sonoma Counties (Wirthlin Worldwide, 2000a). During the 1990s, tourism expenditures in Monterey increased by 58% (1.1 to 1.7 billion), constituting 2.46% of the California total. In 2003, Monterey County ranked the 11th highest county for tourism expenditures in the state (CTTC, 2004. TOT collections for fiscal year 2002-03 totaled $36,416,427. Top area collections were Monterey County ($13,182,896), Monterey ($12,530,952), Carmel-by-the-Sea ($3,345,251), and Pacific Grove ($2,785,451) (TOT numbers compiled by Ernest Hoffman Results Consulting and Research found on http://media.montereyinfo.org/page/8464/).

In 2003, Monterey County saw 8.1 million person-trips total—6.6 million for leisure, and 1.5 million for business (D.K. Shifflet & Associates http://media.montereyinfo.org/page/8464/). The county boasts 99 miles of shoreline (including the Big Sur coast), six county parks, 15 state parks, two regional parks, seven state MPAs, a National Forest, a National Monument, a Wilderness Area, a Marine Sanctuary, two harbors, a National Estuarine Research Reserve and Visitor Center, nine museums (history, art, natural history, and children's), 25 golf courses, the 17-Mile Drive in Pebble Beach, Monterey Bay Aquarium, and the National Steinbeck Center. With these natural, cultural, and recreational resources, visitors engage in many activities, from hiking in Big Sur to golfing, kayaking, butterfly watching, SCUBA diving, visiting museums, and shopping. Monterey Bay Aquarium, the most visited attraction in the county and on the "Top Ten" list of California's major tourist destinations, attracted 1,679,929 visitors in 2003. The El Estero Visitor Center attracted 181,013 people, with a daily average of 836 during summer (Monterey County, Facts, Stats, & FAQs, http://media.montereyinfo.org/page/8464/). Other popular destinations in 2004 included Cannery Row, which attracted 56% of visitors to the county; 34% visited downtown Monterey, 30% Carmel, 37% Fisherman's Wharf, and 21% the 17-Mile Drive (MBA 2004b). According to a market research study on Cannery Row tourists, 60% of Cannery Row visitors will visit 6 locations in the county. They are: Cannery Row, Fisherman's Wharf, Carmel, Monterey Bay Aquarium, and 17 Mile Drive and Big Sur (Wirthlin Worldwide, 2000b). Citing the area as beautiful, a good location for families and children, and as a "must see" location for out-of-town guests, more than a third of all visitors stayed in Monterey County overnight (MBA 2004b; Wirthlin Worldwide, 2000a).

Since its inception in 1984, Monterey Bay Aquarium has had over 37 million visitors from around the world and played an important economic and educational role in the city, county, and state. The Aquarium attracts 1.8 million visitors annually-approximately 7-10% of visitors from outside the U.S. About 20 percent from outside California, and 95% from outside Monterey County (MBA, 2004a). In 2004 it ranked first in North American aquarium attendance and attracts more visitors than any other destination in Monterey County (from a total of eight million visitors annually to the county) (MBA, 2004a). The Aquarium drives economic activity for Monterey County and represents a recurring "economic value chain" to the city, county, regional and state economies. As the county's 10th largest employer, it employs more than

400 California professionals, representing $14 million in salaries and wages. In 2003, the Aquarium generated $114 million of direct economic activity (including payroll, expenditures, and economic activity generated through travel, lodging, etc.) and $124 million in indirect economic activity produced by downstream visitor spending. In 2003, Aquarium made payments of $2.7 million to the city, county, and state in the form of fees and taxes (MBA, 2004a). The aquarium also provides direct educational benefits to visitors. In 2003, it offered over 100,000 students and teachers 23 unique educational experiences, from free school program to professional development curricula (MBA, 2004a).

***San Luis Obispo*:** Tourism is a $903.9 million industry in San Luis Obispo County, creating jobs for 16,270 residents and generating $60.5 million in local and state taxes. Hotel and motel occupancy rates have been falling several years in a row (UCSB, 2005). Top attractions include Hearst Castle, the missions (Mission San Luis Obispo de Tolosa and Mission San Miguel Arcangel), beaches (Avila, Cayucos, Morro Strand, Oceano, Pismo, San Simeon), wineries (Paso Robles and San Luis Obispo regions), and Scenic Highway 1. The National Audubon Society routinely ranks Morro Bay among the top ten for number of bird species seen during the annual Christmas bird count; Morro Rock is a Peregrine Falcon Natural Preserve. The county contains four state MPAs. Morro Bay State Park attracted 1.5 million visitors in 2003 (CTTC, 2004). Oceano Dunes, the only California State Park where vehicles may be driven on the beach, also attracts many visitors. (Fact Sheet http://www.sanluisobispocounty.com/static/index.cfm?contentID=19).

***San Mateo County*:** Coastal destinations in the part of San Mateo County that falls within this study region include Pigeon Point, Gazos Creek Coastal Area, Franklin Point, and Año Nuevo State Reserve and Park. Of these, Año Nuevo, a major gathering area for elephant seals, attracts great numbers of nature lovers each winter. In 2003 San Mateo County saw $2,024.5 million in travel spending and generated 34,320 jobs in tourism and tourism-related industries (Runyan, 2004).

***Santa Barbara County*:** In 2003, Santa Barbara County experienced $1,219 million in travel spending and 15,310 jobs in the tourism industry (Runyan, 2004). Over the 10-year period ending in 2002, the county showed an average increase of 6.7% in hotel/motel sales (County Statistical Profile, http://www.countyofsb.org/cao/pdf/budget/0304/Sectionb.pdf). This Central Coast study, which encompasses the northern part of the county, includes many heavily-visited county and state beaches, and contains one state MPA. CNN recently featured an article on Jalama Beach, Ocean Beach, and Rancho Guadalupe Dunes as “undiscovered” treasures of the region (July 20, 2005) (Runyan, 2004).

***Santa Cruz County*:** Tourism in Santa Cruz County is a $513 million industry that generated $14.5 million in local taxes in 2000 (*Runyan, 2004)*. The transient occupancy tax (TOT) collections in fiscal year 2001-2002 totaled as follows: City of Santa Cruz, the most popular city in the county, totaled $3,131,378, Watsonville $703,900, Capitola $470,080, and Scotts Valley $442,505. Santa Cruz County’s primary markets cater to the San Francisco Bay Area and the Central Valley (Schlau, 2000). The county boasts 29 miles of beaches, 14 state parks and beaches, a national marine sanctuary, and dozens of smaller parks, beaches and preserves. Santa Cruz County has no state MPAs. The Monarch butterfly sanctuaries entice winter

visitors. The county's top attraction is the Santa Cruz Beach and Boardwalk, which attracts 3 million visitors annually and rests on the "Top Ten" list of California's most popular destinations (CTTC, 2004). The Seymour Center at Longs Marine Lab has approximately 50,000 vistors and 200 school groups annually (Pers. Com., Terri, Sigler, Seymour Center).

5.4 Commercial Fisheries

There are two main port areas encompassed by the Central Coast study region. The Monterey port area includes the major ports of Monterey, Moss Landing, and Santa Cruz. Relatively small landings, which are included in the Monterey port area statistics, also occur at Mill Creek, Willow Creek, and Big Creek. The Morro Bay port area includes the ports of Morro Bay and Port San Luis/Avila, and the minor port of San Simeon. During the 1999- 2004 period, on average the annual landings from these port areas totaled approximately 68 million pounds of fish and invertebrates with an average annual ex-vessel value (price paid to fishermen) exceeding $15 million (Table 18). The disparity in the average price per pound for total landings from the two port areas is largely due to the major contribution of the coastal pelagic species (CPS) (squid, sardines, mackerel, anchovy) to the Monterey port area landings. These fisheries typically are high-volume with a corresponding relatively low price per pound. Morro Bay generally is not a major port for CPS species, although in some years squid landings may be significant. The two ports areas also differ significantly in the destination of products.

Table 18: Central California Commercial Harbor Areas and Ports with Average Annual Landings and Values for the Six-year Period 1999-2004.

Area	Ports	Total Pounds of Fish	Total Value ($)
Monterey Bay	Moss Landing	54,504,944	$ 7,546,789
	Monterey	8,741,532	$ 2,311,942
	Santa Cruz	585,069	$ 837,385
	All Other Ports	15,614	$ 42,896
	Monterey Bay Area Total	**63,847,159**	**$10,739,012**
Morro Bay	Morro Bay	2,418,482	$ 2,999,266
	All Other Ports	1,928,693	$ 1,426,162
	Morro Bay Area Total	**4,347,175**	**$ 4,425,427**

(Source: California CDFG, California Commercial Landings 1999-2004)

In CDFG's Preliminary California Commercial Landings for 2004,121 categories of fishes and 16 categories of invertebrates are listed with landings in the Monterey and/or Morro Bay port areas. This does not correspond exactly to the number of species landed because some of the categories are market categories containing multiple species. In addition the landings totals include some poundage harvested from north or south of the study region's latitudinal boundaries. In summary, however, these statistics attest to the high value and diversity of fishery resources in waters off the Central Coast.

Brief profiles of the most important commercial fisheries within the Central Coast study region are included as Appendix III. These include the following:

- Finfishes: King salmon, Pacific sardine, sablefish, albacore and other tuna, thornyheads, northern anchovy, Dover sole, California halibut, nearshore, shelf, and slope rockfishes, sanddabs, other flatfish, cabezon, grenadier, lingcod, sharks, white seabass, mackerel, butterfish, kelp greenling, jacksmelt, and surfperches.
- Invertebrates: Squid, spot prawn, Dungeness crab, rock crab, ocean shrimp, and red urchin.

Important commercial fisheries are defined as those fisheries with average annual landings during the 1999-2004 period of at least 10,000 pounds or average annual ex-vessel value of at least $10,000 in one or both port areas. Some of the fisheries contain multiple species due to the nature of the fishing gear and the association of particular species; others target single species and, while other species may be taken incidentally, either their retention is prohibited or they are of little or no economic value.

A longer time series of annual landings will likely show greater variability for some species but also may reveal long-term cycles in landings which are directly related to natural cycles of abundance or availability of the target species. Several important documents summarizing fishing trends for harvested species in the region are:

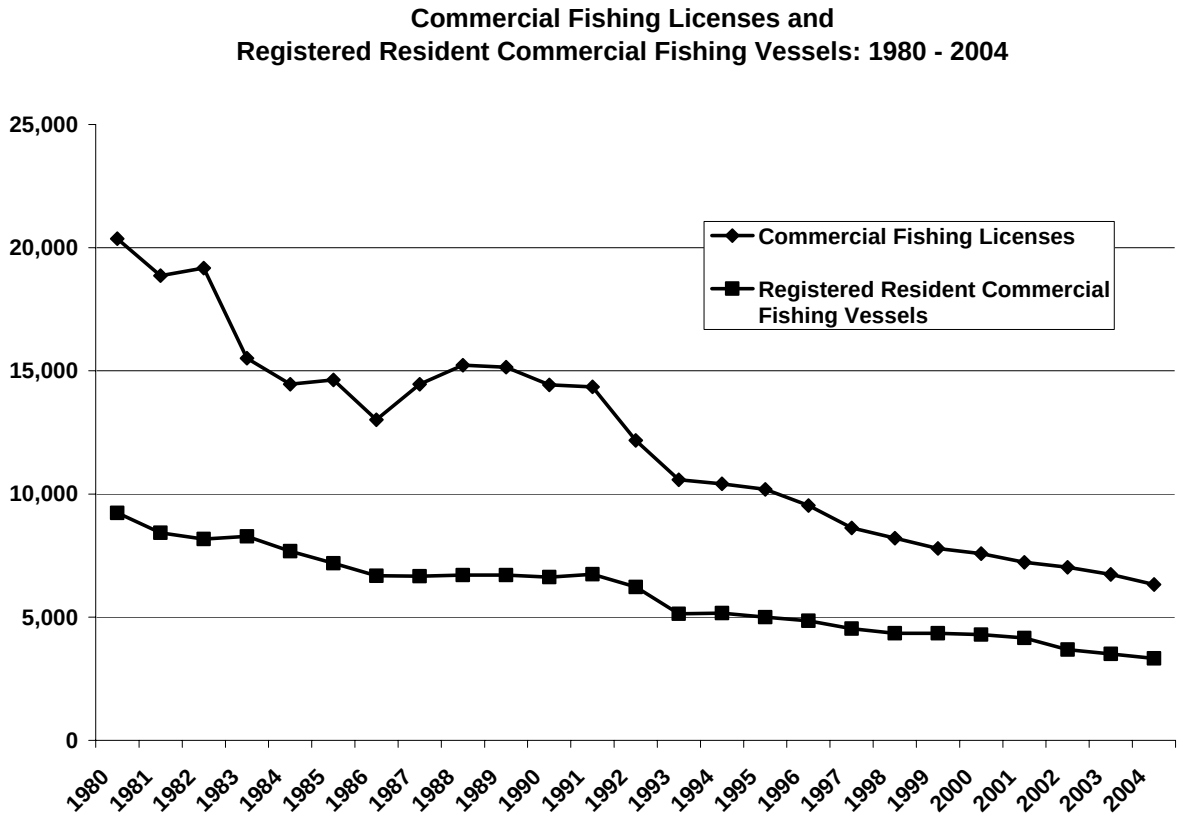
- *Trends in Fisheries and Fishery Resources Associated with the Monterey Bay National Marine Sanctuary from 1981-2000* (Starr, Cope and Kerr, 2002a, California Sea Grant College Program, 156 pages). While this publication covers an area not identical to the Central Coast study region (i.e. it includes landings from the port of Half Moon Bay and excludes those from the ports of Avila Beach and Port San Luis), it does provide much information on historical trends in landings within the majority of the study region.
- *California's Living Marine Resources: A Status Report* (CDFG 2001). This document, which was provided to the Regional Stakeholder Group and the Blue Ribbon Task Force, contains synopses of the history of the fishery, status of biological knowledge, and status of the population for most of California's harvested species, organized by an ecosystem approach.
- *Preferred Alternative Groundfish Essential Fish Habitat Draft Environmental Impact Statement* (The Pacific Fishery Management Council, www.pcouncil.org) for an explanation of Essential Fish Habitat, Habitat Areas of Particular Concern, and possible changes in federal regulations within the Central Coast study region based on concerns for habitat protection.

The reader is referred to Starr et al. 2002a (cited above) for an historical perspective on commercial as well as recreational fishing in the Central Coast study region.

During the past quarter century there has been a trend of a decreasing number of commercial fishermen and commercial fishing vessels participating in California's commercial fisheries. While data are not available specifically for the Central Coast study region, it is likely that the

statewide trend reflects local trends. Since 1980 the number of commercial fishing licenses sold statewide has declined by 69%, from approximately 20,400 to 6,300 in 2004 (Figure 3). Since 1988, a decline in licenses sold has occurred every year and has averaged 3.7% per year.

Figure 3: Commercial Fishing Licenses and Registered Resident Commercial Fishing Vessels : 1980-2004



Since 1980 the number of commercial fishing vessels registered statewide has declined by 64%, from approximately 9,200 to 3,300 in 2004. Although a decline in registered vessels has not occurred every year since 1988, the overall decline has averaged 3.2% per year since then.

These trends are due to a combination of many factors, including: relatively recent knowledge that the status of many rockfish stocks is poor; recent information that rockfishes are not as productive as once thought; increasingly restrictive fishery management regulations which have attempted to reduce fishing effort (e.g. through the implementation of restricted access fisheries or area-based fishery closures), attempts to reduce, in otherwise healthy fisheries, bycatch of species of concern; and the intention to reduce potential habitat damage from certain types of fishing gear (e.g from the use of trawls with large roller gear in complex habitats). In addition, oceanographic conditions during the last two decades of the 20th century have not been conducive to the successful annual recruitment of young rockfishes of many

species. However fishery scientists have seen much stronger recruitment during several years since 2000 which may indicate a return to more favorable oceanographic conditions for this important group of fishes.

