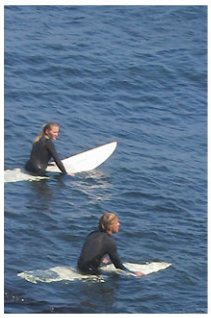
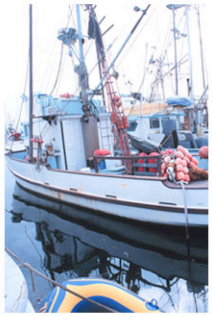
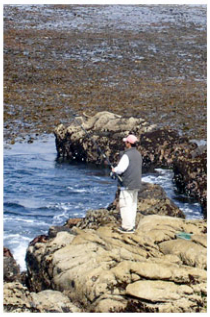
California Marine Life Protection Act (MLPA) Initiative
Regional Profile of the Central Coast Study Region
(Pigeon Point to Point Conception, CA)

DRAFT FINAL

August 1, 2005 (v.2.0)


Comments on this draft should be addressed to MLPA staff via email to ccrsgcomments@resources.ca.gov, by August 16, 2005. Comments should be as specific as possible, and please reference the page or section to which the comment applies.

INSIDE COVER MEMO:

This Draft Final Regional Profile of the Central Coast Study Region (Pigeon Point to Point Conception, CA) is still a ***work in progress***. 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).

The first Draft Regional Profile was provided to the Central Coast Regional Stakeholder Group on June 1, 2005. Verbal and written comments were received from the stakeholders and addressed to the extent possible in this draft final version. This Draft Final profile will be revised and updated based on input from the Central Coast Regional Stakeholder Group and Science Advisory Team. The Final Regional Profile will be completed in early September 2005.

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:

- A refinement of selected commercial fishing data through interviews to apportion historic effort to microblocks (Ecotrust)
- An assessment of non-consumptive use pattern along the Central Coast (Chris LaFranchi)
- Characterization of upwelling zones, retention areas, and freshwater plumes in the Central Coast based on satellite data (Bernardo Boitman, UCSB).

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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 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 are being compiled for use in the Central Coast MPA planning process. All of the data that are in a spatial geographic information system (GIS) format are 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, 8-10
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	Regional Description; Land-Sea Interactions; Socioeconomic Setting; Academic Institutions, Research, Public Outreach, and Education; Existing MPAs and Coastal Protected Areas;

manner consistent with protecting biodiversity.	Maps 2-3, 10 -11
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 2-3
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 6-12
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 2-3

Regional Description: The study region encompasses approximately 866 square nautical miles and extends from the shoreline (mean high tide) to a maximum depth of approximately 1475 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; and,
- 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 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 quite 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 and lagoons where coastal streams meet the sea.

- 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, has not yet been mapped.

- 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 over time due to changes in climatic and environmental conditions.

- Hard substrata habitats (rocky reefs) are much less common than soft bottom habitats in the region in all depth zones (4-17% of the region for hard substrata in different depth zones versus 83-96% for soft substrata). Coarse-scale mapped data for substratum type is available for the entire study region, higher resolution data is available for portions of the northern part of the region.

- Underwater pinnacles are rocky cones or outcrops that can be important as areas where fish and other species aggregate. Underwater pinnacles have not yet been mapped.

- 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. Freshwater plumes 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
- Large estuaries with eelgrass beds and tidal flats
- Small estuaries with presence of coho or steelhead populations
- Canyon heads and large submarine canyons, both soft and hard substrata
- Headlands with upwelling centers, epecially those with kelp forests and rocky reefs in retention areas in the lee of the upwelling center
- Persistent kelp beds (present in more than 2 survey years) and nearshore rocky reefs
- Areas of high bathymetric complexity
- Shallow and deep pinnacles
- Shelf-slope break (150-250m)
- Rocky intertidal shores, including those in inaccessible areas not subject to much trampling or harvest
- Seabird colonies and marine mammal rookeries and haulouts
- Areas of high fish or seabird diversity and/or density

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, CenCOOS) 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 (**GOALS 1-6**) and objectives. T

Gap Analysis. Gap Analysis will be conducted by mid-August 2005 to evaluate the approximate amount of each habitat present in existing state MPAs in the region. This 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 are being compiled for use in the Central Coast MPA planning process. This regional profile provides an overview of some of that data. All of the data that are in a spatial geographic information system (GIS) format are 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 MLPA Initiative staff.

Between August 2004 and December 2006 five key objectives must be achieved by the MLPA Initiative: (1) a draft Master Plan Framework developed, (2) the development of alternative proposals for MPAs in the Central Coast study region, (3) recommendations on long-term funding sources for MPA implementation and management, (4) 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. To facilitate the regional MPA planning process, this regional profile is being prepared.

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 are being compiled for use in the Central Coast MPA planning process. This regional profile provides an overview of some of those data. All of the data that are in a spatial geographic information system (GIS) format are 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, where it transitions downward to become the continental slope, is called the shelf-slope break and 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 Rivers) 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.

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 (MBNMS, 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 it's 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 Ecosystem and Habitats

The MLPA requires that MPAs, with specific reference to state marine reserves, in each bioregion 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. Regional habitats are described below and have been mapped, to the extent possible, given readily available information (Maps 2, 3, and 4).

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 as follows:

Table 1: Depth Zone as Percent of Central Coast Study Region

Depth Zone	Square nautical miles	Percentage of Study Region
Intertidal to 30 m (0 to 16 fm)	273.3	31.5%
30 to 100 m (16 to 55 fm)	435.6	50.3%
100 to 200 m (55 to 109 fm)	61.5	7.1%
200 m and deeper (109 fm and deeper)	95.9	11.1%

Bathymetric complexity (a measure of rugosity) is high in the portion of the study region where the large submarine canyon complexes (Monterey Canyon, Soquel Canyon, Carmel Canyon, Mill Creek and Partington Canyon) enter state waters 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.

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 area. Rocky intertidal communities, from the splash zone to the lower intertidal, vary in composition and structure with tidal height and wave exposure (Ricketts et al. 1985; Foster et al 1988). Intertidal boulders, platforms, and cliffs, as well as tidepools, are home to many species of algae, barnacles, anemones, snails, mussels, crabs, sea stars, and fishes. Mussel beds (*Mytilus* spp.), sea palm (*Postelsia palmaeformis*), algal beds (*Endocladia muricata* and many other species), and surfgrass (*Phyllospadix* spp.) are patchily distributed along rocky shores but support high biodiversity. In addition to the tidal height and steepness, the underlying geology of a rocky coast can affect the ecological communities present. The following rocky shore types have been mapped in the Central Coast study region (Table 2):

- **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 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.
- **Exposed wave-cut rocky platform with beach**: same as above, but with a beach either landward or seaward.
- **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; 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.

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.
- **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.
- **Tidal flat / Marsh**: includes areas with both tidal flat (sheltered or exposed) and coastal marsh present.

Table 2 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 mapping for NOAA's Environmental Sensitivity Index (ESI).

Table 2: 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	51.4	13.9%
Exposed Wavecut Rocky Platform	76.7	20.7
Exposed Wavecut Rocky Platform with Beach	53.7	14.5
Sheltered Rocky Shore	0.5	0.1
Gravel Beach	14.2	3.8
Mixed Sand and Gravel Beach	10.6	2.9
Coarse-grained Sand Beach	21.1	5.7
Fine-Medium Grained Sand Beach	93.2	25.1
Coastal Marsh	16.1	4.3
Exposed Tidal Flats	3.0	0.8
Sheltered Tidal Flats	2.1	0.6
Tidal Flat/Marsh	15.2	4.1
Riprap (man-made)	10.6	2.9
Seawall (man-made)	2.4	0.7

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. The aerial extent of estuaries in the Central Coast study area totals 6.9 nmi2 (see Maps 2a and 2b). The maps of coastal estuaries represent a composite from multiple sources, including the National Wetlands Inventory, California Natural Diversity Database, 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. Anadramous species such as salmonids and lampreys must pass through estuaries on their migration pathways. Steelhead in the Central Coast spend a significant part of their juvenile phase in coastal estuaries. Since estuaries and lagoons are important habitat linkages between marine, aquatic and terrestrial habitats, their condition is closely tied to the condition of the surrounding watershed. Estuaries provide critical ecosystem services such as filtering sediments and nutrients from the watershed, stabilizing shorelines, and providing flood and storm protection.

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 a large populations and a 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. 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. Eelgrass beds have been mapped in Morro Bay (Morro Bay National Estuary Program) and Elkhorn Slough (Elkhorn Slough National Estuarine Research Reserve). Total coverage of eelgrass beds in Morro Bay is approximately 0.8 nmi^2 and Elkhorn Slough is 0.025 nmi^2. (see Map 2b). 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 of 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.

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. In 2003, there were 7.2 nmi^2 of kelp bed in the Central Coast study area (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 affected by climatic and oceanographic changes, as well as certain types of fisheries (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

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. 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 3, 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 based on data compiled by Greene et al (2004) for the *Fisheries Habitat Characterization of the California Continental Margin*. Table 3 shows hard and soft bottom habitats by depth zone in the study region (amounts should be considered approximate based on Greene et al. 2004 coarse scale data).

Table 3: 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	36.4 (14%)	227.0 (86%)
30-100m	16.9 (4%)	419.4 (96%)
100-200m	10.8 (17%)	51.5 (83%)
>200m	14.0 (14%)	82.9 (86%)
Total	78.1 (9%)	780.8 (91%)

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”. The species that associate with hard substrata differ greatly with depth and type of substratum. Rocky substrata are much less common than soft substrata in the region at all depth zones (Table 3). 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. In addtion to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. 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).

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. More refined data from hydroacoustic mapping of 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. These multi-beam and sidescan sonar maps reveal the greatest detail and show relief and rugosity for hard bottom substrata; these data are currently being compiled into a GIS data layer. 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.

