The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

NORTHERN CALIFORNIA MARINE ECOREGIONAL ASSESSMENT

FEBRUARY 27, 2006

THE NATURE CONSERVANCY OF CALIFORNIA
201 MISSION STREET, 4TH FLOOR
SAN FRANCISCO, CA 94105

Northern California Marine Ecoregional Assessment

February 27, 2006, Version 1.1

Citation: The Nature Conservancy of California. 2006. *Northern California Marine Ecoregional Assessment*. Version 1.1, Feb. 27, 2006.

Planning Team:
Mary Gleason
Matt Merrifield
Chuck Cook
Miguel Hall

Contact:
Mary Gleason
The Nature Conservancy of CA
201 Mission Street, 4th Floor
San Francisco, CA 94105
mgleason@tnc.org

The Mission of The Nature Conservancy is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

Photo credit. Cover: Whale tail off the Carmel Coast. ©Rebecca Wells, TNC.

Design & Layout: Audrey Davenport, Sylvia Stone

TABLE OF CONTENTS

LIST OF TABLES, FIGURES & APPENDICES

Tables

Figures

Appendices

California Sea Lion in Kelp. © Andrew Drake

EXECUTIVE SUMMARY

The mission of The Nature Conservancy (TNC) is to preserve the plants, animals, and natural communities that represent the diversity of life on earth by protecting the land and waters they need to survive. Recognizing that a focus on the marine realm is critical to achieving our mission, TNC has launched a Marine Initiative to link land and sea conservation. With the support of the Marine Initiative, science and planning staff of The Nature Conservancy of California prepared this assessment of the most important areas for conservation of marine biodiversity in the Northern California Marine Ecoregion – one of four major divisions of the California Current System – that extends from Oregon south to Point Conception and covers 11 million hectares (42,493 square miles). The California Current is recognized as a globally significant region of temperate upwelling that supports a rich diversity of marine life. TNC recently completed the Southern California Marine Ecoregional Assessment for the region from Point Conception south to mid-Baja California (TNC 2004). An ecoregional assessment provides a framework to set priorities and guide conservation actions. The data and decision support tools required to develop a marine conservation assessment can guide both conservation and ecosystem-based management efforts.

This ecoregional assessment follows a planning methodology outlined in TNC's planning guidance document, *Designing a Geography of Hope,* and builds on a growing body of experience in marine conservation planning. The objective of an ecoregional assessment is to identify a *portfolio* of conservation areas that together contain multiple and viable examples of important ecological systems, communities, and species across their environmental gradients and represents the biodiversity of the region. Our assumption is that the biodiversity of the ecoregion can be efficiently conserved in a well-designed portfolio that includes both irreplaceable and representative conservation areas. To do this, we identified *conservation targets*, or elements of biodiversity (ecological systems, habitats, species) that were the focus of the assessment and represent the ecoregion's diversity. We compiled spatial data on the distribution of 146 conservation targets in a geographic information system (GIS) database. We used a *coarse filter approach* that relied primarily on the distribution of ecosystems and habitats, and incorporated species-level targets selectively. The conservation targets included ecosystems and communities (such as beaches, rocky intertidal, tidal flats, coastal marsh, kelp beds), benthic habitats, biologically significant areas (such as seamounts, the shelf-slope break, submarine canyons), and selected species (such as seabird colonies, marine mammal rookeries, estuarine dependent species). We then set quantitative conservation *goals* for each target, stratified by subregion across the ecoregion to capture environmental and genetic variation. We used MARXAN, a site-selection software tool, to identify a portfolio of marine conservation areas that best met the biodiversity conservation goals. We then convened a workshop of marine scientists to help us review and revise our portfolio.

The assessment identified a portfolio of conservation areas that represent the diversity of estuarine, near-shore and off-shore habitats and provides a conservation vision for the ecoregion. A total of 55 marine and estuarine portfolio conservation areas were delineated; these conservation areas together represent 25% of the area of ecoregion. While the ultimate goal is the protection of the entire portfolio, a preliminary and qualitative assessment of threats and opportunities in the ecoregion was used to identify priority action areas.

With this assessment, TNC and its private and public partners can be confident that site level marine conservation activities are not isolated, but part of a larger conservation design for the region that meets specific conservation goals. The identification of these 55 portfolio conservation areas makes no presumption about the best strategies for conservation at individual sites. Assessment of critical threats to these conservation areas during site-scale planning will drive the development of key strategies. TNC and its partners utilize a variety of strategies for marine conservation including habitat protection, acquisition of coastal lands through fee or easement, leasing and ownership of submerged lands, elimination of destructive fishing practices, improved watershed management, and policy changes. At some sites, TNC has found that marine protected areas (MPAs) are the most appropriate strategy for the conservation of marine biodiversity. MPAs can take many forms, from no-take reserves to mixed use areas, and may be zoned for different uses that preserve and enhance conservation, recreational, commercial, scientific, or cultural values. TNC recognizes that MPAs will only be successful if supported by the communities that surround them and the stakeholders that utilize them.

INTRODUCTION

The mission of The Nature Conservancy (TNC) is to preserve the plants, animals, and natural communities that represent the diversity of life on earth by protecting the land and waters they need to survive. In California, TNC initiated a Coastal and Marine Program to expand our work into the estuarine and marine environment. There has been increasing attention worldwide on the declining state of the coasts and oceans, the loss of vital ecological services, and diminished fishery resources. The recent Pew Oceans Commission report and the U.S. Commission on Oceans Policy (USCOP) report both describe the declining condition of our nation's bays, estuaries, and ocean waters and identified the many threats to the health of these systems. Both reports came to similar conclusions and made similar recommendations on important changes in ocean governance and management needed to reverse the trends (Pew Oceans Commission 2003, USCOP 2004).

With the support of the Marine Initiative, TNC science and marine program staff in California prepared this assessment of the Northern California Marine Ecoregion (NCME). It follows an ecoregional assessment methodology outlined in *Geography of Hope* (Groves *et al.* 2000) and builds on a growing body of knowledge and experience in conservation planning (Groves *et al.* 2002; Groves 2003; Beck 2003). The goal of an ecoregional assessment is to identify a *portfolio* of conservation areas that contain multiple and viable examples of important ecological systems, communities, and species represented across environmental gradients. This assessment identified a portfolio of conservation areas that represent the diversity of shoreline, estuarine, near-shore and off-shore ecosystems of the region. An ecoregional assessment provides a framework to set priorities and guide conservation actions. The data and decision support tools required to develop a marine conservation assessment can guide both conservation and ecosystem-based management efforts.

This is the first comprehensive assessment of marine biodiversity in the Northern California Current region. TNC also recently completed an ecoregional assessment for the Southern California Marine Ecoregion (SCME), a 16 million hectare region extending from Point Conception south to mid-Baja California (TNC 2004). TNC's Oregon field office is currently conducting a similar assessment of the Oregon, Washington, and Vancouver Island coasts and shallow near-shore environments (Pacific Northwest Coast Ecoregion). The NCME is also contiguous to two terrestrial ecoregions, the California Central Coast and the California North Coast, for which TNC has completed ecoregional assessments (TNC 2001; TNC 2006).

This assessment was completed using methodology consistent with TNC's ecoregional assessment approach (Groves *et al.* 2002) and more recently developed marine planning approaches (Beck 2003). In general terms, the assessment involved:

- **Identifying and mapping conservation targets:** We identified conservation targets and compiled regional datasets of target distribution.
- **Establishing conservation goals for each target:** We established quantitative conservation goals based on the distribution and abundance of targets, with consideration of historical distributions when possible.
- **Determining stratification and planning units:** We divided the ecoregion into subregions (or stratification units) that allowed us to more evenly include representation of conservation targets across the ecoregion. We further divided the ecoregion into hexagonal-shaped planning units to facilitate the planning process and identification of priority conservation areas.
- **Assessing suitability:** We identified "cost factors" that would make an area less suitable for conservation based on the level of human impacts and compiled spatial data on the distribution of these factors.
- **Designing a portfolio of conservation areas:** We designed a portfolio of marine conservation areas that met the biodiversity conservation goals and together represent a conservation vision for the ecoregion.
- **Assessing gaps in marine protection:** We evaluated existing level of protection for targets in coastal and marine protected areas and identified gaps.
- **Assessing threats and opportunities:** We qualitatively evaluated threats and opportunities in the ecoregion.
- **Developing strategies:** We developed a preliminary list of strategies for marine conservation in the region, with the goal of building on TNC's strengths to achieve protection of the portfolio of conservation areas.
- **Prioritizing portfolio conservation areas:** While protection of the entire ecoregional portfolio of conservation areas represents the ultimate goal, we prioritized among portfolio conservation areas to identify initial action areas.

We compiled data on the distribution of conservation targets in the ecoregion in a marine spatial database called a geodatabase (ESRI). The geodatabase is the repository for all spatial and tabular data used in the assessment. In addition to supporting the ecoregional plan, this geodatabase will facilitate future refinement of the assessment, evaluation of opportunities against ecoregional goals, and provide the initial data framework for site-scale planning. The geodatabase format (stored as a single MS Access mdb file) and thus facilitates easier sharing with partner organizations. All of the spatial layers were contributed to the state's Marine Life Protection Act Initiative in 2005 and are stored in a California Marine Geodatabase housed at the Marine Science Center at the University of California, Santa Barbara. Those data and others can be accessed over the Internet at http://www.marinemap.org/mlpa.

We used MARXAN (v.1.8.0), a site-selection software tool developed by Ian Ball and Hugh Possingham (2000) to identify a portfolio of marine conservation areas for the ecoregion. Site-selection software tools are increasingly being used in marine conservation planning to provide decision-support due to their usefulness in optimizing the selection and configuration of conservation areas and their flexibility for evaluating different planning scenarios (Sala *et al.* 2002; Airame *et al.* 2003; Stewart *et al.* 2003; Leslie *et al.* 2003). The outputs of the MARXAN site selection process were used to develop a draft portfolio of conservation areas for expert review.

A peer review workshop was held at the University of California Santa Cruz Long Marine Laboratory's Seymour Discovery Center facility on November 16, 2004 with a leading group of marine scientists from the region (see Appendix I for participant list). The TNC planning team presented a first draft of the assessment, including targets, stratification units, suitability factors, conservation goals, and resulting conservation areas. The workshop participants provided input and suggestions to improve the data layers and to refine the portfolio of conservation areas; these suggestions were incorporated to the extent possible, given available data. In addition to the peer review process, TNC has engaged in discussions with state and federal agencies, non-governmental organizations (NGOs), and resource users on our planning approach and results of this assessment.


Garrapata State Park, Marine Sanctuary Coastline. © Richard Herrmann

DESCRIPTION OF THE ECOREGION

Ecological Setting

The NCME is one of four major divisions of the California Current System along the West Coast of North America (Figure 1). The California Current is considered globally important for biodiversity because of its high productivity and the large numbers of species it supports (World Wildlife Fund Global 200 Ecoregions, http://www.worldwidelife.org/science/ecoregions/g200.cfm). 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 four temperate upwelling zones in the world where seasonal winds cause cold nutrient-rich water from deep in the ocean to unwell to the surface, supporting a diverse marine food web. The California Current is one of the most productive of these Eastern Boundary Currents and is characterized by seasonal upwelling, periodic El Nino - 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 with large numbers of invertebrates, fish, seabirds, and marine mammals that are dependent on this seasonal abundance of prey resources. Seabirds from as far away as New Zealand migrate to the area to feed during periods of high productivity.

The boundaries between the ecoregions of the California Current are diffuse and are known to change in response to long-term climate variations such as ENSO. While Cape Blanco in Oregon generally defines the northern boundary of the NCME ecoregion, the political boundary of the Oregon/California state border (25 miles or 40 kilometers south of Cape Blanco) was used as the northern boundary of this assessment since TNC's Oregon field office is conducting an assessment of the marine environment off Oregon. The southern boundary of the ecoregion, generally considered to be in the Point Conception area, was extended south in the offshore to include three of the Channel Islands (San Miguel Island, Santa Rosa Island, and San Nicolas Island) that are surrounded by colder water typical of the NCME. The ecoregional assessment evaluated biodiversity from the shoreline out to the 3500 meter (m) depth contour, which is the approximate depth where the continental slope flattens out into the abyssal plain. Six offshore seamounts are also included in the ecoregion. In total, the NCME spans some 11 million hectares or 42,493 square miles (Figure 2).

In central and northern California, the main currents are the southward flowing California Current, which is located 90-130 miles (or 145-209 kilometers) offshore of the shelf-slope break, and the subsurface northward flowing 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 cannot cross.

The region is characterized by three seasons driven largely by oceanographic conditions (Airame *et al.* 2003). The seasons are the upwelling season, wind relaxation period, and winter storm period (Table 1). 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 bathymetric features such as the shelf-slope break and seamounts.

Table 1: Oceanic Seasons in the Northern California Marine Ecoregion

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 characterized by highly variable oceanographic conditions. The ENSO is a large-scale change in atmospheric pressure, trade winds, and sea surface temperatures of the tropical Pacific that occurs every few years and has significant effects on the California Current System. During ENSO events, there is a reduction in upwelling of cold nutrient rich waters, increased onshore and northward flow, increased sea surface temperature, and increased northward advection of warm subtropical waters. ENSO events generally result in a decline in zooplankton and reductions in productivity that can affect fish, seabird, and marine mammal populations. Kelp forests can be negatively affected by increased winter storm waves and reduced nutrient availability during ENSO events. There is generally a decline in cold water organisms and an increase in warm water organisms in the California Current. Some recent very strong ENSO events occurred in 1983, 1992, and 1997. The cold water phase of the cycle is called La Nina.

Longer term decadal and multi-decade climatic cycles also affect a wide variety of marine organisms. Changes in atmospheric circulation in the central and northern Pacific and other factors yet unknown result in shifts in mean sea surface temperature 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. The most recent shift occurred in 1998.

The NCME is characterized by highly diverse and productive ecosystems. The coastline extends about 600 miles (direct line from Point Conception to Oregon, not including San Francisco Bay). The coastal portion of the ecoregion is characterized by steep coastal mountains and numerous rivers and streams that meet the sea. Some of the larger rivers include the Klamath River, Eel River, Sacramento River, San Joaquin River, and Salinas River which historically supported large number of anadramous salmonids.

There are dozens of estuaries and lagoons along the coast, ranging from small lagoons cut off from the sea to San Francisco Bay, which is the largest estuary on the West Coast. Bays and estuaries are partially enclosed bodies of water along the coast that are protected from the full force of ocean waves, winds, and storms. They form a transition zone from land to sea, fresh to salt water, and are critical as linkage areas for anadramous species such as steelhead and salmon. Bay and estuarine habitats typically have coastal salt marshes on their margins, sustain high levels of productivity and support key life-stages of many species including shorebirds, clams and oysters, Dungeness crabs, California halibut, and Pacific herring. Many coastal bays and estuaries are an important part of the Pacific Flyway and host thousands of shorebirds and waterfowl on their migrations. Some of the larger bays or estuaries in the ecoregion include Humboldt Bay, Tomales Bay, San Francisco Bay, Monterey Bay, Elkhorn Slough, and Morro Bay.

There are about 20,000 rocks and islets offshore of the California coast, many of which are important seabird colonies and marine mammal haul-out sites. In addition, there are larger islands, such as the Farallones and Channel Islands, that are globally significant due to their seabird colonies and marine mammal rookeries.

Near-shore habitats are found from the coastal high tide line out to a depth of about 40 meters and include rocky intertidal habitats, sandy beaches, kelp beds, rocky reefs and broad expanses of sand and mud. Rocky intertidal communities support dozens of species of algae, invertebrates, fish and shorebirds. Beaches are somewhat more depauperate in invertebrates but provide important foraging and nesting areas for shorebirds and some seabirds, haul-out sites for pinnipeds, and habitat for beach spawning fish. Kelp forests are home to species such as kelp bass, rockfish, spiny lobster, abalone, and sea otters. Rocky substrates are rare in the near-shore environment and are important for anchoring kelp and providing habitat for many species of invertebrates and fish.

The continental shelf varies in width throughout the ecoregion, from very wide (48 km or 30 mi) off the Golden Gate to very narrow (2-3 kms or 1-2 mi) off the Big Sur coast. 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 200-300m. A unique feature of the ecoregion is the presence of numerous large submarine canyons which extend into the near-shore, resulting in deep sea communities being in close proximity to near-shore communities. Some notable large submarine canyons that begin near-shore include Spanish Canyon, Delgada Canyon, Monterey Canyon, Carmel Canyon, Sur Canyon, Partington Canyon, and Mill Creek Canyon; there are numerous other canyons that begin further offshore (Mattole Canyon, Bodega Canyon, Pioneer Canyon, Arguello Canyon). Off Cape Mendocino, three continental plates meet and the San Andreas fault veers offshore resulting in an area of high geological activity and bathymetric complexity. The Gorda escarpment is just recently being explored and unusual aggregations of spawning deep sea fish and octopi have been found (Drazen *et al.* 2003).

Off-shore benthic habitats include various seafloor features such as canyons, seamounts, and hard and soft bottoms that are home to diverse assemblages of invertebrates and numerous species of demersal fish. Many large and small submarine canyons bisect the continental shelf and slope further offshore. Biogenic communities of sponges and deep sea corals form important deep sea habitats on the continental shelf and slope. Soft-sediment communities reach their peak in diversity of invertebrate epifauna and infauna around 70-230 meters, especially in areas where the shelf is wide and riverine input is present (J.Oliver, pers.comm). Hard (rocky) bottom habitat is much more rare than soft bottom habitat at all depth zones throughout the ecoregion.

The upwelling centers in the region (off the headlands of Cape Mendocino, Point Arena, Point Reyes, Davenport, Point Sur, and Point Conception) fuel the pelagic food web composed primarily of plankton, krill, squid, fish, seabirds and marine mammals. Variation in factors such as water temperature, upwelling and currents determine areas of productivity where squid, anchovy, seabirds, and marine mammals congregate in the pelagic ecosystem. Many off-shore species tend to be highly mobile or migratory including sardines, salmon, tuna, albatross, shearwaters, sharks, and whales. Recent research is now showing how different water masses affect distribution of these large pelagic species (Forney 2000; Yen *et al.* 2004). The entire California coast is part of the annual gray whale migration route and gray whales and other cetaceans are commonly seen over the continental shelf, often very near-shore.

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, especially in coastal counties that border the ecoregion, affect marine resource use patterns, influence public perception and stakeholder interest, and should be considered in the development of conservation strategies. A brief overview of demographic and economic trends in the region is provided as context for the assessment; socioeconomic factors were not included as inputs into the selection of conservation areas but provide important information to help identify priorities and strategies. Selected demographic and economic statistics are provided in Appendix II. Additional information on the socioeconomic setting and fisheries of the Central Coast portion of the ecoregion can be found in the Central Coast Regional Profile developed by the MLPA (2006).

Demographics of Coastal Counties

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. The north coast (Sonoma to Del Norte counties) is one of the least-populated regions in the state, with a total population of just under one million, nearly half of whom live in Sonoma County. Consistent with the rural character of the north coast, a large portion of the population lives in un-incorporated areas. Counties along the Central Coast (Marin to Santa Barbara) generally have much higher populations than in the north; population centers include the largely urbanized counties of the San Francisco Bay Area, as well as the urban centers of Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara counties (Appendix II, Table 1).

Populations of all coastal counties (except San Francisco) 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. Del Norte, Sonoma, Solano, Contra Costa, and San Luis Obispo counties all had rates of growth greater than 15% in that period (Appendix II, Table 1). Based on a demographic model that incorporates fertility, migration, and survival rates, population projections for the year 2050 indicates that Sonoma, Napa, Solano, Contra Costa, Alameda, and Monterey counties will have population changes of greater than 50% (Appendix II, Table 2).

Economics of some Ocean-dependent industries

California's ocean resources are an integral part of the state's economy. The State Resources Agency conducted an assessment of seven ocean-related industries (commercial fishing, mariculture, kelp harvesting, offshore oil and gas, coastal mineral production, port activity, and coastal tourism / recreation) and found they directly or indirectly contributed 17.3 billion dollars to the State's economy and supported over 370,000 jobs in 1992 (California State Resources Agency, 1995). Of that $17.3 billion, coastal tourism and recreation contributed the largest share at $9.9 billion. California's ports and port-related activities contributed $6 billion and 179,000 jobs. Offshore oil and gas production contributed $853 million in 1992 and employed 25,600 people, while minerals (such as sand and salt) contributed $10 million. Commercial fisheries, mariculture, and kelp harvesting contributed $554 million and provided 17,000 jobs (California State Resources Agency, 1995). These statistics underscore the importance of managing ocean resources sustainably for economic and environmental benefits.

Commercial Fishing

Fisheries within state waters (generally 0-3 nautical mile state jurisdiction) are managed by the California Department of Fish and Game (CDFG). Most offshore fisheries (3 nmi to 200 nmi) are under federal jurisdiction and managed by the Pacific Fisheries Management Council (PFMC). Important commercial fisheries in the region include (Guerrero and Kvitek, 1996):

- Hook and line troll fishery for salmon and tuna
- Trawl fishery for rockfish and flatfish
- Long-line fishery for rockfish
- Gill and trammel-net fishery for swordfish and shark
- Roundhaul and lampara net fishery for squid, anchovy, herring, mackerel, and sardine
- Trap fishery for prawn, Dungeness crab, and rock crab
- Diver-based fishery for urchin

There are numerous commercial fishing ports in the ecoregion (Figure 2). Eureka area ports, San Francisco area ports, and Monterey Bay area ports lead in terms of total value of landed catch at $13-14 million each (Appendix II, Table 3). Crab and groundfish fisheries are the most important fisheries in the northern portion of the ecoregion, leading in total pounds, total value, and number of vessels participating (Appendix II, Table 4) Eureka and Crescent City dominate the state's Dungeness crab fishery. In the southern half of the ecoregion (along the Central Coast), groundfish, crab, herring, and salmon are the leading fisheries (Appendix II, Table 5). Monterey Bay is one of the prime fishing areas for market squid and San Francisco Bay has a small but important herring fishery.

Stocks of many important commercial species have been depleted over time under the existing management regimes. The five species of abalone (green, black, white, pink, and red) that have been commercially harvested in California were managed as a single stock and spatial and inter-specific serial depletion and the partial recovery of sea otter populations in the Central Coast have resulted in the decline of all species and eventual end to the commercial harvest (CDFG 2001). Sardine populations in Monterey Bay crashed in the late 1940s due to over-fishing and environmental factors and have still not recovered. Salmon runs have declined precipitously. The commercial salmon catch, one of the state's most valuable fisheries, has declined from a high of 13 million pounds in 1913 to less than 4 million pounds in 1991 (Guerrero and Kvitek, 1996). There are over 80 species of marine fish included under the Pacific Coast Groundfish Fishery Management Plan, many of them are overfished or in decline. The National Marine Fisheries Service (NMFS) is currently conducting an Essential Fish Habitat Environmental Impact Statement (http://www.pcouncil.org/groundfish/gfefheis) to develop alternatives to delineate and protect essential fish habitat. Flatfish (Dover, English, and petrale sole) have not declined as dramatically as have rockfish species; populations of many species of rockfish – along with lingcod – are considered in poor condition. In recent years, fishery quotas have grouped rockfish into three categories – near-shore, shelf, and slope assemblages; restrictions have been imposed on both recreational and commercial fishing for rockfish. For the commercial fishery, the rockfish quota for 2001 was reduced by more than half compared to the 1997 quota; lingcod quotas were reduced even further – more than 80 percent – in the same time period.

Improved technology has extended the range, depth, and effectiveness of many commercial fisheries in California waters. At the same time, increasing costs, more restrictive regulations, and decreasing catches have driven many smaller fishing operators out of business. Since 1981, the number of vessels has declined while revenues per vessel have increased throughout the ecoregion (Appendix II, Tables 6 and 7). Revenue increases for some fisheries represent an increase in proportion of high-value catch (e.g. higher landings of tuna and salmon, higher prices for squid, higher value for fish in the live fish food trade). With the exception of commercial passenger fishing vessel (CPFV) permits, the number of permits and licenses for most fisheries has declined since 1995, due in part to regulatory moratoriums or limits on new permits for some fisheries. Statewide, the number of commercial boat registrations has declined by nearly 30 percent – from approximately 5,000 to 3,500 – between 1995 and 2003. The number of commercial salmon stamps and salmon vessel permits issued has declined by 40 to 50 percent since 1995. Dungeness crab vessel permits have declined by less than 10 percent in that period. The number of commercial passenger vessel licenses, however, has grown nearly 20 percent, from 363 to 432 in the same period (Appendix II, Table 8).