Each fishery profile in Appendix III is organized into sections for the Monterey and Morro Bay port areas, and has the following information**:**

- Port area
- Fishery
- Species targeted
- 2004 preliminary landings and ex-vessel value
- 2003 landings and ex-vessel value
- 1999-2004 average landings and ex-vessel value
- Rank of average annual landings and annual value in port area 1999-2004 (additional landings and value data from 1989 to 1998 are provided as summary tables in the appendices)
- General trend in annual landings 1999-2004
- Comments on the trend in landings
- Number of fishermen making landings in 2003 and/or 2004 in port area
- Primary gear type(s) used in the fishery
- Primary depth range in which the fishery occurs
- Primary habitat(s) in which the fishery occurs
- Primary area of fishery (state waters and/or federal waters)
- Synopsis of regulations applicable to Central Coast study region

Within each port area, the fishery profiles are organized by descending order of 1999-2004 average annual landings. Some fishery profiles are not included in both port areas due to relatively few landings in one area. Profiles for the butterfish, jacksmelt and sardine/mackerel/anchovy fisheries are provided for the Monterey port area only. Profiles for the surfperch, ocean shrimp, and urchin fisheries are provided for the Morro Bay area only.

Four tables, provided in the Appendix III, contain annual landings and ex-vessel values from 1989 through 2004 for all of the species or species groups described in the fishery profiles for the particular port area (See Appendix III). One pair of tables precedes each port area profile section. Figures 4-12 below summarize landings (volume) and ex-vessel value of finfish and invertebrates. Monterey Bay total landings and ex-vessel values are significantly higher than those for Morro Bay. Monterey Bay ex-vessel invertebrates values are highly variable due to squid catch.

Figure 4: Monterey Ex-vessel Landings: Finfish

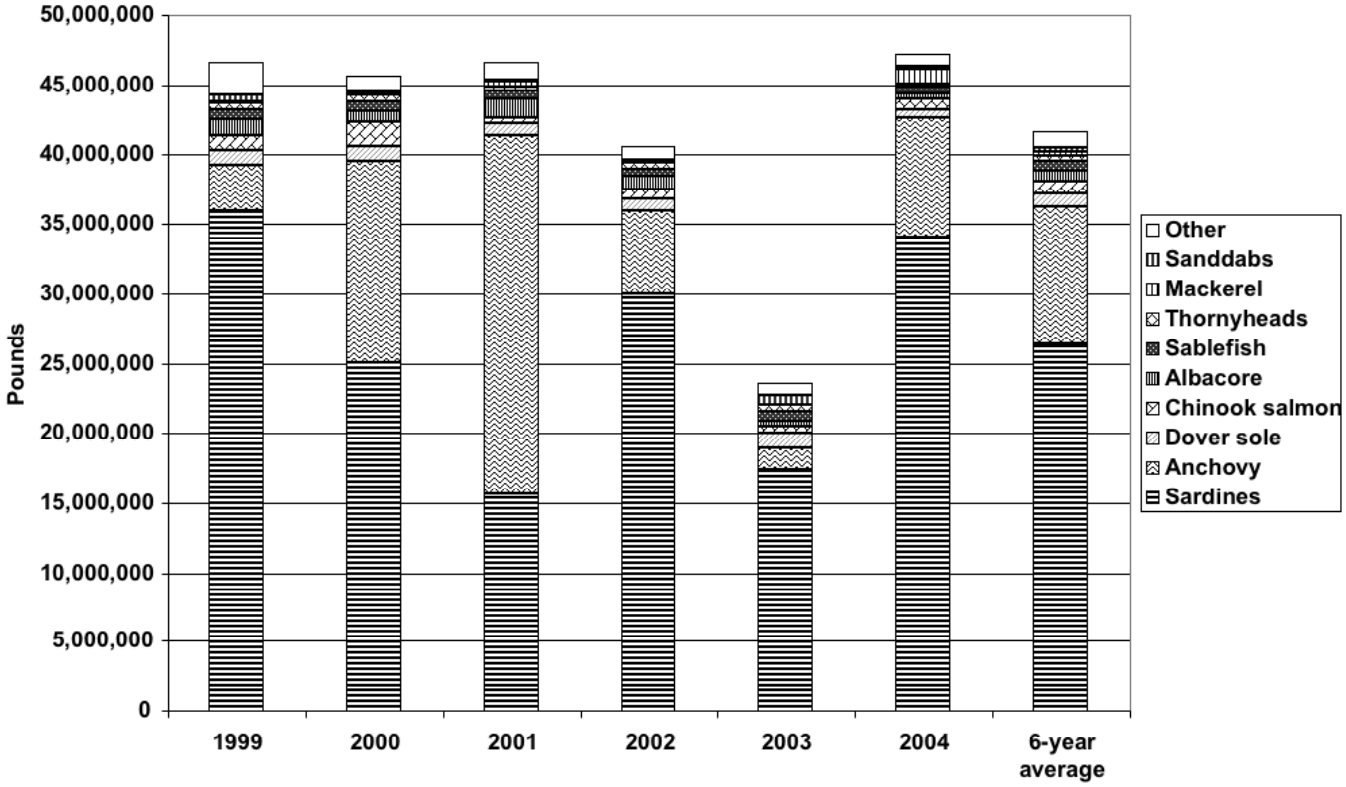


Figure 5: Monterey Port Area Landings Volume: Finfish Other than Anchovy and Sardine