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. All pinnacles have not been mapped, but will be provisionally identified using bathymetric and substratum data in a GIS analysis.

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, and 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 at least other canyons with their heads in state waters in the northern half of the study region (Map 3a).

Submarine canyons provide areas of high bathymetric complexity, bring deep water communities close to shore, and affect local and regional circulation patterns. The south side of Monterey Canyon is very productive because prey organisms migrate up from the canyon depths to feed and are transported by currents southward to be trapped in shallow shelf waters, where they are then preyed upon by fish, birds, and marine mammals (Airame et al 2003). 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 affect productivity, ecological assemblages, and recruitment patterns. While highly complex and dynamic, some oceanographic features are relatively predictable or persistent and can be considered important habitats for spatial planning of MPAs.

In 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 affected by winds, ocean temperatures and salinities, tides, coastal topography, and ocean bottom features.

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 4). 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. Upwelling is also associated with coastal features, such as headlands, and bathymetric features such as the shelf-slope break and offshore banks.

Table 4: 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 affect fish, seabird, and marine mammal populations. Longer term decadal and multi-decade climatic cycles also affect a wide variety of marine organisms. Changes in atmospheric circulation in the central and northern Pacific and other factors yet unknown result in shifts in mean 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.

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). 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; probability maps of the likelihood of upwelling features are shown in Map 4

- **Upwelling zones**: The presence of upwelling 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. Map 4 shows upwelling zones – 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 (map is forthcoming) 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. 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. 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 still being developed.
- **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 areas. These plumes reach their greatest extent during winter storm events. Maps of rivers plumes are still being developed.

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 (Appendix II).

Species are included in this list based on three conditions:

a) if they occur in the Central Coast study region,
b) they are taken directly or indirectly in commercial and/or recreational fisheries, and / or
c) they have life history characteristics that make them more condusive to protection by MPAs, such as sedentary behavior, long life spans, slow growth, and 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 (i.e. below the range of natural fluctuations) abundance or abnormally low size frequency.

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 does include 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: Declines in populations of abalone (red, pink, green, black, and white) have been linked to multiple factors, including commercial harvest, increased market demand, sport fishery expansion, an expanding population of sea otters, pollution, disease, loss of kelp populations associated with El Niño events, and inadequate wild stock management (CDFG 2001). Specifically for red abalone, the term “depleted” only applies to that portion of the population south of San Francisco. 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 2002) has recommendations on the use of MPAs for abalone management and recovery. The plan states that abalone recovery (i.e. to a status in which a fishery may be permitted) many not be possible within the established range of sea otter.

Other invertebrates: In addition to abalone, several other macro-invertebrate species (Dungeness crab, brown rock crab, 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.

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, when mean length remains depressed and is coupled with an overall decline in abundance it becomes a concern.

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, as mapped by the NOAA Biogeographic Assessment of the MBNMS are are shown on Map 5.

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 affect 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 rookery sites, juvenile habitat (such as estuaries for salmonids), and important foraging areas within MPAs can help to provide additional protections, increase public awareness, and support monitoring and enforcement efforts.

A list of special status species expected to occur in the region compiled by the MBNMS is provided in Appendix I. 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 (Map 5) based on a variety of sources (Adams et al 1999; Jigour et al 2004; Busby et al, 1996; Titus et al 2000).

Sea otters: Historically, the sea otter, *Enhydra lutris*, ranged from Japan to Baja and numbered approximately 15,000 along the California coast; they were hunted almost to extinction until receiving protection in the early 1900s. Sea otters are listed as federally threatened. Sea otter populations are slowly recovering and they are expanding their range. 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 (S.Shimek, The Otter Project, pers comm.). Their current distribution from Pigeon Point to Purisma Point near Pt. Arguello and at San Nicolas Island (though occasionally otters are seen further south and further north along the mainland shore) almost includes the entire, the Central Coast study region. They are predators on invertebrates such as abalone, urchins, crabs, sea stars, mussels, and clams. Sea otters play an important ecological role in maintaining kelp forests along the Central Coast by preying on sea urchins and other herbivores that, if not controlled, would overgraze the kelp resulting in denuded areas. Sea otters use many near-shore habitats along the coast, from estuaries to kelp forests and rocky habitats, but rarely venture more than 1.5 miles 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 Map 5.

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 Map 5:

- ***California sea lion***: The California sea lion, *Zalophus californianus,* breeds in the Channel Islands but migrates as far north as British Columbia during the non-breeding season. They tend to feed in cool upwelling waters of the continental shelf. California sea lions feed on a variety of prey including squid, pelagic fish, and demersal roundfish (Pauly et al 1998); market squid were the most important prey type in a southern California study (Lowry and Carretta, 1999).
- ***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. While not colonial, they are gregarious while molting and resting and haul out in groups on sandbars and rock ledges along the Central Coast. Harbor seals eat primarily fish, especially demersal roundfish and salmonids (Pauly et al. 1998). In a southern California study, harbor seals were found to mostly eat rockfish, octopus, spotted cusk-eel, and plain midshipman (Stewart et al. 1994).

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 Devil's Slide Rock. 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 Map 5, based on data compiled by USFWS (Sowls et al 1980; Carter 1992). Areas of high seabird diversity and density are also shown on Map 5.

3.3 Areas of Biodiversity Significance

Spatial data are available (or soon to be 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). 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 or unique combinations of habitats
- Large estuaries with eelgrass beds, tidal flats, and coastal marsh
- Small estuaries with presence of coho or steelhead populations
- Submarine canyon heads and large submarine canyons (soft and hard substrata-dominated)
- 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 and nearshore rocky reefs
- Areas of high bathymetric complexity
- Shallow and deep pinnacles
- Rocky subtrata in all depth zones
- Shelf-slope break (150-250m)
- Rocky intertidal shores, including those in inaccessible areas not subject to much trampling or harvest
- Seabird colonies and marine mammal rookeries and haulouts
- Areas of high fish or seabird diversity and/or density

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 and vary along the coastal region because they depend upon a unique combination of factors that include biotic factors, climate, human use, and ocean currents.

Watersheds bring freshwater and sediments to bays, estuaries, and the ocean. These riverine environments once supported large numbers of salmon, steelhead trout, and sturgeon. Today, however, due to degradation of watersheds and freshwater ecosystems and the presence of barriers to fish passage, many native anadromous fish stocks throughout California are in danger of extinction (Airamé et. al., 2003).

Estuaries and bays are particularly vulnerable to coastal development, pollution, introduction of invasive species, and commercial and recreational fishing for species that live in nearshore waters. Increases in sedimentation, diversion of freshwater, and channelization have impacted the conditions in salt marshes, brackish water and eelgrass meadows. Urban runoff transports bacteria, viruses, and toxins that can cause harmful algal blooms and reduced oxygen concentrations. 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). Bays and esturaries along the Central Coast study region are small; however, they support thousands of birds during migration and numerous marine species use embayments, lagoons, and estuaries as spawning and nursery grounds. 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. Healthy coastal wetlands are critical to the existence of organisms that depend on these habitats for survival. Two major estuaries in the Central Coast study region are Elkhorn Slough (a National Estuarine Research Reserve or NERR site) and Morro Bay (a National Estuary Program or NEP site).

Throughout the region there are many short streams flowing into small estuaries in which mixing and dilution occur within a short distance of river mouths (Coastal Reserves Working Group, 2005). 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). Episodic and seasonal factors influence terrestrial input to marine environments. In the study region, substantial net export from estuaries to the ocean usually occurs during the rainy season and primarily during storm events (Coastal Reserves Working Group, 2005). Furthermore, since the California current is such a nutrient rich upwelling zone, the contributions of nutrients from land use are not significant relative to ocean-derived nutrients (Coastal Reserves Working Group, 2005). There are four main classes of land-sea interaction to consider when examining the effects of land use on the marine ecosystems of Central California. They are:

- Watershed processes and the export of sediment and materials of terrestrial origin to estuaries and the ocean (particularly 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); and,
- Socioeconomic interactions between land and sea at the coastal margin (e.g. beach closures or seasonal bans that may affect ecotourism and management of environments) (Coastal Reserves Working Group, 2005).

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

4.1 Ecological Linkages

Many of the ecosystems along the Central Coast study region are the most productive in the world. The structure and function of these communities 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 (from Airamé et. al., 2003):

- **Anadromous fish**, such as coho salmon and steelhead trout produce eggs and juveniles in fresh water. Then the juveniles pass through estuarine environments to mature at sea and return through the estuaries as adults to migrate upstream in coastal rivers for reproduction.
- **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 are part of the Pacific Flyway, one of the four principal bird migration routes in North America.
- **Marine Mammals**, such as sea otters, California sea lions, northern elephant seals, and harbor seals, have many haulout sites, as well as, and a few rookeries on secluded 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 provide 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, intertidal habitats, 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.

4.2 Coastal Watersheds & Landuse

The Central Coast study region extends for over 200 miles along the Californian coast, includes 866 square nautical miles of ocean and drains 9,909 square miles of land (2.5 million hectares) from 11 major watersheds. The largest coastal watersheds of the region are Pajaro, Salinas, and Santa Maria (Table 5). Map 6 shows the 11 large coastal watersheds (hydrologic units) in the study region.

Table 5: Major Watersheds in the Study Region

Hydrologic Unit Name	Area (hectares)
BIG BASIN	95,178
BOLSA NUEVA	13,213
CARMEL RIVER	66,230
ESTERO BAY	194,483
PAJARO RIVER	339,525
SALINAS	913,497
SAN ANTONIO	54,889
SANTA LUCIA	78,370
SANTA MARIA	480,944
SANTA YNEZ	233,137
SOUTH COAST	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).