There are dozens of vessels from ports in the ecoregion (especially Crescent City, Fort Bragg, Princeton, Moss Landing, and Morro Bay) that fish for groundfish under limited entry trawl permits, fixed gear limited entry permits, and open access (Appendix II, Table 9a). The number of vessels participating in other fisheries varies by port. San Francisco, Princeton, Morro Bay and Avila dominate the halibut fishery; Crescent City leads with vessels targeting shrimp and prawn; and Bodega Bay leads in number of salmon boats (Appendix II, Table 9b).

There is a growing recognition of the need to rationalize fisheries through reductions in fishing capacity, elimination of destructive practices, and use of ecosystem-based management approaches (Pikitch *et al.* 2004). Reversing population declines of targeted species and improving the economic viability of fishing will help to both protect marine biodiversity and preserve marine heritage in coastal communities

Recreational Fishing

Recreational fishing can have a significant impact on fish stocks, especially near-shore species targeted by shore and boat based anglers. California is second in the nation, after Florida, in number of saltwater anglers in the state (Coleman *et al.* 2004). Data on recreational fishing in California is spotty relative to that for commercial fishing; however, in 1980 the CDFG initiated the Marine Recreational Fisheries Statistical Survey and is improving efforts to collect data. For the West Coast, California has significantly more anglers, who make more trips, spend more money on sport-fishing, and generate more jobs and local income than Oregon or Washington (Appendix II, Table 10). Recreational fishing is more prevalent in southern California than in northern California.

Recreational fishing includes party boats (CPFVs), private boats, and fishing from the shore. The average catch landed and number of trips was higher for shore-based fishing than private boats or CPFVs from 1980-2000 in Northern California. However, the species targeted also differ; rockfish and lingcod comprise the highest proportion of the recreational catch in boat-based fishing (Appendix II, Table 11; Guerrero and Kvitek, 1996).

Kelp Harvesting

Kelp harvesting is managed by CDFG; there are designated kelp beds that can be leased and a permit for harvesting is required. Kelp harvested mechanically or by hand and is cut at a depth of about 4 feet (1.2m) below the surface. Kelp is processed for its alginates (used in food, cosmetics, etc) and kelp is also used as food for abalone in mariculture operations. Commercial harvest of kelp began in 1911; most of the kelp harvested in the state is giant kelp (*Macrocystis*) and is taken in southern California waters; a smaller amount of giant kelp is harvested on the Central Coast. Further north, bull kelp (*Nereocystis*) is the prevalent species and since the 1980s there have been harvesting operations targeting bull kelp. CDFG established kelp leases north of San Francisco Bay in 1996; while many of the northern kelp beds are closed to harvesting there are mariculture firms that have harvested bull kelp in the Point St. George area and mixed beds of bull kelp and giant kelp near Bodega Bay. Kelp landings in the 1960s and 1970s ranged between 100,000-200,000 tons and declined in the 1990s to less than 100,000 tons. Declines in kelp harvest are due to ENSO events in the 1980s that devastated southern California kelp beds (CDFG 2001) and to changing business practices with a more recent focus on higher quality kelps (less volume) and more harvesting in Mexico.

Mariculture

In 2000, there were 220 registered aquaculture facilities in the state, with 44 being marine producers. Mariculture in the ecoregion consists primarily of shellfish production (oysters, clams, mussels, and abalone). Statewide, marine shellfish production – primarily oysters and abalone – account for about 10-15 percent of the total value of the aquaculture industry, which also includes freshwater fish production. Oyster production generates the highest volume and value (Appendix II, Table 12).

Shellfish culture is limited to protected bays with the right combination of factors, including the proper salinity, water temperature, and substrate. Oyster cultivation also requires excellent water quality; since oysters are filter feeders, pathogens in polluted water can be a hazard to human consumption. Humboldt Bay supports five shellfish operators, located in Arcata Bay at the north end of Humboldt Bay. In 2002, growers in Humboldt Bay produced shellfish worth nearly $3.7 million, most of which were oysters for the shucked oyster trade (Appendix II, Table 13). In Humboldt Bay, Coast Seafoods dominates the trade, with 80 to 90 percent of the total production. Also in Humboldt Bay is an onshore operation that produces oyster seed, supplying growers throughout California.

Tomales Bay supports six shellfish growers, located along the eastern shore of the bay who grow oysters largely for the half-shell trade, a value-added product that takes longer to grow but garners a higher value. In 2002, Tomales Bay and Drake's Bay together produced just over $3 million in value. Tomales Bay growers suffer many days of closure – from 30 to as many as 60 days per year – from storm events that increase runoff from surrounding agricultural lands and, in turn, result in high coliform bacteria counts. Drake's Bay has one oyster grower, Johnson's, which was once the largest grower on the north coast. Limited oyster culture also occurs in Morro Bay.

There are also several shore-based abalone farms in the central part of the ecoregion (Santa Cruz, Monterey, and Cayucos) that pump seawater to onshore facilities where abalone are reared to market size over the course of several years. These facilities either purchase or harvest their own kelp to feed the abalone.

Ports and Port-Related Activities

Commercial vessels operating in the NCME include container ships, oil tankers, gas and chemical tankers, vehicle carriers, and cruise ships. The San Francisco Bay Vessel Traffic Separation Scheme is a routing system that directs vessel traffic into north, south, or west shipping lanes on approach to San Francisco Bay. In 1992, 3,646 vessels entered San

Francisco Bay of which over 1,000 were oil tankers; 58% of the ships arrived using the southern approach lane through Monterey Bay National Marine Sanctuary.

The largest ports in the NCME are in San Francisco Bay and include San Francisco, Oakland, Richmond, Benicia, Redwood City, and Encinal in Alameda. Oakland is the largest port, with around 2,000 vessels arriving per year, accounting for more than 99% of containerized goods entering or leaving northern California (http://www.portofoakland.com). Port development activities in San Francisco Bay, including issues of dredging and disposal of dredged material, are overseen by the Bay Conservation and Development Commission.

Smaller ports such as Humboldt Bay, Bodega Bay, Moss Landing, Morro Bay, and Avila, support the State's recreational and commercial fisheries; these smaller ports are not granted permitting authority under the Coastal Act and must apply for coastal permits for development activities.

The Port of Humboldt Bay is managed by the Humboldt Bay Harbor, Recreation and Conservation District that oversees a wide range of resources and economic uses in the bay, including erosion control, recreation, aquaculture, and commercial fishing. Over the past 20 years, shipping in Humboldt Bay grew steadily to a peak of 1.2 million tons in 1991, then dropped to between 400,000 and 600,000 tons throughout the 1990's; most of the decrease was due to a drop in shipment of forest products.

Coastal Tourism and Recreation

Tourism and recreation are important economic drivers in coastal California counties. In the north coast, many residents and local businesses look to tourism as a growing source of jobs and revenues to offset declines in fishing and timber economies. Tourism revenues include general expenditures on gas, food, and hotels as well as expenditures on local parks and recreational opportunities (recreational fishing, boating, diving, surfing, sightseeing). Tourism jobs can be especially important in small communities, such as coastal towns and rural areas, where employment opportunities are often scarce. Another benefit to local communities is income derived from transient occupancy taxes on hotel room rates, one of the few sources of unrestricted funds available to local governments. In Mendocino, Sonoma, and Marin counties, transient occupancy tax revenues grew by roughly fifty percent between 1992 and 2000. Sonoma County supports one of the largest tourism economies in the region, generating over $952 million in travel expenditures, and supporting more than 15,000 jobs in 2001. Humboldt and Mendocino counties each generated roughly $300 million in travel expenditures and supported about 6,000 jobs in 2001. San Mateo and Monterey counties generated roughly 2 million in travel expenditures and 20,000-30,000 jobs (Appendix II, Table 14).

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 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. The Monterey Bay area is a world-class diving destination and an estimated 70% of all dives that occur in the ecoregion occur in Monterey Bay (Guerrero and Kvitek, 1996).

The ecoregion hosts many coastal state and federal parks that each draw thousands of visitors a year including Pffeifer-Big Sur State Park, Elkhorn Slough National Estuarine Reserve, Ano Nuevo State Reserve, Big Basin Redwoods State Park, Don Edwards San Francisco Bay Wildlife Refuge, Golden Gate National Recreation Area, Point Reyes National Seashore, King Range National Conservation Area, Redwood National and State Park. In addition, there are dozens of smaller state parks, state beaches, state marine reserves, state marine parks, and state marine conservation areas. The Sonoma beaches, Point Reyes, and Morro Bay State Park each had 1-2 million visitors in 2003; Golden Gate National Recreation Area had 13 million visitors. Monterey Bay Aquarium is a world class marine attraction that has at least 1.5 million visitors a year and represents an important regional asset for marine conservation education (Appendix II, Table 15).


Morro Bay Harbor. © Mary Gleason

Coastal and Marine Planning in the Region

TNC has recently completed a marine ecoregional assessment for the Southern California Marine Ecoregion (SCME, TNC 2004). Results of this assessment of the NCME will be integrated with the portfolio of conservation areas delineated in the SCME assessment, particularly in the Point Conception and Channel Islands areas where the planning boundaries meet. Similarly, identification of marine/estuarine portfolio conservation areas for the NCME will be integrated with terrestrial ecoregional plans completed for the North Coast Ecoregion (TNC 2001) and a recent update to the Central Coast Ecoregional Assessment (TNC 2006). In addition, TNC has completed site-level plans for some coastal areas in the region, such as Elkhorn Slough.

There have been other planning efforts by partners in the region that have helped to identify important data sources and priority areas. The Baja to Bering (B2B) Initiative, a tri-national conservation planning effort focused on entire West Coast from Baja California to the Bering Sea, held a series of workshops to identify areas of highest conservation priority. Twenty eight priority areas were identified including three that occur within the NCME: central-Oregon to Cape Mendocino, the Central Coast of California, and the Channel Islands (Morgan *et al.* 2005).

At the federal level, the National Marine Sanctuary Program is currently updating management plans for all of the National Marine Sanctuaries (NMS) in the ecoregion (Channel Islands NMS, Monterey Bay NMS, Gulf of the Farallones NMS, and Cordell Bank NMS); these revisions to the management plans are tackling issues such as boundary changes and the need for marine reserves within the Sanctuaries. To support those reviews, NOAA recently completed *A Biogeographic Assessment Of North/Central California* that includes the Monterey Bay National Marine Sanctuary (MBNMS), Gulf of Farallones National Marine Sanctuary (GFNMS), and Cordell Bank National Marine Sanctuary (CBNMS; NOAA 2004). The NOAA biogeographic team is currently developing a similar biogeographic assessment for the Channel Islands NMS (CINMS).

BLM has completed a draft management plan and environmental impact statement (EIS) for the California Coastal National Monument that covers the rocks and islands within 12 nautical miles of the coast statewide (BLM 2004).

At the state level, California is leading the nation in an effort to increase protection of marine systems. The Marine Life Protection Act (MLPA) passed in 1999, and provided the mandate for the state to design and manage a network of marine protected areas (MPAs) to protect marine life and habitats, preserve ecosystem integrity, protect natural heritage, and increase recreational and educational opportunities in state waters.

Recently, a public-private partnership among the California Resources Agency, CDFG, the Resources Legacy Fund Foundation, and others has renewed the effort to achieve the goals of the MLPA through the development of a MLPA Initiative. A Master Plan Framework has been adopted by the Fish and Game Commission. A Central Coast Project was launched in spring 2005 as a pilot to develop a network of MPAs for the Central Coast (Pigeon Point to Point Conception). A science-based stakeholder process developed planning documents and alternative MPA network designs for the Central Coast that will be considered by the Fish and Game Commission in the fall of 2006. The design of a network of MPAs for the entire state is scheduled to be completed by 2011. More information can be found at http://dfg.ca.gov/mrd/mlpa.

PRBO Conservation Science recently completed a first draft of *The California Current Marine Bird Conservation Plan* (Mills and Sydeman 2003) and have been funded to develop a California Current Joint Venture.

The California Coastal Conservancy is just now completing a statewide plan to prioritize coastal and estuarine lands for acquisition or other habitat protection strategies; this statewide plan is a prerequisite for obtaining funding under the national Coastal and Estuarine Lands Program (CELP) managed by NOAA.

At the local level, coastal counties have general plans that guide land use and zoning. Coastal counties are also regulated by the California Coastal Act of 1976 which mandates the conservation and development of coastal resources through a planning and regulatory process called the Local Coastal Program (LCP). The LCP functions as a land use plan for the coastal zone within each county and ensures that local government land use plans – both county and city planning and zoning – are consistent with the goals of the Coastal Act. The California Coastal Commission oversees LCPs and proposed development and enforces coastal zone protections. Not all coastal communities have completed LCPs.

Existing Marine Protected Areas and Coastal Public Lands

In California, the Marine Managed Areas Improvement Act (2002) sought to implement a consistent classification scheme that relates the name of state MPAs more directly to level of protection and the purpose of establishment. There are now three types of state MPAs in California: State Marine Reserves, State Marine Parks, and State Marine Conservation Areas with many examples of each in the ecoregion (Table 2). There are 4 national marine sanctuaries in the ecoregion: Channel Islands NMS (partially in the SCME), Monterey Bay NMS, Gulf of Farallones NMS, and Cordell Bank NMS. There are 2 National Estuarine Research Reserves (China Camp and Rush Ranch in San Francisco Bay and Elkhorn Slough). In addition, in coastal watersheds bordering the marine ecoregion there is a national seashore (Point Reyes National Seashore), 1 coastal National Park (Redwood NP), 8 coastal National Wildlife Refuges, and numerous state beaches and state parks (Figure 3).

Table 2: Existing MPAs in the NCME marine and estuarine environments

Type of MPA	Number in Ecoregion	Total Area (ha)	Total Area (sq. mi)
National Marine Sanctuaries	4	2,180,533	8,419
National Estuarine Research Reserves	2	2,135	8.2
State Marine Reserves	13	26,250	101.4
State Marine Parks	10	2,786	10.8
State Marine Conservation Areas	21	15,471	59.7

SELECTING CONSERVATION TARGETS

Conservation targets are the elements of biological diversity, such as ecological systems, species, or processes that are the focus of the planning and conservation effort. Since thousands of species may occur in the ecoregion, the first challenge is to select a subset of targets at multiple scales of biological organization and geography to best represent the biological diversity of the ecoregion. Our analysis relied primarily on a coarse filter approach of identifying key ecological systems and habitats as targets, with the assumption that conservation of multiple viable examples of these coarse filter targets will also conserve the vast majority of species that exist within these systems. To include targets, we needed to have ecoregion-wide data on their distribution; the lack of data on many potential targets limited their inclusion (see Data Management and Data Limitations).

We incorporated fine filter (species-level) targets selectively if there were spatial data available on the target for the entire ecoregion and:

- the species is rare or declining
- the species is a keystone species (i.e. has habitat or ecosystem effects disproportionate to its population size) or
- the species is a good focal species (i.e. wide-ranging or of high ecological importance, sensitive to disturbance by humans), or
- the ecoregion is important for the overall reproductive potential of the species (i.e. most of its reproduction takes place in the ecoregion)

We evaluated observational data sets on marine species, especially mobile species, from the California Cooperative Oceanic Fisheries Investigations (CALCOFI) and the U.S. Department of Interior Mineral Management Service (MMS) but found them to be insufficient for assessing ecoregion-wide distributions of species for conservation planning purposes.

For selected mobile species, such as seabirds and marine mammals, we identified important areas, such as rookery sites, as the target. For other species, especially estuarine species such as the tidewater goby, salt marsh harvest mouse, and California black rail, we used a combination of species occurrence data and habitat polygons from the California Natural Diversity Database (NDDB, CDFG 2004), NOAA Environmental Sensitivity Index (ESI, NOAA-ESI 2002), or regional databases such as the San Francisco Bay EcoAtlas and the Humboldt Bay GIS Atlas.

We identified 146 conservation targets for the NCME assessment. Many targets can be found throughout the ecoregion, while others have more limited distributions (e.g. some are found only in San Francisco Bay). Conservation targets for the NCME included:

- **Ecosystems and communities** – important coarse-scale systems or communities for which there are mapped data.
- **Benthic habitats** – mapped and modeled seafloor habitat types
- **Biologically significant areas** - geographic, bathymetric, or oceanographic features important for regional biodiversity
- **Species** – selected species, not well covered by coarse-scale targets

A list of targets is provided in Table 3; data sources used for each target are summarized in Appendix III.

White Pelicans in Morro Bay. © Richard Herrmann

Table 3: Conservation Targets for the Northern California Marine Ecoregion

Target Group	Targets
Ecosystems and Communities: Shoreline Systems	Exposed wave-cut rocky platform w/ and w/o beach Exposed rocky cliff Exposed rocky cliff w/ talus boulder base Sheltered rocky shore Gravel beach Coarse-grained sand beach Mixed sand and gravel beach Fine to medium grained sand beach Exposed tidal flat Sheltered tidal flat Tidal flat / coastal marsh
Ecosystems and Communities: Onshore Systems	Coastal dunes
Ecosystems and Communities: Near-shore Systems	Estuaries (4 size classes) Coastal marsh Eelgrass bed Kelp beds (4 separate years) Persistent kelp beds Near-shore rocky reef
Ecosystems and Communities: Deep sea systems	Cold seep community
Benthic Habitats	TNC modeled benthic habitats (39 types present) Greene et al. (1999) benthic habitats (26 types present)
Biologically Significant Areas	Sand spit Offshore rocks and islet Near-shore canyon head Major submarine canyon Seamount Shelf-slope break Areas of high bathymetric complexity Upwelling zone San Francisco Bay tidal plume front
Species (Invertebrates and Fish)	Structure forming invertebrates Steelhead stream outlet Coho stream outlet Chinook stream outlet Delta smelt Green sturgeon Sacramento splittail Tidewater goby

	Longfin smelt Surf smelt Night smelt Grunion
Species (Birds and Mammals)	Ashy storm petrel (colony) Leach's storm-petrel (colony) Fork-tailed storm-petrel (colony) Caspian tern (colony) Forster's tern (colony) Western gull (colony) Double-crested cormorant (colony) Brandt's cormorant (colony) Pelagic cormorant (colony) Common murre (colony) Pigeon guillemot (colony) Cassin's auklet (colony) Tufted puffin (colony) Rhinosaurus auklet (colony) Xantus's murrelet (colony) Black oystercatcher (colony) California least tern (nesting site) Western snowy plover (nesting site) Clapper rail California black rail California sea lion (rookery and haulout) Steller sea lion (rookery and haulout) Northern fur seal (rookery) Northern elephant seal (rookery) Harbor seal (haulout) Southern sea otter (3 density classes) Salt marsh harvest mouse

Ecological Systems and Communities

A variety of shoreline, near-shore, and offshore communities or ecosystems were identified as conservation targets. These system level targets were divided up into two groups based on the type of data available. Shoreline systems have been mapped as linear features along the entire California coast. Other systems such as coastal dunes, kelp forests, estuaries, and eelgrass beds have been mapped as polygonal features from a variety of sources. These targets are described below.

Shoreline Systems

The shoreline represents a transition zone between the marine and terrestrial environments and includes many important ecosystems and communities, most of which are intertidal. Rocky shores, beaches, tidal flats and marshes are ecological systems that support a large number of associated communities and species.

The entire coastline of California has been mapped and classified into linear shoreline features as part of NOAA's Environmental Sensitivity Index (ESI) program (NOAA 2002). Originally intended to identify sensitive habitats to guide clean-up efforts for oil spills, the ESI mapped 15 unique natural shoreline types and 3 artificial shoreline types for California. We retained all but two of the mapped ESI natural shoreline types (Scarps and steep slopes in sand were lumped with fine-medium grained sand beaches while vegetated low riverine banks were lumped with coastal marsh).

For many parts of the shoreline, the ESI database lists several shoreline types present at a given location, described from seaward to landward. This results in over 170 unique combinations of shoreline types mapped along the California coast. For those locations with combination of shoreline types, we prioritized among shoreline types and identified a single type at each location based on a set of decision rules (see Appendix IV). Man-made structures and hardened shoreline (ESI categories: riprap, seawalls, man-made structures) were not considered targets but were mapped and included as "cost factors" in a suitability index. The translation of unique ESI types or combinations of types to our shoreline conservation targets is provided in Appendix IV.

Thirteen shoreline targets were identified for the NCME. The general abundance of each type in central California (Point Conception to Point Reyes) and northern California (Point Reyes to the Oregon border) is provided as a measure of the commonness or rarity of each type in the ecoregion (NOAA 2002). Shoreline types are shown on Figure 4.

Rocky Shores

Rocky communities, from the splash zone to the lower intertidal, vary in composition and structure with tidal height and wave exposure. Intertidal boulders, platforms, and cliffs, as well as tidepools, are home to many species of algae, barnacles, anemones, snails, mussels, crabs, starfish and fish. Mussel beds (*Mytilus* spp.), sea palm (*Postelsia palmaeformis*), and algal beds (*Endocladia* spp.) are patchily distributed along rocky shores but support high biodiversity. Surf grass (*Phyllospadix* spp.), a flowering plant, form beds in the low intertidal and shallow subtidal areas. Birds, such as black oystercatchers, feed in intertidal rocky communities and fish forage in tidepools or among the rocks when the tide is in. The following rocky shore types were included as targets:

- **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, starfish, anemones, crabs, and macroalgae abundant. Common in northern California (7% of shoreline) and central California (8% of the shoreline).
- **Exposed rocky cliff / talus boulder base:** the same as above, but with large boulders accumulated at the base
- **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, starfish, crabs, and polychaetes. Common in northern California (23% of the shoreline) and central California (27% of the shoreline).
- **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, seastars, snails, and crabs. Sheltered rocky shores are very rare in northern California (0.3% of the shoreline) and central California (1% of the shoreline); they are typically found inside bays or estuaries.

BEACHES

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 from at the mouths of larger rivers. Small pocket beaches occur where rocky cliffs are eroded along exposed coasts. A variety of invertebrates live in the sand and in wracks of decaying seaweed and other detritus on the sand surface. There are a variety of shorebirds, such as sanderlings, marbled godwits, and willets, that feed at the waters edge. Snowy plovers and California least terns nest on sandy beaches and coastal dunes. A few species of small pelagic fish spawn on sandy beaches; grunion spawn on beaches in central and southern California in the spring, while surf smelt and night smelt spawn on beaches in central and northern California in the spring and summer. Sand dollars, worms, clams, crabs, and flatfish live in the surf zone. The following beach types were included as targets:

- **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 substrates. Gravel beaches comprise 7% of the northern California and central California shorelines.

- **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 substrates support algae, mussels, and barnacles. They comprise over 10% of the northern California shoreline and 8% of the central California shoreline.
- **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. They comprise about 6% of the northern California shoreline and 7.5% of the central California shoreline.
- **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 *Emerita.* They comprise about 20% of the northern California shoreline and over 25% of the central California shoreline.

Tidal Flats and Coastal Marsh

Tidal flats and marshes occur primarily around the edges of bays and estuaries. 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 waters edge. At high tide, tidal flats they 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 salt 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. Dominant plant species show zonation with tidal height; some of the dominant plant species include pickleweed (*Salicornia virginica*), salt grass (*Distichlis spicata*), and cordgrass (*Spartina* spp.). Brackish marshes occur in a dynamic continuum between salt marshes and freshwater marshes associated with the tributary rivers that empty into coastal estuaries. 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. Coastal marshes in the ecoregion support many species of rare and endangered plants and animals, including many found only in San Francisco Bay (eg. the salt marsh harvest mouse). The following shoreline types were included as targets:

- **Coastal marsh:** Coastal marshes are intertidal wetlands that have emergent vegetation; this category includes salt marsh and brackish marsh. The width of marsh varies from a narrow fringe to extensive areas and provides important habitat for a variety of species. Coastal marsh comprises about 10% of the shoreline in northern California and about 8% of the shoreline in central California.