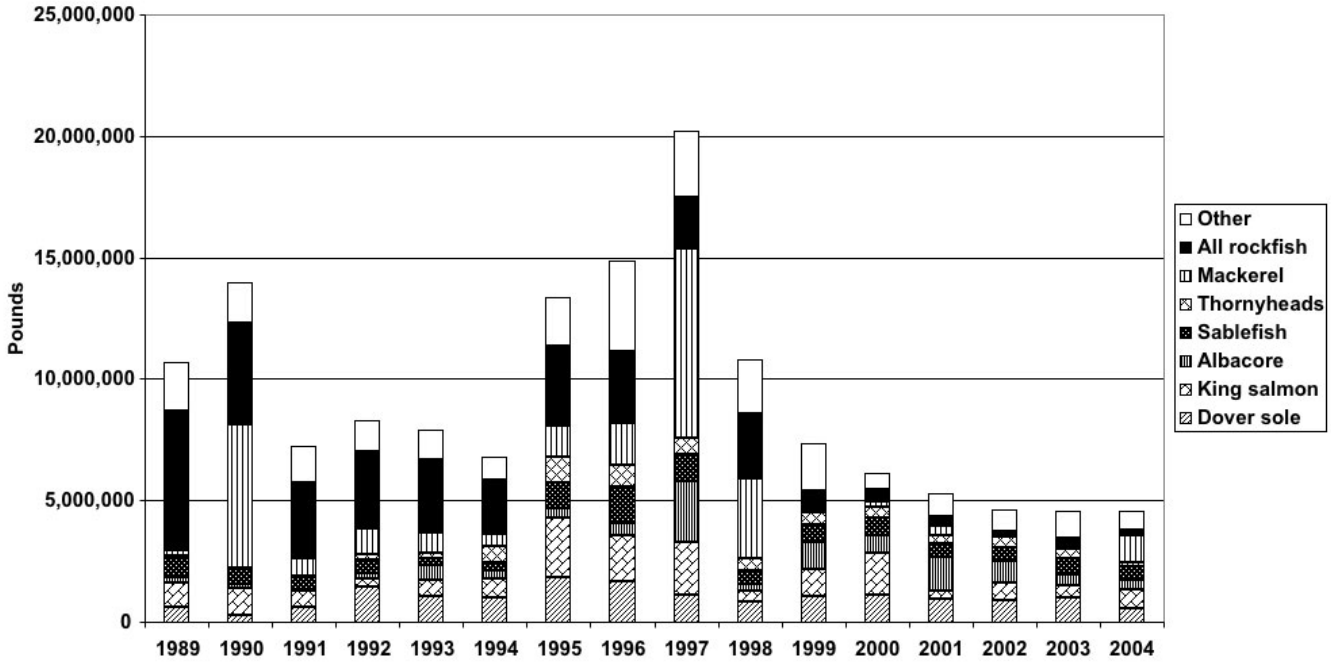


Figure 6: Monterey Ex-Vessel Value: Finfish

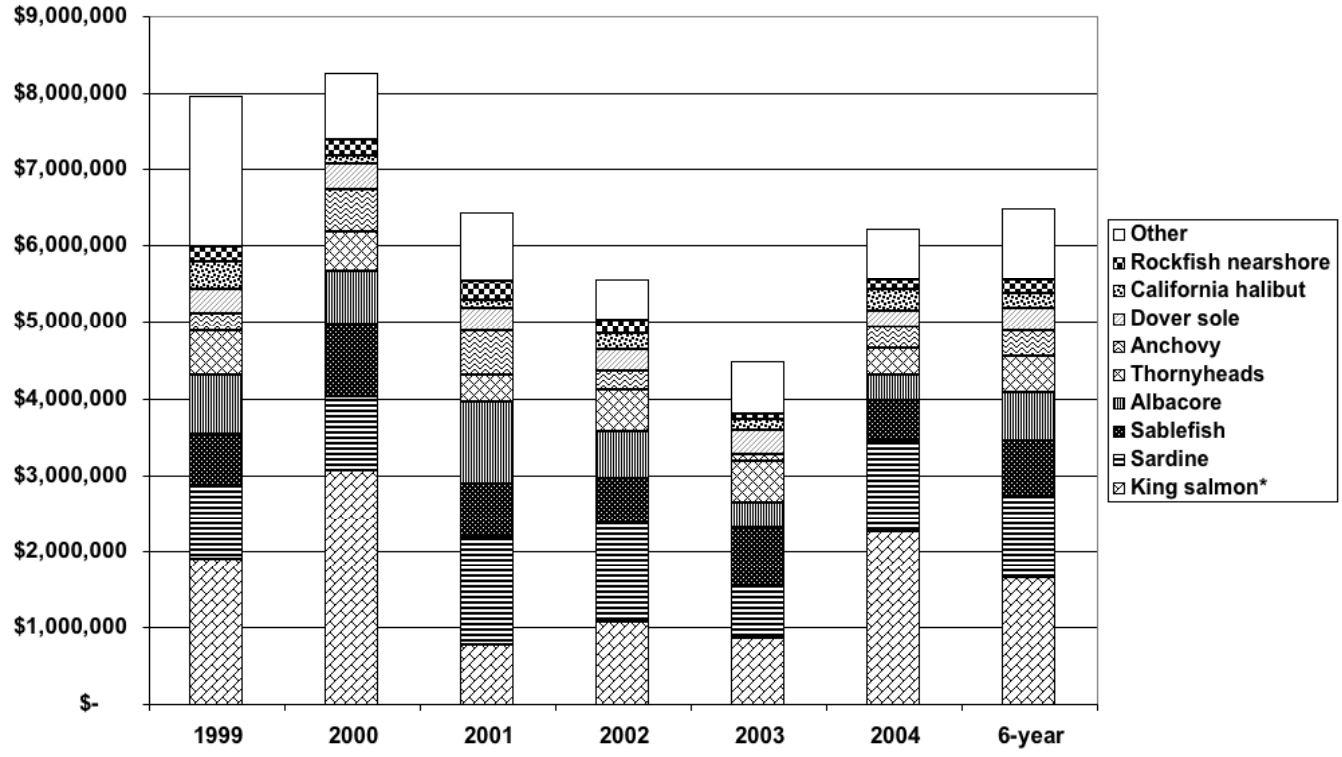


Figure 7: Monterey Ex-Vessel Landings: Invertebrates

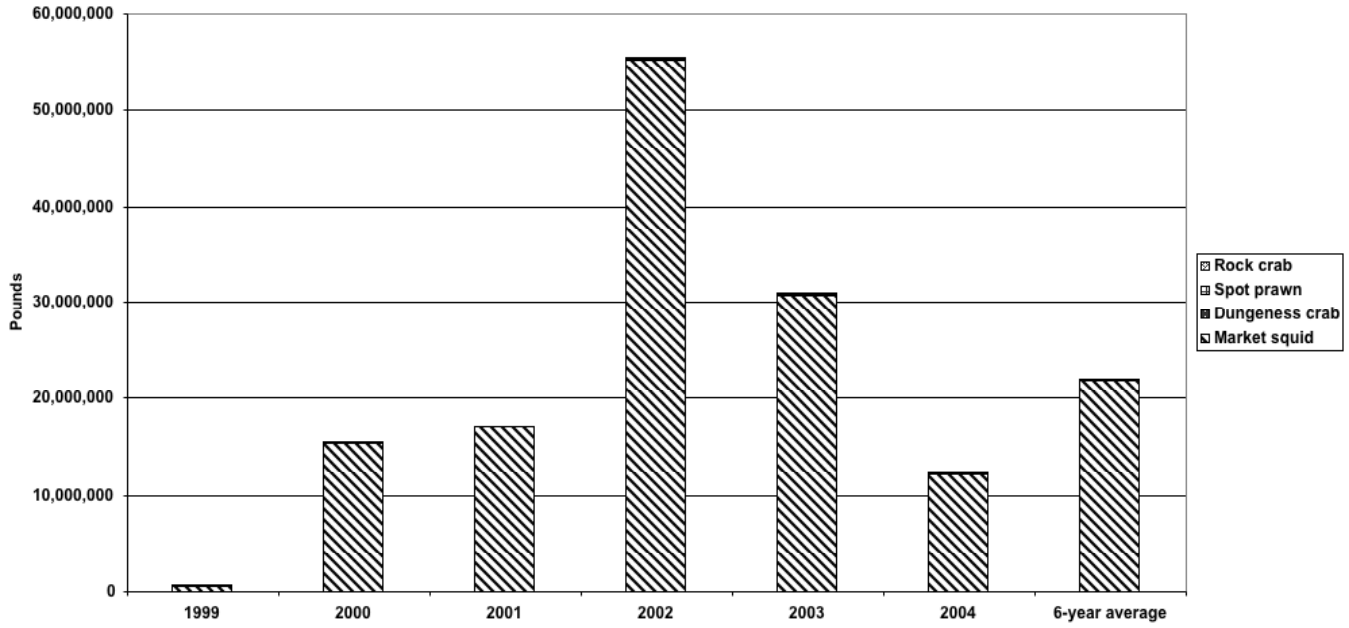


Figure 8: Monterey Ex-Vessel Value: Invertebrates

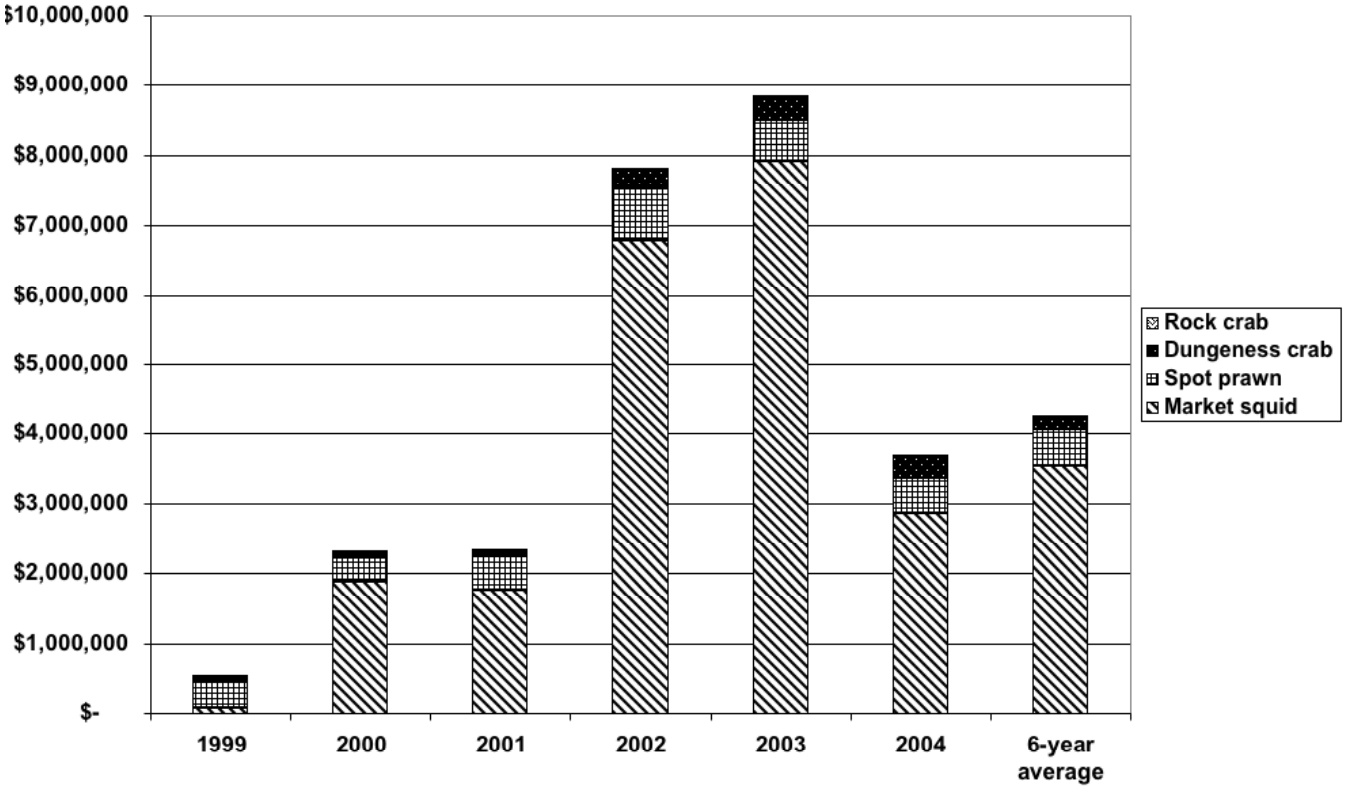


Figure 9: Morro Bay Ex-Vessel Landings: Finfish

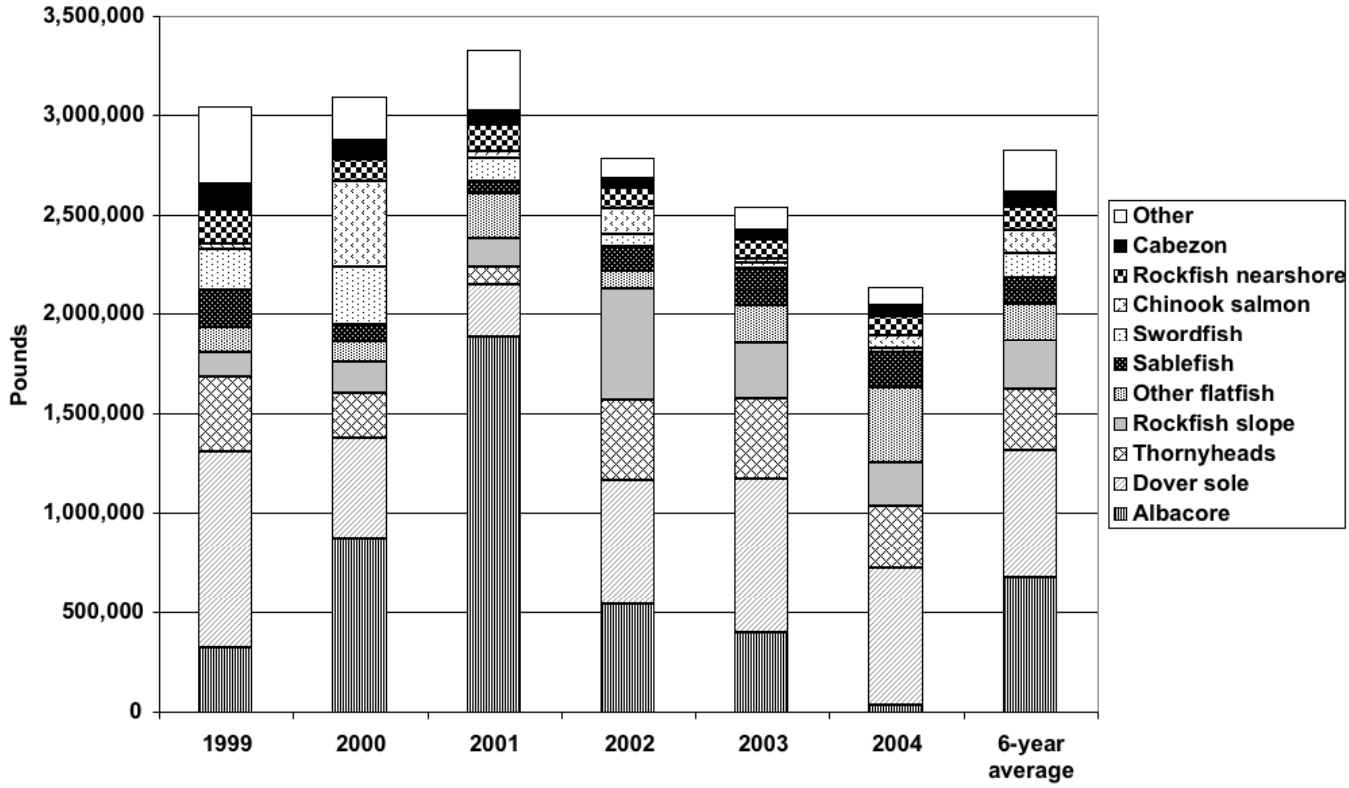


Figure 10: Morro Bay Ex-Vessel Value: Finfish

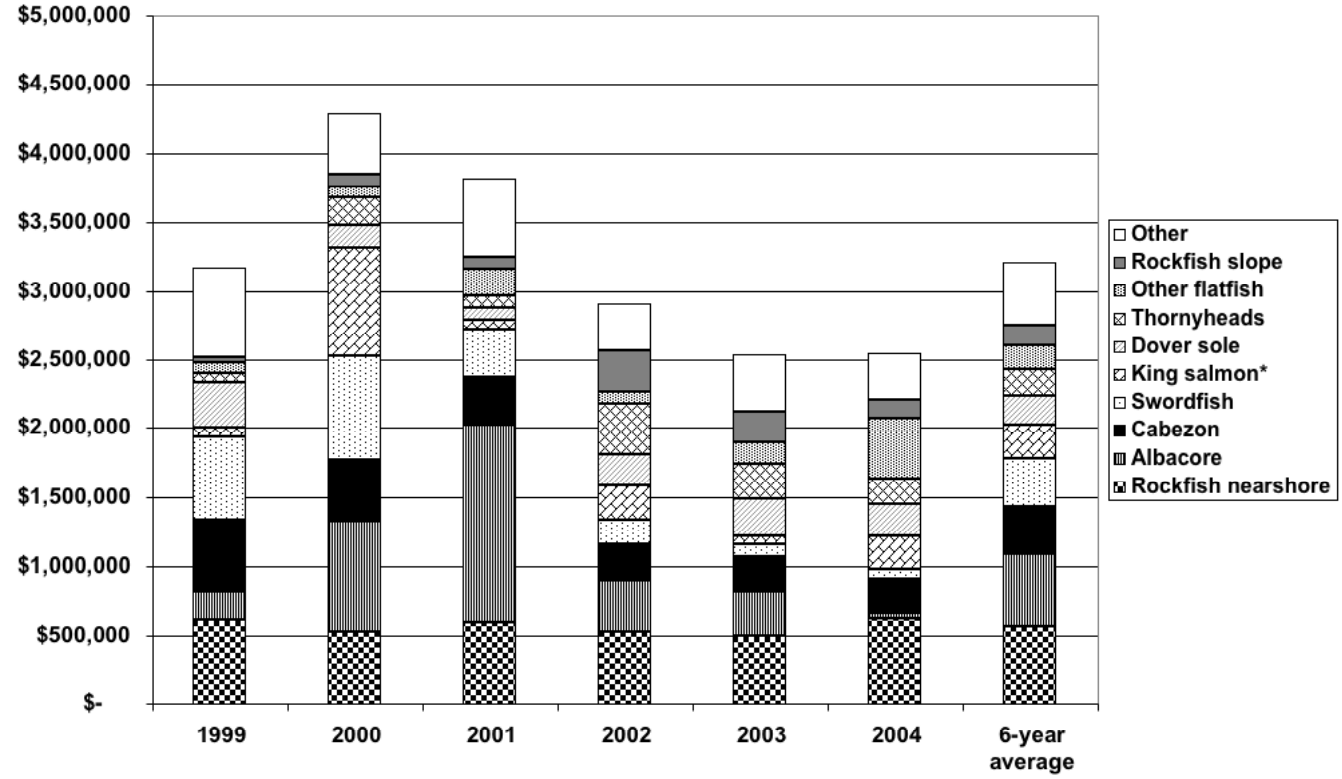


Figure 11: Morro Bay Ex-Vessel Landings: Invertebrates

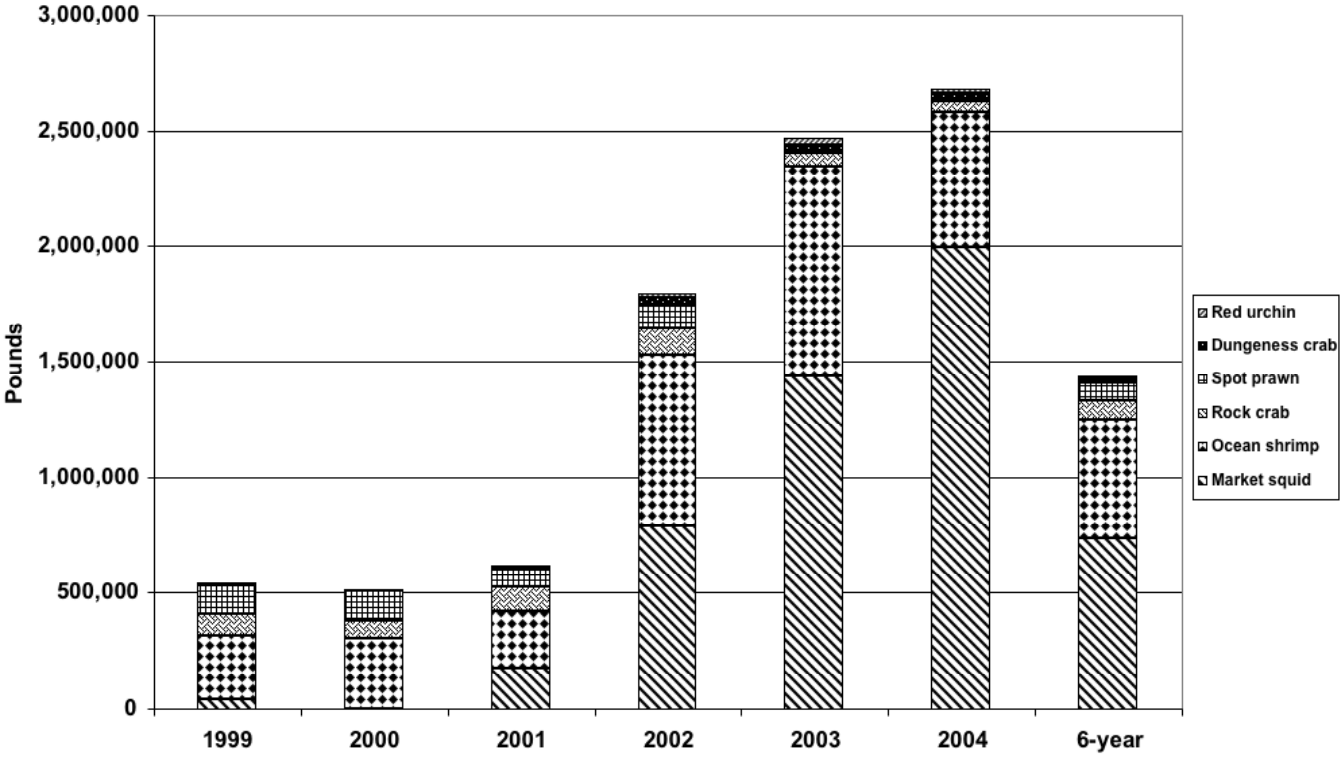
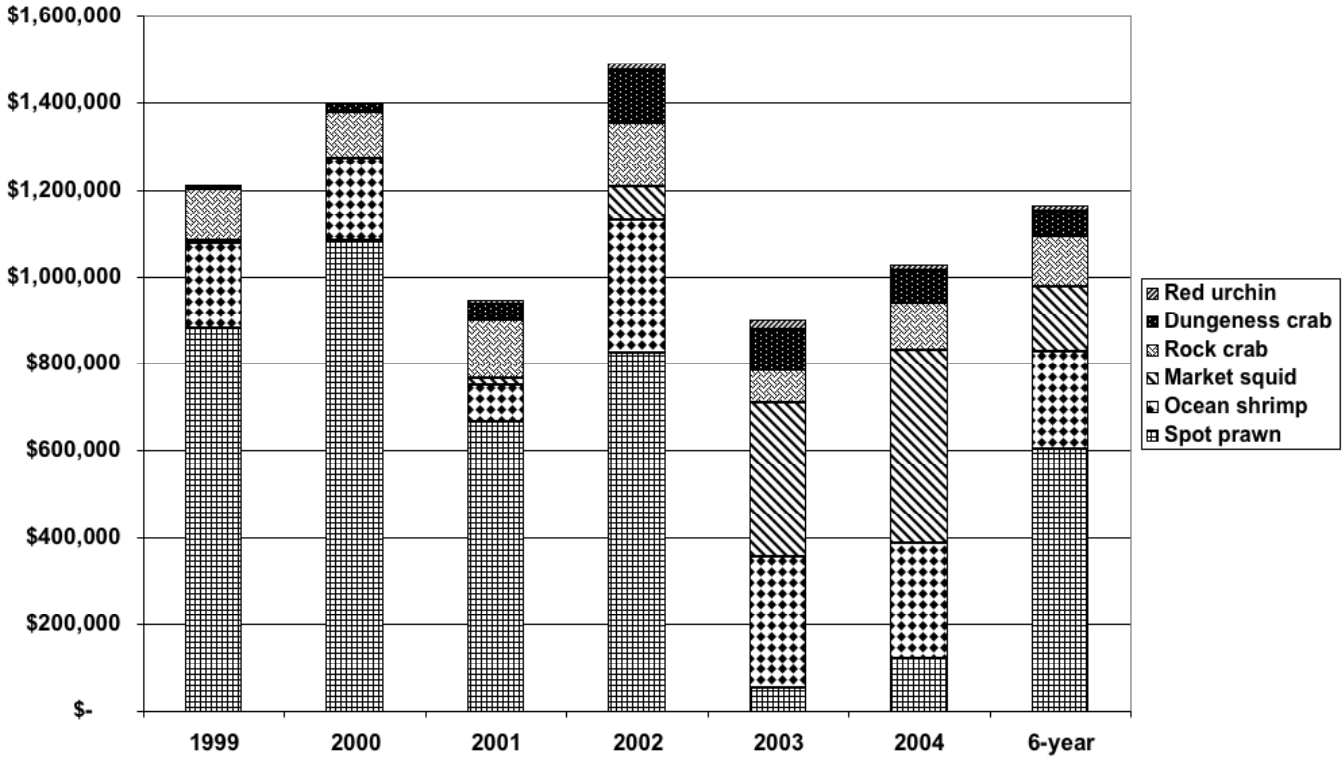


Figure 12: Morro Bay Ex-Vessel Value: Invertebrates



Perhaps the most important aspect of commercial fisheries as related to the MLPA Initiative is the area in which each fishery occurs, more specifically the relative effort occurring in, and the relative value derived from, specific areas. Many of these spatially explicit data sets are being obtained by EcoTrust through direct interviews with fishermen and will be available in October 2005 (and will be included as Appendix VII). The Department will provide spatially explicit data for the squid and trawl fisheries which occur within the study region, based on logbooks submitted by fishermen since the mid- to late-1990's. This information will be available as GIS data layers. CDFG will also provide spatial information from 1997-98 by DFG catch block from logbook data for the spot prawn trawl fishery. Although this fishery operated primarily outside state waters and the use of spot prawn trawl gear is no longer permitted, this data set will provide some perspective on the extent of spot prawn habitat adjacent to state waters within the study region.