Agriculture is one of the largest industries in Monterey County and a large percentage of the economy in Santa Cruz, Santa Barbara, and San Luis Obispo Counties. Agricultural operations can heavily impact both terrestrial and estuarine environments. Intensive cultivation in areas such as Salinas and Pajaro River Valley in Monterey and Santa Cruz Counties, the Morro Bay area in San Luis Obispo County, and in the Santa Maria watershed has modified the landscape and hydrological systems, increased saltwater intrusion into freshwater aquifers, caused sedimentation and siltation of coastal streams and estuaries, and added nutrients and contaminants to coastal estuaries and near-shore waters.

4.3 Coastal Water Quality

Coastal water quality information is important in MPA planning to ensure that any potential threats to marine resources in MPAs from water quality can be addressed through MPA design. *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. 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. This Implementation Plan includes a description of the regional surveillance and monitoring programs, such as the Central Coast Ambient Monitoring Program.

Offshore areas of the Central Coast have few documented water quality problems, but 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), harmful algal blooms, mortality due to toxicity, pathogen contamination, and interference with recreational uses of coastal areas. These adverse water quality impacts can impair designated beneficial uses. Beneficial uses along with the numeric or narrative objectives established to protect those uses jointly constitute federal water quality standards.

4.3.1 Impaired Water Bodies in the Central Coast Study Region

When a water body is not meeting 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 in 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 waterbody and establishes and implementation plan to ensure that the allocations and water quality standards are achieved.

There are a number of water bodies in the study region designated as impaired (For a list of the water bodies, a description of the pollutant/stressor, potential sources, priority level, and area affected 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.

There are several important water quality-related indicators of beneficial use impairment in the Central Coast study region. Elevated tissue burdens of persistent organic pollutants in fish and marine mammals, as well as die-offs of marine birds and marine mammals related to blooms of toxic phytoplankton all suggest that pollutants are degrading the quality of some marine habitats of the Central Coast (Kris Lindstrom, July 14th). Beach closures suggest negative impacts to the water-contact-sport beneficial use. Last, episodic burial of benthic habitats by sediments discharged from rivers suggests degradation of both wildlife and marine habitats.

There are four categories of water quality stressors that might play a causal role in these indicators of impairment. These stressors are persistent organic pollutants, nutrients, pathogens and suspended sediments in river discharges. The relationships between the priority beneficial uses, their related indicators of impairment, and these water-quality stressors are shown in Table 6.

Table 6: 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).

4.3.2 Point Sources

There are more than 40 municipal wastewater treatment facilities that discharge in the RWQCB region, with many of these discharging to 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 there are other kinds of permitted pollution discharge points in the region; these 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. Thermal discharges can change the speed of many chemical reactions and biological processes (including the solubility of oxygen and biological growth rates), which with temperature. 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 colonisation by exotic species from warmer climates. There are three power plants in the study region that produce thermal

waste. They are Diablo Canyon Power Plant, Morro Bay Power Plant, and Moss Landing Power Plant.

4.3.3 Nonpoint Sources

Runoff from nonpoint pollution sources is the primary cause of impairment for more than 76 percent of the water bodies where TMDLs are required in California (SWQCB, 2005 http://www.swrcb.ca.gov/nps/docs/npsfactsheet.pdf). The main sources of nonpoint source pollution are:

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

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 is affected by human disturbance within most coastal watersheds in the study region. The amount and type of sediment entering stream systems can greatly affect stream dynamics and may have detrimental impacts on salmonid populations (FISRWG 2000). Siltstone and mudstone rocks fracture easily, so they 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 substratum 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.

Increased sediment delivery can also result in disruption of biological communities due to the conversion of marine habitats from rocky substrata to soft-bottom and increasing sedimentation in the nearshore water column (MBNMS, 2003). Natural landslides can provide material at the base of the slope for wave protection as well as nutrients from the sediments entering the water (MBNMS, 2003). Based on a study done by the USGS, the Big Sur Highway alone yields approximately 21,000 ± 3200m3 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).

4.3.4 Beach Closings and Advisories

California has some of the most popular beaches in the country, if not the world. Millions of residents and tourists each year visit them to swim, wade, surf, and dive. The State of California has mandated beachwater monitoring beginning 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. They are tested for coliform, fecal coliform, and enterococcus bacteria. Beach closings are generally triggered in three ways: presence of bacteria, discharge of untreated sewage, and excessive rainfall.

Table 7 lists the number of beach closings in days for each year from 2000 to 2003 by county within the study region. Table 8 lists all beach closing 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, please see http://www.nrdc.org/water/oceans/ttw/titinx.asp.)

Table 7: 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

Table 8: Beach Closing By County in the Study Region

County	Beach Name	Number of Closures in 2003
Monterey	Coral and Oceanview 3	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

4.3.5 Water Quality Programs and Monitoring

The MBNMS staff recognized that water quality was key to ensuring protection for all Sanctuary resources, and 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).

Water quality issues led eight key water quality agencies within the sanctuary region into the memorandum of agreement (MOA) described above, 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.

The U. S. Environmental Protection Agency has a number of ongoing projects along the Central Coast, such as the Elkhorn Slough Wetlands Water Quality Project, Morro Bay Watershed Management Plan, and the Monterey Bay Urban Runoff Water Quality Project. For more information on these types of projects see: http://endeavor.des.ucdavis.edu/nrpi/.

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 get 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 there are many programs that 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

5.0 Socioeconomic Setting

California's marine and coastal environments form part of the State's identity and support important economies that depend on healthy ocean resources. Socioeconomic conditions, affect marine resource use patterns, coastal livelihoods, and human activities. A brief overview of coastal counties, ocean economy, demographics, and resource use in the 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 product1. 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.

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 remains significant in Seaside, Sand City, Monterey, and Moss Landing.

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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).

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 9). 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 9: 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 10). Employment in Tourism and Recreation increased between 1990 to 2001 by 94% and wages increased by 120%. Coastal construction employment grew by 4%.

Table 10: 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 (Table 14). 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 11).

Table 11: 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 (Table 12). Transportation and Tourism and Recreation sectors expanded (Table 12).

Table 12: 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 13). 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 13: 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 14). Population centers include the largely urbanized cities of Salinas, Santa Cruz, the Monterey Peninsula, and Santa Maria.

Table 14: 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 14). 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 14). 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. 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 15: 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 contacns 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).

5.4 Commercial Fisheries

These are two main port areas encompassed by the Central Coast study region. The Monterey port area includes the ports of Monterey, Moss Landing, and Santa Cruz. The Morro Bay port area includes the ports of Morro Bay, Port San Luis/Avila, and San Simeon. In 2004 approximately 65 million pounds of fish and invertebrates were landed in these port areas with an ex-vessel value (price paid to fishermen) exceeding $13 million (Table 16). The significant 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.

Table 16: Northern California Commercial Harbor Areas and Ports (2004)

Area	Ports	Total Pounds of Fish	Total Value ($)
Monterey Bay	Moss Landing	55,479,886	$6,892,646
	Monterey	3,682,742,	$1,889,024
	Santa Cruz	584,374	$1,061,074
	Mill Creek	14,126	$38,500
	All Other Ports	847	$4,138
	Monterey Bay Area Total	**59,761,975**	**$9,885,383**
Morro Bay	Morro Bay	3,131,285	$2,261,647
	Avila/Port San Luis	1,632,855	$1,299,407
	All Other Ports	63,706	$19,064
	Morro Bay Area Total	**4,827,847**	**$3,580,117**

(Source: California CDFG, California Commercial Landings (preliminary), 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.

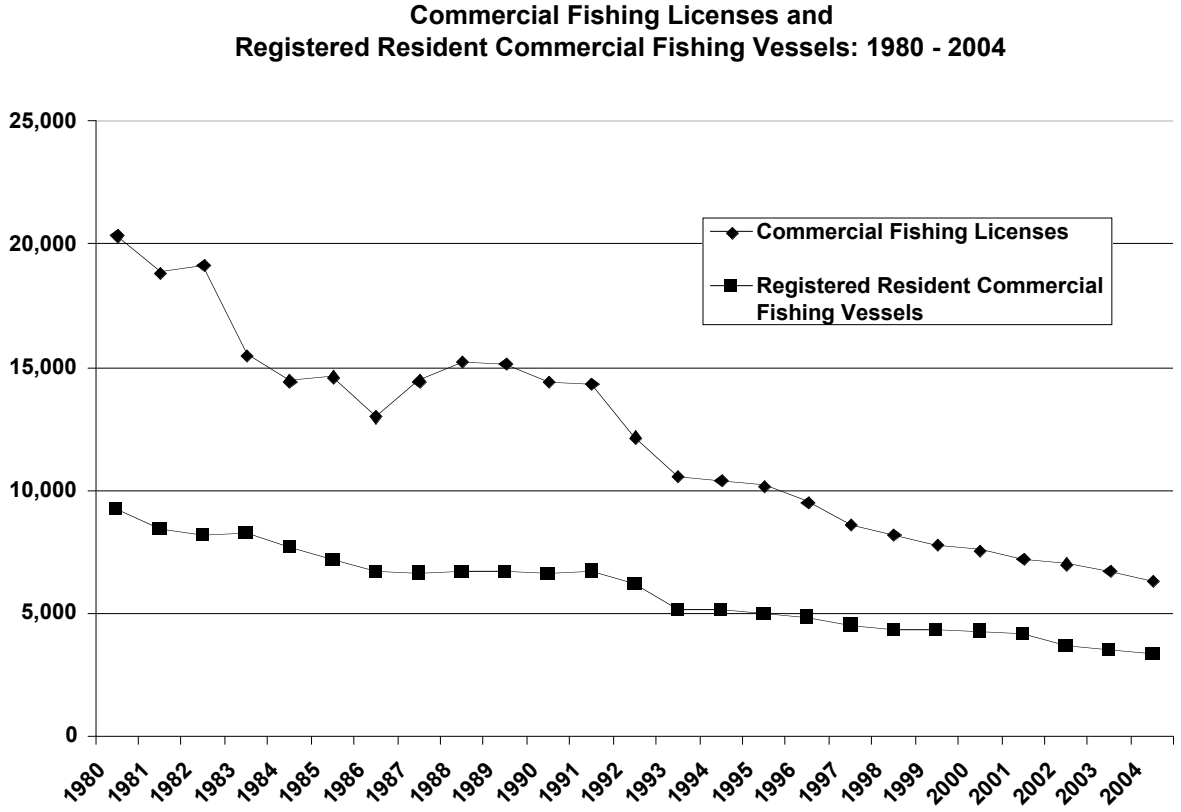
Important commercial fisheries are defined as those fisheries with average annual landings during the 1999-2004 period of at least 10,000 pounds or average annual ex-vessel value of at least $10,000 in one or both port areas. Some of the fisheries contain multiple species due to the nature of the fishing 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, 2002, 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.