- **Exposed tidal flats:** includes intertidal flats composed of sand and mud; the presence of some wave exposure generally results in the presence of sand. Occurs in bays and lower sections of rivers. Sediments generally water saturated with the presence of infaunal community that attracts foraging shorebirds. Used as roosting site for birds and haul-out site for marine mammals. Relatively rare, comprising 3% of the northern California shoreline and 1% of the central California shoreline.
- **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. Sheltered tidal flats are relatively rare, comprising 4% of the northern California shoreline and 7% of the central California shoreline.
- **Tidal flat / Marsh:** includes areas with both tidal flat (sheltered or exposed) and coastal marsh present.

Other Ecosystems and Communities

Many coastal ecosystems and smaller-scale patch communities in the onshore, near-shore and offshore environment are important for marine conservation due to the presence of high biodiversity, their importance as nursery grounds or critical habitat for threatened species, and their relatively high level of impact or degradation from human influences (Beck *et al.* 2003). Data on mapped distribution of ecosystems and communities throughout the ecoregion are limited; however sufficient data were available to include the following targets:

Coastal Dunes

Coastal dunes are formed onshore where large quantities of sand are deposited by waves and carried inland by winds; grasses and herbaceous vegetation gradually stabilize older dunes. Sand dunes have unique plant communities and are important as nesting habitat for some shorebirds. Dune-backed beaches provide more important habitat for shorebirds than cliff or bluff-backed beaches. Sand dunes are unique features along the California coast and are important sand reservoirs and linkage areas between marine and terrestrial environments.

Coastal dunes in California were mapped and described by Cooper (1967); these hardcopy maps were used to identify general locations of coastal dunes. The largest coastal dune systems are found along northwest facing coastlines near San Luis Obispo, Monterey, Point Reyes, Humboldt Bay, and Point St. George. For this assessment, sand dunes were mapped using several different data sources including:

- California GAP vegetation (Davis *et al.* 1998): vegetation categories included beaches and coastal dunes, central dune scrub, northern dune scrub, and sand areas
- California NDDB (CDFG 2004): vegetation categories included central dune scrub, central foredunes, and southern foredunes
- USGS Togographic maps (1:24,000): areas identified as sand dunes on topographic maps were digitized.

The sand dune polygons from all the data sources were merged to identify the greatest areal extent of coastal dunes at each location.

Estuaries / Coastal Lagoons: Estuaries form at the mouths of rivers and streams where freshwater and saltwater meet; the salinity in estuaries and lagoons varies seasonally and over longer timeframes when the river mouths get closed by sand spits or other barriers. Lagoons are coastal water bodies that are cut off from the sea and generally have low freshwater inputs. Estuaries also differ in their geomorphic origin (coastal plain estuaries, river mouth estuaries, canyon mouth estuaries, and tectonic estuaries).

Estuaries and lagoons are very productive coastal ecosystems that play a key role as nursery habitat for many invertebrates and fish. Anadramous species such as salmonids, sturgeons, and lampreys must pass through estuaries on their migration pathways; estuaries are important juvenile rearing habitat for salmonids. Open water habitat support large densities of waterfowl; many coastal estuaries in the NMCE are important stops on the Pacific Flyway.

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. Many estuaries in California have been significantly altered with hardened shorelines and dredging to maintain port and marina facilities, loss of wetland habitat due to development, large numbers of invasive species, and relatively high pollutant loads.

We mapped the estuarine target to represent the entire ecosystem from coastal marsh to intertidal flats to open water and subtidal habitats; the estuary target therefore overlaps with other targets such as coastal marsh and eelgrass beds embedded within them. Estuaries and lagoons were mapped primarily using data from the National Wetlands Inventory (USFWS 1992); all system types in the "E" (estuarine) category, both intertidal and subtidal components, were included. The NWI dataset is not complete (especially in the north coast region from Bodega Head to Cape Mendocino), so that dataset was augmented by including areas where estuarine systems could be inferred by the presence of salt marsh or tidal flats from the NOAA-ESI dataset, coastal salt marsh or brackish marsh from NDDB. Other known estuary/lagoon areas not mapped by the above sources were digitized from USGS 1:24,000 topographic maps.

A minimum size of 2 acres (0.003 sq. mi) was set for the small coastal lagoons and estuaries. The hydrologic and tidal status of these systems varies over time, so no attempt was made to distinguish between estuaries and lagoons. A size classification was used to develop 4 different estuary targets to improve representation of different sizes of estuaries in the final portfolio. The four estuary targets were defined as:

- **Mega estuary:** >100,000 acres (San Francisco Bay)
- **Large estuary:** 7,500 – 100,000 acres (Humboldt Bay and Tomales Bay)
- **Medium estuary / lagoon:** 1,000 – 7,500 acres (Morro Bay, Elkhorn Slough, Bolinas Lagoon, Drakes Estero, Eel River estuary, Big Lagoon, and Lake Earl)
- **Small estuary / lagoon:** 2 – 1,000 acres (eg. Watsonville slough, Estero Americano, Russian River estuary, Mad River estuary, Stone Lagoon, Tillas Slough, and many other small coastal stream outlets)

Coastal marsh: Coastal marshes are found in bays and estuaries along the coast where they form a transition zone from land to sea and from fresh to salt water, as described above. Coastal marshes have been mapped as polygons by a variety of agencies. We included both salt marsh and brackish marsh in the coastal marsh category. We developed a composite GIS layer for marshes based on a hierarchical approach by starting with the coarsest resolution data and updating it with data that had finer spatial scales. This allowed us to preserve polygon geometry and source information for finer scale mapping efforts and to disaggregate these data based on source. In most cases this approach is conservative in that it often produced the largest areal extent of coastal marsh.

For mapping coastal marsh, we used California Department of Forestry (CDF) Fire and Resource Assessment Program (FRAP) multi-source landcover data (CDF 2002, v.1) as the primary source of data (mapped as saline emergent wetland) and we updated that with the following finer-scale mapping efforts:

1) Data from Natural Diversity Database (CDFG 2004, mapped as northern coastal salt marsh, southern coastal salt marsh, and brackish marsh) and
2) Other local datasets. Local data sets including (a) National Park Service (1994) – Point Reyes / Golden Gate National Recreation Area vegetation map (mapped as saltgrass, pickleweed, and cordgrass alliances), (b) Tomales Bay data from CDFG 1992 (mapped as salt marsh interior and salt marsh perimeter), (c) Humboldt Bay GIS Atlas (mapped as 1993 brackish marsh and salt marsh), and (d) San Francisco Estuary Institute – EcoAtlas of San Francisco Bay (1998) – current tidal marsh

distribution (mapped as young high tidal marsh, old high tidal marsh, young-low mid-tidal marsh, and muted tidal marsh).

As described above, coastal marsh was also mapped as a linear shoreline feature based on the NOAA-ESI data. The polygon and linear features sometimes, but not always, overlapped; based on the high loss of coastal mashes, we decided to retain and use all sources of mapped data (linear and polygon) for coastal marshes.

Eelgrass bed: Seagrass habitats are among the most productive and biologically diverse ecosystems on the planet. The most common type of seagrass in California is *Zostera,* or eelgrass, which grows under water in estuaries and in shallow coastal bays of the ecoregion. 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 was mapped using information from a variety of sources in a hierarchical approach (similar to that used for coastal marsh) with data from NOAA ESI (NOAA 2002) as the primary source. These data were updated with other finer-scale local sources including (1) NOAA CCAP data (1998), (2) Humboldt Bay GIS Atlas (http://www.humboldtbay.org/gis) (1997 eelgrass beds), (3) Tomales Bay data from CDFG for 1992, 2000, and 2002, and (4) Morro Bay National Estuary Program (2000 data).

Near-shore Rocky Reefs: Near-shore rocky reefs provide hard substrate to which kelp, other alga, and many invertebrates can attach. In addition, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. Rocky substrates are less common than soft substrates in the NCME. Near-shore rocky reefs were identified as a separate target from other rocky benthic habitat due to their importance for near-shore biodiversity.

Nearshore rocky reefs were defined as rocky substrates occurring within 3 nautical miles of shore. Data on substrate type from the California continental shelf mapping project (Gary Greene, Moss Landing Marine Laboratory) was used to identify areas with hard substrates (ie. rocky) that have been mapped in the near-shore environment. This layer of mapped rocky substrate was compared with NOAA nautical charts to identify additional named rocky reefs that have not yet been mapped as rocky substrate. Out of a total of 9 named reefs in the NCME, there were 6 reefs that were not yet mapped as rocky substrate (St. George, Saunders, Robinson, Ross, Sunken, and Santa Rosa reefs) in the near-shore. These reefs were digitized from USGS 1:24,000 topographic maps or NOAA Nautical charts as polygons, using the 10m depth contour, and combined with the near-shore rocky substrate map to create a near-shore rocky reef layer.

Kelp beds: Kelp beds are one of the most productive marine habitats along the coast of California and provide habitat and nursery areas for many species of fish and invertebrates. California's giant kelp forests (*Macrocystis pyrifera*) are globally unique and significant; they are found in near-shore waters with hard substrate where the kelp can attach from Baja California up through central California (approximately Ano Nuevo). North of San Francisco, bull kelp (*Nereocystis luetkeana*) becomes the dominant kelp. 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).

Aerial videography surveys conducted in California by CDFG in 1989, 1999, 2002, and 2003 provided mapped data on extent of kelp beds (giant kelp and bull kelp). Due to the importance of kelp beds and the inter-annual variability in their distribution and abundance, the kelp coverage in each of those four years was included as a separate kelp target. In addition, we were interested in identifying areas of high coverage of kelp that were persistent over three out of four years of the surveys; these areas may be more resilient over time and were treated as a unique target we called "persistent kelp". We did this by overlaying all four years of kelp data and selecting polygons that had kelp present in any 3 of the 4 years mapped.

Cold seep communities: Cold seep communities are small patch communities of chemosynthetic bacteria and metazoans that are found in deep sea areas where methane and sulfide-rich fluids are seeping or diffusing from the seafloor. The organisms depend on chemical energy produced by chemoautrophic bacteria that utilize the sulfides associated with the seeps for their metabolism. The bacteria in turn support a community of larger animals, including vesicomyid clams and vestimentiferan tubeworms, many of which are endemic to cold seeps. Cold seeps are generally found on continental margins on steep, eroded slopes and canyon walls. In Monterey Canyon, the cold seep communities vary in size from 0.5m to 200m and are generally found below 400m depth (Jim Barry, MBARI, pers. comm.). Data on locations of cold seep communities in the Monterey Canyon area were provide by Jim Barry (MBARI). These data represent only a preliminary set of mapped cold seep communities; these communities are expected to be found in scattered locations in most steep-sided canyons and escarpments in the ecoregion including Eel Canyon, Mendocino Canyon, the Gorda escarpment; however, deep sea communities in those areas have not yet been mapped.

Benthic Habitats

The continental shelf and slope environments include soft and hard bottom habitats in areas that range from flat expanses to slopes to deep submarine canyons and high ridges. The expanses of sand and mud and outcropping bedrock provide diverse habitats for marine species from the near-shore to the bottom of the continental slope at approximately 3500m. The biodiversity associated with different types of benthic habitats has not yet been described or mapped, especially in the deep sea. Therefore, we used a coarse-filter approach to identify a range of potential benthic habitats that may differ in their biological structure and diversity.

Benthic habitat targets were identified using two approaches: 1) a benthic habitat classification scheme and map developed by Gary Greene (Moss Landing Marine Laboratory) and colleagues ("Greene benthic habitats") and 2) a benthic habitat model that we developed ("TNC benthic habitats"). These two approaches resulted in the development of two sets of benthic targets that were used independently in site-selection. For both sets of benthic habitat targets, the presence of a minimum total area of 100 hectares in the ecoregion was used to identify habitats present in significant amounts to qualify as ecoregional targets. We did not use either Greene data or the TNC benthic habitat model for San Francisco Bay or other large estuaries; no benthic targets were identified inside estuaries.

Greene Benthic Habitats: Gary Greene and colleagues have conducted seafloor mapping and compiled data from other sources (including original maps produced by the Division of Mines and Geology, USGS, and California Coastal Commission and more recent seafloor mapping by other researchers) to develop digital maps of California continental shelf geology from Oregon to the Mexico border. The digital data are comprised of seven adjacent but discrete maps with seafloor types depicted as polygons. The dataset delineates 35 benthic habitat types (26 are found in ecoregion), based on geologic and physiographic features, classified according to a deep water benthic habitat classification scheme (Greene *et al.* 1999). The dataset is relatively complete, though coarse-scale, for the entire ecoregion with just a few areas on the continental slope that have not yet been mapped.

We used the most recently available dataset that Greene and his colleagues developed for the National Marine Fisheries Service (NMFS) for the Groundfish Essential Fish Habitat Environmental Impact Statement. For this EFH dataset, the mixed substrate type category was removed and those substrates formerly classified as mixed were classified as sedimentary if >50% sedimentary and rocky if > 50% rocky. The scale of resolution in this dataset varies across the ecoregion as some areas, such as Monterey Canyon, have been mapped very extensively and other areas have not been mapped as well; in addition there are some areas that have not been mapped at all. Appendix II lists the full set of Greene benthic habitats used as targets in the assessment. Greene benthic habitats are shown in Figure 6.

TNC Modeled Benthic Habitats: To develop a more spatially uniform data layer of potential benthic habitats across the eocregion, we modeled benthic habitats using depth, topographic position, and substrate as inputs. The primary benefits of this approach are the development of a wall-to-wall dataset with similar resolution across the ecoregion and a more consistent scale of predicted habitats than the Greene data. The benthic habitat modeling approach is summarized below; detailed methodology is provided in Appendix V.

We used four depth classes in the benthic model; these were similar to Allen and Smith (1988) but modified with feedback from regional marine scientists. The inner shelf (0-40m) includes the near-shore photic zone; the midshelf (40m to 200m) includes much of the continental shelf to the shelf/slope break; the mesobenthyl (200-700m) includes the shelf/slope break down to the depth of the oxygen minima zone; and the bathybenthal (>700m) includes the deep slope down to approximately 3500m depth. These depth zones were mapped for the ecoregion using a bathymetric digital elevation model (DEM) bathymetry compiled by CDFG at a 200m scale of resolution.

Topographic position was classified into four categories: ridge, slope, flats, and canyon. This classification was based on a topographic position index model developed by Weiss (2003), and similar to Iampietro and Kivitek (2002), that compares the elevation in a given cell in the DEM to the mean elevation of the neighborhood of cells around it (see Appendix V).

Substrate data were classified into three seafloor hardness types (hard, soft, and unclassified) based on the induration type category in the continental shelf mapping data developed by Greene *et al.* for the Groundfish EIS – EFH process (described above).

Table 4: TNC Benthic Habitat Model Inputs

Depth (from DEM)	Inner-shelf (0-40m) Mid-shelf (40-200m) Mesobenthal (200-700m) Bathybenthal (>700m)
Topographic Position (from DEM)	Ridge Slope Flats Canyon
Substrate (from Greene)	Hard Soft Unclassified / No Data

Table 5 summarizes the inputs used to define the benthic habitat model that predicts 48 (4x4x3) potential habitat types such as "Inner-shelf_flats_hard" or "bathybenthal_canyon_soft". Some habitat types were not present in the ecoregion and were removed from the targets list, leaving 39 modeled benthic habitat types. Appendix III lists the full set of modeled TNC benthic habitats used as targets. TNC benthic habitats are shown in Figure 7.

Pardington Cove Tide Pool, Big Sur Coast. © Richard Herrnmann

Biologically Significant Areas

Geographic, bathymetric, or hydrographic features that are important to regional biodiversity were identified as targets and included when mapped data were available (Figure 8). Geographic features such as sand spits and near-shore rocks and islets are important for seabirds and shorebirds. Bathymetric features, such as shelf-slope breaks, banks, canyons, and seamounts, alter water flow patterns, cause localized upwelling, and enhance mixing that concentrate prey species and aggregate predators.

Persistent hydrographic features, such as currents and frontal systems are important areas for biological diversity, especially on continental shelves. Hydrographic features such as upwelling zones, eddies, and offshore jets are characterized as short-lived (days to weeks) gradients in temperature or other parameters. Upwelling causes elevated productivity that fuels the pelagic ecosystem. Upwelling centers interact with dominant currents to form eddies and coldwater offshore jets that can extend for tens or hundreds of kilometers across the shelf or along-shore. These convergence zones or fronts aggregate prey species and are exploited by predators such as tuna, whales, and seabirds who concentrate their foraging activities around these temporary water mass boundaries. Eddies are dynamic features that occur along current edges and near bathymetric features and are important areas for pelagic predator. Eddies can also play an important role in larval retention and recruitment of algae, invertebrates, and fish in nearshore environments (Hyrenbach *et al.* 2000, Yen *et al.* 2004). Spatial data on distribution of fronts and eddies is not yet well developed (see section on Data Gaps), so, for this assessment, we only incorporated upwelling zones and the San Francisco Bay tidal plume front.

The following biologically significant areas were identified as conservation targets:

Sandspits: Sand spits occur at the mouths of rivers and estuaries and are important foraging areas for shorebirds, roosting areas for pelicans, and haul-outs for harbor seals. The generalized ESI beach types described above did not adequately capture the uniqueness of sand spits. Sand spit locations were identified from USGS 1:24,000 topos as narrow strips of sand at the mouth of rivers and estuaries and were mapped as point locations.

Near-shore emergent rocks and islets: Near-shore rocks and small islands provide important habitat for a variety of marine life including seabirds and pinnipeds. Intertidal and subtidal portions of rocks also provide habitat for fish and invertebrates. The tops of rocks are often vegetated with coastal plants, including rare and endemic plants whose populations have declined on large islands and coastal areas subject to grazing. We used a comprehensive dataset compiled by the Bureau of Land Management for the California Coastal National Monument to map rocks and islets for the California coastline; there are more then 20,000 rocks and islets along the California coast between the mean high tide and the 12 nm limit, encompassing a total of 833 acres (BLM 2004).

Off-shore banks: Off-shore banks (>10 nmi from shore) were included as targets for their importance for regional fisheries and benthic biodiversity. Off-shore banks are topographic features where migratory and highly mobile fish, such as tuna and marlin, congregate. Offshore banks were identified from NOAA nautical charts and digitized as polygons, generally following a consistent depth contour to define the outer limit. The offshore banks included Cordell Bank, Rittenberg Bank, Fanny Shoal, Four-Fathom Bank, and Santa Lucia Bank.

Major submarine canyons: The northern California continental shelf has numerous large submarine canyons, generally extending from near-shore to offshore that provide unique deep and structurally complex habitats. The following major submarine canyons were digitized from NOAA nautical charts as linear features and included as conservation targets: Eel Canyon, Delgada Canyon, Mendocino Canyon, Vizcaino Canyon, Noyo Canyon, Bodega Canyon, Pioneer Canyon, Monterey Canyon, Soquel Canyon, Carmel Canyon, Sur Canyon, Lucia Canyon, and Arguello Canyon.

Near-shore canyon heads: In addition to the canyons themselves, the canyon heads that occur in near-shore water were 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. The heads of canyons were identified using the shaded relief DEM and mapped as point locations; only canyons with heads within 20 miles of shore were included.

Seamounts: Seamounts are undersea mountains rising from the ocean floor that do not break the water's surface and are considered "hotspots" for marine biodiversity. The crests of seamounts are often characterized by accelerated currents and an abundance of suspension feeders such as gorgonians and anemones (Genin *et al.* 1986). Seamounts are often associated with localized upwelling, higher productivity and aggregations of large predators. Seamounts have a high degree of endemism, may be centers of speciation, and may act as "stepping stones" for the dispersal of species (de Forges *et al.* 2000). Off the California coast, seamounts may represent some of the last untrawled benthic habitat left, as there has been extensive trawling over decades on the continental shelf and slope. San Juan, Rodriquez, Pioneer, Guide, Gumdrop and Davidson Seamounts are the only true seamounts in the NCME; they were mapped as point locations (MCBI 2003).

Shelf-slope break: The shelf –slope break occurs at approximately the 200m depth contour and is where the seafloor on the continental shelf transitions downward to become the continental slope. Studies by Williams and Ralston (2002) and NOAA (NOAA 2004) indicate that rockfish species diversity and richness peaks along the shelf-slope break in the 200-250m range in northern and central California. We defined the shelf-slope break as a polygon between the 200-300m depth contours based on the bathymetric digital elevation model (DEM).

Areas of bathymetric complexity: In marine environments, increased habitat complexity is generally associated with increased biodiversity. Areas with varying habitat offer more niches for organisms to occupy and habitat complexity may affect predator-prey relationships in ways that promote species co-existence (Grabowski 2004). As a surrogate for habitat complexity, we developed a measure of bathymetric complexity that defines how the elevation of the bottom changes over a given area. Bathymetric complexity was derived from the bathymetry DEM and defined as the standard deviation (square of the variance) of bathymetry for all grid cells located within a one kilometer radius of each cell. The resultant map of values was then classified into three groups; high bathymetric complexity was defined as greater than 2 standard deviations above the mean. This method efficiently identifies areas where bathymetry changes rapidly and was used by the NOAA biogeographic assessment team (NOAA 2004).

Upwelling zones: Off-shore, oceanographic processes such as currents, water masses, and temperature influence marine biodiversity. The importance of these processes and their predictability over time is leading to a greater emphasis on identifying persistent oceanographic features, such as oceanic fronts and upwelling areas, as important for conservation of the pelagic ecosystem (Pelagic Working Group 2002). For this planning effort, only areas of upwelling were included as conservation targets.

To identify recurring patterns of cold water as indicators of upwelling zones, we utilized AVHRR (Advanced Very High Resolution Radiometer, 1.1 km resolution) data compiled by NOAA Coast Watch (west coast node) to derive average sea surface temperatures. For this analysis we used the High Resolution Monthly Composites product from NOAA, which compiles AVHRR data by month for scene footprints that are approximately 300,000 km2. The composites were created using night-time images only, computing median values. We used data from four recent years (2000-2003) that did not correspond to strong ENSO events and were consistent with typical upwelling signatures. While the upwelling season can last from March to August, based on NOAA's 15-year compilation of upwelling indices for Point Arena (39N 125W) and Big Sur (36N 122W), May and June are the months of strongest upwelling in the region (http://www.pfeg.noaa.gov/products/PFEL). We only used data from May and June for the four years; four scenes covered the ecoregion for a total of 32 files (2mo * 4years * 4 scenes). Original files were provided by NOAA as binary raster format and were converted to ESRI GRID format. Each GRID file was then tiled (MOSAIC command) both vertically (to eliminate the effect of areas with no data – generally due to clouds) and horizontally to create a seamless spatial and temporal data set of the entire ecoregion.

In order to emphasize local variability in defining upwelling zones and because water temperatures gradually increase from north to south, these data were then clipped to subregions. Subregions were identified such that known centers of upwelling were captured within a subregion. For each subregion, upwelling was defined as the cells that had temperatures less than or equal to 1.5 to 2.5 standard deviations below the 4-year May-June average for that subregion, with the edges of the resulting polygons smoothed in some cases. Table 5 shows the subregions, temperature statistics, and threshold temperatures used to define upwelling zones.

Table 5: Definition of upwelling zones by subregion

Subregion	Mean (SD) Temperature in May-June (degrees C)	Min – Max (degrees C)	Upwelling Threshold Used	Upwelling Zone (degrees C)
Oregon border to Trinidad Head	12.9 (1.7)	6.5-15.4	< 2 SD below mean	Less than or equal to 9.5
Trinidad Head to Cape Vizcaino	12.5 (1.3)	6.4-14.0	< 2 SD below mean	Less than or equal to 9.8
Cape Vizcaino to Bodega Head	12.4 (1.4)	7.4-14.2	<2 SD below mean	Less than or equal to 9.7
Bodega Head to Pigeon Point	11.9 (1.0)	7.5-13.6	<1.5 SD below mean	Less than or equal to 10.4
Pigeon Point to Point Lobos	12.5 (0.7)	7.7-13.7	<2 SD below mean	Less than or equal to 11.1
Point Lobos to Point Arguello	13.0 (0.9)	6.8-16.5	<2.5 SD below mean	Less than or equal to 10.6
Point Arguello to San Nicolas Island	13.9 (1.0)	8.1-17.0	< 1.5 SD below mean	Less than or equal to 12.3

In general, most of the upwelling zones were defined as having May-June temperatures between 9-12 degrees centigrade depending on the subregion; warmer waters in the southern part of the ecoregion required a slightly higher temperature threshold in the southernmost subregion around Point Conception. Our analysis indicated identified the strongest upwelling centers at Cape Mendocino, Point Arena, Point Reyes, Davenport, Big Sur and Point Conception; these are areas where upwelling is persistent and strong and probably enhanced by coastal headlands (see Figure 8).