Some of the fisheries included in these profiles operate largely or entirely outside of state waters; these include the albacore and other tuna, swordfish, shark, and ocean shrimp fisheries. In addition, while red urchins are harvested within state waters, the harvest occurs outside of the Central Coast study region. Spatially explicit data are not available for these fisheries nor are these data specifically germane to the MLPA Initiative process. However, these fisheries are still important to the local economy within the study region.

Commercial fisheries which have the greatest potential to be impacted by the implementation of new or expanded MPAs are those which occur primarily or significantly within state waters of the Central Coast study region and target primarily residential, non-migratory species.

These include the following: nearshore and shelf rockfishes, lingcod, cabezon, kelp greenling, California halibut, butterfish, jacksmelt, surfperches, squid, spot prawn, Dungeness crab, and rock crab.

5.5 Aquaculture and Kelp Harvesting

Within the Central Coast study region, aquaculture and kelp harvesting are intricately linked. There are four marine aquaculture operations, one in Cayucos, (San Luis Obispo County), two in Monterey, and one in Davenport, (Santa Cruz County), that culture red abalone (*Haliotis rufescens*). The primary source of food for these abalone is giant kelp (*Macrocystis pyrifera*). All of the kelp is sustainably harvested from beds within the study region. In addition, one abalone aquaculturist in Goleta, Santa Barbara County, and one at Pillar Point harbor, San Mateo County, harvest kelp from beds within the study region. Oysters are cultured in Morro Bay.

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 25 administratively numbered kelp beds within the study region; one of these (Pt. Sal to Pismo Beach Pier) has no kelp. Three of these beds are closed, six are leasable, six are leased, and 10 are open. Kelp harvesting by aquaculturists presently occurs in three leased beds between Pismo Beach and Cambria and three open beds from Cypress Pt, Monterey County, to Pt. Año Nuevo. Harvesting in beds 204, 207, and 208 is accomplished using a mechanical harvester; harvesting in other beds is done by hand. Approximately 3,600 tons of kelp are harvested annually as follows:

Table 19: Kelp Bed Location and Annual Harvest

Admin. bed number	Location	Annual harvest (tons)
204 and 207	204: Pismo Beach Pier toPt. San Luis 207: Morro Rock to Pt. Estero	1,950 (combined)
208	Pt. Estero to Von Helm Rock	850
220 and 221	220: Cypress Point to Monterey Pier 221: Monterey Pier to Santa Cruz Pier	550
222	Santa Cruz Pier to Sand Hill Bluff	250

In addition to the beds listed above, beds 209, 219, and 223 are also considered to be important to the industry. Giant kelp is also harvested within the Central Coast for use on the herring eggs-on-kelp fishery in San Francisco Bay. Sections of kelp plants are suspended from

lines secured to rafts or under piers; after herring spawn on the kelp fronds, the product is harvested. Important beds for this fishery are numbers 221 to 223.

In June 2005, the country's largest kelp harvesting facility, ISP Alginates, announced it was closing its plant in San Diego County after 76 years in operation. ISP Alginates conducted the majority of their harvesting in southern California. However, the company did harvest on a regular basis in some of the beds in the southern half of the study region and, infrequently, their kelp cutter traveled as far north as Carmel Bay to harvest kelp. It is likely that the leases ISP Alginates had for harvesting kelp beds north of Pt. Conception will not be renewed. The harvest estimates in Table 19 reflect a zero harvest by ISP Alginates in 2004, thus it is likely that the exodus of this company will not result in a decrease in these harvest figures.

5.5.1 Synopsis of Kelp Harvest Regulations

No kelp or other aquatic plant may be harvested in a state marine reserve or state marine park. A kelp harvester may harvest kelp by cutting and removing portions of attached kelp or by collecting unattached kelp. A kelp harvester may not cut attached kelp at a depth greater than four feet below the surface at the time of cutting.

Between April 1 and July 31, a kelp harvester may not harvest bull kelp from a nonleased 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.

A kelp harvester may not harvest kelp in that portion of kelp bed 220 in Monterey County that lies between the tip of the Monterey breakwater and a line created by a seaward extension running 40° magnetic north from the northern-most portion of the unnamed point that lies seaward of the Chart House restaurant, approximately 3000 feet northwest of the tip of the Monterey breakwater.

5.5.2 Recreational Kelp Harvest

There is a small but unknown amount of kelp harvest occurring within the study region by licensed 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.

5.5.3 Other Aquaculture

One other aquaculture enterprise exists in the Port San Luis area. Central Coast Salmon Enhancement is a local non-profit entity that raises fingerling salmon in a grow-out holding pen in San Luis Obispo Bay for a few months each year and then releases them in the fall.

5.6 Recreational Fisheries

Recreational fishing occurs throughout the Central Coast study region. According to data provided by the Pacific States Marine Fisheries Commission (PSMFC), more than 150 species of finfishes were caught by recreational anglers in 2004 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 PSMFC using federal funds from the National Marine Fisheries Service and state funds from the 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 the department'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).

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

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 as opposed to weather or other considerations. CPFVs operate out of the ports of Santa Cruz, Moss Landing, Monterey, Morro Bay, and Port San Luis. 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. CPFVs from Santa Cruz regularly fish as far north as Point Año Nuevo. Monterey-based CPFVs travel as far south as Point Sur. Morro Bay and Port San Luis CPFVs genrally fish between Purisima Point and Piedras Blancas on single day trips, while some Morro Bay vessels conduct multi-day trips as far north as Point Sur. CPFV operators from the port of Princeton, to the north of the Central Coast study region, occasionally run single-day trips as far south as Pt. Año Nuevo, within the study region.

Private and rental skiffs, with some exceptions, generally fish closer to port or launch ramp areas than CPFVs, although albacore anglers may travel considerable distances. The port areas for private and rental boats within the study region are the same as those for CPFVs, with the addition of the Capitola pier, Santa Cruz County, where rental boats are available, and a primitive small boat launch site at Leffingwell's in Cambria, San Luis Obispo County. A rental boat facility is also available on the Santa Cruz Wharf.

In general the most important areas for private recreational boat fishing are within 10 miles of the marinas and launch ramps of Santa Cruz, Moss Landing, Monterey, Cambria, Morro Bay, and Port San Luis. However, albacore and salmon fishermen often travel father to find good fishing, and during fair weather other anglers will venture in excess of 20 miles from port.

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 king salmon, rockfishes/lingcod/cabezon/kelp greenling, California halibut, sanddabs, and albacore. A minor amount of effort is directed towards the harvest of Dungeness crab, using traps, by boats originating from the Santa Cruz harbor.

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. Shore-based angling comprises the overwhelming majority of fishing effort in this mode. Primary target species/species groups in this region are surfperches, jacksmelt, and several nearshore rockfishes. Additional information is being gathered from the consumptive diver representatives to adequately characterize this subset of fishing effort within the Central Coast study region. Kayak fishing generally has a range of 5 miles from any publicly accessible beach or other launch site. A 46-page report (http://www.dfg.ca.gov/mrd/mlpa/pdfs/comments/kfasc_030805.pdf) compiled by the Kayak Fishing Association of Southern California lists the most frequently used launch sites from Pt. Conception to Pt. Arena. A GIS layer based on this report is available to the central coast regional stakeholder group.

Some of the relatively higher-effort shore areas include Santa Cruz Pier, the Monterey Coast Guard breakwater, and the beach area south of Guadelupe Nipomo Dunes in San Luis Obispo County.

Manmade structures consist of piers, jetties and breakwaters; if these structures are public a fishing license is not required. These structures are relatively limited within the Central Coast study region and with few exceptions are in close proximity to the major port areas. Those exceptions are Capitola Pier in Santa Cruz County, Stillwater Cove in Monterey County, and San Simeon and Cayucos Piers in San Luis Obispo County.

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.

Recreational fishing effort in angler-days differs by fishing mode along the California Central Coast. Effort estimates by mode of fishing from the CDFG 2004 CRFS program are: beach and bank 39,000, man-made structure 260,000, private and rental boat 55,000, and CPFV 75,000. Currently shore mode fishing is 70% of all fishing effort with man-made structures accounting for 61% of all fishing.

The Department conducted a recreational fishing catch and effort study from 1957 to 1961 from the California-Oregon border to Pt. Arguello. The study estimated 1,134,000 average annual days for skiff, diver and CPFV effort (80% of total), and 277,000 average annual angler days for shore effort (20% of total). Although the percentages of shore-based effort from the two studies are close, the historical study area was larger and the study took place more than 40 years ago.

Estimates 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.

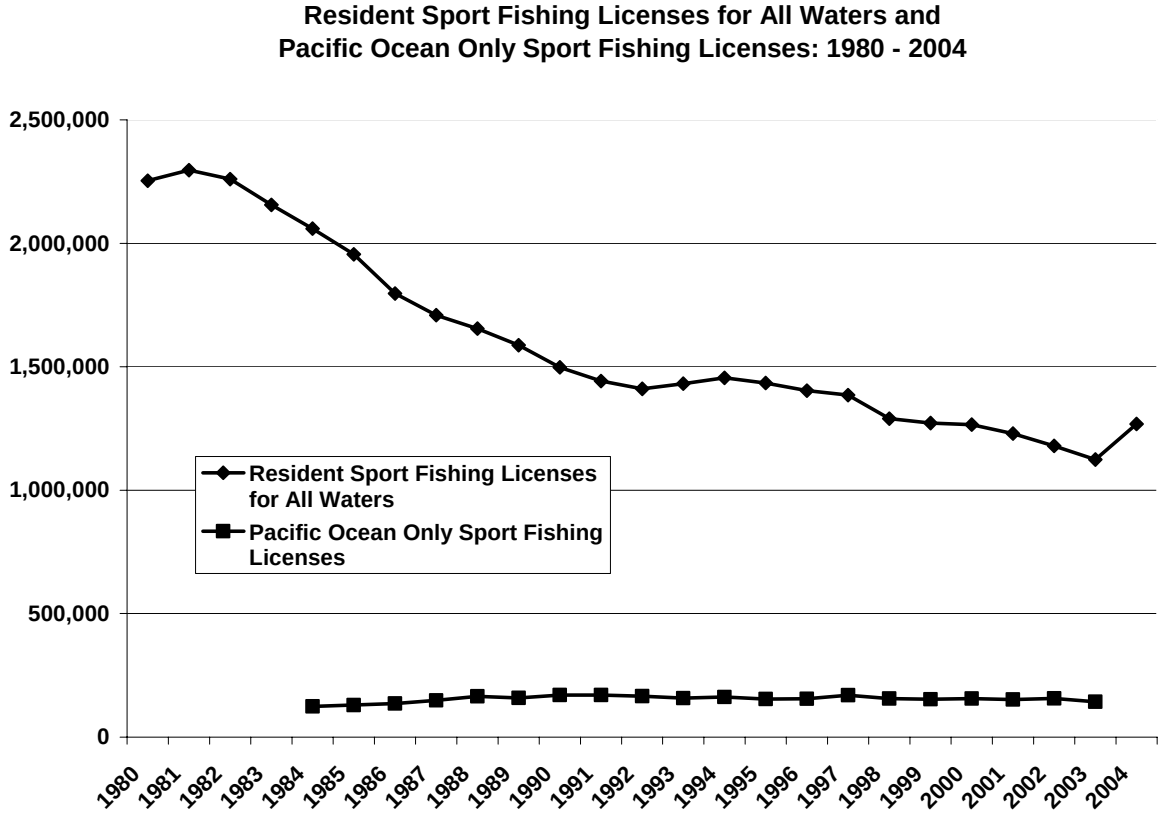
Because of differences in study areas, coverage of fisheries, sampling methods, estimation methods and potential changes in angler demographics and fishing opportunities over time, the potential observed change in effort from shore to boat fishing and the observed high man-made structure effort in the 2004 CRFS does not appear to represent a significant change in Central Coast fishing behavior.

One form of recreational fishing not sampled by the CRFS program is the charter consumptive dive industry. Within this study region only a few such boats operate; vessel owners are required to submit CDFG logbooks summarizing their activities.

Another subset of recreational fishing which occurs within the study region, but is usually not sampled by the CFRS program, is competitive free-diving meets sponsored by the Central California Council of Divers (CenCal). Several sites within the study region are used on an approximately annual basis for these meets and several other sites have been used less frequently. Fortunately, the Department has monitored a high proportion of these dive meets since the late 1950’s, recording diver effort in hours, species composition, and length frequency of retained fishes. The species composition and length frequency are influenced by meet regulations which have changed over time, thus the data may not be comparable to that of more random spearfishing by divers or by hook-and-line fishing. However, the data do provide a long-term index of relative abundance of the primary target species in specific locations.

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 2000 and have since fluctuated with no trend (Figure 13). This represents a 44% decrease in a 20-year period.

Figure 13: Resident Sport Fishing Licenses for All Waters and Pacific Ocean Only Sport Fishing Licenses: 1980-2004

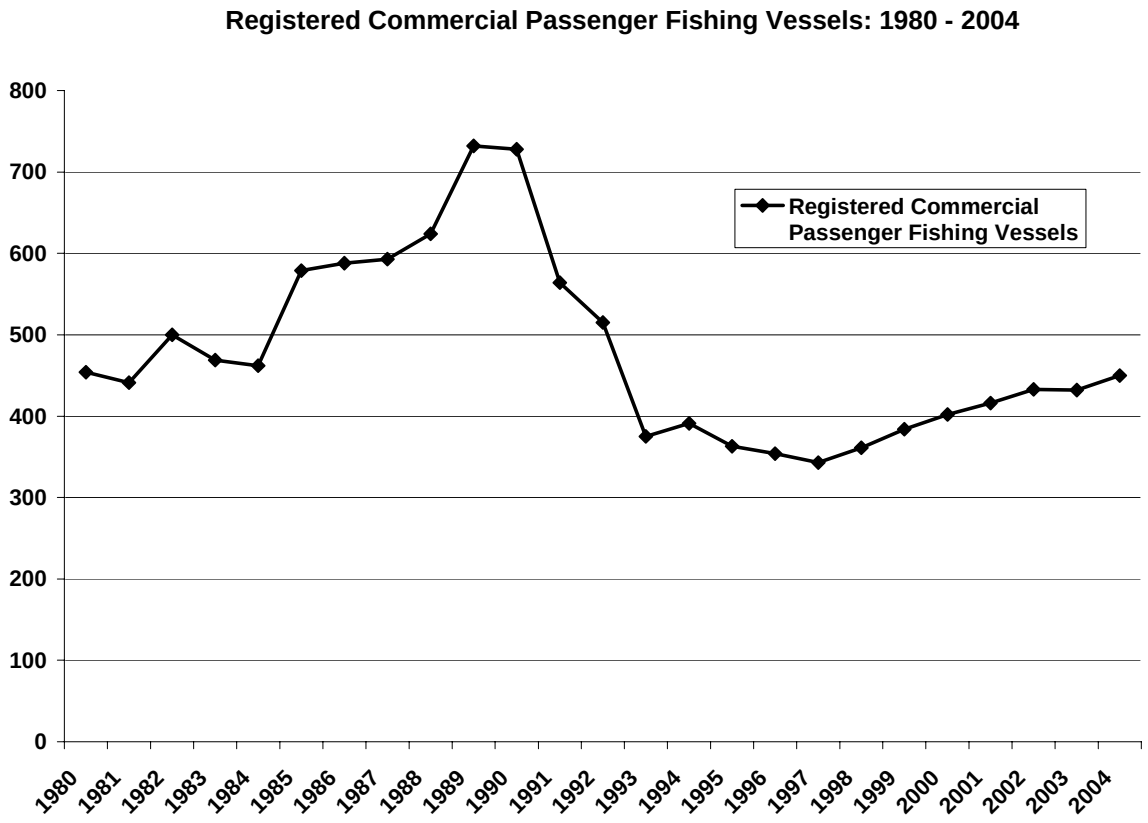


However, the trend in the sale of Pacific Ocean only sport fishing license is quite different (Figure 13). The Department issued this type of license from 1984 to 2003. From 1984 to 1991 license sales increased by 37%, then gradually declined by 16% during the next 12 years to a level higher than that in 1984.