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 1). Since 1988, a decline in licenses sold has occurred every year and has averaged 3.7% per year.

Figure 1: 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 largely due to 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), reduce bycatch, and reduce potential habitat damage (e.g from the use of trawls with large roller gear in complex habitats) in order to achieve long-term sustainable fisheries.

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
- 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 1999 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 2-9 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.

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 August 2005. 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, and shark fisheries. 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.

Figure 2: Monterey Ex-vessel Landings: Finfish

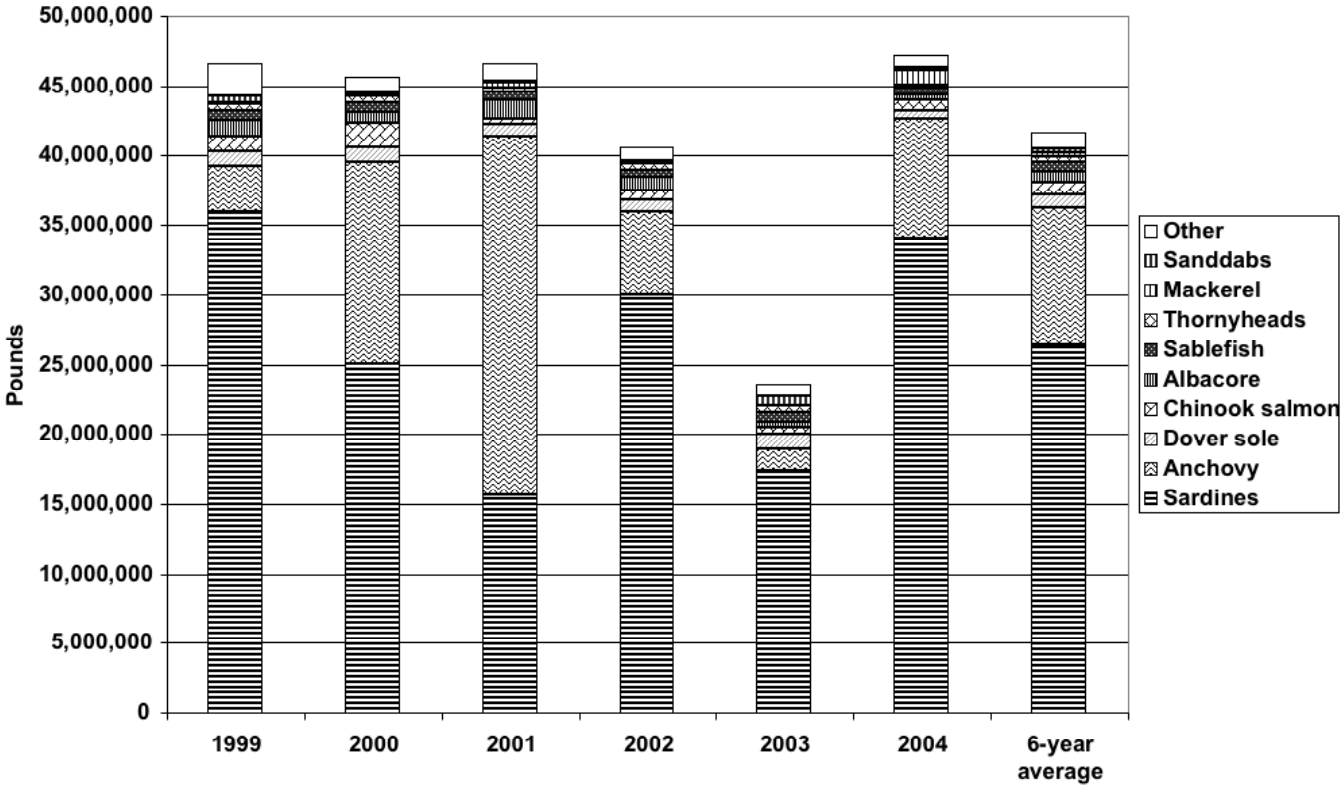


Figure 3: Monterey Ex-vessel Value: Finfish

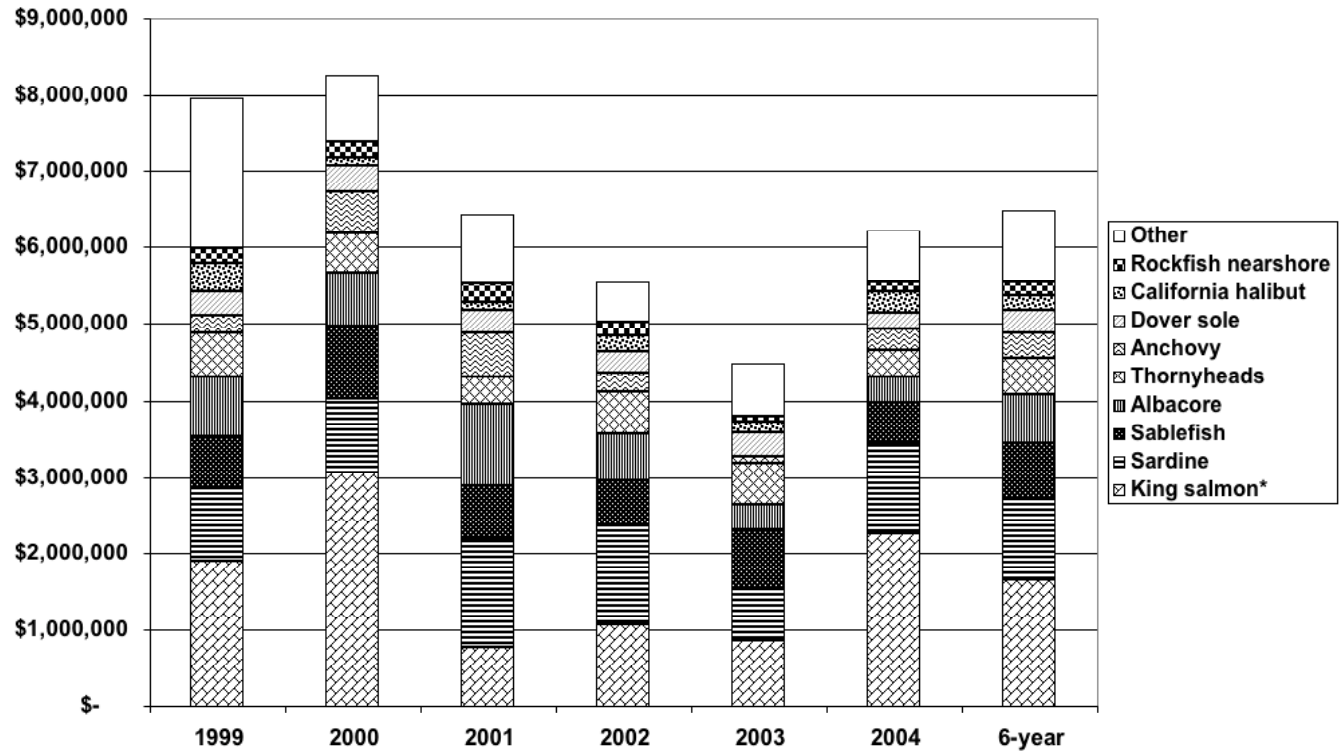


Figure 4: Monterey Ex-Vessel Landings: Invertebrates

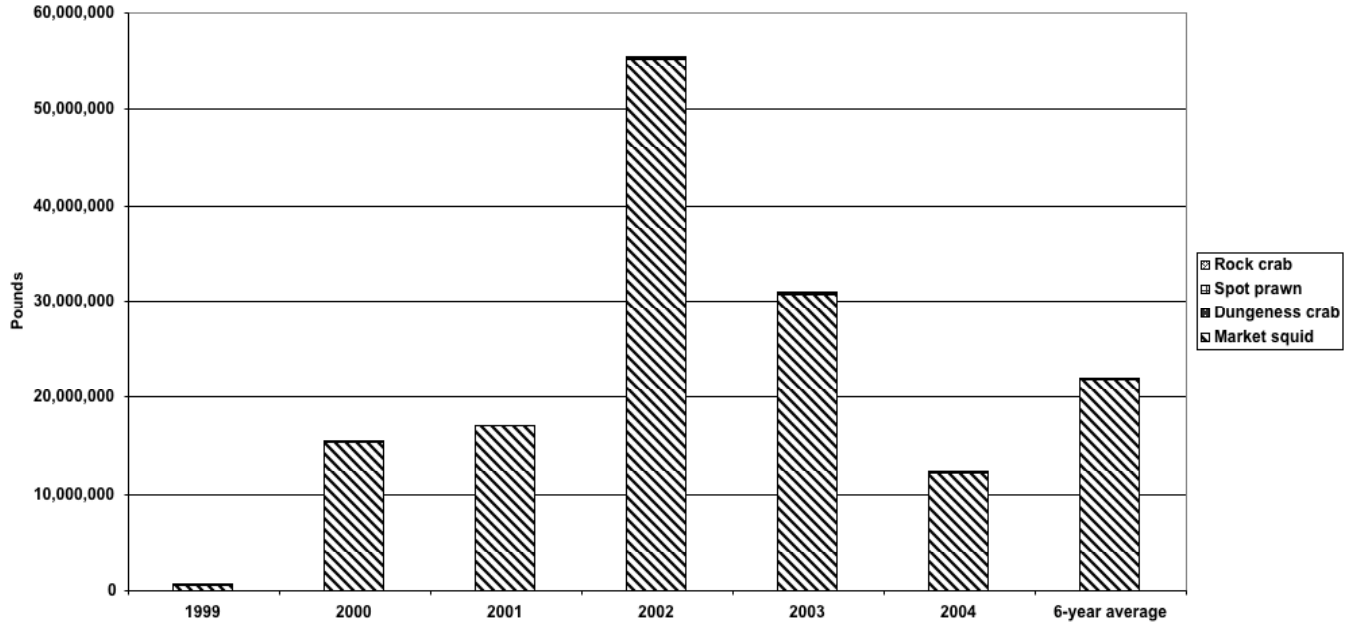


Figure 5: Monterey Ex-Vessel Value: Invertebrates

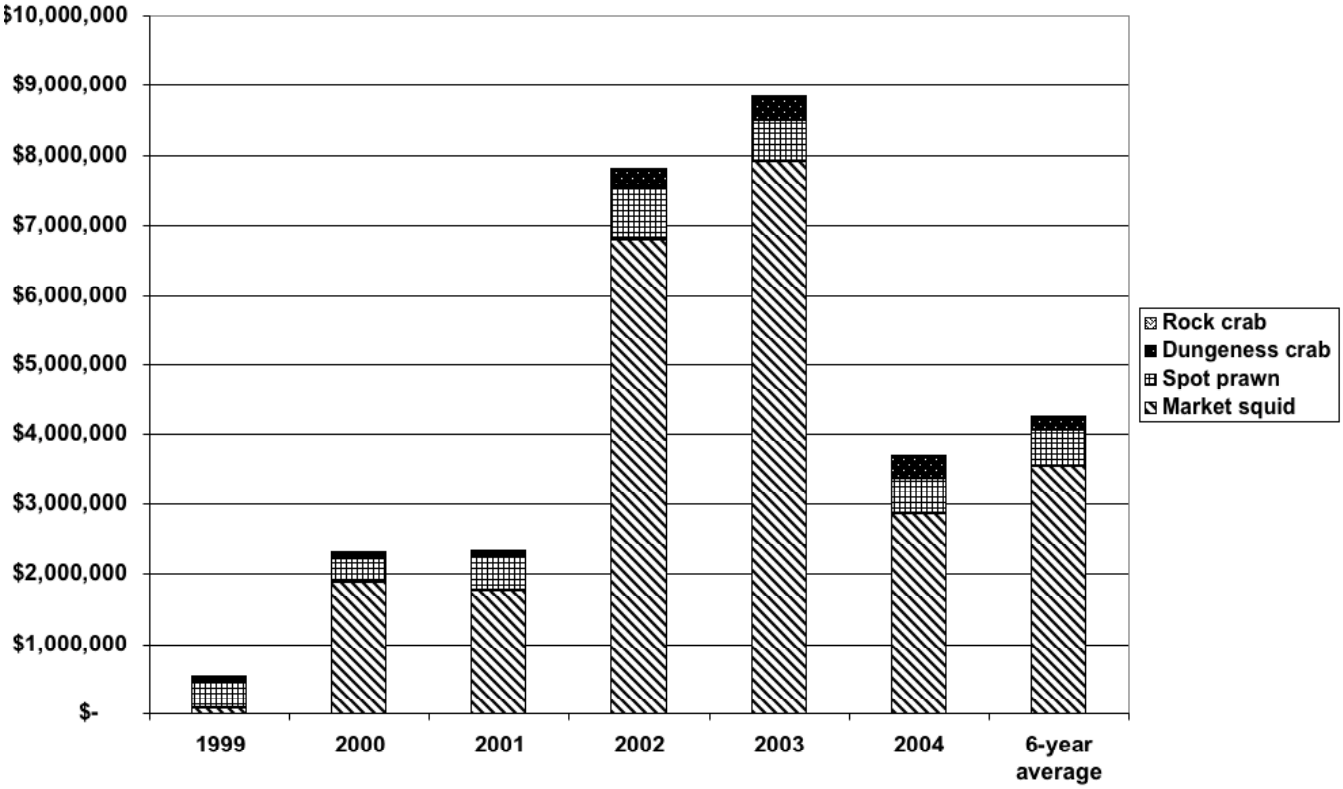


Figure 6: Morro Bay Ex-Vessel Landings: Finfish

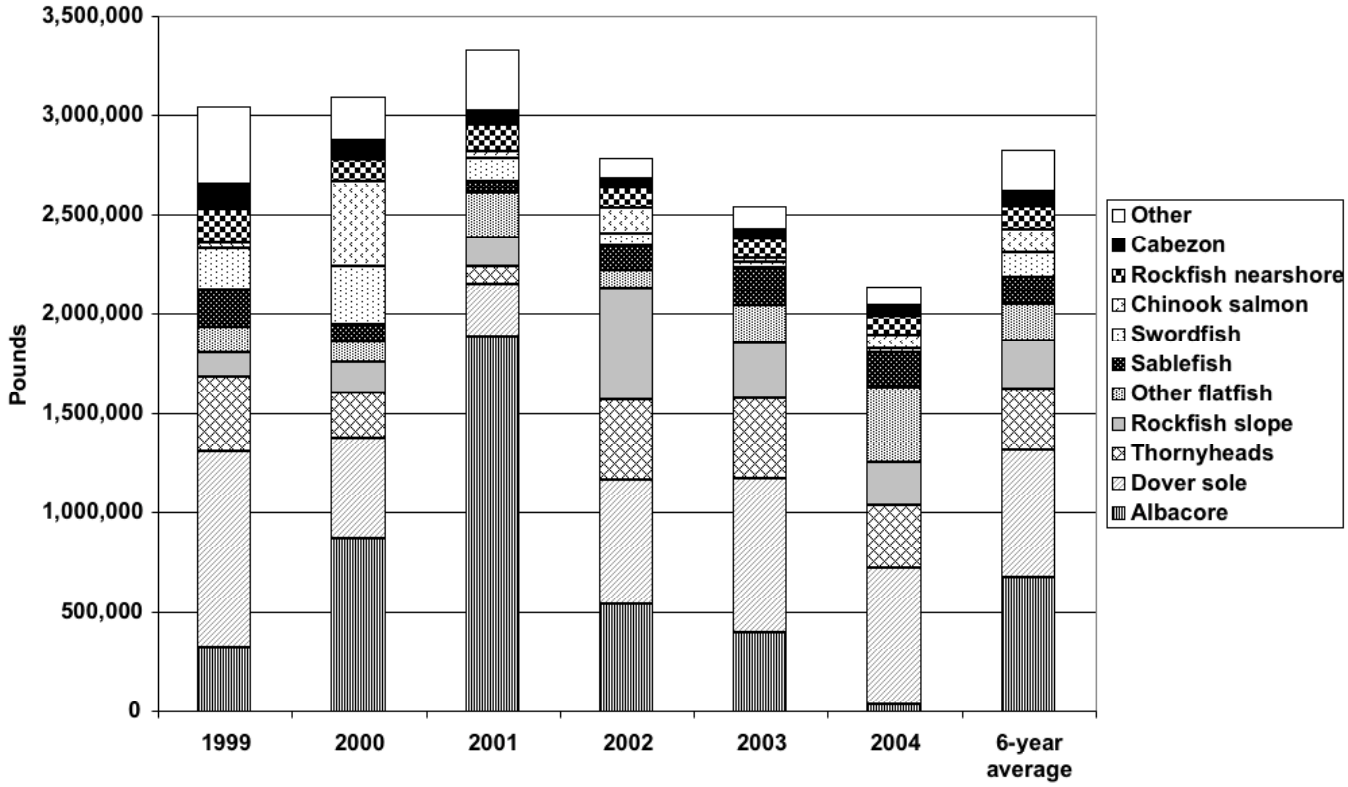


Figure 7: Morro Bay Ex-Vessel Value: Finfish

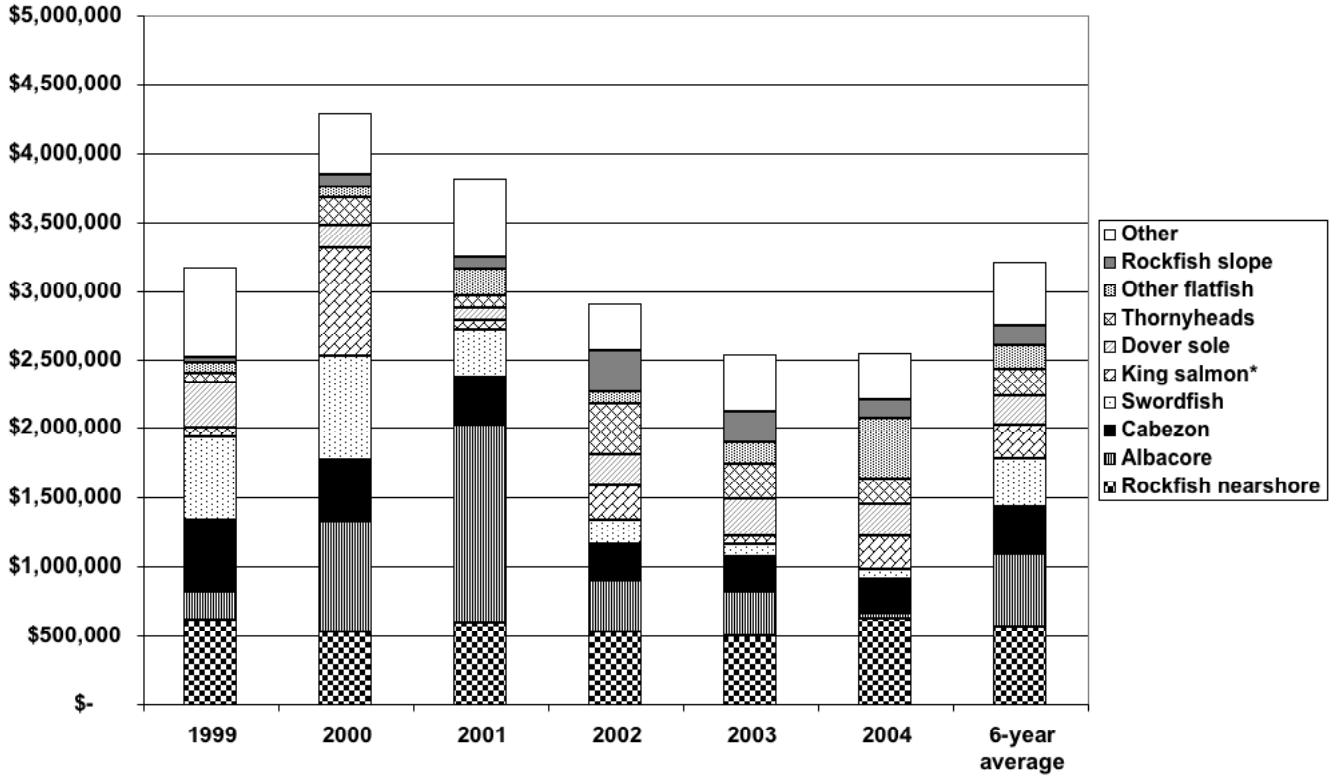


Figure 8: Morro Bay Ex-Vessel Landings: Invertebrates