San Francisco Bay Tidal Plume: San Francisco Bay is the largest estuary on the West Coast and freshwater from the entire Central Valley of California drains into it. Ebb flows during spring tide can reach 6 knots. The estuarine water flowing out of the Golden Gate is lighter and warmer than the continental shelf waters and is visible as a distinct plume. This tidal plume reaches its greatest extent during the spring snowmelt and this tidal front is an important foraging area for seabirds, especially from the large colonies on the Farallon islands. The plume exits the bay and extends out to the 30-40m contour and bends southward, as described in a study of continental shelf currents (Noble 1998). Using a Landsat Thematic Mapper image, we digitized the leading edge or front of this plume as a band extending along the 30-40 m depth contour outside the Golden Gate. The image was from April 2003 to try capture high freshwater flow (spring runoff) and rendered in true color which highlighted this feature very well.

Elephant Seals on Beach, San Simeon. © Harold E. Malde

Species

Selected species were included as targets if they were not considered well-captured by coarse-filter targets and for which there were adequate spatial data for the ecoregion. The conservation status (global / state ranks, legal status) of species-level targets is summarized in Appendix VI. The distribution of species level targets are shown in Figures 9a and 9b.

Structure-forming Invertebrates. Deep sea corals, anemones, and sponges are poorly studied and their distributions are not well known. Due to their three-dimensional structure, these invertebrates provide habitat for other species. Deep sea corals are known to occur on rocky habitats in waters generally deeper than 200m, typically in areas with strong currents. There are over 100 species of deep sea corals along the West Coast of the U.S.; this estimate will likely rise with further study. They occur on the continental shelf and slope, in submarine canyons, and on offshore seamounts. Many deep sea corals and sponges are very slow-growing and may live for hundreds of years (Etnoyer and Morgan 2003). They are very sensitive to physical disturbance; the most critical threat to these deep sea invertebrate communities is bottom trawling. Data on locations of anemones, corals, and sponges were compiled by Terralogic GIS, Inc. from the NMFS Alaska Fisheries Science Center Slope and Triennial Trawls. These trawl surveys were designed for groundfish and occurred primarily on soft substrates; data on these invertebrates represent incidental observations and do not adequately represent occurrences of these invertebrate communities (especially on undersampled hard bottoms).

Salmonid stream outlets. Anadramous salmonids are trout and salmon that are born and reared in freshwater, migrate to coastal estuaries as juveniles, and move into the marine environment to mature before returning to the freshwater streams to reproduce. Coastal streams and rivers in the NCME are home to several species of anadramous salmonids whose populations have been subdivided into evolutionarily significant units (ESU). All ESUs of Steelhead (*Oncorhynchus mykiss*), chinook salmon (*O. tshawytscha*), and coho salmon (*O. kisutch*) present in the ecoregion were considered important conservation targets; many of these populations have declined dramatically and are currently federally listed as endangered or threatened. Salmonids are important elements for integrating marine and terrestrial conservation plans due to their dependence on estuarine systems along the California coast during their juvenile states, nearshore and offshore marine systems during the adult phase, and their migrations upstream into rivers and streams throughout northern and central California to spawn.

For this assessment, we identified the outlet where coastal streams and rivers meet the sea as the conservation target for each species; outlets were mapped as point locations. A statewide database on presence of salmonids in all the coastal streams was not available; therefore we compiled various sources of information to document current presence of these salmonid targets in coastal streams in the ecoregion. Reliable data on population abundances in coastal streams were not available, so we only identified streams and rivers with salmonids confirmed present in the last 10 years. While historic presence may be an important parameter for restoration efforts, we used current presence to focus the assessment on remaining populations.

The National Hydrographic Dataset (NHD, 1:100,000) was used to identify streams that touch the coastline. These stream outlets were then attributed with the current presence of steelhead, coho, and chinook based on a variety of sources; NDDB was queried for these salmonid species, but did not provide additional occurrences beyond the sources already listed for each species. The salmonid targets and data sources are described below.

- **Steelhead stream outlets:** Steelhead are migratory rainbow trout that are born and reared in freshwater, migrate to coastal estuaries as juveniles, and move into the marine environment to mature before returning to the freshwater streams to reproduce. There are four steelhead ESUs in the NCME: South Central California Coast ESU, Central California Coast ESU, California Central Valley ESU, and Northern California ESU. Data on current presence of steelhead in streams of the ecoregion were obtained from (1) a GIS database compiled by Verna Jigour and Associates based on field observations by R.G. Titus (R.G. Titus *et al.*, in prep) and other sources, (2) NOAA's Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California (Busby *et al.* 1996), (3) the Klamath Resource Information System (KRIS) CDs for East Marin/ Sonoma, West Marin/ Sonoma, Noyo River, Redwood Creek, and Tenmile Creek (http://www.krisweb.com), and (4) the CalFish database (http://www.calfish.org).
- **Coho stream outlet:** There are 2 coho salmon ESUs in the NCME: Central California Coast ESU and the Southern Oregon/Northern California ESU. In 1995-1997, coho were found to be present in only 51% of the coastal streams and rivers where they were historically present (Adams *et al.* 1999). Data on current presence of coho in streams of the ecoregion were obtained from (1) Status Review of Coho North of San Francisco (CDFG 2002b), (2) a NMFS status report on coho (Adams *et al.* 1999), (3) KRIS CDs for Mattole River and Tenmile Creek (http://www.krisweb.com), and (4) the CalFish database (http://www.calfish.org)
- **Chinook stream outlet:** There are 5 chinook salmon ESUs present in the NCME that are distinguished by the timing of their migration and the geographic area: California Coastal ESU, Central Valley Spring Run ESU, Central Valley Fall and Late Fall-run ESU, Sacramento River Winter Run ESU, and the Upper Klamath-Trinity Rivers ESU. The Central Valley and the Klamath-Trinity Rivers historically produced enormous numbers of chinook salmon that supported Native Americans and fostered a large commercial fishery;

chinook salmon have declined precipitously over the last decades (Yoshiyama *et al.* 1998). For the Central Valley ESUs, there is an important chinook migration corridor through San Francisco Bay to the upper end of Suisun Bay and the confluence of the Sacramento and San Joaquin Rivers. Similarly, the Klamath-Trinity stocks are concentrated during migration at the Klamath estuary. Data on current presence of chinook in streams of the ecoregion were obtained from (1) a GIS file of chinook presence developed by the NMFS Santa Cruz Laboratory (Robert Schick), (2) the West Coast Chinook Salmon Biological Review Team's Status Report (BRT 1997), and (3) KRIS CDs for Redwood Creek (http://www.krisweb.com).

Estuarine or estuarine-dependent fish. We identified estuarine or estuarine-dependent species that are of conservation concern for which we could obtain adequate spatial data. Habitat maps for native estuarine or estuarine-dependent fish were obtained from NOAA ESI (NOAA 2002) and cross-checked with maps of critical habitat from the Native Delta Fish Recovery Plan (USFWS 1995). For the tidewater goby, these data were augmented with occurrence data from the CNDDB. The estuarine or estuarine-dependent fish included as targets were:

- **Delta smelt:** Delta smelt, *Hypomesus transpacificus*, are small fish that are found only in the San Francisco Bay Delta where the Sacramento River and San Joaquin River converge. They occur primarily in the Sacramento River below Isleton, in the San Joaquin River below Mossdale, and in Suisun Bay. They migrate upstream in the late winter to early summer to spawn and the larvae and juveniles are washed downstream into the entrapment zone in Suisun Bay. Most delta smelt live only one year. Reductions in outflow of freshwater to the estuary and entrapment in water diversions have greatly reduced their populations; they are currently federally listed as threatened (USFWS 1995).
- **Longfin smelt:** Longfin smelt, *Spirinchus thaleichthys,* is a native smelt that was historically present in large numbers in the Sacramento-San Joaquin estuary, Humboldt Bay, Eel River, and Klamath River. In the Sacramento – San Joaquin estuary, they are mostly found in the lower Delta and Suisun, San Pablo, and North San Francisco bays. Due to reductions in outflow, entrainment in water diversions, and other threats, populations in the Sacramento-San Joaquin estuary declined 90% between 1984 and 1992. The species has also recently disappeared from the Eel River and Humboldt Bay (USFWS 1995).
- **Sacramento splittail:** Sacramento splittail, *Pogonichthys macrolepidotus*, is a large cyprinid endemic to the Central Valley. It is primarily a freshwater species and it was once widespread in the Central Valley but, due to dams, diversions, and agricultural development, is now limited to the Delta, Suisun Bay, Suisun Marsh, Napa River, and Petaluma River (USFWS 1995).

- **Green sturgeon:** Green sturgeon, *Acipenser medirostris*, are large, long-lived fish that range in the ocean from Baja California to the Bering Sea, but spawn in coastal rivers. Green sturgeon are found occasionally in many coastal estuaries, but spawn primarily in the Klamath and Sacramento Rivers; the Sacramento River is the species southernmost spawning location. Spawning probably once occurred in the Eel River (USFWS 1995). They spawn upstream in the Klamath and Sacramento Rivers in late spring – early summer; juveniles migrate to the ocean before the end of their second year. Green sturgeons are caught recreationally in California by fishermen who are targeting the more common white sturgeon. Major threats to sturgeon include overfishing and alteration of spawning habitat (USFWS 1995).
- **Tidewater goby:** The tidewater goby, *Eucyclogobius newberryi*, is a small annual species adapted to shallow coastal lagoons and the upper brackish zone of larger estuaries. It is found only in California, ranging from coastal lagoons in San Diego to Tillas Slough at the mouth of the Smith River. All life stages occur in coastal lagoons or estuaries; typically it is found in brackish water less than 1 meter deep. It has been documented in 124 localities, but extirpated from 23% of them and another 45-55% of localities are so small or degraded that its persistence is questioned (USFWS 2004). Major threats include loss of habitat, water diversions, introduced species, and water quality.

Beach spawning fish. Several species of fish spawn in wet sand on selected beaches in California. Protection of representative beaches may not adequately protect the particular beaches where these species reproduce. Data on the beaches known to be spawning habitat were obtained from NOAA–ESI (NOAA 2002). The beach spawning species included as targets were:

- **Grunion:** Grunion, *Leuresthes tenuis*, spawn on the beaches of central and southern California during the spring and summer (March – August). They typically spawn after high tides that occur 2-6 nights after the full or new moon. They range from Point Conception south to Punta Abreojos, Baja California and occasionally north as far as Monterey Bay (Airame *et al.* 2003). They are the target of a recreational fishery.
- **Night smelt:** Night smelt, *Spirinchus starksi*, are schooling planktivorous fish that spawn on selected beaches at night. Spawning occurs from January to September, typically on the same beaches used by surf smelt; peak spawning occurs between dusk and midnight on outgoing tides. They range from Point Arguello to Alaska. They are the target of recreational and commercial fisheries; most of the commercial catch occurs near Eureka and Crescent City (CDFG 2001).
- **Surf smelt:** Surf smelt, *Hypomesus pretiosus*, are schooling planktivorous fish that spawn on selected beaches in the ecoregion at predictable times (June-

September). They spawn in the surf zone at high tide during the daytime, typically on coarse-grained sand or gravel beaches where there is some freshwater seepage. They are widely distributed in California but more common north of San Francisco Bay. Surf smelt are the target of both recreational and commercial fisheries (CDFG 2001).

Seabird colonies. The ecoregion 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. Millions of seabirds migrate through or breed in the region annually. Many populations of seabirds in the NCME 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 the San Francisco Bay tidal plume are all important foraging areas for seabirds in the region. While there are many seabird colonies in California, areas that serve as the most important breeding sites for many species include Castle Rock and Prince Island in northern California, Southeast Farallon Island, Ano Nuevo Island, and Prince Island and Castle Rock off San Miguel Island.

We used seabird colonies as conservation targets and included species restricted to or having a significant proportion of their breeding population in the ecoregion, species at the edge of their range, and species with threatened or endangered legal status. We used available spatial data on colony locations and population estimates from the USFWS survey reports (Sowls *et al.* 1980; Carter *et al.* 1992). For the California least tern we also used data from the CNDDB on nesting locations; the San Francisco Bay locations were updated via personal communication with staff from S.F. Bay Bird Observatory (Cheryl Strong, SFBBO).

Sixteen species of seabirds were included as conservation targets based on the location of their breeding colonies or nesting locations:

- **Leach's storm-petrel:** The Leach's storm-petrel, *Oceanodroma leucorhoa*, is a highly migratory species that is widespread in the northern hemisphere, with four recognized subspecies. *O.l. leucorhoa* breeds on the Farallones and *O. l. beali* breeds on San Miguel Island in the NCME. Storm-petrels are generally nocturnal and burrow-nesting. Large colonies are found at Trinidad Bay, Little River Rock, and South Farallon.
- **Ashy storm-petrel:** The ashy storm-petrel, *Oceanodroma homochroa*, is endemic to the region and a year-round resident; the Farallones and Channel islands support 98% of the breeding population. Populations have declined due to predation by western gulls and other species; squid lights and contaminants are

other potential threats (Mills and Sydeman 2003). The largest colonies are found at Prince Island/Castle Rock in northern California and South Farallon.

- **Fork-tailed storm petrel:** The fork-tailed storm petrel, *Oceanodroma furcata*, breeds at six colonies in northern-central California, with the bulk of the population occurring further north in British Columbia (Mills and Sydeman 2003). In the NCME, the largest colonies are at Castle Rock and Little River Rock in northern California.
- **Western Gull:** The western gull, *Larus occidentalis*, is endemic and resident to the California Current system, with 50-77% of the breeding population concentrated in California. Populations have generally been increasing, probably due to increased feeding at dumps, but may be leveling off (Mills and Sydeman 2003). The biggest colony is at South Farallon, followed by Ano Nuevo Island and San Nicolas Island.
- **Caspian tern:** The Caspian tern, *Sterna caspia*, breeds at scattered locations in the NCME; largest colonies are found at Bair Island and Alviso in San Francisco Bay.
- **Forster's tern:** *Sterna foresteri* breeds at 21 colonies in California representing about 7% of the North American breeding population. Populations in San Francisco Bay and Monterey Bay have declined in the last 20 years due to predation and wetland/riparian habitat loss (Mills and Sydeman 2003). The largest colonies are at Guadalupe slough and the Alviso ponds.
- **Common murre:** While globally distributed and widespread, California has about 34% of the common murre (*Uria aalge*), breeding population in the California Current system. Common murres have declined along Central California due to gillnet and oilspill mortality (Mills and Sydeman 2003). The largest colonies are at False Cape Rock, Castle Rock, Flatiron Rock, False Klamath Rock, Green Rock, Point Reyes, and the Farallones.
- **Pigeon guillemot:** Pigeon guillemot, *Cepphus columba*, are globally distributed but the majority of the California Current population breeds in California. The largest colonies are at South Farallon, Prince Island/Castle Rock at San Miguel Island, Castle Rock in northern California, and Point Reyes.
- **Xantus's murrelet:** In the NCME, *Synthliboramphus hypoleucus*, or Xantus's Murrelet breeds only on San Miguel Island (Prince Island); the majority of the population nests on other Channel Islands or Baja California islands in the SCME.
- **Cassin's auklet:** About 37% of the U.S. population of Cassin's Auklets, *Ptychoramphus aleuticus*, breeds in California. Large colonies are found on Prince Island and Castle Rock off San Miguel Island, Castle Rock in northern California, and South Farallon. Populations have been declining throughout their range, probably due to increased predation.
- **Rhinocerus auklet:** Rhinocerus auklets, *Cerorhinca monocerata*, were extirpated from California in the 1860s but have recently been recolonizing their historic

range. The largest colonies are found at Castle Rock in northern California, South Farallon, and Ano Nuevo Island.

- **Tufted puffin:** The tufted puffin, *Fratercula cirrhata*, is a crevice-nesting seabird with approximately 276 breeding birds in California, primarily at Castle Rock in northern California and South Farallon.
- **Double-crested cormorant:** Double-crested cormorants, *Phalacrocorax auritus*, are found in marine and estuarine habitats throughout California. The largest colonies are found on the San Francisco-Oakland Bay Bridge, the Richmond Bridge, South Farallon, and Prince Island in northern California.
- **Brandt's cormorant:** Brandt's cormorant, *Phalacrocorax penicillatus*, is endemic to the west coast of North America, with over 87% of the population breeding on the California and Oregon coasts (Mills and Sydeman 2003). It is a year-round resident. The largest colonies are found on Castle Rock in northern California;, Bird Rock, Bird Island, and Piedras Blancas on the central coast; and Prince Island and Castle Rock off San Miguel Island.
- **Pelagic cormorant:** About 45% of the North American population of pelagic cormorants, *Phalacrocorax pelagicus*, breeds within the California Current system. The largest colonies in California are at Humboldt Bay, Prince Island and Castle Rock in northern California, and South Farallon.
- **California Least tern:** California least tern, *Sterna antillarum*, nest on the ground on beaches, estuarine shorelines, and in abandoned salt ponds in San Francisco Bay. In the NCME they are found primarily in central-south San Francisco Bay (Alameda to the salt ponds in the south bay) and on selected beaches north of Point Conception.

Other birds. There are dozens of species of shorebirds, waterfowl, and other birds that utilize the coastal environment in the NCME; most shorebirds were assumed to be adequately captured by the estuary, saltmarsh, tidal flat, or beach system-level targets. Three shorebird species were included as separate targets due to their limited distribution and conservation status.

- **Black oystercatcher:** Black oystercatchers, *Haematopus bachmani*, are residents of the rocky shores of the California coast where they feed on intertidal invertebrates and nest on rocky ledges. The largest breeding colonies are located at Ano Nuevo Island, South Farallon, and Santa Rosa Island. For the black oystercatcher, we used population estimates for breeding colonies from the USFWS survey reports on seabird colonies on islands, islets and beaches (Sowls *et al.* 1980; Carter *et al.* 1992).
- **Western snowy plover:** The western snowy plover, *Charadrius alexandrinus*, is a small shorebird that nests on barren or sparsely vegetated areas such as beaches, dunes, salt pans, salt ponds, and lagoon or bay margins along the northern and central coast. Their numbers have declined due to habitat loss and predation; they

are currently listed as federally threatened (Goals Project 2000). For the western snowy plover we used current nesting location data from CNDDB, unpublished survey data from PRBO Conservation Science (PRBO, Gary Page, pers. comm.) and San Francisco Bay Bird Observatory (SFBBO; Cheryl Strong, pers. comm.). Gary Page provided expert review of current nesting locations.

- **California clapper rail:** The California clapper rail, *Rallus longirostris obsoletus*, is a non-migratory resident of San Francisco Bay emergent tidal and brackish marshes. It is a secretive bird that prefers pickleweed and cordgrass habitat with tidal sloughs and channels. Historically it occurred in marshes from Humboldt Bay to Morro Bay, but is now restricted to the South Bay, Napa marshes, and other North Bay marshes in San Francisco Bay. Hunting by humans, habitat loss, and predation by introduced red fox are the primary causes of the decline of this species (Goals Project 2000). For the clapper rail we used occurrence data from CNDDB (point data) and clapper rail habitat (as polygons) mapped by NOAA-ESI (NOAA 2002).
- **California black rail:** The California black rail, *Laterallus jamaicensis coturniculus*, is small, sparrow-sized, secretive rail that prefers vegetated high elevation salt marsh. On the California coast it was historically found from Central California south to Baja California. Currently, it is found primarily in the northern portion of San Francisco Bay (San Pablo Bay and Suisun Marsh), with occasional occurrences in Tomales Bay, Bodega Bay, Bolinas Lagoon, and Morro Bay (Goals Project 2000). Habitat loss and predation have contributed to their decline; they are currently listed state threatened. For the black rail, we used occurrence data from CNDDB (point data) and black rail habitat (as polygons) mapped by NOAA- ESI (NOAA 2002).

Pinniped rookeries and haul-outs . Spatial data for mobile animals such as seals and sea lions are limited; therefore, we focused the assessment on the breeding and haul-out locations that pinnipeds use repeatedly year after year. Five species of pinnipeds have colonial rookeries or haul-out sites in central–northern California:

- **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.
- **Steller sea lion:** Central California is the southern extent of the range of the Steller sea lion, *Eumatopias jubatus*, also known as the Northern Sea Lion.
- **Northern fur seal:** The northern fur seal, *Callorhinus ursinus*, is one of only two fur seals in the Northern Hemisphere (the other is the Guadalupe fur seal in the SCME). San Miguel Island is the only breeding site in the NCME; most of the breeding population is found in the Aleutian islands, Bering Sea, and off Japan.

- **Northern elephant seal:** The northern elephant seal, *Mirounga angustirostris*, was hunted almost to extinction by the late 1800s. Today there are breeding colonies at the Channel Islands (San Miguel, San Nicolas Island, and Santa Rosa Island), Farallon island, and Ano Nuevo island. On the mainland there are colonies at Piedras Blancas, Cape San Martin, Point Ano Nuevo, Point Reyes, and Punta Gorda.
- **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.

Breeding rookeries for California sea lions, Steller sea lions, Northern fur seals, and Northern elephant seals were mapped as point locations using data from Mark Lowry at NOAA (Lowry 2002) and the NOAA Biogeographic Assessment of Central and Northern California (NOAA 2004). Approximate locations for pinniped haul-outs (for harbor seals, California sea lions, and Steller sea lions) were mapped as point locations based on data provided by NOAA (Lowry and Carretta 2003) from aerial photographic surveys. Data include counts, derived from photographs, for harbor seals.

Southern Sea Otter. Historically, the sea otter, *Enhydra lutris*, ranged from Japan to Baja California and numbered in the tens of thousands on the California coast; they were hunted almost to extinction until receiving protection in the early 1900s. There are currently around 2100 otters on the central California coast. Sea otters use many near-shore habitats, from estuaries to kelp forests and rocky habitats, along the coast. Survey data of rangewide abundance of otters were used to map distribution of this species. Summed linear densities of sea otters were obtained from the NOAA Biogeographic Assessment (NOAA 2004) from data collected by the USGS-BRD, CDFG, and the Monterey Bay Aquarium. Counts of otters were made in the spring (May 5-22) of 2002 in 0.5 kilometer segments of the coastline (out to the 5 fathom depth contour). Linear densities were summed for 10 kilometer long by 2 kilometer wide segments of the coast. We classified these densities into three classes (using the natural breaks – Jenks optimization function in GIS): low (0-26 otters), medium (26-62 otters), and high (62-107 otters). All three density classes of otters were retained as separate targets to best capture their expanding range and their natural densities.

Salt marsh harvest mouse. The salt marsh harvest mouse, *Reithrodontomys raviventris*, is a small native mouse endemic to the San Francisco estuary and is listed as federally endangered. These herbivores live primarily in middle to upper reaches of saltmarshes, typically pickleweed marshes, and their populations have declined as the tidal marshes around the bay have been diked and filled. There are two subspecies, a northern subspecies (*R. r. haliocoetes*) and a southern subspecies (*R. r. raviventris*) in the S.F. Bay estuary (Goals Project 2000). They were selected as a conservation target because they are currently found only in disjunct populations in larger expanses of saltmarsh around the bay; those locations would not necessarily be captured by selecting representative salt marsh using the ecosystem-level target. For the salt marsh harvest mouse we used occurrence data from CNDDB (point data) and salt marsh harvest mouse habitat (mapped as polygons) from NOAA- ESI (NOAA 2002).

Cormorant Drying Wings. © Brain E. Small

SETTING CONSERVATION GOALS

We set conservation goals to define the number and spatial distribution of each conservation target needed to adequately conserve the target across the ecoregion. Goals have two components: a representation goal specifies the number or amount of that target, and a stratification component that ensures that the target will be represented across the ecoregion. Each goal is described as a percentage of the total abundance of that target as mapped in the ecoregion and is expressed as an area (hectares), linear length (kilometer), number of individuals, or number of planning units with that target present.