Statewide registration of CPFVs demonstrates a trend different from both commercial boat registrations and recreational license sales (Figure 14). The number of registered CPFVs increased by more than 60% from 1980 to 1989, declined by almost 50% during the next 4 years, and have shown a steady and modest increase during the past decade. Some CPFVs have converted from recreational fishing to whale-watching trips.

Data are not available for the number of CPFV registrations in the Central Coast study region. However, as a proxy, data are available which show the number of registered CPFVs in the Central Coast study region which have submitted logbooks each year from 1980 to 2004; this is representative of the active CPFVs in the region, which comprise less than 10% of all CPFVs registered in the state. The trend for Central Coast CPFVs mirrors that of the statewide registration until 1997; after that point, the number of active Central Coast CPFVs was variable but showed no trend, while the number of registered CPFVs statewide showed a gradual but steady increase.

Figure 14: Registered Commercial Passenger Fishing Vessel Licenses: 1980-2004



Recreational fisheries within the Central Coast study region which have the greatest potential to be impacted by the implementation of new or expanded MPAs are those which target primarily residential, non-migratory species. These include the following: nearshore and shelf rockfishes, lingcod, cabezon, kelp greenling, California halibut, jacksmelt, surfperches, and Dungeness crab.

Five regional profiles are provided for recreational fishing: one for each of the four primary CRFS fishing modes and a fifth for consumptive diving. Each of the profiles (Appendix IV) is organized as follows:

- Port area
- Fishing mode
- Species targeted
- Estimated number of fishing trips in 2004 in study region by target species
- 2004 estimated catch (number of fish)
- 2004 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 Central Coast study region

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

1. For CPFV fishing targeting rockfish and lingcod, CDFG has compiled effort data (number of sampled trips by microblock), over an 11-year period from an onboard observer program. This will provide an estimate of the relative amount of fishing effort in discrete locations, which is in turn an estimate of the relative value of particular locations to the CPFV industry. The data will be available as a series of maps panning the Central Coast study region, with relative effort indicated by different colors (Map 9). This data base will contain estimates of overall average catch per hour of the most frequently observed species in each microblock. While more recent spatially explicit data is available from the 2004 CRFS program, this is depth-limited due to more restrictive fishing regulations; thus the historic data set provides a more compete picture of species distribution in a large percentage of hard bottom habitat within the study region.
2. For private and rental boat recreational fishing, CDFG has compiled spatially-explicit data from 2004, the first year of the CRFS program. While this data is depth-limited in scope for bottom-oriented fishes due to regulations, it is the only data available with this degree of resolution for private and rental boat fishing. This data is available on microblock-based maps with colors representing the total number of sampled trips to each microblock in 2004. A composite is presented with all targeted trips combined (excluding albacore trips, for which the data were problematic), and separate map sets are available for the following target groups: king salmon, rockfish/lingcod, California halibut, and sanddabs (Map 8). It is important to note that this data includes fishing trips in which no catch occurred. The microblocks compiled in this data set are those reported by the fishermen to the samplers.
3. Beach and bank fishing locations will be depicted on maps as predetermined sampling areas by the CRFS program, with the shoreline color-coded by relative angler effort (average number of anglers encountered per sampling day).

4. On the same maps, manmade structures used for fishing will be identified.
5. Fishing effort data from divers will be provided from three primary sources:
   a. The 2004 CRFS program, which included interviews of divers in private and rental boats
   b. Department- monitored Central California Council of Divers free-diving meets
   c. Consumptive diver areas based on input from user groups

5.6.1 Species harvested jointly by commercial and recreational fisheries within Central Coast study region

The following species/species groups occurring within the Central Coast study region experienced measurable harvest by both the commercial and recreational fishing sectors in 2004: salmon, nearshore rockfishes, lingcod, cabezon, kelp greenling, California halibut, sanddabs, surfperches, albacore, jacksmelt, northern anchovy, and Pacific sardine. For some species, such as northern anchovy and Pacific sardine, more than 99% of the combined harvest in 2004 was from the commercial sector. For the other species and species groups, the percent of harvest from each sector was highly variable (Table 20)

Other species, such as shelf rockfishes and white seabass, are also harvested by both sectors, but in 2004 fishery regulations significantly curtailed the harvest of the former, while the latter was generally not available locally to recreational anglers.

Table 20: Estimated 2004 total harvest of selected species in the commercial and recreational fishing sectors within the Central Coast study region.

Species or group	Estimated recreational harvest (lb)	Percent of total	Estimated commercial harvest (lb)	Percent of total	Estimatedtotal harvest (lb)
King salmon*	44,700*	41.2	63,800*	58.8	108,500*
Nearshore rockfish	395,400	76.3	123,100	23.7	518,500
Lingcod	42,500	45.4	51,200	54.6	93,700
Cabezon	4,500	6.4	66,100	93.6	70,600
Kelp greenling	3,700	57.8	2,700	42.2	6,400
California halibut	35,900	25.4	105,700	74.6	141,600
Sanddabs	48,800	23.5	159,300	76.5	208,100
Surfperches	83,700	76.6	25,600	23.4	109,300
Albacore	24,600	5.4	431,700	94.6	456,300
Jacksmelt	44,800	95.3	2,200	4.7	47,000
Northern anchovy	2,200	0.1	8,577,600	99.9	8,579,800
Pacific sardine	2,200	0.1	34,047,000	99.9	34,049,200

*For king salmon only, figures listed are for number of fish, not pounds.

Recreational annual harvest figures for species other than king salmon are less reliable from previous years and thus cannot be compared to commercial harvest estimates. However, data is available from the Pacific Fishery Management Council on numbers of salmon harvested by

the commercial and recreational fisheries in the "Monterey" region)Table 21); this includes all salmon fisheries south of the San Francisco area, and is roughly equivalent to the Central Coast study region because few salmon are harvested south of Pt. Conception. The percent of the total annual harvest, in number of fish, has ranged from 8 to 41 for the recreational sector during this period. During the period 1989 to 2004 the number of commercial salmon vessel permits issued by the Department decreased from more then 5,400 to less than 1,800. Although the data does not show a steady increase in the proportion of salmon harvested by the recreational sector during this period, two of the last three years show the highest recreational proportion of harvest during the 15-year period.

Table 21: Estimated annual harvest of king salmon by commercial and recreational fisheries in the Monterey region* 1986 to 2004

Year	Commercial harvest 1000s of fish	Recreational harvest 1000s of fish	Total harvest 1000s of fish	Percent commercial harvest	Percent recreational Harvest	Number of commercial salmon permits
1986-90	144.8	30.1	174.9	82.8	17.2	5,429 (1989)
1991	79.8	24.8	104.6	76.7	23.3	4,705
1992	97.0	19.5	116.5	83.3	16.7	3,444
1993	104.7	20.6	125.3	83.6	16.4	3,455
1994	70.5	24.2	94.7	74.4	25.6	3,056
1995	313.1	198.9	512.0	61.2	38.8	3,224
1996	181.5	44.8	226.3	80.2	19.8	2,435
1997	228.7	84.4	313.1	73.0	27.0	2,273
1998	95.3	43.5	138.8	68.7	31.3	1,986
1999	81.0	7.1	88.1	91.9	8.1	1,957
2000	196.4	81.8	278.2	70.6	29.4	1,944
2001	35.9	20.0	55.9	64.2	35.8	1,839
2002	70.0	47.7	117.7	59.5	40.5	1,865
2003	36.1	13.1	49.2	73.4	26.6	1,720
2004	64.7	44.2	108.9	59.4	40.6	1,764

*Monterey region includes all waters south of the San Francsico/Half Moon Bay port area.

Areas closed to fishing within the Central Coast study region

Within the Central Coast study region, the only areas in which all fishing by all gear types is prohibited year-round are the national security area closure off Diablo Canyon nuclear power plant and the five state marine reserves: Elkhorn Slough, Hopkins, Pt. Lobos, Big Creek, and Vandenberg. There are other areas closed to some types of fishing year-round, but other types of fishing are permitted. These are summarized below.

Year-round closures to specified commercial gear types

1. All waters within 3 miles of shore closed to use of trawl gear
2. Within the Rockfish Conservation Area (RCA), take and possession of rockfish, lingcod, California scorpionfish (not found within 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. The RCA is 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 Central Coast study region, which is approximately 4% of the study region. For non-trawl fisheries, the portion of the RCA which is closed year round is from 30 to 150 fm within the Central Coast study region, which is approximately 37.8% of the study region. The area from 20 to 30 fathoms is open to fishing during certain months in 2005.
3. In waters shoreward of the RCA but outside 3 miles from shore, small footrope gear is required on trawl nets.
4. Within state waters, the use of gill nets and trammel nets to take rockfish is prohibited.
5. Gill nets and trammel nets may not be used within 3 miles of the mainland shore.
6. Within Military Danger Zone 4, off Vandenberg Air Force Base, per Title 33 CFR 334.1130, the stopping and loitering of any person or vessel is expressly prohibited between the mouth of the Santa Ynez River and Point Arguello, unless prior permission is obtained.

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

1. Waters greater than 20 fathoms deep north of Lopez Pt.; this is approximately 37.2% of those waters within the study region north of Lopez Point.
2. Waters greater than 40 fathoms deep south of Lopez Pt.; this is approximately 8.2% of those waters within the study region south of Lopez Point.
3. Within Military Danger Zone 4, off Vandenberg Air Force Base, per Title 33 CFR 334.1130, the stopping and loitering of any person or vessel is expressly prohibited between the mouth of the Santa Ynez River and Point Arguello, unless prior permission is obtained.

See the Appendices for summaries of fishing regulations for each profiled commercial and recreational fishery.

A map depicting the RCAs is available on the Department's ftp web site http://ftp.dfg.ca.gov/outgoing/mr/ftp and show in Map 14.

In addition to the above year-round closures, seasonal closures exist for many commercial and recreational fisheries within the Central Coast study region. While these seasonal closures provide benefits by helping to sustain those fisheries, unlike state marine reserves they do not allow populations of fished species in the areas where the seasonal closures occur to achieve the same size and age structure.

5.7 Scientific Collecting

Title 14, Section 650 authorizes the take or possession of marine plants or animals for scientific, educational, or propoagation purposes with a permit issued by the Department. 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 inviduals hired by; public or private companies, educational institutions, zoological gardens or aquariuns, 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: resdient, 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. Scientific collecting may be allowed on a case-by-case basis in all three classifications of state MPAs.

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

The Department has an electronic data base for processing scientific collecting permit applications. In 2005 the Department began the development of an electronic data base for compiling information from the annual reports which are required by all permit holders.

The trend in the number of permits issued (Table 22) clearly reflects the bi-annual permit cycle. From 1991 to 2003 the number of permits issued was relatively constant every other year; 2004 saw the highest number of permits issued since 1989.

Table 22.Statewide scientific collecting permits issued by DFG

Number of scientific collecting Permits issued statewide

Year	Number
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

Permits holders are required to notify the Department by phone or fax prior to collecting. Notifications to the Monterey office of intent to collect marine organisms within the Central Coast study region during the most recent complete fiscal year, July 1, 2004 to June 30, 2005, were tallied. The following information on the geographical distribution of intended collecting areas may not be complete, because collectors may have notified other Department offices, but it contains the majority of collecting effort notification and reveals relatively important areas within the study region used by collectors (Table 23). A total of 94 individuals notified the Monterey office of their intent to take marine organisms within the Central Coast study region in fiscal year 2004-05; many of them indicated multiple areas for collecting. These numbers show intent to collect and location, but do not indicate the actual amount of organisms taken.

Table 23. Summary of geographical distribution of intent to collect within the Central Coast study region using scientific collecting permits July 1, 2004 to June 30, 2005.

Geographic region within Central Coast	Number of individuals intending to collect there
Pigeon Pt. to Pt. Año Point	4
Pt. Año Nuevo to El Jarro Pt.	4
El Jarro Pt. to Needle Pt.	3
Needle Pt. to Soquel Pt.	9
Soquel Pt. to Moss Landing harbor entrance	10
Elkhorn Slough	19
Moss Landing harbor entrance to Seaside	8
Seaside to Pt. Pinos	36
Pt. Pinos to Cypress Pt.	13
Cypress Pt. to Pt. Lobos	11
Pt. Lobos to Kassler Pt.	8
Kassler Pt. to Pt. Sur	2
Pt. Sur to Lopez Pt.	2
Lopez Pt. to Cape San Martin	2
Cape San Martin to Pt. Piedras Blancas	3
Pt. Piedras Blancas to San Simeon Pt.	5
San Simeon Pt. to Pt. Estero	8
Pt. Estero to Pt. Buchon	8
Morro Bay	9
Pt. Buchon to Pt. San Luis	3
Pt. San Luis to Pt. Sal	5
Pt. Sal to Purisima Pt.	1
Purisima Pt. to Pt. Arguello	5
Pt. Arguello to Pt. Conception	4

5.8 Non-consumptive Uses

In 1999 and 2000, more than 43% of all Americans participated in some form of marine recreation. Americans flock to beaches and shores to swim, fish, boat, and view the natural scenery. While the proportion of the population that participates in marine recreation is expected to decline over the coming decade, population growth in the coastal zone is expected to offset this trend. Overall, 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 (Leeworthy et al. 2005). California ranks second to only Florida in the number of participants in coastal recreation (17.6 million participants). While California also ranks second to Florida in the percent of its population that participates in marine recreation (10.7% for Florida, 8.7 % for California), its large population places California first in the Nation in the number of residents that participate in marine recreation annually (12.2 million; Table 24).

Table 24. Participation in Coastal Recreation in CA
(civilian non-institutionalized population 16 years and older, Sept. 1999, sample of 27,854 households from Leeworthy and Wiley 2001)

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
Any Coastal Activity	17,954,215

5.8.1 Recreational Beach Use

The Central Coast's approximately 300 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 Pendleton and Kildow (California Ocean Economics Report) 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. Revenues at state beaches in the study region were nearly $3 million during the 2003/2004 fiscal year. Beaches managed by the state can also bring in revenue from user fees, and concessions (Table 25).

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).