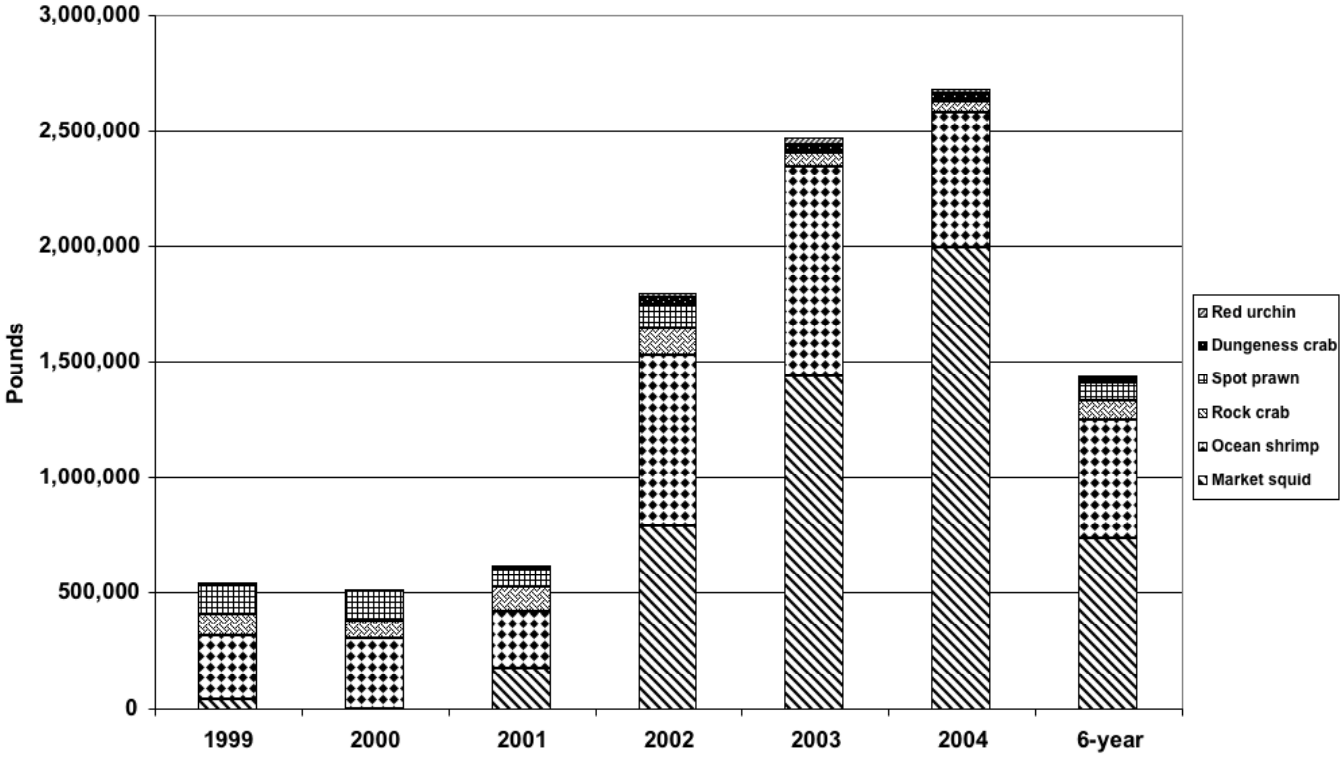
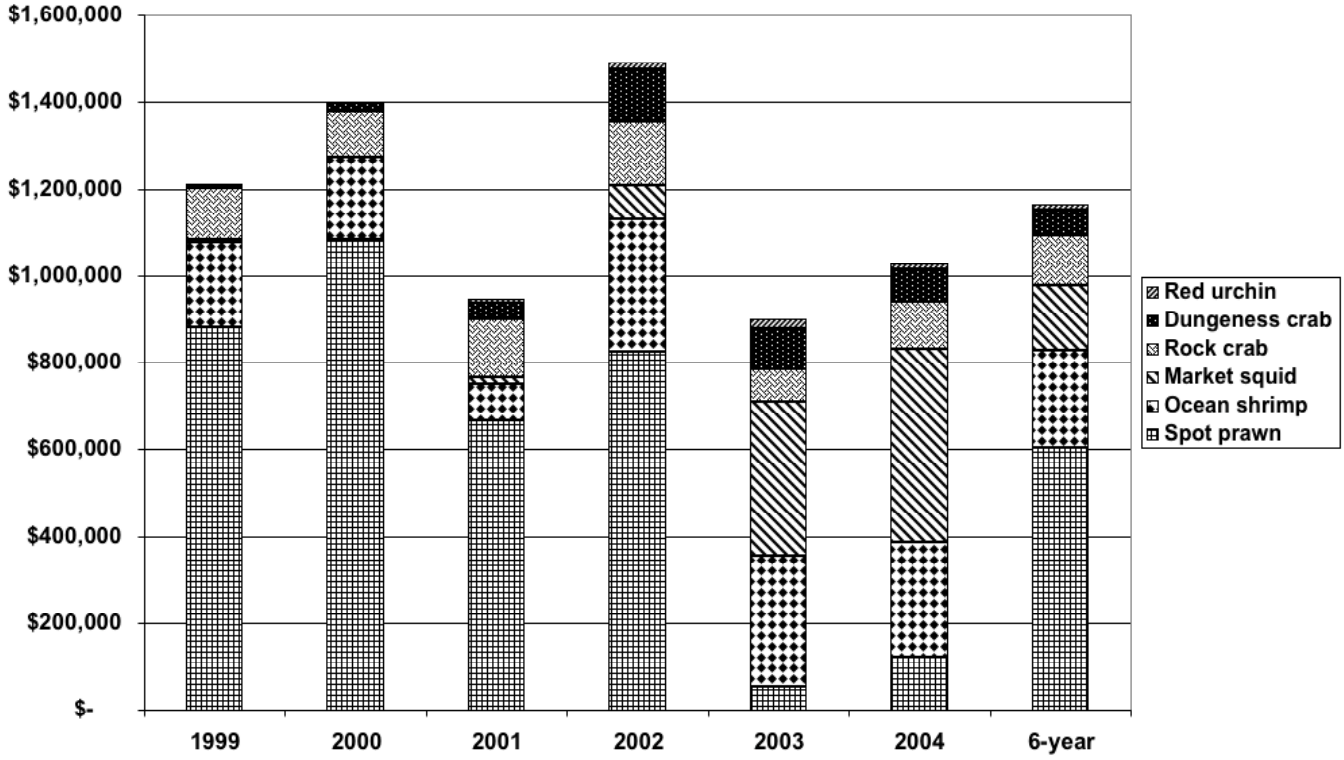


Figure 9: Morro Bay Ex-Vessel Value: Invertebrates



5.5 Aquaculture and Kelp Harvesting

Within the Central Coast study region 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 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 17: 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 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 16 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.

Annual estimates of total recreational fishing catch and effort are important statistics to state and federal fishery managers, as well as to the anglers themselves. 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.

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.