Although there is no specific formula for how much habitat or how many populations are necessary to conserve a target, representation goals should be based on relative abundance and distribution (Groves *et al.* 2002; Groves 2003). Generally, in terrestrial environments goals are set in the 30-40% range for widespread ecosystems and communities with the assumption that those goals will capture 80-90% of species (Groves 2003). Rare patch communities and globally ranked targets require higher goals. In the marine environment, slightly lower goals may be more appropriate since the area around sites may continue to support species and ecosystems to a greater extent than in terrestrial environments where land conversion is a significant threat (Beck 2003). It is also important to consider historical distributions and to select higher goals for species or systems whose abundance has been significantly diminished (such as coastal salt marsh in California).

Goals for conservation targets were set at low (15 - 30%), medium (50%), or high (75 - 100%) values depending on target distribution patterns, historic abundance, and conservation status of the target. A summary of representation goals for general categories of targets is provided in Table 6; details on the representation goal set for each target is provided in Appendix III.

For shoreline targets, goals were set at 30% for each shoreline type, except for coastal marsh for which a 75% goal was used due to historic losses of almost 90% of coastal marshes in California. The NOAA-ESI (NOAA 2002) dataset is of high quality and an effort was made to identify the priority shoreline type at each location when multiple types present. This ensured that the rarer shoreline types would be well represented in the mapped distributions used in the site selection process.

Many coastal and near-shore ecosystems, such as estuaries, eelgrass beds, coastal salt marsh, coastal dunes, and kelp beds, have experienced significant degradation or declines in recent history and higher goals were set for those targets (50 - 75%).

Important geographic, bathymetric, or oceanographic features, such as offshore banks, canyon heads, and the shelf-slope break, which are known to be associated with higher diversity or abundance of species were given goals of 30 - 50%.

There are only 6 seamounts in the ecoregion and they were "locked in" with a 100% goal. Seamounts are relatively undisturbed deep benthic habitats (and may represent some of the last untrawled habitat) with rich suspension feeding communities, high levels of endemism, aggregations of large predators. Since there are only 6 in the ecoregion, they were considered rare and a high goal was used to ensure they become part of the portfolio of conservation areas.

For benthic habitat types identified using the either the TNC benthic habitat model or mapped by Greene *et al.* (1999), we evaluated the abundance of the habitat type in the ecoregion and set conservation goals of 15% for the most common habitat (which occupy >20% of ecoregion), 20% for common targets (which occupy 1 - 20% of the eocregion) and 30% goals for less common benthic habitat types (which occupy <1% of the ecoregion). The benthic habitat model has not been validated for its accuracy nor have these benthic habitat types been correlated with biodiversity; therefore, relatively low goals were set. For most species level targets, a goal of 50% was used. For species that are globally rare or rare in California (species ranked G1, G2, S1, or S2), a higher goal of 75% was used.

Table 6: Representation Goals for Conservation Targets

Target Group	Examples	Conservation goal
Shoreline systems	Beaches, rocky shores, tidal flats	30%
Other ecosystems / communities	Coastal dunes	30%
Other ecosystems / communities	Kelp forests, eelgrass beds, estuaries	50%
Other ecosystems / communities	Coastal marsh	75%
Biologically significant areas	Offshore rocks and islands; upwelling areas	30%
Biologically significant areas	Offshore banks, canyon heads, shelf/slope break	50%
Biologically significant areas	Seamounts	100%
Benthic Habitats	Most Common Benthic Habitats (>20% of ecoregion)	15%
Benthic Habitats	Common Benthic Habitats (1-20% of ecoregion)	20%
Benthic Habitats	Less Common Benthic Habitats (<1% of ecoregion)	30%
Species Occurrences	Structure forming invertebrates; marine mammal haulouts;	30%
Species Occurrences	Tidewater goby; most seabird colonies; sea otter habitat	50
Species Occurrences	Salmonid stream outlets; marine mammal rookeries; G1/G2 or S1/S2 ranked species	75%

IDENTIFYING STRATIFICATION & PLANNING UNITS

Marine ecological systems and habitats should be represented sufficiently across environmental and latitudinal gradients in the portfolio to account for ecological and genetic variability. To achieve this, we defined subregions within the ecoregion and set the representation goals for each target within each of these "stratification units".

The distribution of marine habitats and species in the NCME changes from north to south in response to water temperatures and other environmental conditions. We used major headlands or biogeographic boundaries to divide the ecoregion into six subregions or "stratification units" of similar sizes (Figure 10). Stratification unit boundaries were drawn using latitude lines so that each stratification unit (except San Francisco Bay) included nearshore and offshore targets. Point Arguello, just north of Point Conception, was chosen as the northern boundary for the southernmost stratification unit to separate the important biogeographic break at Point Conception and the associated upwelling center from the Big Sur coast just to the north and to ensure that some coastal and near-shore targets were included in the most southern stratification unit. Seamounts further offshore were included in the nearest subregion. The San Francisco Bay was made a separate stratification unit due to the many unique targets present in that area. For benthic habitats, the depth component of the benthic habitat model also provides a degree of stratification from near-shore to offshore.

The following stratification units were identified for the ecoregion (Figure 10):

- Oregon border to Cape Mendocino
- Cape Mendocino to Point Reyes
- San Francisco Bay (Golden Gate to confluence of San Joaquin and Sacramento Rivers)
- Point Reyes to Point Sur (including Pioneer and Gumdrop seamounts)
- Point Sur to Point Arguello (including Davidson and Guide seamounts)
- Point Arguello south to San Nicolas Island (including San Juan and Rodriquez seamounts).

To facilitate planning, we divided up the ecoregion into small equal-sized planning units that could be used as "bins" for information on target distribution. This is a necessary component of using site selection algorithms like MARXAN and has the added benefit of giving planners a normalized unit of analysis for summary statistics on number and diversity of targets. The NCME was divided into 3,400 hexagonal planning units, each 3,500 hectares in size (Figure 10). Hexagons were chosen as planning units, rather than grids, because their six-sided shape allows for more choices for clumping planning units in the optimization algorithm.

ASSESSING SUITABILITY

Ideally in an ecoregional assessment, all target occurrences are screened for viability, with occurrence size, condition or landscape context used to screen out non-viable occurrences or to identify most viable examples of each target. For a few targets (eg. western snowy plover, California least tern) we had detailed information on nesting success over time at multiple locations and used expert input to remove non-viable occurrences (G. Page, PRBO Conservation Science). That detailed knowledge was not available for most targets, so instead a suitability layer was created that could be used to steer conservation area selection away from places likely to be heavily impacted by human uses. We also used expert review of the draft portfolio to ensure that only viable or restorable sites were included in the final portfolio.

A suitability layer was developed by compiling spatial data for five types of impacts (or cost factors). We generated a suitability map by counting the number of cost factors within each planning unit. The cost factors included the presence of:

1. Infrastructure: marinas, ports, ferry terminals, hoists, major airports
2. Toxic sites: military dumping areas, dredge disposal sites, leaking shipwrecks
3. Artificial / hardened shoreline: presence of seawalls, riprap, and other manmade structures along the shoreline

Table 7: Cost factors used to assess suitability

Cost Factor	Units	Data Source
Marinas, ports, ferry terminals, hoists, major airports	Presence / absence	NOAA-ESI (NOAA 2002)
Military dumping areas	Presence / absence	NOAA Nautical charts
Dredge disposal sites	Presence / absence	Army Corps of Engineers Open Ocean and In-bay disposal sites (SF Bay Watershed Mapping and Database project)
Leaking shipwrecks	Presence / absence	NOAA Shipwrecks database http://www.cinms.nos.noaa.gov/shipwreck/dbase.html
Riprap, seawall	Kilometers	NOAA–ESI (NOAA 2002)

All cost factors were weighted similarly (one kilometer of hardened shoreline was weighted the same as one disposal site or one marina). Each planning unit was attributed with the total number of cost factors and summed to create a suitability index (Figure 11). Most planning units had no cost factors and were considered to have the high suitability for conservation. Planning units with multiple cost factors (especially adjacent to urban areas) were considered the least suitable. As described further below, the MARXAN algorithm evaluates planning units for their cost relative to the amount of conservation targets that planning unit contributes towards achieving overall conservation goals.

We also evaluated impacts in coastal watersheds based on analysis of road density and urban area, but opted to use that information in a qualitative threat assessment rather than as a cost factor in the MARXAN algorithm. We did this by looking at the following elements per coastal watershed:
1. Road density – sum length of all roads in the watershed divided by the area of that watershed (Km/Ha). Large values represent minimally impacted watersheds while values approaching 1 suggest heavily impacted watersheds.
2. Percent agricultural lands in watershed
3. Percent urban areas in watershed
4. Number of dams present in watershed
5. Number of Superfund CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) sites.
6. Number of sites regulated by the EPA's Toxic Release Inventory program.

All inputs were scaled such that the maximum in any category is 1000. The cost categories were then added up to create a total cost for the watershed. While these data were not explicitly used in the MARXAN algorithm they did provide useful in choosing the final representative portfolio of conservation areas.

Sea Lions on Rocks, Monterey Bay. © Rebecca Wells

DESIGNING A PORTFOLIO OF CONSERVATION AREAS

Ecoregional assessments identify a portfolio of conservation areas that together capture the biodiversity of the region. The portfolio of conservation areas provides a conservation vision that will guide prioritization, more detailed conservation area planning and the identification and implementation of conservation strategies. The objective of the portfolio selection process is to ensure that conservation goals are met for all targets in an efficient design that minimizes cost factors and total area. Other conservation planning principles that were implicit in this effort included:

- **Representativeness:** Examples of all targets represented multiple times across environmental gradients.
- **Efficiency:** Areas with highest diversity (multiple targets present) given priority.
- **Functionality:** Areas considered to be ecological functional or restorable to a functional condition.
- **Irreplaceabiltity:** Irreplaceable areas (with multiple and unique target combinations or containing rare and important target occurrences) included in the portfolio.

Site Selection Approach

We used MARXAN (Ball and Possingham 2000) to assemble a portfolio of marine conservation areas for the ecoregion. MARXAN requires three inputs: (1) the conservation targets present and the amount of that target in each planning unit, (2) the suitability index for each planning unit, and (3) the conservation goals for representation of each target in each stratification unit. Given those inputs, the algorithm seeks to select a set of planning units which meet conservation goals for all targets, as cheaply (relative to suitability) and in as compact a set of planning units as possible.

We used the "simulated annealing" algorithm option in MARXAN. Under this option, MARXAN begins with a random set of planning units and, at each iteration, randomly swaps planning units in and out of that set and measures the change in cost. The program evaluates 1,000,000 iterations and keeps the least cost configuration before moving on to the next selection set. As the process continues, the algorithm becomes more selective in what constitutes a best configuration of planning units.

Some additional parameters that have to be selected before running MARXAN include (1) the number of repeat runs, (2) the species penalty factor, which is the penalty for not meeting stated conservation goals, and (3) the boundary length modifier, a weighting factor which determines how much clumping or dispersion is favored in the model output. We ran MARXAN many different times with the number of repeat runs and determined that 1000 repeat runs was sufficient. The species penalty factor was set at 1 for all targets. After experimentation, we selected a boundary length modifier of 0.3 to achieving significant clumping, while still allowing for numerous distinct conservation areas that had biological relevance as seascapes.

A variety of spatial configurations of selected planning units can be used to meet conservation goals. Outputs from MARXAN include the “best solution” and the “summed solution”. The best solution is the selection set with the minimum number of planning units that best meets conservation goals; while most efficient, it reflects only one possible result. The summed solution describes how many times each planning unit was selected in all iterations and provides an indication of the conservation value or “irreplaceability” of each planning unit in the overall design.

We ran MARXAN many times with different sets of targets and goals during an experimentation phase. We determined that both the TNC modeled benthic habitats and the Greene benthic habitats had value in the assessment, but could be used most effectively if included in separate MARXAN runs. The draft portfolio was therefore developed using results from two scenarios:

- **Scenario 1:** TNC modeled benthic habitats and all other system, species, and biologically important area targets using goals identified in Appendix III
- **Scenario 2:** Greene benthic habitats and all other system, species, and biologically important area targets using goals identified in Appendix III.

The “best solutions” for each scenario are presented together in Figure 12 and represents two possible and efficient solutions. The “summed solutions” for both scenarios are shown together in Figure 13. The combined summed solutions show areas of highest conservation value when both scenarios are included together. While there is a lot of overlap in the two solutions there are also areas where they differ. This is due in large part to either data gaps in the Greene benthic habitat coverage (particularly offshore in northern California) or more detailed mapping by Greene and others in some areas (eg. Monterey Canyon).

Delineating Marine Conservation Areas

We delineated marine portfolio conservation areas (PCA) that together represent the biodiversity of the ecoregion and met conservation goals. A relatively small number of planning units were needed to meet goals for rare and very rare targets and were selected consistently; however, for more common targets a variety of planning units could be incorporated into the design to meet goals. The summed solution for both scenarios shows how consistently planning units were selected to meet conservation objectives and was used to initially define a draft portfolio of marine conservation areas.

Delineation of marine conservation areas centered on planning units with high conservation value based on the combined summed solutions for both scenarios. Planning units selected in 50% or more of the repeat runs in the summed solution were included in the draft portfolio. We then evaluated the goals met by that set of planning units and identified targets for which goals had not yet been met. For benthic habitat targets, we decided to focus on meeting goals for TNC benthic habitats and not Greene benthic habitats; meeting goals for both would be inefficient and likely redundant. We identified additional planning units to include using the following general criteria to guide us:

- Planning units with targets for which goals had not yet been met
- Planning units identified in the "best" solutions
- Planning units that would contribute most to creating a functional seascape at the conservation area (eg. capturing the full extent of the estuary or the offshore extent of a submarine canyon or the spatial extent of an upwelling zone, etc).

The draft portfolio was reviewed by a panel of marine scientists at a workshop in November 2004 and was generally well-received (see Appendix I for participants). During this workshop we received input on additional data sources and a few areas important for biodiversity that were not yet included in the portfolio. We revised the target data inputs slightly based on that input and ran the MARXAN scenarios again, going through the same process as described above to delineate the portfolio. We finalized the portfolio by including additional planning units identified by the scientists during the workshop as important to regional biodiversity.

Planning units included in the final portfolio were aggregated into 55 conservation areas. Creating a portfolio of conservation areas using the planning units' geometry makes for a jagged edge of hexagon boundaries. In an effort to create a smoother boundary, and take into account the values of neighboring planning units outside the 50% cutoff, we used a focal neighborhood analysis. We calculated the mean value of the summed solution using a 3km neighborhood (expressed as a buffer). Three kilometers was chosen because it is roughly the size of the planning units and would thus account for values in adjacent planning units. This has the effect of smoothing the edges and incorporates the summed solution values of planning units' adjacent selected planning units. The smoothed conservation area boundaries are purely cartographic. Our reporting of conservation targets present and goals met uses the hexagonal boundaries (i.e. the planning units that make up the conservation areas).

The NCME portfolio represents 25% of the area of the ecoregion (853 planning units) and 74 % of the shoreline (Figure 14). The portfolio met goals for almost all targets (Appendix VII). Goals were not met for five of the TNC benthic habitat targets and twelve of Greene benthic habitats; however, meeting goals for both TNC modeled and Greene classification benthic habitats is probably duplicative. Overall, the portfolio was efficient in that only 25% of the ecoregion was selected; however, a large percentage of the coastline is included. The portfolio exceeded the goals for many targets, due in large part to the size of the planning units, which were probably too large at 3500 hectares. A large planning unit can be inefficient since other targets are captured in addition to the targets driving the selection of that planning unit.

The PCA area boundaries should be considered approximate; more detailed conservation area planning of these "seascapes", and especially their coastal boundaries, would be required to accurately map local marine biodiversity resources, determine the most appropriate boundary for the conservation area, and develop site-specific strategies to abate critical threats. A description of each marine PCA and the targets present is provided in Appendix VIII.

DATA MANAGEMENT AND DATA LIMITATIONS

The assessment is based on the compilation and evaluation of numerous spatial datasets for the ecoregion. An ESRI geodatabase was used to store and manage data. There were notable data gaps and sources of uncertainty that should be the focus of additional research efforts.

Marine Geodatabase and Data Management

To facilitate effective and efficient decision making we have implemented a data management strategy with following principles:

1. Data in the planning process is inherently spatial (with a few exceptions) and highly relational; therefore the ESRI Geodatabase model was used
2. Data elements needed to be consistent with other planning efforts within TNC, thus we made effort to adhere to TNC's data standards The reliance on MARXAN to help define an efficient set of conservation areas required data elements to support creation of MARXAN inputs, thus creating a modular and transparent data process.

The geodatabase includes the definitions, integrity rules, and behavior for an integrated collection of datasets used to represent the collection of thematic layers in GIS (Arctur and Zeiler 2004). This platform offers all the power of a traditional relational database, as well as being highly scalable. The desktop or personal geodatabase was implemented in MS Access which can be readily ported to an enterprise version (i.e. multiple users with remote access) and hosted in one of the standard large scale formats like Oracle or SQL Server.

TNC's conservation data managers recently published the first version of data standards for ecoregional assessments (TNC 2004, Ecoregional Assessment Data Standards, Standard Number 01-001). This document provides a data framework for planning teams by defining data entities and relationships that are standard to the process. To the extent possible, we have adhered to these standards which provide both documentation of data entities and consistency with other plans.

Reliance on the MARXAN algorithm to define an efficient set of conservation areas allows for a repeatable process. The geodatabase allowed us to dynamically create the inputs necessary for MARXAN through queries in an MS Access relational database. This efficiency allowed for much more experimentation and evaluation of multiple scenarios. Ultimately we strived for data management that was both transparent (others could create identical inputs) and modular (pieces of the process could be altered easily).

TNC contributed the marine spatial data layers compiled for this assessment to support the state's MLPA Central Coast Project. A California Marine Geodatabase is housed at the University of California, Santa Barbara and includes many spatial data layers from a variety of governmental and non-governmental organizations. The data layers can be viewed and accessed via an Internet Mapping Service site (http://www.marinemap.org/mlpa).

Data Gaps and Limitations

For the ecoregional assessment, we relied primarily on large readily available datasets that allowed us to map the distribution of targets over the entire region. We relied heavily on a coarse-filter approach to identifying conservation targets; this approach may not adequately protect all species-level targets, especially wide-ranging ones. While more detailed data are available for some local areas that are well-studied, these types of data are best used for site-level conservation planning.

Based on the datasets and approach used, there were several data gaps or data limitations that should be considered important sources of uncertainty at the scale of the ecoregional assessment:

Lack of Mapped Data for Some Important Targets: There were a variety of conservation targets that we would have liked to include in the assessment, but appropriate spatial data were not available. While some of these potential targets may be captured or embedded in our existing targets, we would recommend that future mapping efforts or assessments develop better information on these potential targets:

- **Hydrographic features:** Persistent fronts, eddies, and offshore jets are important hydrographic features that influence 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. Recent work by Tim Mayvor (NOAA) and Larry Breaker and William Broenkow (MLML) on developing monthly frontal probabilities for the region based on sea surface temperate shows great promise. In addition to sea surface temperature data, other potential sources of data potentially useful to describe these features include satellite altimetry and ocean color mapping. We did not have the resources necessary to fully develop and analyze data to describe hydrographic features beyond upwelling zones. These other hydrographic features would be important to consider in designing a network of MPAs for the region as they are important for connectivity. We would encourage the development of spatial datasets that capture persistent oceanographic features over long enough time periods that adequate probabilities for their occurrence can be derived.

- **Marine Fish:** Data on the occurrence and distribution of most marine fish species has not yet been compiled in a spatial format. Ongoing work to develop Habitat Suitability Indices (HSI) or Habitat Suitability Probabilities (HSP) is in progress for many species, including groundfish under the Essential Fish Habitat Environmental Impact Statement (EFH-EIS) process. With the exception of estuarine-dependent species, this assessment has relied on a coarse-filter approach to capturing marine fish diversity.

  NOAA has recently completed a biogeographic assessment for northern–central California that involved synthesizing data on distribution and abundance of 119 species of midwater and demersal fish from a variety of sources (CDFG recreational fishing data, NMFS shelf, slope, and midwater trawl data) and included 119 species of fish; however, their assessment only covered the portion of the ecoregion from Point Arena to Point Sal. We used their results to validate whether our portfolio captured important areas for fish in that region. We used two synthetic layers developed by NOAA to identify areas important for fish and evaluated what percentage of these areas we captured in the final portfolio: (1) Top 20th percentile fish diversity: This layer was generated by NOAA to identify fish diversity hotspots from interpolated estimates of total diversity for each 5 minute grid in the study area and (2) Top 20th percentile fish density: This layer was generated by NOAA to identify fish density hotspots from interpolated estimates of total density for each 5 minute grid in the study area.

- **Market Squid:** California market squid, *Loligo opalescens*, are important prey species in the near-shore and pelagic food chains and the target of one of the largest commercial fisheries on the West coast in terms of weight and dollar value. Squid spawn in aggregations on near-shore sandy bottoms, typically at depths ranging from 18 - 55m but as deep as 800m (CDFG 2004). A habitat suitability index (HSI) model of squid spawning habitat has been developed by NOAA and others based on depth and substrate type; however, this model is very general and describes the whole near-shore environment as moderate or high suitability and does not provide detail on locations of known spawning aggregations. Squid fishers target spawning grounds and a fisheries-dependent map of landings data identifies some known spawning grounds (such as the southern part of Monterey Bay, just south of San Luis Obispo, and the southern side of Santa Rosa island; however, these data are mapped at the 10minx10min fishing block scale and do not represent all (or even most) spawning grounds. The northern fishery is centered around Monterey Bay and fishers generally operate within a half-mile of the shoreline. Rather than incorporate fisheries-dependent data or a generalized HSI map as a data input into the site-selection process, we made sure that the final portfolio included squid spawning habitat and known squid spawning aggregations. The squid fishing industry is currently developing a map of the resource that may be useful in later iterations of this assessment.

- **Native shellfish:** Two groups of native shellfish were considered potentially important targets because of their role in creating habitat structure that supports many other species. The native Olympia oyster, *Ostrea lurida*, ranges from Alaska to Baja California and was formerly common in NCME bays and estuaries. They were the target of commercial harvest and culture through the early 1900s; their natural populations have been greatly reduced by harvesting, pollution, and habitat alteration (USFWS and US ACOE 1989). At this time, information on the distribution of native oysters in California bays and estuaries has not been compiled. Most researchers say that native oysters are found in limited numbers in many bays or estuaries (Humboldt Bay, Tomales Bay, San Francisco Bay, and Elkhorn Slough) wherever hard substrate are available; large aggregations are rare but are found at select locations in San Francisco Bay (such as Bair Island). An evaluation of the potential role of native oyster restoration as a conservation strategy would also be useful; currently, there are pilot restoration efforts in Tomales Bay (Ted Grosholz, U.C. Davis, pers.comm.) and San Francisco Bay (Brian Mulvey, NOAA/NMFS, pers.comm.).

  Native mussels, *Mytilus* spp., form dense beds in the rocky intertidal and on hard structures in bays and provide habitat structure for many other species. With the exception of a few mussel beds in the southern part of the ecoregion mapped by NOAA – ESI, large beds of mussels along the coast of California have not been mapped. We had to assume that by including sheltered and exposed rocky shore habitats as targets that we would capture some portion of existing mussel beds. An effort to map areas with important mussel beds would be valuable.

- **Pelagic Hotspots:** Cetaceans, sharks, tunas, seabirds and other species that migrate and forage widely are difficult to include in the assessment as their distributions are affected by highly dynamic hydrographic processes that affect their food sources and movement patterns. Incorporating data on the distribution of these species (other than seabird colony locations) is problematic and, for many species, those data are not available in a spatial format except for geographically limited areas. Identifying pelagic hotspots, or areas in the open ocean that are important for numerous species, is one approach. Recent efforts to correlate cetacean and seabird observations with habitat and environmental conditions (Forney 2000; Yen *et al.* 2004) provide a preliminary list of areas important to these species that we used to evaluate the final portfolio. There are ongoing collaborative research projects, such as "Tagging of Pacific Pelagics" (TOPP, Barbara Block, pers.comm) that aim to identify pelagic hotspots through tagging of large numbers of diverse species of pelagic predators by numerous researchers; these data are not yet available but should be incorporated into future assessments.