Table 25: Examples of State Beach Revenue 2003/04

Site	County	Revenue
Asilomar State Beach and Conference Center	Monterey	$1,371,695
Marina State Beach	Monterey	$0
Monterey State Beach	Monterey	$0
Pismo State Beach	San Luis Obispo	$939,797
Point Sal State Beach	Santa Barbara	$0
Natural Bridges State Beach	Santa Cruz	$57,254
New Brighton State Beach	Santa Cruz	$47,481
Seacliff State Beach	Santa Cruz	$429,897

(Source: Department of Parks and Recreation, 2004. California State Park System Statistical Report. Sacramento, CA)

The Central Coast's miles of beaches, from narrow cove beaches flanked by granite 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 (NSRE, 2000). A recent study by a student at California State University put a dollar value on the surf spot "Pleasure Point" in Santa Cruz as $8.4 million using a method called travel cost modeling (Tilly, 2002). Table 26 lists some surf spots in the region; Table 27 provides examples of beach use in Santa Cruz County.

Table 26. Surfing Spots in the Central Coast Region

Location in Region	Name of surfing location		
North of Santa Cruz	Pigeon Point Scott's Ck.	Año Nuevo	Waddell Ck.
Santa Cruz Area	Davenport Stockton Ave. Cowell's Murph Bar 38th Ave. Private's	Four Mile Mitchell's Cove Rivermouth 26th Ave. The Hook	Natural Bridges Steamer Lane The Harbor Pleasure Point Sharks Cove
South of Santa Cruz	Manresa	Sunset	Moss Landing
Monterey Area	Marina Del Monte Mole Point.	Boneyard Asilomar Carmel Beach	Lover's Point 17 Mile Drive
Big Sur and South	Andrew Molera San Corpoforo	Sand Dollar	Willow Ck.
Cambria	San Simeon	Moonstone	
Morro Bay	Cayucos Pier	Morro Rock	Hazard Canyon
Pismo Beach and Lompoc	Pismo Pier	Jalama	El Capitan

Locations taken from maps located on the www.surfline.com

Table 27: Examples of Recreational Beach Use, Santa Cruz County, California

Beach	Recreational use
Waddell Creek Beach (part of Big Basin Redwoods State Park)	Windsurfing, hang gliding, surfing, birdwatching (nearby wetland provides habitat for water birds)
Scott Creek Beach	Dunes, tidepools, lagoon
Red, White and Blue Beach	Camping (tents and RVs), volleyball, picnic sites, clothing optional
Wilder Ranch State Park	Nature observation, tidepools, hiking; contains best preserved coastal strand vegetation in north coast area of country
Natural Bridges State Beach	Nature walk, guided tidepool tours, picnic site, visitor center
Santa Cruz Beach and Boardwalk	Mile-long sandy beach for swimming, boardwalk and amusement park. *This beach alone attracted* 3,000,000 visitors in 2004, making it the seventh top amusement/theme park destination in California (Source: California's Top Attractions, http://visitcalifornia.com).
Twin Lakes State Beach	Picnic area, volleyball, hiking, fishing from harbor jetty
Capitola City Beach	Sandy beach for swimming, surfing, volleyball, kite flying
Seacliff State Beach	Fishing pier, picnic site, swimming, trailer campsites, interpretive center. The beach, which attracted 2,503,230 visitors in 2003-2004, ranked number five for visitation to state parks in California (Source: Top Ten State Parks CA, California Fast Facts 2005).
Rio Del Mar Beach	Pedestrian/bike path leading to beach

(Source: California Coastal Commission, California Coastal Resource Guide*, Berkeley: University of California Press, 1987)*

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 Pigeon Point in San Mateo and Point Conception in Santa Barbara, the region encompassed in this study (Table 28).

Table 28: Facilities at Beaches Along Central Coast Study Region (Pt. Pigeon to Pt. Conception)

County	# Campgrounds	# Stairs to Beach	# Paths to Beach	# Hiking Trails	# Boating Facilities	# Fishing Sites
San Mateo	0	0	2	1	0	4
Santa Cruz	7	18	21	8	4	19
Monterey	11	8	24	18	8	24
San Luis Obispo	8	10	22	11	6	14
Santa Barbara	1	0	3	2	0	6

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

Beach going activities generate non-market values for the many Californians who visit the beach each year on a day use basis. Pendleton and Kildow (2005) provide a summary of studies conducted in California to estimate the non-market value of beach going in the state (Table 29). Based on these studies, the authors estimate the non-market value of beach going in the state to be just over $2 billion annually.

Table 29: Estimates of the Non-Market Value of Beach Visits in California

Consumer Surplus/Trip	US$(1990)	US$ (2000)
Cabrillo-Long Beach[1]	$8.16	$10.98
Santa Monica[1]	$18.36	$24.71
Pismo State Beach[2]	$26.20	$35.26
Leo Carillo State Beach[1]	$51.94	$69.91
San Onofre State Beach[2]	$57.31	$77.14
San Diego[2]	$60.79	$81.82

Source: *Environmental Damages in Court: The American Trader Case*, published in The Law and Economics of the Environment, 2001, Anthony Heyes, Editor, pp. 319-367. The data are extracted from 1) Leeworthy and Wiley (1993) and 2) Leeworthy (1995).

5.8.2 Boating

Boating is also popular. Recreational boating with motor-powered, sail-powered, and hand-powered vessels also occurs throughout the region, with the highest density around major harbors (Weinstein). 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 registered recreational vessels in 1994 (Guerrero and Kvitek 1996). The popularity of non-motorized craft such as kayaks has also increased in most coastal waters. Many boaters in the Central Coast bring trailerable boats to launch ramps in the area.

The California Recreational Fisheries Survey conducts interviews of anglers returning to public launch ramps. Anecdotal information collected includes the number of private and rental boats which are not recreationally fishing for finfish. A summary is provided for data collected in 2004, divided into the Monterey/Santa Cruz and Morro Bay/Port San Luis port areas (Table 30). CRFS samplers intercepted approximately 7000 private and rental boats upon return to port; 83% fished or intended to fish recreationally. Approximately 4% were commercial fishing vessels. The remaining 13% were involved in nonconsumptive activities, including sightseeing, sailing, diving, research, and vessel maintenance.

These figures are in no way indicative of the overall proportions of vessels engaging in consumptive and nonconsumptive activities within the Central Coast study region. Many vessels, in particular sailboats, are moored in the regions's marinas and buoyed areas. The Monterey Coast Guard launch ramp is a relatively unique site in that a relatively high proportion of nonconsumptive boat effort is from recreational divers. This site is a secondary CRFS sampling site because total effort is significantly less than that of the Monterey Harbor launch ramp. CRFS samplers interviewed people on 225 boats returning to the Coast Gurad launch ramp in 2004; 31.5% of the boats were engaged in non-consumptive activites, with most boats engaged in nonconsumptive diving.

Table 30: Number of Trailored Private and Rental Boats

Type of	Number of vessels Counted				
	Santa Cruz	Monterey/ Moss Landing	Morro Bay / Port San Luis / Avila Beach	Total	Percent of Grand total
Fished recreationally for finfish	2030	2252	1408	5690	81.3
Fished recreationally for invertebrates	18	55	1	74	1.3
Intended to fish recreationally but no gear in water	12	6	25	43	0.6
Total recreational fishing	2060	2313	1434	5807	83.0
Fished commercially	34	81	155	270	3.9
Total fishing	2094	2394	1589	6077	86.9
Sailing/sightseeing	145	99	208	452	6.5
Non-consumptive diving	6	79	10	95	1.3
Maintenance	79	51	64	194	2.8
Research	10	30	10	50	0.7
Personalized Watercraft	14	4	10	28	0.4
Removing boat from harbor	13	0	3	16	0.2
Unidentified/Other	17	17	49	83	1.2
Total not fishing	284	280	354	918	13.1
Totals all boats	2378	2674	1943	6995	

5.8.3 Recreational SCUBA Diving

The Central Coast is a world-class diving destination that boasts abundant marine life, including diverse species of fish and invertebrates and marine mammals such as sea otters, sea lions, and harbor seals. The Central Coast also contains sheltered bays, dramatic rock reefs, and kelp forests, as well as good access from shore and by boat. Southern Monterey Bay and Carmel Bay encompass the most popular diving spots along the west coast between Puget Sound in Washington and the Channel Islands in southern California. These two bays also enjoy the heaviest use by non-consumptive divers along the Central Coast (refer to previous Recreational Fishing section for discussion of consumptive diving). A map of dive sites and dive use areas generated by regional stakeholders and Reef Environmental Education Foundation (REEF) is provided in Map 10 (a and b).

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 (Al Hornsby, PADI, pers. comm., 7/2005). 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. Forty-five dive shops in northern and central California serve customers who dive primarily in the Monterey Bay area (see http://groups.yahoo.com/group/ba_diving/links). These dive shops routinely bring divers to Monterey for their open water training and certification dives. Some out-of-state dive shops from Oregon, Nevada, and Utah also bring large groups of divers for an extended stay in Monterey for training and recreational diving tourism.

Six commercial vessels berthed exclusively in the Monterey Harbor serve divers (*Cypress Sea*, *Monterey Express*, *Escapade*, *Silver Prince*, *Sanctuary*, and *Beach Hopper II*). Private vessels used for diving are typically small enough to transport by trailer, though a few berthed private boats are also used for diving. A substantial portion of the usage of the two small-boat launch ramps within the Monterey Harbor is by private dive boats.

In addition to the dive shops and dive boats, numerous local businesses in Monterey are involved in the increasingly popular sub-category of underwater photography, including a retail business devoted exclusively to underwater photography, an equipment manufacturer that builds underwater camera housings, and a media production studio specializing in marine life documentaries. In addition, dozens of professional underwater image makers have located their businesses in the Monterey Bay region. These include still photographers, cinematographers, and fine artists, whose work regional and international audiences appreciate year-round.

A survey was conducted in 2005 by Chris LaFranchi and colleagues on non-consumptive use patterns in the Central Coast (see Appendix VI, LaFranchi and Tamahaha, 2005). The survey results are are preliminary in that they are limited in scope, depth, spatial resolution, and spatial coverage; however these data do provide some general information on diving in the study region. Though strict randomization protocols were followed in enumerating the intercept surveys for divers, a relatively small number of users were surveyed in-depth. It is important to note that this method provides a random sample of users at a site on any given day, but does not provide a sample that is randomly drawn from all users. This method reduces the potential for biased sampling at a location, but does not provide a sample that can be extrapolated to all users. The information presented here on users represents the values, characteristics, and spatial use of the small number of people who participated and completed the in-depth survey. For this reason, we provide the results of the data without significant analysis. The numbers in this report DO NOT represent non-consumptive users of the California Central Coast generally.

Over the course of two weekends, 147 divers were interviewed using a short-format survey. Of those, 26 divers participated in an in-depth surveys and were asked to provide some information about their expenses (Appendix VI, LaFranchi and Tamahaha, 2005). Divers were intercepted for interviews during/after a dive trip, and were asked to list their expenses for their trip that day.Seven of the respondents were interviewed after diving from a charter dive boat. The other 19 divers were intercepted during self-planned dive trips.

Table 31 Average Expenditures per Person

	Charter Boat Dive	Self-Planned Dive
Charter / Boat Fees[2]	$155.00	N/A
Boat Rental	N/A	$0.00
Boat Fuel	N/A	$1.05
Ramp Fees	N/A	$0.00
Food / Snacks	$22.25	$18.05
Film / Processing	$0.00	$0.56
Sundries	$14.17	$2.16
Parking	$6.33	$2.87
Air Fills	$5.00	$5.68
Lodging	$7.57	$10.13
Other[3]	$23.93	$7.86
Average Total Expenditure	$226.00	$45.91

(Source: LaFranchi and Tamanaha, C. 2005, Spatial Patterns of Non-consumptive Use on the California Central Coast; see Appendix VI)

Based upon this data, seven divers spend the majority of their money on charter and boat fees as well food and snacks (Table 31). The other 19 divers spent the most money on food and snacks and lodging.

Specific Diving Areas

Divers consider many factors when determining where to dive: ease of access from shore and by boat (commercial dive boats, kayaks, private motorized boats); proximity to parking; diversity and abundance of marine life; and presence of calm water. Data from the LaFranchi and Tamahana non-consumptive use study (Appendix VI) ranks factors influencing diver site choice from 26 divers (Table 32). Most recreational diving for values such as accessibility, sight seeing, photographing, and observing marine life occurs in Monterey and Carmel Bays.

[2] One of the charter boat divers interviewed indicated that all other expenses were covered in the charter boat fee.
[3] Other expenses generally included equipment rental.

Table 32: Factors Influencing Respondents' Site Choices

Factors that Increase Likelihood of Site Choice
Abundance and variety of fish
Abundance and variety of invertebrate animals, such as sea anemones and soft corals
Access to dive sites by car and beach
Presence of kelp beds
Chance to dive with a marine mammal, such as a seal, dolphin, or sea otter
Access to dive sites by boat only
Presence of other divers who a diver may see underwater
Factors that Decrease Likelihood of Site Choice
Traveling a long distance to dive site
Presence of people fishing from kayaks near your dive site
Hook and line fishing and spearfishing is allowed at site
Presence of sport/commercial fishing vessels near your dive site

(Source: LaFranchi and Tamanaha, C. 2005. Draft Report: Spatial Patterns of Non-consumptive Use on the California Central Coast; see Appendix VI)

While Monterey and Carmel Bays are the main dive destinations for non-consumptive recreational SCUBA divers, diving does occur in other areas of the Central Coast study region. Divers also travel by boat southward beyond Carmel Bay to visit sites along the north Big Sur coast, from Point Lobos south to Point Sur. Along the south Big Sur coast, divers also access dive sites primarily by boat, with one commercial dive boat company conducting a few multi-day dive trips each year. One major shore dive site on the Big Sur coast is Jade Cove, where divers go for touring and underwater photography, as well as the recreational extraction of jade by hobbyists. Julia Pfeiffer Burns State Park and Garrapata Park also have beach entry dive sites. South from San Simeon and Cambria, several dive sites, ranging from Mill Creek to Point Conception, each have a mix of non-consumptive, underwater photography, and consumptive diving uses.

Most recreational diving along the Central Coast occurs within the three-mile State water line (the majority within a half mile of shore), at depths shallower than 130 feet, and for durations of less than an hour, though technical diving to deeper depths has gained popularity. Results from LaFranchi and Tamanaha (Appendix VI) fall into two categories for diving frequency based upon short-format interviews of 147 divers and in-depth interviews of 26 divers. Table 33 shows the number of respondents falling into five trip frequency intervals. The 26 respondents to the in-depth survey were asked more specifically about two categories of trips: (1) one-day trips taken in the past 12 months (trips not involving an overnight stay in the area), and (2) multi-day trips.

Table 33. Number of Trips Taken in the Last 12 Months

	Short-Format (n = 147)	**In-depth Survey** (n = 26)		
	Total Trips		**One-Day**	**Multi-Day**
Average Number of Trips	*19*	*23*	*20*	*4*
< 2 trips	38	6	10	17
2-5 trips	22	5	6	4
6-10 trips	19	1	3	2
11-20 trips	18	4	4	1
> 20 trips	34	9	3	2
No exact number given[4]	11	0	0	0
Not indicated	5	0	0	0

(Source: LaFranchi and Tamanaha 2005. Draft Report: Spatial Patterns of Non-consumptive Use on the California Central Coast)

Based on the intercept surveys, the Monterey Breakwater and Lovers Point area were the most heavily used by the divers surveyed (LaFranchi and Tamanaha, 2005; Appendix VI). An estimated 65,000 annual diver days occur in the area between Breakwater (San Carlos Beach) and Lover's Point in Monterey Bay alone (Saunders, R., Okey, T.A. and Sobel, J. 1997). Monterey Breakwater (San Carlos Beach) is also the most popular training dive site for open water SCUBA certification in the U.S. (Rodale's *Scuba Diving* magazine, 1993/1994). In April 2001 the Fish & Game Commission recognized the unique recreational and biological values around the Cannery Row area. The Breakwater and surrounding waters support one of the most diverse assemblages of fishes in the entire Monterey Bay, and also boast perhaps the greatest fish species diversity along the California coast, with over 90 fish species reported by REEF (Reef Environmental Education Foundation) fish surveys conducted by volunteer divers (more than any other west coast REEF survey site), and similar results reported by professional marine biologists (www.reef.org , 2005; D. Gotshall, per. comm, .8/2005).. Because of its accessibility, Monterey Breakwater offers students and beginning divers the potential of a rich experience even on their first dive.