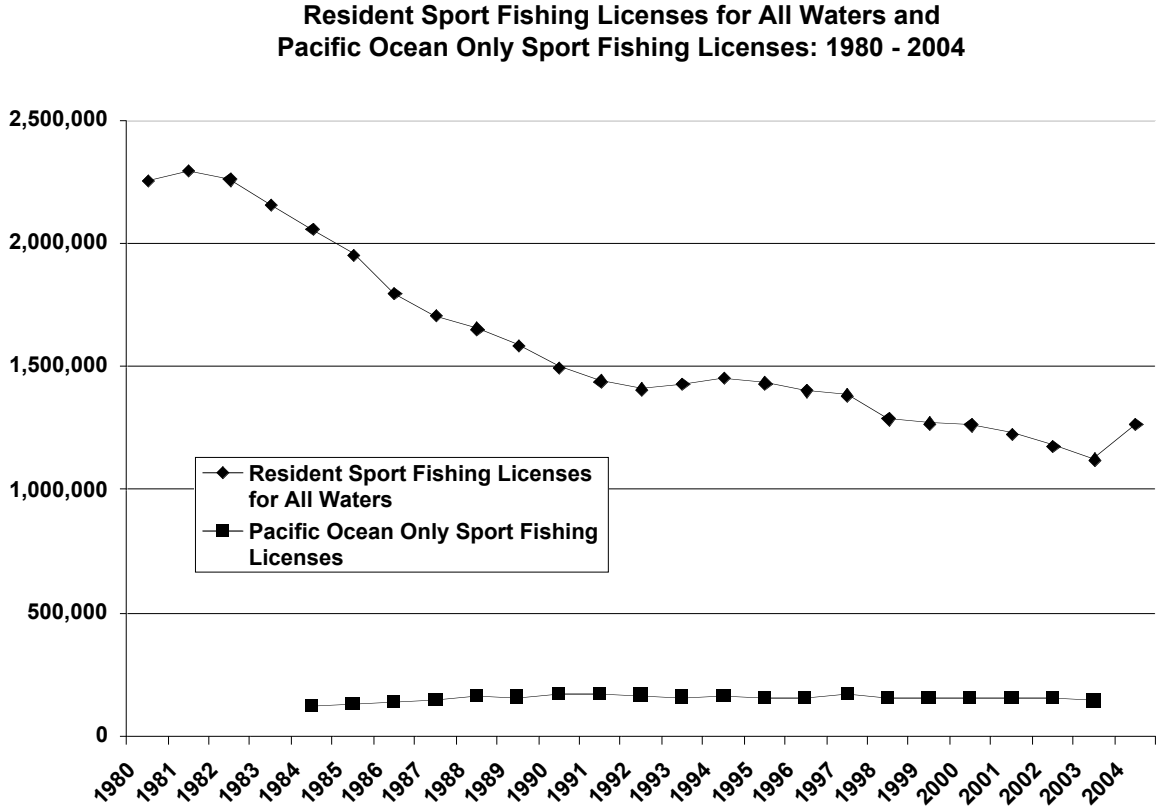
Recreational fishing effort, in terms of total number of angler-days, is considerably higher at man-made structures along the central coast than other modes of fishing. Based on estimates from the 2004 CRFS data, the following are the estimated total number of angler days by mode of fishing: beach and bank 39,000; manmade structures 260,000;
private and rental boats 55,000; CPFV 75,000."

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 10). This represents a 44% decrease in a 20-year period.

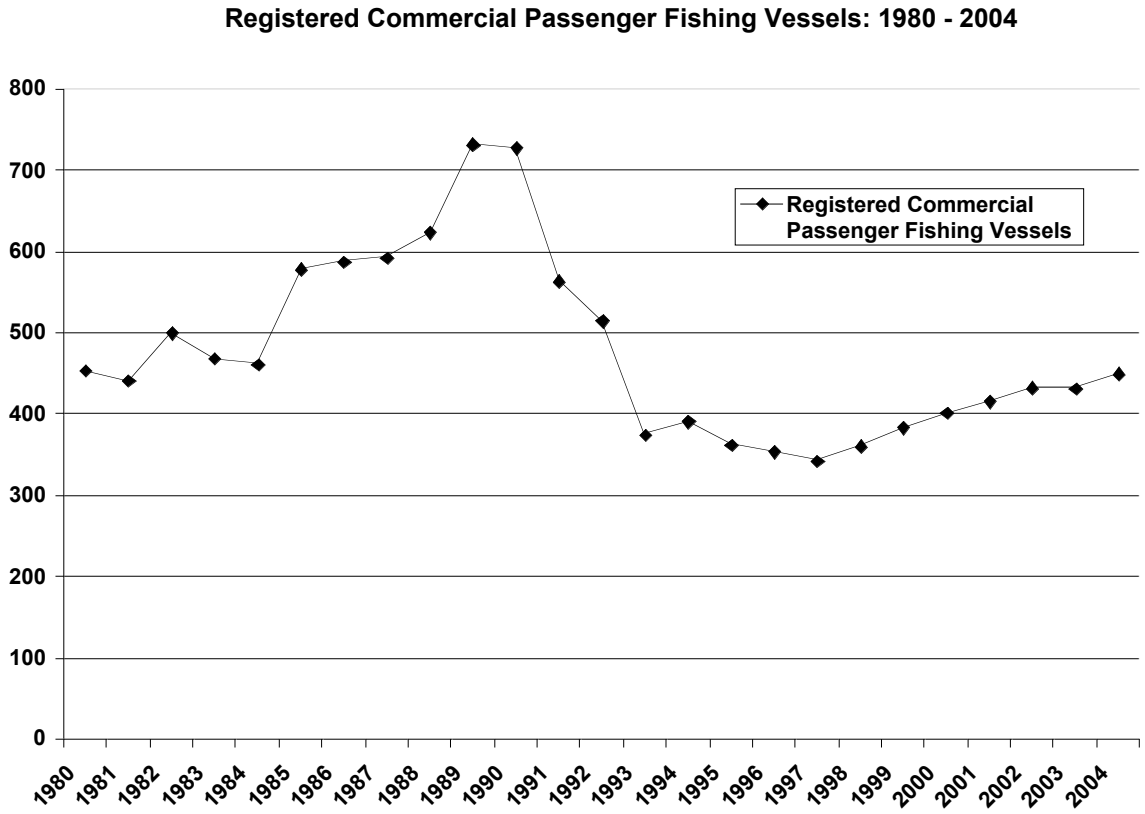
Figure 10: Resident Sport Fishing Licenses for All Waters and Pacific Ocean Only Sport Fishing Licenses: 1980-2004



However, the trend in the sale of Pacific Ocean only sport fishing license is quite different (Figure 10). 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 11). 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.

Figure 11: 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 three 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 are available from the 2004 CRFS program, these data are 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 these data are depth-limited in scope for bottom-oriented fishes due to regulations, they are the only data available with this degree of resolution for private and rental boat fishing. These data are 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 these data include fishing trips in which no catch occurred. The microblocks compiled in this data set are those reported by the fishermen to the samplers.
3. 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 18)

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 18: 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.

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 portion of the RCA closed year-round to these gear types comprises approximately 4% of the Central Coast study region.
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 Closure Zone 4 off Vandenberg Air Force Base, only salmon trolling is permitted (Walter Schobel, personal communication: vessels may not loiter in the area)

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.
2. Waters greater than 40 fathoms deep south of Lopez Pt.
3. Within Military Closure Zone 4 off Vandenberg Air Force Base, only salmon trolling is permitted (Walter Schobel, personal communication: vessels may not loiter in the area)

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

5.7 Non-consumptive Uses

A major non-consumptive use of marine resources is marine recreation. Recreational activities along the Central Coast study region include recreational boating, diving, sightseeing, hiking, surfing, kayaking, whale watching, beachgoing, and tidepooling. Recreational boat use and sport diving have increased in the Central Coast over the last 2 decades. The number of registered boats increased by more than 50% in the state between 1978 and 1991; 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.

5.7.1 Recreational Beach Use

As dynamic landforms altered by wind, waves, and seasonal cycles of sand deposition and loss, beaches appear different from summer to winter, year to year. Such mutability makes them both universally appealing and biologically and geologically diverse. The coast supports distinct communities of flora and fauna, and ranges in terrain from mountains to rivers, marine terraces, estuaries, rocky shores, bays, and sandy beaches. The Central Coast's approximatley 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.. Beaches managed by the State can also bring in revenue from user fees, and concessions (Table 19).

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 19: 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 20: 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 2,424,419 visitors in 2000-2001, ranked number six for visitation to state parks in California (Source: National Park Service, 2002).
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 Resource Guide* describes each coastal area along California's 1,100 miles of continent abutting the Pacific Ocean. Ninety-seven coastal destinations occur between Pigeon Point in San Mateo and Point Conception in Santa Barbara, the region encompassed in this study.

Table 21: Beaches and Coastal Areas Along California's Central Coast Region

County	Some Beaches/Coastal Areas
Monterey	Zmudowski State Beach, Moss Landing State Beach, Elkhorn Slough, Salinas River State Beach, Salinas River Wildlife Area, Marina State Beach, Monterey State Beach, Monterey Beach Park, Coast Guard Pier ("the Breakwater"), Macabee Beach, Cannery Row, Shoreline Park, Lover's Point, Perkins Park, Point Piños Lighthouse Reservation, Asilomar State Beach, Spanish Bay, Fanshell Beach, Cypress Point Lookout, Pescadero Point, Pebble Beach, Stillwater Cove Access, Carmel City Beach, Carmel River State Beach, Point Lobos State Reserve, Malpaso Creek, Point Sur Lighthouse, Andrew Molera State Park, Pfeiffer Beach, Julia Pfeiffer Burns State Park, Limekiln Beach Redwoods Campground, Mill Creek Picnic Area, Sand Dollar Picnic Area and Beach, Jade Cove, Willow Creek Picnic area, Redwood Gulch
San Luis Obispo	Ragged Point, Point Sierra Nevada, Piedras Blancas Point, William R. Hearst Memorial State Beach, San Simeon State Beach, Estero Bay, Cayucos Beach, Morro Strand State Beach, Atascadero State Beach, Morro Bay State Park Sand Spit, Montana del Oro State Park, Point Buchon, Diablo Canyon, Port San Luis, Avila State Beach, Pismo Beach, Pismo State Beach, Nipomo Dunes
San Mateo	Pigeon Point, Gazos Creek Coastal Area, Franklin Point, Año Nuevo State Beach
Santa Barbara	Santa Maria River Mouth, Mussel Rock Dunes, Point Sal State Beach, San Antonio Creek, Purisima Point, Ocean Beach County Park, Point Arguello, Jalama Beach County Park, Point Conception
Santa Cruz	Waddell Creek Beach and Marsh, Greyhound Rock Fishing Access, Scott Creek Beach and Marsh, Davenport Overlook, Bonny Doon Beach, Red, White and Blue Beach, Wilder Ranch State Park, Natural Bridges State Beach, Lighthouse Field State Beach, Cowell Beach, Santa Cruz Municipal Wharf, Santa Cruz Beach and Boardwalk, Seabright Beach, Twin Lakes State Beach, Bonita Lagoon, Lincoln Beach, Sunny Cove, Moran Lake, Pleasure Point, Capitola Fishing Wharf/Hooper Beach, Capitola City Beach, Capitola Bluffs, New Brighton State Beach, Seacliff State Beach, Rio Del Mar Beach, Manresa State Beach, Sunset Beach, Palm Beach, Pajaro River and Dunes

(Source: California Coastal Commission, California Coastal Resource Guide*, 5th edition, Berkeley: University of California Press, 1997)*

5.7.2 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). In the Central Coast study region, the trend illustrates climbing numbers of registered boats. The number of registered boats in the Central Coast (as defined by the Department of Boating and Waterways) increased by more than 70% between 1985 and 2005. Compared with recreational fishing licenses 1984-2003 (Figure 10), which showed a steady decline, boat use is increasing and will likely continue to do so in the future (Table 22). The popularity of non-motorized craft such as kayaks has also increased in most coastal waters.