The NOAA biogeographic assessment (NOAA 2004) synthesized information from a variety of spatial data sets on seabird distribution and abundance. As for the fish, their assessment only covered the portion of the ecoregion from Point Arena to Point Sal. A second phase of this assessment will focus on marine mammals. We used two synthetic layers developed by NOAA to validate whether we had captured areas important to seabirds in our final portfolio. The two synthetic layers included: (1) Top 20th percentile bird diversity: This layer was generated by NOAA to identify seabird diversity hotspots from interpolated estimates of total diversity for each 5 minute grid in the study area, and (2) Top 20th percentile bird density: This layer was generated by NOAA to identify seabird density hotspots from interpolated estimates of total density for each 5 minute grid in the study area.

- **Deep Sea Hotspots:** Research institutions in the NCME lead the world in deep sea exploration; however, with the exception of portions of submarine canyons in the Monterey area, the Gorda Escarpment, and a few seamounts, most of the deeper reaches of the ecoregion have not been explored for their biodiversity. Recent surveys in those areas have described a sample of that biodiversity such as cold seep communities (Jim Barry, MBARI, pers.comm.), relatively pristine areas of deep sea corals and anemones on seamounts (MBARI and MBNMS joint explorations), and aggregations of spawning sculpin and octopi on the Gorda escarpment (Drazen *et al.* 2003). Since so little is known about patterns of biodiversity in the deep sea, we relied on coarse-scale targets such as representative benthic habitats, seamounts, and submarine canyons to capture that biodiversity. A spatial database of areas of biodiversity importance in the deep sea would improve a future assessment.

Lack of validation of the benthic habitat model. The benthic types generated by the benthic habitat model play an important role in the MARXAN algorithm because of the high number of benthic targets and the fact that they were often the only targets in off-shore areas. The accuracy of the benthic model (ie. whether a predicted habitat type is really present) has not been validated. The bathymetric DEM is based on a 200m grid size and is mosaic in nature. In addition, the species and communities associated with these benthic types, and hence their conservation significance or value, is not known. A sampling effort to validate the model and correlate at least a subset of types with other measures of biodiversity would add value to the assessment. More refined benthic mapping statewide, especially in near-shore areas, would be very useful for conservation planning.

Need for improved viability assessment. Developing quantitative criteria and the data to support an evaluation of viability for all marine target occurrences would improve the assessment. For this assessment, we relied on expert input and literature review for species-level targets to remove non-viable occurrences. We relied on the suitability layer to steer conservation area selection away from less-viable habitats with multiple human impacts. There is a need for a more integrated approach to incorporating watershed impacts in the near-shore environment.

Lack of information on regional threats. Spatial data on marine threats is generally lacking. Cost factors were used to drive site-selection away from areas considered to be impacted. A very qualitative assessment of threats was conducted based on readily available information for places that are well known or well-studied to help identify action areas. However, both a regional assessment of threats to marine biodiversity and more site-specific information is needed to better identify the conservation areas that are most highly threatened. TNC's site planning approach, known as the 5-S framework, will be used to assess threats at selected action areas in the future. The 5-S framework (Low 2003) can be used to identify key systems (conservation targets and the attributes that maintain their viability), stresses (types of destruction, degradation or impairment threatening those systems), sources (agents generating the stresses), strategies (activities employed to abate threats), and measures of success (measures of biodiversity health and threat abatement).

Lack of spatial socioeconomic data. The importance of understanding socioeconomic conditions and marine resource use patterns for developing appropriate conservation strategies is widely recognized; however, the compilation of spatial data related to human use of or impacts on marine resources has not kept pace. For this assessment we were limited to compiling basic socioeconomic information in a narrative form.

IDENTIFYING STATEWIDE GAPS IN MARINE PROTECTION

We did not build the portfolio around existing MPAs. This was, in part, because the state's MPAs are undergoing a re-evaluation during the MLPA process and new MPAs will likely be implemented. A critical component of terrestrial conservation has been the assessment of current levels of protection and the identification of ecosystems or habitat types that are underrepresented in protected areas, a process termed "gap analysis" (National Gap Analysis Program 1994; Jennings 2000). Gap analysis involves categorizing areas by the level of protection they offer (their "conservation management status" or CMS) and then evaluating the amount of each habitat or ecosystem in each category of protected status. A gap analysis for terrestrial California was completed in 1998 (Davis *et al.* 1998), but a similar analysis of marine ecosystems in California has been lacking.

We conducted a statewide marine gap analysis to assess current levels of permanent protection for selected marine ecosystems and habitats in permanent MPAs in California (Gleason *et al.*, in press). MPAs range from "no-take" reserves, to "limited take" MPAs that allow some extractive uses, to more broadly-defined MPAs with little habitat protection. In California, various types of permanently designated MPAs are surrounded by areas where extractive uses of public trust resources like fishing practices or oil and gas leasing, are regulated by a variety of state and federal agencies.

For our analysis, we assigned marine CMS categories based on permanence and level of protection, allowable extractive uses, and development of a management plan. There are three types of state MPAs in California: State Marine Reserves, State Marine Parks, and State Marine Conservation Areas. We assigned only fully protected State Marine Reserves to CMS 1. For CMS 2, we included limited-take State Marine Parks, where commercial fishing is excluded but recreational fishing is allowed. We categorized State Marine Conservation Areas as CMS 3 since recreational fishing and some types of commercial fishing are allowed. National Marine Sanctuaries and National Estuarine Research Reserves were also categorized as CMS 3, since these areas have few restrictions (beyond existing state and federal regulations) on fishing and other extractive uses but have broad protection mandates. Marine managed areas, such as temporary fishery closures and military security zones, and areas not designated at all were categorized as CMS 4. Even though some portion of these areas may be covered under a state or federal fishery management plan, they do not offer permanent habitat protection. In locations where more than one designation overlapped (e.g., a State Marine Reserve inside a National Marine Sanctuary), we assigned the more protective CMS category (Figure 3). As on land, we considered CMS 1 and 2 marine protected areas, which are designated for ecosystem protection and characterized by full protection or limited take regulations, as well protected.

We also evaluated estuarine and shoreline areas that are in terrestrial protected areas (e.g., National Seashores, National Parks, National Wildlife Refuges, State beaches, and State parks), and retained the original terrestrial gap status (from Davis *et al.* 1998) for those areas. Where terrestrial protected areas were adjacent to MPAs, we used the most protective CMS category to assess the intervening shoreline habitats.

Less than 0.3% of the statewide area (shoreline to 3000 meters) is categorized as CMS 1 or 2 (Table 8). We have done a better job of protecting the coast; 30% of the linear coastline (not including San Francisco Bay) is categorized as CMS 1 or 2 based on both terrestrial and marine protected areas that abut the shoreline. Of California's MPAs with permanent status, all those categorized as CMS 1 and 2 are in state waters and most are small (average size of 2.9 sq. mi. or 1,828 acres). The largest MPAs in California are the National Marine Sanctuaries (CMS 3), which account for 15% of the statewide study area but offer little habitat protection; about 84% of the marine realm is categorized as CMS 4. However, it should be noted that a significant portion of the area outside MPAs and classified as CMS 4 area is currently closed to bottom fishing or trawling to protect groundfish (rockfish, flatfish, and other species) in the Rockfish Conservation Area (5% of the statewide study area), Cowcod Closure Area (10% of the statewide study area), and federal No-Trawl Zones (16% of the statewide study area). These temporary fishery management closures cover large areas, but they do not offer permanent protection to seafloor habitats as they can be re-opened when groundfish stocks recover.

We evaluated the existing level of protection for a subset of important marine and estuarine ecological ecosystems and habitats, for which we had available mapped data, by comparing their distribution with protected areas. Some near-shore ecosystems, such as shoreline types, coastal marsh, eelgrass beds and kelp forests, are relatively well mapped by state or federal agencies (CDFG and NOAA). Other habitats, such as hard bottom seafloor habitats in both state and federal waters have been mapped at a very coarse scale (Greene *et al.* 2004) and these estimates of overall amount and representation in MPAs are approximate and should be revisited when more accurate mapping has been conducted. Most habitats or ecosystems have little (<5%) or no representation in CMS 1 and 2 areas (Table 9). Coastal marsh has a high percentage of its total area under CMS 1 or 2 at 32%; however, the current amount of coastal marsh left in California is <10% of its historic abundance, so this ecosystem is not well conserved. Globally unique kelp forests have less than 5% of their areas under CMS 1 and 2, despite their importance to threatened near-shore rockfish assemblages, sea otters, and a host of other species. Rocky shores (37% of total area in CMS 1 or 2) and sandy beaches (28% of total area in CMS 1 or 2) are relatively well protected by coastal national parks and wilderness areas, national seashores, and state MPAs.

Table 8 - California Marine Protected Areas Summary

Conservation Management Status (CMS)[1]	Type (Description)	#	Area (sq.km)	% of marine study area[2]	% of state waters[3]	% of federal waters in study area[4]
MPAs (Permanent Status)						
CMS 1	State marine reserves (Living and non-living resources fully protected)	21	356.9	0.25	2.4	NA
CMS 2	State marine parks (recreational fishing allowed; no commercial fishing allowed)	26	39.5	0.03	0.3	NA
CMS 3	State marine conservation areas (some types of recreational fishing and commercial fishing allowed)	33	195.3	0.14	1.3	NA
	National marine sanctuaries (recreational and commercial fishing allowed)	4	22,102.0	15.70	33.5	13.6%
	National Estuarine Research Reserves (recreational and commercial fishing allowed)	3	30.8	0.02	0.2	NA

Notes: 1. Marine Conservation Management Status from Gleason *et al.*, in press. 2. Marine Study Area includes the shoreline out to 3000m depth (140,899 sq. km). 3. State waters include shoreline to approximately 3 miles offshore (14,816 sq. km). 4. Federal waters in study areas includes state waters boundary out to 3000m depth contour (126,083 sq. km); note federal jurisdiction extends to 200 nmi but habitat data are not available beyond the continental slope. NA= not applicable.

Table 9 - California Marine Gap Analysis Summary. Level of existing protection for selected marine and estuarine ecological systems and habitats in California as percentage of total abundance in statewide study area (Study area is 140,900 sq.km, 14,816 sq. km of state waters, 126,083 sq. km of federal waters).

	Percentage of Total Amount of Habitat in each CMS Category			
Selected Conservation Targets	CMS 1 (fully-protected reserves)	CMS 2 (limited-take areas)	CMS 3 (limited protection)	CMS 4 (no permanent protection)
Rocky intertidal[1]	23.5	13.5	34.9	28.0
Sandy beach[1]	13.8	14.4	38.4	33.4
Salt marsh[2,3,4,5]	3.6	28.8	8.9	58.7
Eelgrass bed[3,4,5,6]	0.6	1.8	17.5	80.1
Kelp forest [7]	3.7	< 0.1	48.7	47.6
Near-shore canyon head[10]	1.9	0	41.5	56.6
Submarine canyon[10]	0	0	25.9	74.1
Near-shore soft bottom substrate (State waters)[8]	2.6	< 0.1	34.7	62.7
Offshore soft bottom substrate (Federal waters)[8]	0	0	11.9	88.1
Near-shore hard bottom substrate (State waters)[8]	2.5	0.1	44.4	53.0
Offshore hard bottom substrate (Federal waters)[8]	0	0	4.3	95.7
Shelf-slope break (200-300m depth contour)[9]	0.5	0	22.7	76.8
Seamounts[9,10]	0	0	0	100

Notes on sources of spatial data: 1. NOAA Environmental Sensitivity Index, 2. National Wetlands Inventory, 3. Humboldt Bay GIS Atlas, 4. CDFG Tomales Bay data, 5. San Francisco Bay EcoAtlas, 6. National Estuary Program, 7. CDFG 2002 kelp survey , 8. California Continental Shelf Mapping Project (Gary Greene, Moss Landing Marine Laboratory), 9. Digital Elevation Model Bathymetry from CDFG, and 10. NOAA Nautical charts (1:200,000 scale).

ASSESSING THREATS AND OPPORTUNITIES

Assessment of threats to biodiversity and opportunities for conservation are necessary to develop strategies for conservation action and to prioritize among portfolio conservation areas. A preliminary and qualitative assessment of threats and opportunities was conducted for the ecoregion to identify areas where TNC and its partners could take actions that would make substantial progress toward abating threats or sustaining biodiversity. More detailed threat assessments should be completed on a site by site basis during conservation area planning. A summary of general threats and opportunities across the ecoregion is described below; a more rigorous threat assessment for the region is also needed.

Threats

Spatial data on threats are not generally available. We compiled available spatial layers for human use activities in the marine environment such as ports, access areas, and shipping lanes. To characterize potential impacts of human activities in coastal watersheds, we used parameters such as road density, urban area, and agricultural area to develop an index for the human use footprint or extent of coastal land conversion in coastal watersheds (Calwater 2.2. basins) bordering the ecoregion. We conducted literature reviews and talked with experts to identify the most important threats in the region. The primary threats to conservation areas in the NCME are described below.

Overfishing and Destructive Fishing. Overfishing occurs when the quantity of fish harvested exceeds the amount that can be re-supplied by natural growth and reproduction. High quotas, poor regulation, lack of enforcement, bycatch, and destructive fishing gear can directly cause species declines and can lead to ecological imbalances in marine ecosystems (Tegner and Dayton 2000; Jackson *et al.* 2001; Dayton *et al.* 2002; Myers and Worm 2003). The emphasis on single-species fisheries management has not adequately protected many fished species nor the habitats they depend on. Populations of many large predatory fish are experiencing significant declines worldwide correlated with overfishing (Myers and Worm 2003). Populations of some rockfish species on the West Coast have dropped to less than 10 percent of their past levels (MacCall and He 2002 cited in Pew 2003).

Some commercial fisheries, such as those using bottom trawling gears, destroy habitat in the course of normal fishing practices and can have a significant effect on marine biodiversity (Thrush and Dayton 2002; Engel and Kvitek 1998; NRC 2002).
In discussions with regional scientists, there is general agreement that bottom-trawling is one of the most serious threats to benthic biodiversity in the region, as most of the shelf and much of the slope have been trawled repeatedly over the last 100 years. The

continental shelf environments of California have been trawled since 1876, more recently trawlers are moving into deeper waters of the shelf and slope. Trawling, primarily for groundfish, increased in the 1970s due to federal subsidies but groundfish landings have steadily declined in the last 20 years as stocks declined (some to the point of being declared overfished) and the fishery was subject to increasing regulation to reduce catch (Engel and Kvitek 1998). Recent efforts to evaluate the status of groundfish stocks and the need for increased protection of Essential Fish Habitat are positive steps. A large amount of biomass has been removed from the ecosystem over decades of intensive fishing. Many fisheries also have significant impacts on marine biodiversity due to large volumes of by-catch of non-commercial fish and invertebrate species that are thrown back dead as well as accidental catch of seabirds, turtles, and marine mammals.

Recreational fishing may be the primary source of fishing mortality for some targeted species, especially near ports (Schroeder and Love 2002; Coleman *et al.* 2004). California ranks 2nd in the nation for number of saltwater anglers (after Florida); California had 1.7 million recreational anglers making 6 million trips in 2000 and 2.2 million of those fishing trips were in northern California (CDFG 2002a). Boat based anglers target near-shore rockfish species over rocky outcrops and recreational landings of near-shore finfish are higher than commercial landings. Commercial passenger fishing vessels account for a significant portion of the recreational catch; CPFV trips and total catch have declined since the peak in the 1980s in northern California (CDFG 2002a).

Harvesting of native invertebrates by indigenous peoples and more intensively during the last 100 years has resulted in significant declines in species such as abalone, clams, mud shrimp, grass shrimp, and native oysters (Airame *et al.* 2003).

Habitat loss and alteration. Habitat loss, conversion, and alteration has directly affected many coastal ecosystems in northern and central California. Less than 10% of coastal wetland habitat remains in California; coastal marshes have been lost as a result of shoreline hardening, dredging and the draining, diking, and filling of wetlands. Large Pacific coast estuaries, such as San Francisco Bay, once contained vast wetlands and marine resources and are now largely urbanized or impacted by human population. As much as 82% of tidal marshes in the San Francisco Bay estuary have been lost or altered; 50,000 acres of historic baylands have been filled (Goals Project 2000).

Increased sedimentation in coastal rivers caused by upstream logging, grazing, mining, and development has altered spawning habitat for salmonids in coastal rivers and altered sediment input into coastal estuaries and nearshore habitats. The direct adverse impacts on salmonid spawning habitat of increased sedimentation has been well studied; however, less is known about the ecological impacts of altered sedimentation regimes in coastal water bodies.

Coastal development has drastically altered or converted coastal habitats in heavily populated areas around Humboldt Bay, San Francisco Bay, Monterey Bay, Morro Bay, and San Luis Obispo. Modifying shorelines to reduce erosion, such as the construction of riprap and seawalls, alters habitat structure and function.

Beaches and other dynamic coastal systems have been impacted by alteration of sand/sediment transport, coastal development, and recreational use. Construction of jetties blocks longshore transport of beach sand. Beach grooming (the removal of seaweed wrack and other debris on recreational beaches) removes an integral part of the beach ecosystem that provides food and habitat for a variety of species; groomed beaches show lower diversity of invertebrates and seabirds than beaches not subject to grooming (Dugan 2004).

Rocky intertidal communities in areas with public access can be affected by over-harvesting of targeted species (eg. black abalone, owl limpets, mussels) and trampling of sensitive species such as algae. In some areas, visitor use is very high; Point Pinos in Monterey gets 30,000-50,000 visitors a year while the Fitzgerald Marine Reserve on the San Mateo coast receives 100,000 visitors a year to the intertidal zone (MBNMS 2003).

Kelp forests are important structural components of the near-shore environment and likely play a role as nursery habitats for many species (Beck *et al.* 2003). Loss of these important ecosystems affects many marine communities that are dependent on them. Climatic changes can have significant effects on kelp abundance and persistence (Tegner *et al.* 1997). In addition, tens of thousands of wet tons of kelp canopy are harvested every year for their alginates (CDFG 2001); the effect of this harvest on the dynamics of species dependent on the kelp canopy, especially for its nursery role, is not known.

Repeated bottom trawling in offshore areas with fishing gear that drags across the ocean floor destroys benthic communities of sponges and corals and other invertebrates that provide important habitat structure for many species. Destructive bottom trawling is a significant threat to the complexity and biodiversity of these seabed communities directly and through alteration of benthic habitat (Thrush and Dayton 2002).

Pollution and degraded water quality. Pollution from land and sea-based sources releases inorganic and organic chemicals and nutrients into the ocean where they may accumulate to the extent that they may cause adverse impacts to species, communities, and the functioning of ecosystems. Sources of marine pollution include point sources such as industrial discharge pipes, oil spills, toxic waste dumps, cruise ships, and sewage treatment outfalls, as well as non-point sources such as urban and agricultural runoff. Some of the coastal watersheds in the NCME are largely urbanized and have high amounts of impervious surfaces that result in polluted runoff reaching the near-shore marine environment. San Francisco Bay has numerous oil refineries and Superfund sites that line its shores; a regional monitoring program and site investigations have documented dozens of areas with significant levels of pollution in the Bay. Wood processing plants around Humboldt Bay have released organic contaminants into estuarine sediments and waters.

Oil and gas development in the southern portion of the ecoregion (offshore San Luis Obispo and Santa Barbara counties) and high levels of shipping traffic in San Francisco Bay and down the coast are potentially significant sources of chronic low-level pollution and catastrophic spills. Recent political efforts to open up offshore leases for new oil and gas development add urgency to addressing the oil development threat.

Marine debris or plastics are also increasingly a problem for seabirds and sea turtles. Beaches in central and northern California generally have good water quality and are not routinely closed due to public health concerns over bacterial counts as are some southern California beaches (www.healthebay.org).

Altered hydrologic regimes. Alterations in fresh-water inputs change the basic characteristics of estuaries by altering the dynamic exchange between fresh and salt water. The natural flow patterns of rivers and streams are important mechanisms for maintaining adequate oxygen, salinity, and temperature levels and changes in the natural flow regime (volume and timing) affect the abundance and distribution of many target species and habitats. Alteration of hydrologic regimes by water diversions and flow reductions has affected many native estuarine-dependent fish and anadramous fish in California. Barriers to fish passage have restricted spawning of steelhead, salmon, lampreys, and sturgeons. Several species of native fish, such as the Sacramento splittail, are now restricted to the brackish waters of Suisun Bay, when they once were distributed throughout the delta and in many of the Central Valley rivers (USFWS 1995). Many estuaries (including San Francisco Bay) have gotten more saline as freshwater flow has been reduced causing changes in extent of brackish marsh and brackish water habitats.

In addition, upstream activities such as logging and agriculture increase sedimentation rates and water temperatures and affect in-stream habitat quality, as well as down-stream estuaries. A century of logging in the region has caused extensive erosion and sedimentation in coastal rivers resulting from timber cutting and, more importantly, associated road-building. Current logging practices have been subject to much greater restrictions, but impacts to habitat for endangered species, especially fish, remain. The Environmental Protection Agency and California State Water Resources Control Board have listed over 85 percent of the rivers and streams in the north coast as sediment or temperature impaired.

Invasive species. Exotic species that are invasive can crowd out native species, alter habitats, and introduce foreign pathogens. The rate of introduction of exotic marine species has risen exponentially over the past 200 years and shows no sign of leveling off (Carlton 2001). Most of the introduced marine species have arrived in ship ballast water, but other important means of introduction include improperly disposed home aquarium water, hull fouling, commercial aquaculture, and intentional introductions (CDFG 2002c). More than 175 species of introduced marine invertebrates, fish, algae, and higher plants live in San Francisco Bay; it is now, one of the most invaded estuaries in the world (Cohen and Carlton 1998; Cohen and Carlton, unpublished data in Pew Ocean Commission 2003). Over 97% of the species and 99% of the biomass in San Francisco Bay are comprised of introduced species (Airame *et al.* 2003). Many of the more invasive species pose a potential threat to smaller California estuaries as they move up and down the coast from the larger estuaries where they first appeared; most bays and estuaries along the coast already have a significant number of introduced species (CDFG 2002c). On land, introduced species such as the red fox can have serious impacts on ground-nesting birds such as clapper rails; feral species, such as cats and rats, prey on many ground-dwelling shorebirds and seabirds.

Recreation/Disturbance of wildlife. Disturbance of seabirds, shorebirds, and marine mammals can occur from recreational activities (eg. boating, fishing, diving, kayaking, surfing, and whale-watching), shore and island-based development and industries (eg. tourism) and military activities (eg. bombing, overflights, underwater sonar) especially when they occur near nursery or rookery areas. In Monterey Bay and Tomales Bay, the increasing popularity of kayaking has resulted in increasing interactions between humans and wildlife such as sea otters, pinnipeds, and seabirds. In rocky intertidal areas, tidepooling can result in trampling impacts on fragile species and population impacts on harvested species.

Climate change. Climatic changes resulting from human use of fossil fuels will likely create drastic regional and global challenges. Global air temperature is expected to warm by 2.5 to 10.4oF (1.4 to 5.8oC) in the 21st century, affecting sea-surface temperatures and raising the global sea level by 4 to 35 inches (9 to 88 cm) (IPCC 2001 in Pew 2003). Climate change will likely modify the flow of energy and cycling of materials within marine ecosystems - in some cases, altering their ability to provide the ecosystem services many species depend upon. The California marine environment may experience changes in oceanographic patterns, productivity and distribution of species due to climate change. Sea level rise may affect coastal marsh systems if vertical accretion of sediments cannot keep pace with sea levels.

Opportunities

There is a growing recognition of the need for marine conservation efforts in the NCME. All of the planning efforts by partners described represent potential opportunities for TNC to align our conservation vision with others. Some additional opportunities in the region included:

California Ocean Protection Act: The California Ocean Protection Act and recently established Ocean Protection Council will streamline and consolidate oversight for ocean protection and has established a trust fund to support ecosystem-based management efforts.

Marine Life Protection Act Initiative: The near-shore environment of the NCME in state waters (0-3 nmi) is the focus of a statewide mandate to develop a network of marine protected areas (MPAs) through the MLPA. TNC provided data and planning expertise for the Central Coast pilot project. Additional opportunities to support the MLPA are anticipated.

Marine Life Management Act: The MLMA calls for ecosystem management of California's marine resources. As a departure from single-species fisheries management, it provides impetus to protect marine wildlife and their habitat. TNC can use a place-based approach to promote ecosystem-based management of fisheries in priority portfolio conservation areas.