Besides the Breakwater, other popular shore diving entry points include Del Monte Beach, MacAbee Beach, Lovers Cove, Otters Cove, Coral Street Cove, and Point Pinos along Monterey Bay; and Stillwater Cove, Butterfly House, Stewarts Point, Monastery Beach, and

[4] Where a range was given by the respondent, the response was excluded.

Point Lobos along Carmel Bay (Environmental Defense 2004, LaFranchi and Tamanaha 2005, see Appendix VI). Boat-accessed dive sites are by necessity within small craft distance from boat launching ramps located at Monterey Harbor, Stillwater Cove, and Point Lobos. Maps 10a and b show the names and locations of recreational and technical dive sites provided by the Reef Environmental Education Foundation and regional stakeholders, along with coastal access points.

The relative popularity of dive areas can also be gauged by where volunteer divers conduct fish surveys in the Central Coast region. Of 1400 surveys conducted at 87 dive sites between 1997 and 2004, 64% of survey dives occurred in south Monterey Bay and 29% in Carmel Bay, with the remainder along adjacent coastal areas (REEF, 2005). A more detailed breakdown is tabulated in Table 34, based on REEF volunteer fish surveys.

Table 34: Relative Popularity of Stretches of Monterey and Carmel Bay Coasts for Divers

Stretch of Coast	REEF fish surveys
Moss Landing to Monterey Harbor	04%
Breakwater (San Carlos Beach) to Lovers Pt	41%
Lovers Point to Point Pinos	21%
Point Pinos to Cypress Point	02%
Cypress Pt to edge of Pt Lobos Reserve	20%
Point Lobos Marine Reserve	09%
South of Point Lobos to Point Sur	03%

(Sources: REEF, 1997-2004, based on 1400 fish surveys conducted by volunteer divers;)

5.8.4 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).

As mentioned in the section on recreational diving, a survey was conducted in 2005 by Chris LaFranchi and colleagues on non-consumptive use patterns in the Central Coast (LaFranchi and Tamahaha, 2005, Appendix VI). The survey results are are preliminary in that they are limited in scope, depth, spatial resolution, and spatial coverage; however these data do provide some general information kayaking, whale-watching, and other wildlife-viewing activites in the study region. The information presented here on users represents the values, characteristics, and spatial use of the small number of people who participated and completed the in-depth survey and DOES NOT represent non-consumptive users of the California central coast generally.

Some areas of importance for kayaking, whale-watching, and tidepooling are shown on Maps 11a and b. The ocean kayaking survey did not assess use of ocean kayaks for recreational angling. Table 35 shows the number of respondents falling into five trip frequency intervals for ocean kayaking. The 16 respondents to the in-depth survey were asked more specifically about two categories of trips: (1) one-day trips (trips not involving an overnight stay in the area), and (2) multi-day trips. The short-format survey interviewed 83 kayakers about their total number of trips.

Table 35 Number of Ocean Kayaking Trips Taken by participants in the Last 12 Months

	Short-Format (n = 83)	**In-depth** (n = 16)		
	Total Trips		**One-Day**	**Multi-Day**
Average Number of Trips	*3*	*23*	*5*	*4*
< 2 trips	61	9	9	15
2-5 trips	15	4	4	1
6-10 trips	1	1	1	0
11-20 trips	4	1	1	0
> 20 trips	2	1	1	0
No exact number given[5]	0	0	0	0
Not indicated	0	0	0	0

(Source: LaFranchi and Tamanaha, C. 2005. Spatial Patterns of Non-consumptive Use on the California Central Coast, Appendix VI)

Additional factors influencing launch and route choice by 16 kayakers are summarized in Table 36 (LaFranchi and Tamanaha, 2005, see Appendix VI).

[5] Where a range was given by the respondent, the response was excluded.

Table 36: Factors influencing site choice

Factors that Increase Likelihood of Site Choice
Abundance and variety of bird life
Chance to kayak near a marine mammal
Presence of MPA
Access to site by car/beach
Abundance and variety of rocky intertidal flora/fauna
Sea Cliffs/Vistas, "Pour overs"
Presence of tidal flats
Presence of kelp beds
Factors that Decrease Likelihood of Site Choice
Presence of >10 other kayakers in close proximity
Numerous beach goers, divers, surfers
Fishing From Kayaks in close proximity
Long distance to site
Hook and line fishing allowed at site
Presence of sport / commercial fishing vessels in close proximity

(Source: LaFranchi and Tamanaha 2005. Spatial Patterns of Non-consumptive Use on the California Central Coast, Appendix VI)

Kayakers spend money on food and snacks, as well as boat and rental equipment and lodging. The avergage expenditures from 16 kayakers is $157 each (LaFranchi and Tamanaha, 2005, see Appendix VI). They spend the majority of money on food and lodging.

At different times of the year, 35 species of marine mammals occupy the California coast and/or coastal waters. The gray and humpback whales in Monterey Bay and off the Big Sur coast, and elephant seals in Año Nuevo State Park in San Mateo County, for example, offer unparalleled nature viewing opportunities. Results from research by LaFranchi and Tamahana (2005, see Appendix VI) show that on average the 11 people who participated in the short-format survey have gone an average of 1.8 times on wildlife viewing trips on a charter boat in the last 12 months, and 1.1 times for 14 people who particpated in in-depth. Factors influencing their site choice are listed in Table 37.

Table 37: Wildlife viewing from charter, "Whalewatching," Factors that Influence Satisfaction

Factors that Increase Likelihood of Satisfaction
Abundance and variety of dolphins, seals, and sea Lions
Sighting a leatherback turtle
Presence of MPA
Abundance and variety of bird life
Factors that Decrease Likelihood of Satisfaction
More than 1 hour (travel distance)
Commercial fishing allowed in viewing areas
Recreational fishing allowed in viewing areas
Presence of sport/commercial fishing vessels near you
More than 2 additional whale watching boats near you
More than 10 other recreational boats near you
Absence of whale sightings

(Source: LaFranchi and Tamanaha, C. 2005. Spatial Patterns of Non-consumptive Use on the California Central Coast, see Appendix VI)

The 16 charter boat clients who participated in the in-depth survey were intercepted for interviews during the boat trip, and were asked to list their expenses for their trip that day. The average, excluding airfare, was $366, with $199 spent on just lodging (LaFranchi and Tamanaha, 2005, see Appendix VI).

Responses from two professional charter boat captains identified three or four distinct areas in Monterey Bay or near Point Pinos that are important for wildlife viewing (particularly whale watching); these areas are important for the frequency of sightings of migrating gray whales, humback whales, and blue whales relatively near major ports (LaFranchi and Tamanaha, 2005; see Map 11a and Appendix VI). Within California, whale watching also contributes substantially to local revenues; estimates are that whale watching in California generates on the order of $20 million in gross revenues annually and net revenues of between $4 million and $9 million (Pendleton, in prep).

Nature observation is prolific in the study region. For example, the Point Pinos intertidal zone along the shore of the city of Pacific Grove in Monterey County receives approximately 50,000 visitors annually, with an estimated 10,000 being K-12 children (Tenera Environmental, 2003). The region's scenic beauty, diversity of marine life, ease of access, clean environment, and proximity to other attractions in the area encourage visitors to go to this area to relax and engage in many nature activities, including seeing the tidepools (Tenera Environmental, 2003).

5.8.5 National Scenic Byways

Highway 1 is one of the most scenic highways in the world, and residents and tourists use this road to see the views and wildlife (National Scenic Byways Online, 2005). Two locations of particular beauty and attraction along the Central Coast study region include the Big Sur Coast Route 1, which offers sea lion and redwood forest viewing opportunities, and San Luis Obispo North Coast byway, which passes through rural ranchlands (National Scenic Byways Online, 2005).

5.8.6 Tidepool Visitors and Wildlife Watching From Shore

In the LaFranchi and Tamanaha study (2005, see Appendix VI), the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and Multi-Agency Rocky Intertidal Network (MARINe) monitoring groups were contacted and asked to provide some basic evaluation of human tidepooling activity at their monitoring sites. For the tidepool monitoring sites in the study region, the PISCO and MARINe monitoring groups indicated sites that receive either “high” or “moderate” visitation. In addition, the researchers looked at likely web sources that tidepool visitors might use to find tidepooling sites, as well as the frequency with which the tidepool site was listed in web educational resources and tour guides (Table 38).

Table 38: Tidepooling Sites

County	Site	PISCO / MARINe Monitoring Site	Rating	Frequency of "mentions" found in web educational resources and tour guides[6]
San Mateo	Pebble Beach	y		0
San Mateo	Pigeon Point	y	HIGH	2
San Mateo	Franklin Point (Año Nuevo)	y		1
San Mateo	Fitzgerald Marine Reserve			6
Santa Cruz	Scott Creek	y	moderate	1
Santa Cruz	Sandhill Bluff	y	moderate	0
Santa Cruz	Terrace Point	y	moderate	0
	Davenport Landing			2
	Natural Bridges State Park			3
Monterey	Point Pinos			3
Monterey	Hopkins	y		0
Monterey	Stillwater	y		0
Monterey	Carmel Point	y		0
Monterey	Point Lobos	y	HIGH	2
Monterey	Mal Paso	y		0
Monterey	Soberanes	y		0
Monterey	Andrew Molera	y		0
Monterey	Pardington Cove	y		0
Monterey	Mill Creek	y		0
Monterey	Pacific Valley	y		0
San Luis Obispo	Point Sierra Nevada	y		0
San Luis Obispo	Piedras Blancas Lighthouse	y		0
San Luis Obispo	San Simeon	y	moderate	0
San Luis Obispo	Rancho Marino Reserve	y		0
San Luis Obispo	Cayucos	y	moderate	2
San Luis Obispo	Hazard's	y	HIGH	0
San Luis Obispo	Shell Beach	y	HIGH	1
San Luis Obispo	Montana de Oro State Park			3

[6] Top 10 indexed pages of Google search results for "tide pools California" which mentioned the site and basic directions for traveling to the site.

6.0 Academic Institutions, Research, Public Outreach, and Education

The physical setting and regional marine biodiversity make the Central Coast study region, and particularly Monterey Bay and Monterey Canyon, a global center for marine research and education.

6.1 Major Institutions in the Central Coast Study Region

Eighteen marine laboratories and education centers operate around Monterey Bay alone (Weinstein). More than 40 institutions and organizations in the greater Monterey Bay Area currently conduct research on various aspects of the marine environment. Major institutions include California State University at Monterey Bay, Hopkins Marine Station of Stanford University, Monterey Bay Area Research Institute, University of California at Santa Cruz Center for Ocean Health, Monterey Bay Aquarium, and Center for Coastal Marine Science of Cal Poly San Luis Obispo. Map 12 shows institutions compiled from a list of Sanctuary Integrated Monitoring Network (SIMoN) partners in California and the Monterey Bay Crescent Ocean Consortium partners (MBCORC).

6.2 Scientific Research and Collecting

The scientific research within the Central Coast study region is diverse, ranging from water quality and fisheries management to deep sea biology, kelp forest ecology, and ocean conservation. Major marine monitoring programs in the region include Cooperative Research and Assessment of Nearshore Ecosystems (CRANE), Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), Central California Ocean Observing System (CEENOS), Monterey Bay National Marine Sanctuary Integrated Monitoring Network, and Center for Integrative Coastal Observation, Research and Education (CI-CORE), to name a few (see Table 39). These organizations implement diverse marine research programs.

Many concentrated studies take place near marine stations. For example: the marine mammal studies at Terrace Point by Long Marine Lab, evolutionary physiology, biomechnanics, and ecology studies at Point Cabrillo by Hopkins Marine Station, and fishery and fish population studies at Big Creek State Marine Reserve. PISCO focuses on long-term ecological and oceanographic monitoring to inform ocean conservation and management. Long term Monitoring Program & Experiential Training for Students (LIMPETS) trains middle- and high-school students and volunteer groups to monitor the rocky intertidal, sandy shore and offshore areas of Monterey Bay and Channel Islands to increase public awareness and influence policy makers. Elkhorn Slough National Estuarine Research Reserve's (ESNERR) monitoring programs target water quality and weather. The Santa Cruz Laboratory, part of the Southwest Fisheries Science Center of the National Marine Fisheries Service (NMFS), focuses on the Pacific Coast Groundfish and Pacific Salmon. NOAA has the National MPA Center and the Fisheries Lab. These examples illustrate the importance and diversity of marine research along the Central Coast. Map 12 shows provides location information for marine monitoring

sites in and around the MLPA study region from the CeNCOOs, PISCO, LIMPET, and Multi-Agency Rocky Intertidal Network (MARINe) programs (see Table 41).

Table 39: Research and Monitoring Programs in the Study Region

CeNCOOS The Central California Ocean Observing System is a new initiative and part of the national ocean observing system, the Integrated Ocean Observing System (IOOS). There are no monitoring sites established yet. (http://www.cencoos.org/)
LiMPETS LiMPETS is for middle school, high school, and other volunteer groups to monitor the rocky interidal, sandy shore and offshore areas of the five west coast National Marine Sanctuaries. (http://limpets.noaa.gov/)
MARINe Scientists from Federal, State, and local government agencies, universities, and private and volunteer organizations have formed MARINe to monitor important shoreline resources. The network is currently being supported by 23 organizations. Sites are monitored from San Luis Obispo County to San Diego County on the mainland and offshore Channel Islands. (http://www.marine.gov/)
MBCORC The mission of MBCORC is to promote the scientific understanding of coastal and marine systems and to facilitate the application of that knowledge for public policy, environmental awareness, and decision making. MBCORC achieves its objectives by creating, coordinating, promoting, and endorsing research, education, and outreach activities, using the Monterey Bay as a natural laboratory. (http://www.mbcorc.org/)
PISCO PISCO is a large-scale marine research program that focuses on understanding the nearshore ecosystems of the U.S. West Coast. PISCO integrates long-term monitoring of ecological and oceanographic processes at dozens of coastal sites with experimental work in the lab and field. (http://www.piscoweb.org/research/community/subtidal/index.html)
SIMoN The SIMoN 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 SIMoN. (http://www.mbnms-simon.org/)

6.3 Regional Economic Impact of Marine Institutions

Institutions and agencies conducting marine research and sponsoring volunteer and educational programs along the Central Coast do more than provide researchers, educators, students, and policy makers with valuable data about the region's marine and coastal ecosystem. Each program also contributes significantly to the regional economy by providing employment to various professionals, paying wages and salaries, generating taxes to the city or county, and producing direct and indirect economic activity (Table 40).