Table 22: Historical and Forecasted Boat Population and Trends, Central Coast, 1985-20202

Year	1985	1990	1995	2000	2005	2010	2015	2020
Boat Population	20,225	24,438	27,268	30,617	35,196	40,089	45,150	51,009

(Source: Department of Boating and Waterways, 2002)

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 23). 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.

2 This data may include jetskis, we are trying to verify.

Table 23: Number of 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	

5.7.3 Recreational SCUBA Diving

Recreation is one of the foremost non-consumptive uses of marine resources, with SCUBA diving a popular recreational activity. (Refer to Recreational Fishing section above for discussion of consumptive diving.) 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% in the 1980s and 5-7% in the 1990s (Weinstein). Diving also drives related business, such as underwater photography and art galleries, and produces direct and indirect revenue via services and facilities serving the region (Al Hornsby, PADI, pers. comm., 7/2005).

Divers consider many factors when determining where to recreate: ease of access to shore and by boat (commercial dive boats, kayaks, private motorized boats, and swimming); proximity to parking; diversity and abundance of marine life; and presence of calm water. Preliminary data from LaFranchi's nonconsumptive use study ranks factors influencing diver site choice (Table 24). For these reasons most recreational diving—for values such as sight seeing, photographing, and observing marine life—occurs in the Monterey area, including Monterey and Carmel Bays.

Table 24: Preliminary results, Divers, Top factors that influence site choice

Rank	Positively influence	Negatively influence
1.	Abundance/variety of fish	Presence of sport/commercial fishing vessels
2.	Abundance/variety of invertebrates	Hook and line fishing allowed
3.	Access by car/beach	People fishing from kayaks

(Source: LaFranchi, C. 2005. Preliminary Results from Non-consumptive Use Study)

The Central Coast is a world-class diving destination which boasts abundant marine life, including sea otters, sea lions, orcas, gray whales, great white sharks, and diverse species of fishes, invertebrates, and plant species. It also contains sheltered bays, rock reefs, and good access from shore and by boat; six commercial vessels in Monterey Harbor exclusively serve divers, and use of private dive boats has increased (J. Wolfe, per. comm.. 7/2005). As a whole, the Monterey area offers some of the most popular diving spots along the west coast between Puget Sound in Washington and the Channel Islands in southern California. It also shoulders the heaviest use by non-consumptive divers along the Central Coast (Environmental Defense 2004). A survey conducted at 87 dive sites along the northern part of the Central Coast region, between 1997 and 2004 showed that 64% of dives occurred in south Monterey Bay and 29% in Carmel Bay (Reef Environmental Education Foundation). 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; Reef Environmental Education Foundation). All recreational diving along Monterey occurs within the three-mile State water line (the majority with 0.5 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 (Wolfe, per. comm., 7/2005). Preliminary results from LaFranchi's research shows the average number of dives for an individual during the last 12 months is 24, with a range of 1-150. Monterey Breakwater, besides being the most popular beach dive, 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 most popular entry points include Breakwater, Point Lobos, between Shale Beds and Point Lobos, Monastery, Stewart's Point, Point Pinos, Yankee Point and Big Sur (Environmental Defense 2004). Preliminary results from LaFranchi's research on non-consumptive uses lists in (note some are already protected) Table 25 the frequency of use of popular sites and the sites people believe are the most important to protect. Overall, recreational diving brings intrinsic value to its participants and economic benefits to the region. Access points and dive sites have been mapped from a variety of sources (J. Wolfe, REEF, and others) as shown on Map 10.

Table 25: Preliminary results, Divers Site Section

Rank	Frequency of use	Importance for protection
1.	Monterey Breakwater	Mertridium Fields
2.	Stillwater Cove	Whaler's Cove
3.	Lovers Point	Carmel River
4.	Monastery Beach	Stillwater Cove
5.	Otter Cove	Point Cabrillo
6.	MacAbee	Monestary Beach
7.	Mertridium Fields	Ocean Pinnacles
8.	Point Cabrillo	Monterey Breakwater
9.	Blue Fish Cove	Lover's Point
10.	Eric's Pinnacle	Cypress Point

(Source: LaFranchi, C. 2005. Preliminary Results from Non-consumptive Use Study)

5.7.4 Other Recreational Activities

Kayaking, whale watching, and nature observation have all increased in popularity (Weinstein). Preliminary results from LaFranchi's research show that in the last 12 months ocean kayakers on average went out 33 times per individual, with a range of 1-250. Factors influencing their site choice are listed in Table 26.

Table 26: Preliminary results, Ocean Kayakers, Top factors that influence site choice

Rank	Positively influence	Negatively influence
1.	Presence of bird life	Presence of sport/commercial vessels
2.	Encounters with marine mammals	Long distance to site
3.	Presence of an MPA, Access by car (tie)	Hook and line fishing allowed at site

(Source: LaFranchi, C. 2005. Preliminary Results from Non-consumptive Use Study)

Preliminary results from LaFranchi's research on non-consumptive uses are listed in Table 27 the frequency of use of kayak access points and the routes people believe are the most important to protect.

Table 27: Preliminary results, Ocean Kayakers

Rank	Frequency of use (corresponds to specific access points)	Importance for protection (corresponds to kayaking "routes" – areas used by kayakers)
1.	Kirby Park	Elkhorn Slough – Kirby Park
2.	MBK (Monterey Area)	Point Sur area
3.	Elkhorn Slough	Cooper Point/Pfeiffer area
4.	Stillwater Cove	San Simeon area
5.	Cannery Row	Lovers Point to Point Pinos
6.	Pigeon Point	Cannery Row area
7.	Lucus Point	Lopez Point area (Big Sur Coast)
8.	Monterey Harbor	MBK (Monterey area)
9.	Andrew Molera	Point Lobos
10.	Mill Creek/Pacific Valley	Natural Bridges to Santa Cruz Harbor area

(Source: LaFranchi, C. 2005. Preliminary Results from Non-consumptive Use Study)

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 preliminary research by LaFranchi show that on average people have gone 1.1 times per individual on wildlife viewing trips on a charter, with a range of 1-2 in the last 12 months. Factors influencing their site choice are listed in Table 28.

Table 28: Preliminary results, Wildlife viewing from charter, "Whalewatching", Top factors that influence site choice

Rank	Positively influence	Negatively influence
1.	Marine mammal sightings	Absence of whale sightings
2.	Leatherback turtle sighting	Presence of 10 or more private boats in close proximity
3.	Presence of an MPA	Presence of sport/commercial fishing vessels

(Source: LaFranchi, C. 2005. Preliminary Results from Non-consumptive Use Study)

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, with estimated 10,000 being k-12 children (Tenera Environmental, 2003). Visitors go to this area to relax and see the tidepools because of the scenic beauty, diversity of marine life, ease of access, clean environment, and proximity to other attractions in the area (Tenera Environmental, 2003).

5.7.5 National Scenic Byways

Highway 1 is one of the most scenic highways in the world and residents and tourists use the road to see the views and wildlife (National Scenic Byways Online. 2005). Two locations of particular beauty and attraction are along the Central Coast study region are the Big Sur Coast Route 1 and San Luis Obispo North Coast byway (National Scenic Byways Online. 2005).

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 11 shows institutions compiled from a list of Sanctuary Integrated Monitoring Network (SIMoN) partners in California, the Central California Ocean Observing System (CeNCOOS) partners, and the Monterey Bay Crescent Ocean Consortium partners (MBCORC).

6.2 Scientific Research and Collecting

The scientific research within the Central Coast study regiona 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 29). 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 11 shows provides location information for marine monitoring

sites in and around the MLPA study region from the CeNCOOs, PISCO, LIMPET, and MARINe programs (see Table 29).

Table 29: 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).
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.
MARINe **S**cientists 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.
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.
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.
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.

6.3 Regional Economic Impact of Marine Institutions

Institutions and agencies conducting marine research and sponsoring volunteer and educational programs along the Central Coast not only 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 30: 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)
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.

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 30).

Table 31: Organizations and Number of Volunteer Hours in MBNMS3

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.)

3 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 lawsfocused 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.

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

8.1 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; and,
- 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 12) that together encompass 3.8% of the total study region area (Table 17). An evaluation of the effectiveness of three of the state marine reserves in the region has also been conducted (Starr et al 2002a and 2002b). 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 2002a and 2002b).

Table 32: MPAs in Central Coast Study Region4

MPA NAME	Type	Area_nmi2	% 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 MPAs		32.58	3.76
Total Area Central Coast Study Region (including Elkhorn Slough)		867.54	

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 5). Many of the state and federal parks, state beaches, and military lands along the coast provide some protection for shoreline and estuarine habitats. Terrestrial protected areas make good partners for research, monitoring, and enforcement. Furthermore, terrestrial parks can assist and help minimize impacts from landuse.

4 MPA area data is different in Table 17 which is derived from GIS data and the DFG evaluation profiles.

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 Program, 1994).

A gap analysis will be conducted by mid-August 2005 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).

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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