National Marine Sanctuaries: The presence of four NMS in the region represents an opportunity to engage with federal partners and stakeholders during the sanctuary management plan review process and ongoing discussions about boundary changes and the need for marine reserves in those sanctuaries.

NMFS Groundfish Essential Fish Habitat (EFH): The designation of EFH and identification of mitigation actions to address environmental impacts of trawling on EFH represent an opportunity to promote biodiversity conservation in the context of evolving fishery regulations and market-based incentives to reduce fishing effort.

Conservation of pelagic ecosystems: There is growing interest in conservation of pelagic ecosystems. A working group of academic, agency, and non-governmental organizations was recently formed by PRBO Conservation Science to discuss conservation of the pelagic ecosystem of California (the Pelagic Working Group 2002). PRBO was recently funded to develop a California Current Joint Venture to focus on ecosystem management of the marine environment. As one of the few organizations conducting planning on an ecoregional scale, TNC can play a unique role in developing approaches and strategies for open ocean conservation.

Rationalizing fisheries: The increasing awareness of the impacts of recreational and commercial fishing on marine systems and the decline of many fisheries has created opportunities to work with those stakeholders on efforts to improve fisheries management while also conserving biodiversity.

Coastal watershed management: Concerns about water quality impacts and altered sediment loads in estuarine and near-shore environments and declining stocks of anadramous fish have brought together diverse stakeholders and funding agencies interested in improving watershed management. TNC has the opportunity to build on our terrestrial land protection strengths to link terrestrial-aquatic-marine conservation efforts. Partnering with state and federal agencies on threats assessments and prioritzing conservation action in coastal watersheds could be an initial effort.

Building on TNC's terrestrial activities: TNC is well established in many coastal counties of the NCME and has the opportunity to expand existing terrestrial and aquatic conservation projects in the Central Coast, Central Valley (Suisun Bay in the SF Bay Delta), and North Coast to focus on protection of adjacent marine or estuarine targets. TNC already has several active project areas that border the marine ecoregion including: San Luis Obispo County, Monterey County, San Francisco-San Joaquin Delta, Napa County, and Sonoma County. TNC's North Coast project team has identified Humboldt Bay as a priority. There are a variety of funding mechanisms such as NOAA's Coastal and Estuarine Lands Program and Community-based Coastal Restoration Program, as well as state programs through the California Coastal Conservancy and Wildlife Conservation Board.

Establishing new TNC project areas: TNC can establish new estuarine or marine project areas in priority action areas in the ecoregion. New flagship projects could build on TNC's strengths and unique contributions to develop innovative marine conservation efforts in the region.

Partners

Many stakeholders in California are recognizing the need for improved management and conservation of marine biodiversity in the NCME. We expect that this assessment and the underlying database that we developed will help us to forge new partnerships with state/federal agencies, universities, other NGOs, and resource user groups to shape a broad vision for conservation of California's marine biodiversity. Potential organizational partners for marine conservation efforts in the NCME include:

- **Federal agencies:** NOAA/NMFS; CINMS; MBNMS; GoFNMS; CBNMS; NOAA's Marine Protected Areas Science Center; NOAA's National Estuary Program; Department of Defense; BLM; USFWS/National Wildlife Refuges and National Estuarine Research Reserves
- **California State agencies:** California Coastal Commission; California Coastal Conservancy; Department of Fish and Game; California State Parks
- **Councils and Working Groups:** Pacific Fisheries Management Council; MLPA Task Force and MLPA- Initiative; San Francisco Bay Joint Venture; California Current Joint Venture
- **Resource User Groups and other ocean-based economic institutions**: The harbor masters of Port San Luis, Morro Bay, Monterey, Moss Landing, Santa Cruz, and Half Moon Bay; Morro Bay Commercial Fishing Association; Port San Luis Commercial Fishing Association; the Alliance of Communities of Sustainable Fishers; The Central California Joint Cable/Fisheries Liaison Committee; the United Anglers of Southern California; the United Anglers of California; and the Pacific Coast Federation of Fisherman Association
- **Non-governmental organizations:** Environmental Defense; EcoTrust; National Fish and Wildlife Federation; PRBO Conservation Science; Monterey Bay Aquarium Research Institute; Monterey Bay Aquarium / Center for the Future of the Oceans; Marine Applied Research and Exploration (MARE); Natural Resources Defense Council; The Ocean Conservancy
- **Academic/research institutions:** University of California at Santa Cruz; UC Santa Barbara; California State University at Monterey Bay; Moss Landing Marine Laboratory; Bodega Bay Marine Laboratory; Monterey Bay Aquarium Research Institute (MBARI); San Francisco State University; Humboldt State University; Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO).

DEVELOPING STRATEGIES

With this assessment, TNC and its private and public partners can be confident that site level marine conservation activities are not isolated, but part of a larger conservation design for the region that meets specific conservation goals. The identification of these 55 portfolio conservation areas makes no presumption about the best strategies for conservation at individual sites. Assessment of critical threats to these conservation areas during site-scale planning will drive the development of key strategies.

TNC and its partners utilize a variety of strategies for marine conservation including habitat protection, acquisition of coastal lands through fee or easement, leasing and ownership of submerged lands, elimination of destructive fishing practices, improved watershed management, ocean zoning, community-based fisheries that improve stewardship, and policy changes. At some sites, TNC has found that marine protected areas (MPAs) are the most appropriate strategy for the conservation of marine biodiversity. MPAs can take many forms, from no-take reserves to mixed use areas, and may be zoned for different uses that preserve and enhance conservation, recreational, commercial, scientific, or cultural values. TNC recognizes that MPAs will only be successful if supported by the communities that surround them and the stakeholders that utilize them.

Integration of the results of this assessment with those in adjacent terrestrial assessments for the North Coast and Central Coast will improve our conservation implementation in coastal areas. Coastal estuaries, salmonid streams, and rocky shores are important areas where terrestrial and marine efforts should converge. Protecting land on the coast through fee or easement, restoration of coastal habitats, and watershed management approaches can have positive affects on the neighboring marine environments. Conversely, purchasing private lands on the coast which have not historically been open to public access and turning them over to public agencies with public access or recreation mandates can potentially cause adverse impacts on coastal and marine biodiversity. Land protection opportunities in the coastal zone should be evaluated with regard to the protection of both marine and terrestrial biodiversity.

General types of strategies to abate threats to the marine and estuarine environments in the NCME include:

- **Marine protected areas:** A system of multiple use marine protected areas offers a promising opportunity to protect our diverse ocean ecosystems, help sustain our fisheries and provide significant recreational opportunities. However, it is critical that we pay attention to the perceptions surrounding the coherence and effectiveness of MPAs and listen closely to individuals and interest groups that may be skeptical. Establishing multiple use areas straddling both federal and state waters; potential zones could include "no take" areas, limited and responsible fishing areas, and areas protected from destructive or indiscriminant fishing methods.

- **Ocean zoning:** Ocean zoning, if appropriately used, can help separate out incompatible uses and increase marine resource use efficiency while reducing conflicts. Zoning can help us move towards a seamless management of adjacent state and federal waters when they are ecologically connected. Zoning can also help to reconcile spatial management tools such as MPAs and fishery closures.
- **Market-oriented strategies:** Market-oriented strategies can be used to rationalize fisheries, reduce fishing effort and fisheries impacts, and enhance conservation. One idea that is currently under consideration for use of the Ocean Trust Fund established under the California Ocean Protection Act, is to establish a Revolving Loan Fund to assist over-capitalized or destructive fisheries in transitioning into cleaner, more sustainable fisheries. In addition, a Buyout Fund for fishing permits and vessels that participate in destructive fisheries, is also under consideration.
- **Policy initiatives:** Policy initiatives to promote ecosystem management of the California marine environment and to promote the establishment of a new marine policy position within the Resources Agency. The new California Ocean Protection Act was designed to elevate the critical issues of ocean management to a cabinet level and raise the political awareness of threats to the coastal and marine environment. The law is designed to focus on the following over-arching themes – 1) Ecosystem-based marine life and fisheries management 2) coastal water quality enhancement, and 3) establishment of an integrated coastal ocean observation system
- **Community-based fisheries management:** Many past attempts at top-down, command and control fisheries management with poor ability to monitor and implement regulations have been disastrous. Community based fisheries management or co-management (in conjunction with agency management) can provide incentives to fishers to behave consistent with conservation. Both COPA and the MLMA provide interesting opportunities to attempt these emerging strategies.
- **Acquisition of private land** in fee or easement in along the coast, around estuaries, and important salmonid streams can help to protect coastal and marine biodiversity.
- **Leasing and ownership of submerged habitats**, such as kelp beds and subtidal lagoons/estuaries, for scientific research, restoration, and conservation purposes.
- **Restoration of critically imperiled ecosystems and species** such as coastal marshes, intertidal estuaries, eelgrass beds, native oyster beds, and salmonids;

potential funding is available from the NOAA Community-based Coastal Restoration program.

- **Restoration of coastal streams for anadramous fish** through removal of fish barriers and enhancement of spawning habitat for salmonids
- **Improved management of marine resources held in trust by state and federal agencies** by assisting with revisions of management plans, identification of resource management needs, and supporting science-based decisions
- **Abatement of land-based sources of threats** through watershed management and local coastal planning.

Sea Gull in Morro Bay. © Mary Gleason

PRIORITIZING PORTFOLIO CONSERVATION AREAS

As part of statewide prioritization of "The Last Great Places" in California, we will identify priority marine and estuarine areas that are globally and regionally significant. We will qualitatively evaluate biodiversity patterns, threats and opportunities at all the portfolio conservation areas and recommend action areas as initial priorities for TNC's California Coastal and Marine Program.

REFERENCES

Adams, P.B., M.J. Bowers, H.E. Fish, T.E Laidig, and K.R. Silberberg. 1999. Historical and current presence of coho salmon (*Oncorynchus kisutch*) in the Central California coast evolutionarily significant unit. NMFS- Santa Cruz/Tiburon Laboratory. Administrative Report SC-99-02.

Ainley, D.G. and R.J. Boekelheide. 1990. *Seabirds of the Farallon Islands: Ecology, dynamics, and structure of an upwelling-system community.* Stanford University Press, Stanford, California.

Airame, S, J.E. Dugan, K.D Lafferty, H. Leslie, D. A. McArdle, and R.R Warner. 2003. Applying ecological criteria to marine reserve design: a case study from the California Channel Islands. Ecological Applications, Vol. 253:170-184.

Airame, 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. 164p.

Allen, M. J., and G. B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. NOAA Tech. Rept.NMFS 66. 151pp.

Arctur, D and M. Zeiler. 2004. *Designing Geodatabases: Case Studies in GIS Data Modeling.* ESRI Press, Redlands California

Ball I. and H. Possingham. 2000. MARXAN (v1.8.0): Marine reserve design using spatially explicit annealing. A manual prepared for the Great Barrier Reef Marine Park Authority. March.

Beck, M. 2003. The sea around: Conservation planning in marine ecoregions. In, *Drafting a Conservation Blueprint: A practitioner's guide to planning for biodiversity.* C.R. Groves, ed. The Nature Conservancy. Island Press, Washington D.C.

Beck, M. W. and K.L. Heck Jr., K. W. Able, D.L. Childers, D.B. Eggleston, B.M. Gillanders, B. Halpern, C.G. Hays, K Hoshino, T.J. Minello, R. J. Orth, P.F. Sheridan, M.P. Weinstein. 2003. The role of near-shore ecosystems as fish and shellfish nurseries. Issues in Ecology, 11:1-12.

Biological Review Team (BRT), West Coast Chinook Salmon. 1997. Review of the Status of Chinook Salmon (*Oncorhynchus tshawytscha*) from Washington, Oregon, California, and Idaho under the U.S. Endangered Species Act.

Bureau of Land Management (BLM) 2004. California Coastal National Monument: Draft Resource Management Plan / Draft Environmental Impact Statement. California State Office, BLM. BLM/CA/ES-0081790-1600. August.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. NOAA Tech. Memorandum NMFS-NWFSC-27.

California Cooperative Oceanic Fisheries Investigations (CALCOFI), http://www.calcofi.org/calcofi.html

California Department of Fish and Game (CDFG). 2004. Draft Market Squid Fishery Management Plan. April 12, 2004.

CDFG, 2004. Natural Diversity Database (NDDB). GIS spatial data

CDFG. 2002a. Nearshore Fisheries Management Plan. October.

CDFG. 2002b. Status Review of California Coho Salmon North of San Francisco. Report to the California Fish and Game Commission. April.

CDFG. 2002c. A survey of non-indigenous aquatic species in the coastal and estuarine waters of California. Office of Spill Prevention and Response. December.

CDFG, 2001. *California's Living Marine Resources: A Status Report* (ANR Publication #SG01-11) California Department of Fish and Game, http://anrcatalog.ucdavis.edu

CDFG, 2000. Giant and bull kelp commercial and sport fishing regulations. CDFG, Sacramento, CA

CDFG, Marine Region GIS Unit, http://www.dfg.ca.gov/itbweb/gis/mr.html

California Department of Forestry and Fire Protection (CDF), 1991-present. Land Cover Mapping and Monitoring Program, Vegetation Data, http://frap.cdf.ca.gov/data/frapgisdata/select.asp

California State Resources Agency, 1995. California's Ocean Resources: An Agenda for the Future. July. Draft.

Carlton, J.T. 2001. Introduced Species in U.S. Coastal Waters: Environmental Impacts and Management Priorities. Pew Oceans Commission, Arlington, Virginia.

Carter, H.R., D.L. Jaques, G.J.McChesney, C.S. Strong, M.W.Parker, and J.E. Takewawa. 1992. Breeding populations of seabirds on the northern and central California coast in 1989 and 1990. (Draft). With collaboration by Point Reyes Bird Observatory. US. Fish and Wildlife Service, Dixon, CA..

Cohen, A.N., and J.T. Carlton. 1998. Accelerating invasion rate in a highly invaded estuary. Science 279:555–558.

Coleman, F.C. and W. F. Figueira, J.S. Ueland, L.B. Crowder. 2004. The impact of United States Recreational Fisheries on Marine Fish Populations. Science Vol 305:1958-1960.

Cooper, W.S. 1967. Coastal dunes of California. The Geological Society of America, Inc. Boulder, Colorado.

Davis FW, Stoms DM, Hollander AD, Thomas KA, Stine PA, Odion D, Borchert MI, Thorne JH, Gray MV, Walker RE, Warner K and Graae J. 1998. The California Gap Analysis Project – Final Report. University of California, Santa Barbara, CA. (http://www.biogeog.ucsb.edu/projects/gap/gap_rep.html)

Dayton, P.K., S. Thrush, and F.C. Coleman. 2002. Ecological effects of fishing in marine ecosystems of the United States. Pew Oceans Commission, Arlington, Virginia.

De Forges, B.R., J.A. Koslow, G.C. Poore. 2000. Diversity and endemism of the benthic seamount fauna in the southwest Pacific. Nature, Vol. 405: 944-947.

Donlan, C.J., B.R. Tershy, B.S.Keitt, B.Wood, J.A. Sanchez, A. Weinstein, D. A Croll, M.A. Hermosillo, J.L. Aguilar. 1999. Pages 330-338 in, *Proc. of the 5th California Islands Symposium*. D. Browne, H. Haney, and K. Mitchell (eds). U.S. Minerals Management Service and Santa Barbara Natural History Museum.

Drazen, J.C. and S.K. Goffredi, B. Schlining, D.S. Stakes. 2003. Aggregations of egg-brooding deep-sea fish and cephalopods on the Gorda Escarpment: a reproductive hotspot. Biological Bulletin 205:1-7.

Dugan, Jenifer. 2004. Ecological impacts of beach grooming on exposed sandy beaches. Coastal Ocean Research, a publication of Sea Grant California (R/CZ-174:3.1.2001-2.29.2004).

Engel J and R Kvitek. 1998. Effects of Otter Trawling on a Benthic Community in Monterey Bay National Marine Sanctuary. Conservation Biology. Volume 12: 1204-1214.

Etnoyer, P. and L. Morgan, 2003. Occurrences of habitat-forming deep sea corals in the Northeast Pacific Ocean: a report to NOAA's Office of Habitat Conservation. Marine Conservation Biology Institute. December.

Forney, K.A. 2000. Environmental models of cetacean abundance: reducing uncertainty in population trends. Conservation Biology 14:1271-1286.

Genin, A. , P.K. Dayton, P.F. Lonsdale, and F. N. Spiess. 1986. Corals on seamount peaks provide evidence of current acceleration over deep-sea topography. Nature, Vol. 322:59-61.

Gleason, M.G., M. S. Merrifield, C.Cook, A.L. Davenport, and R. Shaw, in press. Assessing gaps in marine conservation in California. Conditionally accepted by Frontiers in Ecology and Environment.

Goals Project. 2000. Baylands ecosystem species and community profiles: Life histories and environmental requirements of key plants, fish and wildlife. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. P.R. Olofson, editor. San Francisco Bay Regional Water Quality Control Board, Oakland, California.

Grabowski, JH 2004. Habitat complexity disrupts predator-prey interactions yet preserves the trophic cascade in oyster-reef communities. Ecology 85:995-1004.

Greene, H.G, R. Kvitek, J.J Bizzarro, C. Bretz, and P. Iampietro. 2004. Fisheries Habitat Characterization of the California Continental Margin. Center for Habitat Studies, Moss Landing Marine Laboratory and Seafloor Mapping Lab, California State University Monterey Bay. GIS Spatial Data.

Greene, H.G., M.M. Yoklavich, R.M. Starr, V.M. O´Connell, W.W. Wakefield, D.E. Sullivan, J.E. McRea Jr., and G.M. Cailliet. 1999. A classification scheme for deep seafloor habitats. Oceanologica Acta. Vol 22: 6. pp. 663-678.

Groves C.R. 2003. *Drafting a conservation blueprint: A practitioner's guide to planning for biodiversity.* The Nature Conservancy. Island Press, Washington, D.C.

Groves, C.R., D.B. Jensen, L.L Valutis, K.H. Redford, M.L. Shaffer, J.M Scott, J.V. Baumgartner, J.V. Higgins, M.W. Beck, and M.G. Anderson. 2002. Planning for biodiversity conservation: putting conservation science into practice. BioScience 52:499-512.

Groves, C., L.Valutis, D. Vosick, B. Neely, K. Wheaton, J. Touval, and B. Runnels. 2000. *Designing a Geography of Hope: A Practitioner's Handbook for Ecoregional Conservation Planning.* The Nature Conservancy. Second edition, April 2000.

Guerrero, J. and R. Kvitek, eds., 1996. Monterey Bay National Marine Sanctuary Site Characterization Report. NOAA and Moss Landing Marine Laboratories (http://bonita.mbnms.nos.noaa.gov/sitechar)

Humboldt Bay GIS Atlas. (http://www.humboldtbay.org/gis).

Hyrenbach, K.D., K.A. Forney, and P.K. Dayton. 2000. Marine protected areas and ocean basin management. Aquatic Conservation: Marine and Freshwater Ecosystems. Vol. 10: 437-458.

Iampietro, P. and R. Kvitek. 2002. Quantitative Seafloor Habitat Classification Using GIS Terrain Analysis: Effects of Data Density, Resolution, and Scale. California State University Monterey Bay, ESSP Seafloor Mapping Lab, http://seafloor.csumb.edu/publications/posters/tpi.pdf

Jackson, J.B.C., M.X. Kirby, W. H. Berger, K. A. Bjorndal, L.W Botsford, B.J. Bourque, R. H. Bradbury, R. Cooke, J. Erlandson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J.M. Pandolfi, C.H. Peterson, R.S. Steneck, M.J. Tegner, and R.R. Warner. 2001. Historical overfishing and the recent collapse of coastal ecosystems. Science, Vol. 293:629-638.

Jennings MD. 2000. Gap analysis: Concepts, methods, and recent results. Landscape Ecol 15:5-20.

Kinlan, B.P. and S.D. Gaines (2003). Propagule dispersal in marine and terrestrial environments: a community perspective. Ecology Vol. 84: 2007-2020

Leslie, H., M Ruckelshaus, I.R. Ball, S. Andelman, and H.P.Possingham. 2003. Using siting algorithms in the design of marine reserve networks. Ecological Applications, Vol. 13:185-198.

Lowry, M.S. 2002. Counts of Northern Elephant Seals at Rookeries in the Southern California Bight: 1981-2001. NOAA Technical Memorandum. NOAA-TM-NMFS-SWFSC-345.

Lowry, M.S. and J.V. Carretta, 2003. Pacific Harbor Seal, *Phoca vitulina richardii*, Census in California during May-July 2002. NOAA Technical Memorandum, NMFS, NOAA-TM-NMFS-SWFSC-353. September.

Low, G. 2003. Landscape-scale conservation: A practitioner's guide. The Nature Conservancy. July, 2003. (available at www.conserveonline.org)

Marine Conservation Biology Institute (MCBI). 2003. Information for Conservation Planning – Baja California to the Bering Sea. CD, v.1.1

Marine Life Protection Act (MLPA) 2005. Central Coast Regional Profile. http://www.dfg.ca.gov/mrd/mlpa

Mills, K.L. and W.J. Sydeman (eds.). 2003. The California Current Marine Bird Conservation Plan, v. 1, PRBO Conservation Science, Stinson Beach, California

Monterey Bay National Marine Sanctuary (MBNMS) 2003. A comparative intertidal study and user survey, Point Pinos, California. Prepared by Tenera Environmental.

Morgan, L., S. Maxwell, F. Tsao, T.A.C Wilkinson, and P. Etnoyer. 2005. Marine Priority Conservation Areas: Baja California to the Bering Sea. Commission for Environmental Cooperation of North America and the Marine Conservation Biology Institute.

Myers, R.A. and B. Worm. 2003. Rapid worldwide depletion of predatory fish communities. Nature. Volume 423:280-283.

National Gap Analysis Program. 1994 . A handbook for gap analysis. Mosco, Idaho. (see also http://www.gap.uidaho.edu. Viewed April 2005).

National Imagery and Mapping Agency (NIMA), Digital Nautical Charts, http://earthinfo.nima.mil/dncpublic/index.htm

National Oceanic and Atmospheric Administration (NOAA), Coast Watch sea surface temperature data http://coastwatch.noaa.gov/cw_dataprod_sst.html and http://cwatchwc.ucsd.edu/data.html

NOAA 2004. *A Biogeographic Assessment of North/Central California*. To support the Joint Managmenet Plan Review for Cordell Bank, Gulf of Farallones, and Monterey Bay National Marine Sanctuaries. http://biogeo.nos.noaa.gov/products/canms_cd/htm

National Oceanic and Atmospheric Administration - Environmental Sensitivity Index, (NOAA-ESI) 2002. National Ocean Service Office of Response and Restoration Hazardous Materials Response Division and the State of California Department of Fish and Game Office of Spill Prevention and Response

NOAA 2001. Endangered and Threatened Species: Reopening Comment Period and Notice of Public Hearing on Proposed Range Extension for Endangered Steelhead in Southern California. (Federal Register, Volume 66, No. 35, February 21, 2001. 50 CFR Part 224.)

NOAA 2000. Chart No. 1: U.S.A. Nautical Chart Symbols Abbreviations and Terms. Eleventh Edition, November 2000. Lighthouse Press, Annapolis, Maryland

NOAA 1998. Coastal Change Analysis Program (CCAP). GIS Spatial Data.

NOAA 1997. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California, NOAA Technical Memorandum NMFS-NWFSC-27

National Research Council (NRC) 2002. *Effects of Trawling and Dredging on Seafloor Habitat*. Academic Press, Washington D.C., 125p.

Noble, M.A. 1998. Current patterns over the continental shelf and slope. USGS Circular 1198: 67-89. (http://geopubs.wr.usgs.gov/circular/c1198/chapters/067-089)

Pelagic Working Group. 2002. Pelagic Predators, Prey, and Processes: Exploring the Scientific Basis for Off-shore Marine Reserves. Proceedings of the First Pelagic Working Group Workshop. January 17, 2002. Santa Cruz, CA.

Pew Oceans Commission. 2003. America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation, Recommendations for a New Ocean Policy.

Pikitch, E.K., C. Santora, E.A. Babcock, A. Bakun, R. Bonfil, D.O. Conover, P. Dayton, P. Doukakis, D.Fluharty, B. Heneman, E.D. Houde, J.Link, P.A. Livingston, M. Mangel, M.K. McAllister, J. Pope, and K.J.Sainsbury. 2004. Ecosystem-based Fishery Management. Science 305:346-347.