Table 40: Examples of Regional Institutional Employment and Budgets, 2001

Agency/Institution	# Staff Employed	Budget
Monterey Bay Aquarium	450 staff; 900 volunteers	$40.4 million
Fleet Numerical Meteorological and Oceanography Center (FNMOC)	260	$25 million
Monterey Bay National Marine Sanctuary	20	$2.5 million
Hopkins Marine Station	102	$2 million
California State University, Monterey Bay (Earth Systems Science & Policy Program)	28 (faculty, lab technicians, administrative analysts)	$1.4 million (grants in excess of $6.5 million)
Institute of Marine Sciences (University of California, Santa Cruz)	153 (faculty, researchers, support staff, student employees)	$633,000
Naval Research Laboratory	75	$22 million
Moss Landing Marine Laboratories	91 (faculty, research associates, research technicians, graduate student assistants)	$1.7 million (grants in excess of $20 million)
Monterey Bay Aquarium Research Institute (MBARI)	200	$40 million
Marine Advanced Technology Education Center (Monterey Peninsula College)	7	$840,000

(Source: Monterey Bay Crescent Ocean Research Consortium, MBCORC Retreat, September 24-25, 2001).

6.4 Public Education and Outreach

Local, state, and federal agencies and institutes throughout the region sponsor public outreach and educational campaigns to garner support for their research and interest in the policy implications. Volunteer Monitoring Programs at various organizations, for example, have a strong focus on water quality and trash in areas where water quality is deteriorating. Coastal Cleanup data were also collected by county (MBNMS, 2003). The Coastal Cleanup debris collected in 2003 by volunteers, by county is summarized below:

San Mateo – 20,977 lbs. trash; 4,694 lbs. recyclables; 1,293 volunteers
Santa Cruz – 8,572 lbs. trash; 4,492 lbs. recyclables; 2,741 volunteers
Monterey – 8,385 lbs. trash; 1,878 lbs. recyclables; 1,539 volunteers
San Luis Obispo – 6,900 lbs. trash; 2,000 lbs. recyclables; 1,400 volunteers

Organizations supporting such volunteer programs include the State Water Resources Control Board, the Monterey Bay National Marine Sanctuary (and the associated Citizen Watershed Monitoring Network), the Morro Bay National Estuary Program, the Coastal Watershed Council, Surfrider Foundation Blue Water Task Force, ESNERR, Land Conservancy of San Luis Obispo, and Friends of the Estuary at Morro Bay. Many organizations, such as the Monterey Bay Aquarium, also provide public education on a variety of marine issues relevant to the Central Coast (refer to Aquarium Tourism). ESNERR offers teacher training programs, volunteer programs, student internships, grants for estuarine technology development, and

graduate research fellowships. Long Marine Lab hosts marine science field trips for K-12 and community college students. Different chapters of the Surfrider Foundation organize environmental science camps for youth. Staff at many of the state beaches, parks, and reserves, including Natural Bridges, Año Nuevo, and Point Lobos, offer guided educational tours for students and visitor groups. Reef Check California is currently developing a scientific monitoring program that will involve members of the public led by marine biologists. The Reef Check California program will be designed to help fill gaps in the existing monitoring network, help build a local marine conservation constituency and aid enforcement efforts.

In 2003 data were collected by the Monterey Bay National Marine Sanctuary on the number of volunteers, hours volunteered, and estimated value of volunteer hours (see Table 41).

Table 41: Organizations and Number of Volunteer Hours in MBNMS7

Año Nuevo State Reserve: 215 volunteers; 14,479 hours
BAY NET Monterey Bay National Marine Sanctuary Volunteer Network: 27 volunteers; 2,000 hours
California State Parks, Monterey District: 431 volunteers; 54,320 hours
California State Parks, San Mateo Coast Sector: 1,929 volunteers; 13,915 hours
California State Parks, Santa Cruz District: 800 volunteers; 45,000 hours
Coastal Watershed Council: 125 volunteers; 3,720 hours
Elkhorn Slough National Estuarine Research Reserve: 111 volunteers; 6,510 hours
Fitzgerald Marine Reserve: 100 volunteers; 5,329 hours
Friends of the Elephant Seal: 80 volunteers; 11,300 hours
Friends of the Sea Otter: 11 volunteers; 1,500 hours
Maritime Museum of Monterey: 55 volunteers; 4,125 hours
Monterey Bay Aquarium: 914 volunteers; 133,146 hours
Monterey Bay National Marine Sanctuary Beach COMBERS: 76 volunteers; 1,248 hours
Monterey Bay National Marine Sanctuary Team OCEAN: 25 volunteers; 332 hours
Monterey Bay Sanctuary Citizen Watershed Monitoring Network: 240 volunteers; 4,100 hours
Pigeon Point Lighthouse: 30 volunteers; 2,142 hours
Return of the Natives Restoration Education Project of the Watershed Institute, CSUMB: 3,131 volunteers; 10,323 hours
San Gregorio Environmental Resource Center: 20 volunteers; 700 hours
Save Our Shores, San Mateo: 606 volunteers; 2,554 hours; Santa Cruz: 55 volunteers; 800 hours
Seymour Center at Long Marine Lab, UCSC: 285 volunteers; 18,000 hours
Surfrider San Mateo County Chapter: 12 volunteers; 494 hours
The Marine Mammal Center: Monterey: 51 volunteers; 4,660 hours; Santa Cruz: 47 volunteers; 4,910 hours; San Mateo: 58 volunteers, hours not available
Total number of volunteers: 9,434 Total hours donated: 345,607
Total value of volunteer services (calculated at $15.00/hour): $5,184,105

(Source: MBNMS. 2003. Ecosystem Observations for the Monterey Bay National Marine Sanctuary. Monterey, CA.)

7 Some of the volunteer work may take place outside of the study region.

7.0 Jurisdiction & Management

7.1 Federal, State & Local Agencies

No single federal, state, or local agency has complete jurisdiction over the marine environment. The main agencies are highlighted below with a brief description of their role and responsibility.

7.1.1 Federal Agencies

Bureau of Land Management (BLM), has management responsibility for the recently-established California Coastal National Monument that includes most of California's rock and islets. Management authority pertains to lands at and above the mean high tide line.

Minerals Management Service, a bureau in the U.S. Department of the Interior, is the Federal agency that manages the nation's natural gas, oil and other mineral resources on the outer continental shelf (OCS).

National Marine Fisheries Service, a division of NOAA, with a mission is to manage living marine resources and Essential Fish Habitat between 3 and 200 miles seaward of the U.S. coast. This agency has management jurisdiction for pinnipeds and cetaceans.

National Oceanographic and Atmospheric Administration (NOAA), guides the use and protection of ocean and coastal resources and through the National Marine Sanctuary Program manages the Monterey Bay National Marine Sanctuary.

U.S. Air Force, has responsibility in the waters of the Pacific Ocean in an area extending from the shoreline out to a distance of three miles from Pt Sal to east of Point Conception in order to conduct certain firing tests and operations whose characteristics to range and reliability may be conducted without requiring the evacuation of the entire area due to the nature of the hazardous operation being conducted. These areas are described in Title 33 CFR 334.1130.

U.S. Army Corp of Engineers, plans, designs, constructs, operates, and maintains a wide variety of water resources infrastructure to support U.S. national economic interests (navigation structures, channels, shore protection, and restoration projects).

U.S. Fish and Wildlife Service (USFWS), monitors and implements programs that manage migratory birds and fish, national wildlife refuges, national fish hatcheries, and endangered species. Has management authority over marine birds and sea otters.

U.S. Geological Survey (USGS), is the earth science research and information agency.

U.S. Coast Guard, is the primary maritime law enforcement agency.

U.S. Environmental Protection Agency (EPA), the EPA 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.

7.1.2 State Agencies

Ocean resource management in California is under the authority of the Resources Agency and the California Environmental Protection Agency (CalEPA). The Resources Agency coordinates with 17 departments, commissions, conservancies, and boards with the mission to preserve, manage, and enhance California's cultural and natural resources.

California Coastal Commission (CCC), together with coastal cities and counties, plans and regulates the use of land and water in the coastal zone.

California Department of Fish and Game (CDFG) The mission of the CDFG is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. Has management authority for all marine fishes, invertebrates, and plants within state waters.

California Department of Parks and Recreation, manages state park units, including underwater areas off some coastal state parks, but does not have authority concerning the take of living marine resources.

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.

State Coastal Conservancy, protects, restores, and improves coastal resources, and provide access to the shore.

State Lands Commission, has jurisdiction over all of California's tide and submerged lands, and the beds of naturally navigable rivers and lakes. Management responsibilities extend to activities within submerged land and those within 3 nautical miles of the shore.

State Water Resources Control Board and the Regional Water Quality Control Board, issue permits and set conditions for the discharge of materials into coastal waters from point and nonpoint sources.

7.2 Governmental Programs

Federal, state, and local agencies support a variety of marine resource management programs that may have a significant link to the effectiveness of existing or future MPAs along the Central Coast. There follow brief descriptions are a sample of programs.

7.2.1 Federal Programs

The Monterey Bay National Marine Sanctuary Integrated Monitoring Network is a consortium of more than 40 institutions conducting monitoring in Monterey Bay.

National Estuary Program, (EPA) identifies, restores, and protects nationally significant estuaries such as Morro Bay.

National Estuarine Research Reserve Program, (NOAA) focuses upon the protection and management of estuarine resources, environmental education and interpretation, and monitoring and research within designated sites (Elkhorn Slough is a NERR site).

The National Marine Protected Areas Center, includes a Science Institute based in Santa Cruz and a Technical and Training Institute in North Carolina. Both of these institutes sponsor research and training in a range of MPA matters relevant to the Central Coast MPA process.

The National Marine Sanctuary Program, (NOAA) manages four national marine sanctuaries off the California coast including the Monterey Bay National Marine Sanctuary.

The Pacific Fishery Management Council (PFMC) plays a lead role in managing fisheries in federal waters, including some groundfish species also managed by the CDFG.

Water Quality Protection Program, Coordinated by the Monterey Bay National Marine Sanctuary, a partnership of federal, state, and local agencies and private groups that have developed and implemented plans for monitoring and addressing polluted runoff from urban, agricultural, rural, and marina/boating sources.

7.2.2 State Programs

Critical Coastal Areas Program, California Coastal Conservancy, fosters collaboration among local stakeholders and government agencies to focus resources and efforts to reduce polluted runoff in coastal zone watersheds.

California Ocean Resources Management Program, (CORMP), is a program of the California Resources Agency. The mission of the program is to ensure comprehensive and coordinated management, conservation, and enhancement of California's ocean resources.

The state Nonpoint Source Pollution Interagency Coordinating Committee involves 28 agencies in implementing California's federally-approved nonpoint source pollution control program by promoting a watershed approach and by providing a forum for resolving policy and programmatic conflicts.

7.2.3 Local Government Programs

The City of Monterey has sought to establish an underwater park to 10 fathoms off part of its shoreline, based on treaty doctrine. City's ordinace only restricts spear fishing and requires a permit for kelp harvesting.

The City of Pacific Grove passed an ordinance preventing all extraction of marine invertebrates within the intertidal area of its city limits.

7.2.4 Non-governmental Programs

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

8.0 Existing MPAs & Coastal Protected Areas

The Central Coast study region has 12 existing state MPAs and 1 existing state Special Closure area. A large part of the central coast study region is included in the Monterey Bay National Marine Sanctuary. In addition, while these designations do not warrant special protections, Elkhorn Slough is a National Estuarine Research Reserve and Morro Bay is in the National Estuary Program. There are also many state beaches, state parks, Department of Defense property, and other protected lands along the coastline.

8.1 Existing State Marine Protected Areas

A marine protected area, according to California State 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's existing MPAs to assess the need for changing existing MPAs or adding new ones in order to fulfill the MLPA requirement. The preliminary site characterizations and evaluations of existing MPAs in the region have been completed by CDFG 2005b (Appendix V). Within the characterization there is a preliminary assessment on the overall effectiveness of each MPA based upon the following criteria:

- baseline monitoring studies
- comparing species diversity and density
- individual animal sizes
- ability to conduct research, educational, and non-extraction recreation activities
- ability to enforce regulation

These evaluations will be further refined after the development of regional goals and objectives to better characterize the role existing MPAs play in meeting regional objectives.

There are 12 MPAs and a Special Closure area that are in the Central Coast study region (Map 13) that together encompass 3.8% of the total study region area (Table 42). An evaluation of the effectiveness of three of the state marine reserves in the region has also been conducted (Starr et al 2002b; Starr et al 2002c). This evaluation concluded 1) marine reserves need to be extended into deeper waters and 2) the existing marine reserves in Central California need to be expanded because they do not cover area large enough to achieve the goal of conserving biodiversity or habitats of the region (Starr et al 2002b; Starr et al 2002c).

Table 42: MPAs in Central Coast Study Region

MPA NAME	Type	Area (nmi^2)	Percentage of Total Region
Special Closure: Año Nuevo Invertebrate Area	Special Closure	1.66	0.19
Elkhorn Slough	State Marine Reserve	1.02	0.12
Hopkins	State Marine Reserve	0.12	0.01
Pacific Grove	State Marine Conservation Area	1.16	0.13
Carmel Bay	State Marine Conservation Area	2.11	0.24
Point Lobos	State Marine Reserve	0.90	0.10
Julia Pfeiffer Burns	State Marine Conservation Area	2.00	0.23
Big Creek	State Marine Reserve	1.71	0.20
Atascadero Beach	State Marine Conservation Area	4.78	0.55
Morro Beach	State Marine Conservation Area	5.15	0.59
Pismo	State Marine Conservation Area	0.06	0.01
Pismo-Oceano Beach	State Marine Conservation Area	10.04	1.16
Vandenberg	State Marine Reserve	1.87	0.22
Total Area of State Marine Reserves		5.62	0.65
Total Area of State Marine Parks		0	0
Total Area of State Marine Conservation Areas		25.3	2.91
Total Area of State MPAs in Central Coast		32.58	3.76
Total Area Central Coast Study Region (including Elkhorn Slough)		868.4	

8.2 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 (Map 13). 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. In 2005 (and thus not shown on map), the Department of Parks and Recreation acquired approximately 1,000 acres of coastal property through a conservation easement west of Highway 1 from Ragged Point to Pico Creek in San Luis Obispo County. 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.

9.0 Gap Analysis

A gap analysis is an evaluation of the amount of each habitat in a protected area; gap analysis helps to identify habitats that are underrepresented in protected areas (National Gap Analysis Program, 1994). A gap analysis will be conducted to evaluate the approximate amount of each habitat present in existing state MPAs in the region. This analysis has not yet been completed, as not all data on habitat distribution have been compiled. This analysis will be quantitative for those habitats with good spatial data (eg. kelp) and much more qualitative for those habitats with insufficient spatial data (eg. rocky reefs in the southern part of the region). Results will be provided in the “Evaluation of Existing Central Coast Marine Protected Areas” document.

10.0 Conclusions

The Central Coast study region is the first region to begin implementation of the MLPA planning process. The regional profile summarizes and provides background information on the biological, oceanographic, socioeconomic and governance aspects and draws upon suggestions and information provided by regional stakeholders and the SAT. The profile serves as a foundation for setting goals and objectives, evaluating existing MPAs and describing alternatives of potential new MPAs, and identifying needs for additional data and information.

The MLPA Initiative 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 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 Central Coast study region has many important and unique features including:

- Globally rare and significant upwelling-driven system that supports high marine biodiversity in open waters (plankton, invertebrates fish, marine mammals, seabirds)
- Globally unique giant kelp forests and associated fish assemblages (such as many species of rockfish)
- Occurrence of multiple submarine canyons in near-shore waters and high bathymetric complexity in the northern part of the region, which bring deep sea and near-shore assemblages in close proximity
- Rare and regionally important estuaries (Elkhorn Slough and Morro Bay)
- Rich and productive fisheries that have supported coastal communities and provided fresh seafood to the region and the world
- Renown as a diving, kayaking, fishing, and whale-watching destination; marine recreational activities help to support coastal tourism and coastal communities
- An unusual 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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