Possingham, H. P., I.R. Ball, and S. Andelman. 2000. Mathematical methods for identifying representative reserve networks. Pages 291-306 in Quantitative methods for conservation biology. Ferson, S. and M. Burgman, (eds). Springer-Verlag, New York.

Sala, E., O. Aburto-Oropeza, G. Paredes, I. Parra, J.C. Barrera, P.K. Dayton. 2002. A general model for designing networks of marine reserves. Science, Vol. 298:1991-1993.

San Francisco Estuary Institute. 1998. The San Francisco Bay Area EcoAtlas. http://www.sfei.org/ecoatlas/

Save the Redwoods League and Bureau of Land Management (SRL & BLM) 2001. North Coastal California Stewardship Report. November.

Schroeder, D. and M. Love. 2002. Recreation fishing and marine fish populations in California. CalCOFI Report, Volume 43.

Sowls, A.L., A.R. DeGrange, J.W Nelson, and G.S. Lester. 1980. Catalog of California seabird colonies. FWS/OBS-80/37. U.S. Fish and Wildlife Service, Washington, D.C.

Steneck, R.S. and J.T. Carlton. 2001. Human alteration of marine communities. In, *Marine Community Ecology*, M. Bertness, S. Gaines, and M. Hay, eds. Sinauer Press, Sunderland, Massachusetts.

Stewart, R.R., T.Noyce, and H.P. Possingham. 2003. Opportunity cost of ad hoc marine reserve design decisions: an example from South Australia. Marine Ecology Progress Series Vol. 253:25-38.

Tegner, M.J. , P.K Dayton, P.B. Edwards, and K.L. Riser. 1997. Large-scale, low frequency oceanographic effects on kelp forest succession: a tale of two cohorts. Marine Ecology Progress Series Vol 146:117-134.

Tegner, M.J. and P.K.Dayton. 2000. Ecosystem effects of fishing in kelp forest communities. ICES Journal of Marine Science. Vol 57:579-589.

The Nature Conservancy (TNC) 2006. Draft Central Coast Ecoregional Assessment Update. February 2006.

TNC 2004. Southern California Marine Ecoregional Assessment. February 28, 2004

TNC 2001. California North Coast Ecoregional Plan. June 2001.

Titus, R. G., D. C. Erman, and M. W. Snider (draft manuscript). History and status of steelhead in California coastal drainages south of San Francisco Bay. California Department of Fish and Game. Sacramento.

Thrush, S. and P. Dayton. 2002. Disturbance to marine benthic habitats by trawling and dredging: implications for marine biodiversity. Annual Review of Ecology and Systematics, Vol. 33: 449-473.

U.S. Commission on Ocean Policy (USCOP) 2004. *An ocean blueprint for the 21st century*. September 20, 2004.

U.S. Department of Interior, Mineral Manegement Service, MMS, Pacific Outer Continental Shelf Region, http://www.mms.gov/omm/pacific/index.htm

U.S. Fish and Wildlife Service (USFWS) 2004. Draft Recovery Plan for the Tidewater Goby (*Eucyclogobius newberryi*). Pacific Region, U.S. Fish and Wildlife Service, Portland, Oregon. October.

USFWS 1995. Sacramento-San Joaquin Delta Native Fishes Recovery Plan. USFWS, Portland, Oregon.

USFWS 1992. National Wetlands Inventory. GIS spatial data.

USFWS and U.S. Army Corps of Engineers: Waterways Experiment Station, 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Northwest): Olympia Oyster. Biological Report 82 (11.124). December.

U.S. GLOBEC Report No. 11. 1994. A Science Plan for the California Current.

Watling, L. and E.A. Norse. 1998. Disturbance of the Seabed by Mobile Fishing Gear: A comparison to Forest Clearcutting. Conservation Biology 12:1180-1197.

Weiss, A. 2003 (in prep). Topographic Position Index (TPI) and Landforms Classification.

Williams, E.H. and S.Ralston. 2002. Distribution and co-occurrence of rockfishes (family: Sebastidae) over trawlable shelf and slope habitats of California and southern Oregon. Fisheries Bulletin 100:836-855.

Wolf, S.G. 2002. The relative status and conservation of island breeding seabirds in California and Northwest Mexico. M.S. Thesis, U.C. Santa Cruz. 80pp.

Yen, P.P.W, W. J. Sydeman, and K.D. Hyrenbach, 2004. Marine bird and cetacean associations with bathymetric habitats and shallow-water topographies: implications for trophic transfer and conservation. J. of Marine Systems 50: 79-99.

Yoshiyama, R. M., F.W. Fisher, P.B. Moyle. 1998. Historical abundance and decline of chinook salmon in the Central Valley Region of California. North American Journal of Fisheries Management 18: 487-521.

LIST OF FIGURES

FIGURE 1

WEST COAST MARINE ECOREGIONS

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

FIGURE 2

NORTHERN CALIFORNIA MARINE ECOREGION

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

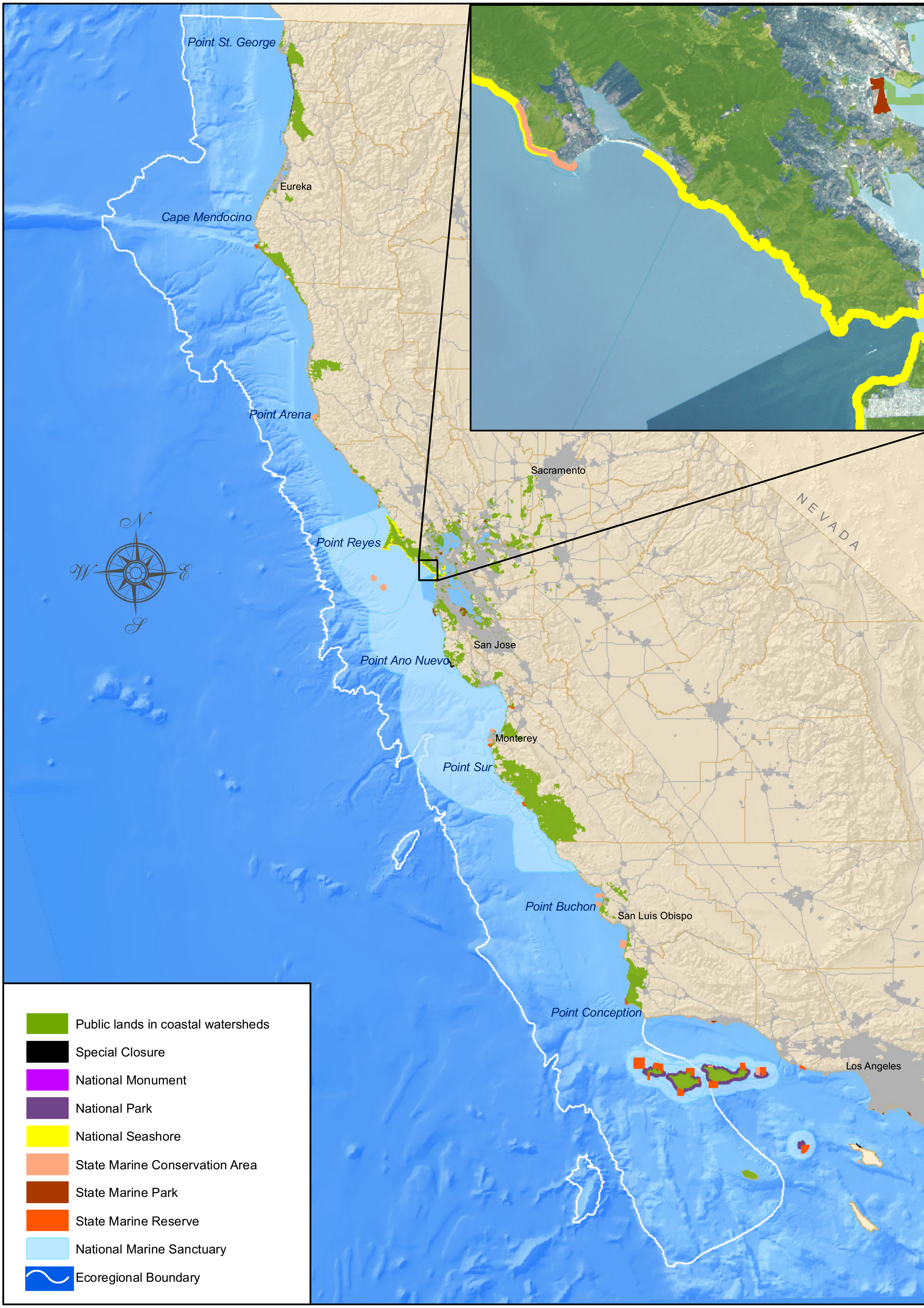


FIGURE 3

NORTHERN CALIFORNIA MARINE ECOREGION
MARINE PROTECTED AREAS AND PUBLIC LANDS

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

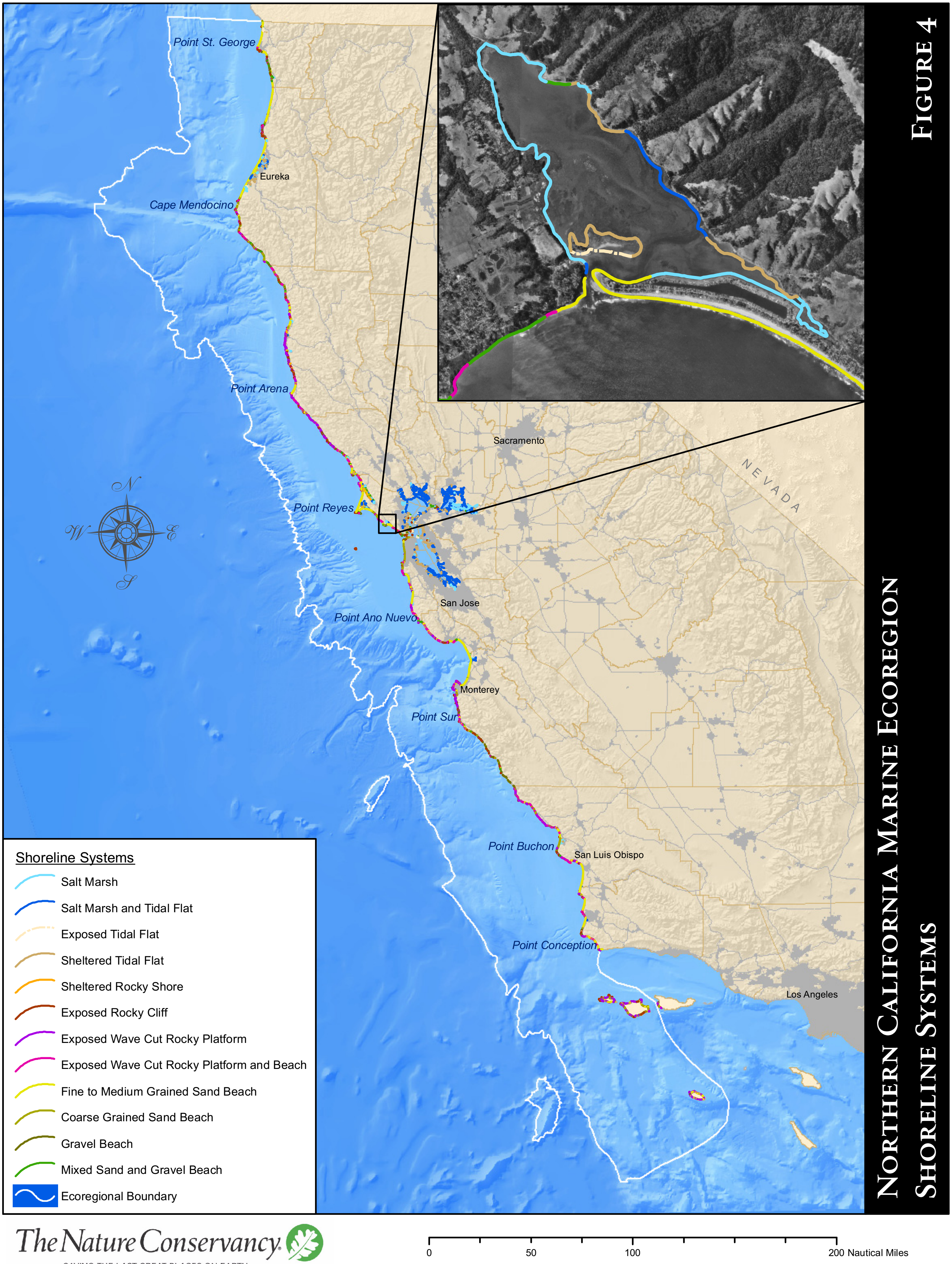


FIGURE 4

NORTHERN CALIFORNIA MARINE ECOREGION
SHORELINE SYSTEMS

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

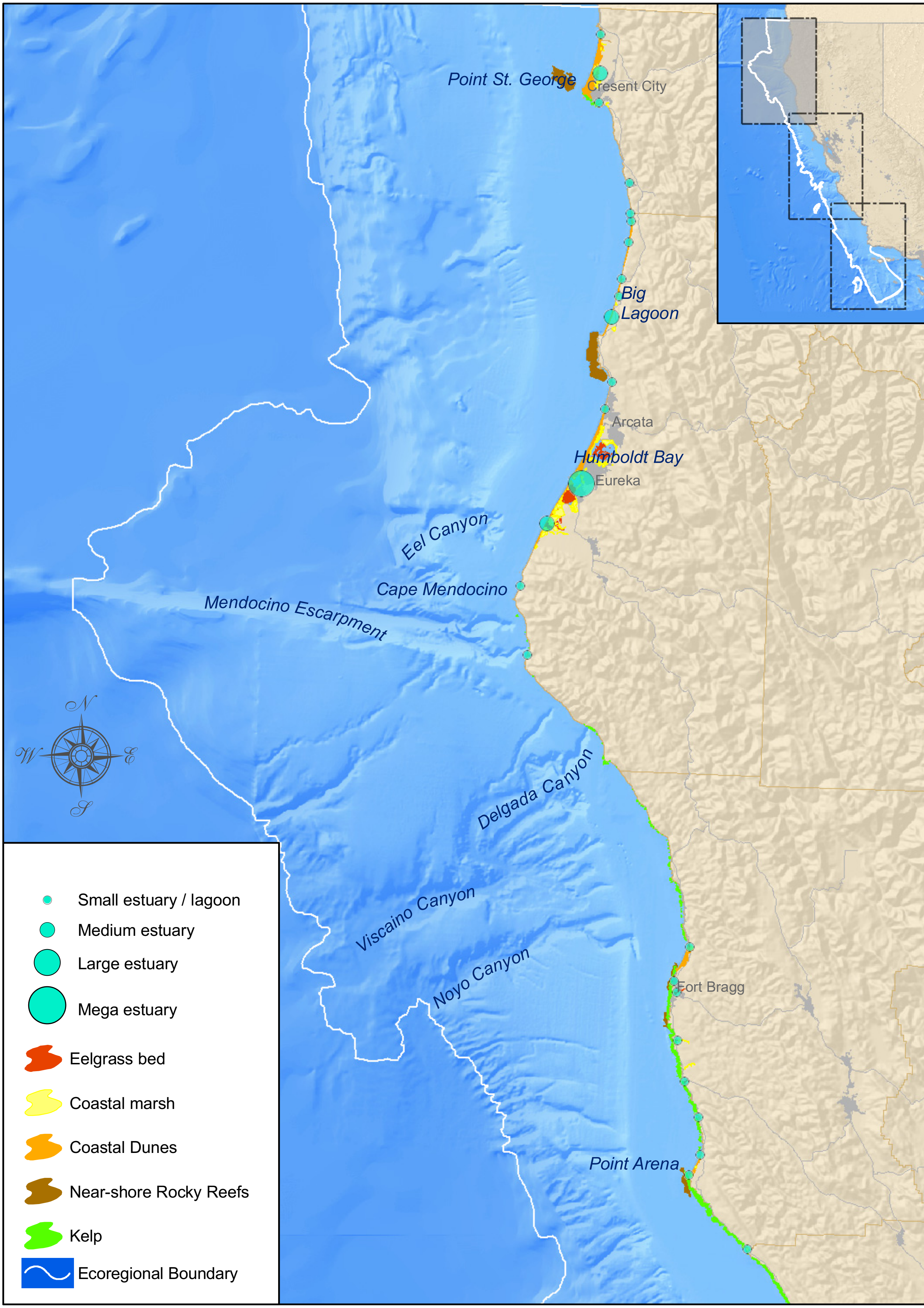


FIGURE 5A

NORTHERN CALIFORNIA MARINE ECOREGION
ECOSYSTEMS AND COMMUNITIES

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

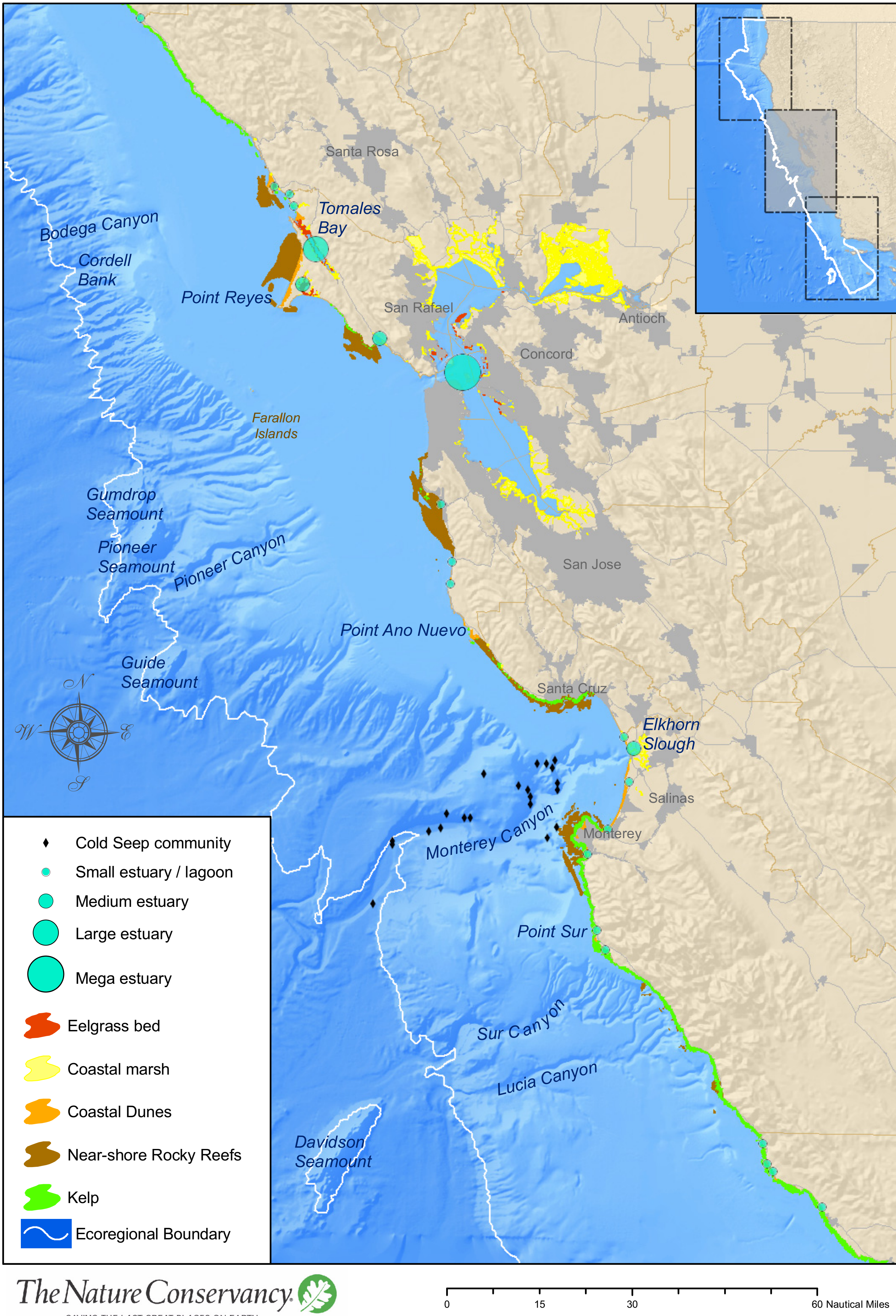


FIGURE 5B

NORTHERN CALIFORNIA MARINE ECOREGION
ECOSYSTEMS AND COMMUNITIES

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

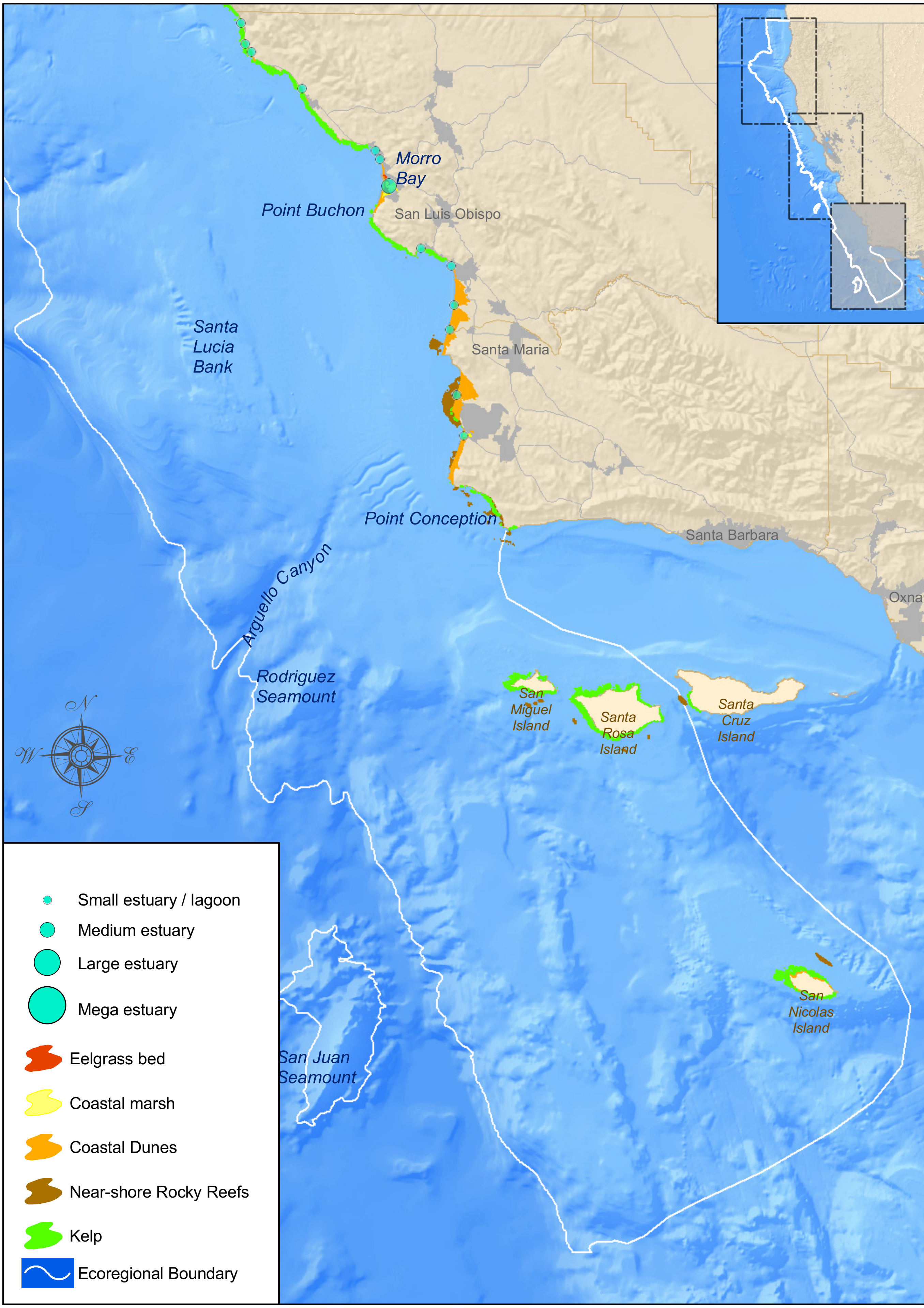


Figure 5C

Northern California Marine Ecoregion Ecosystems and Communities

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

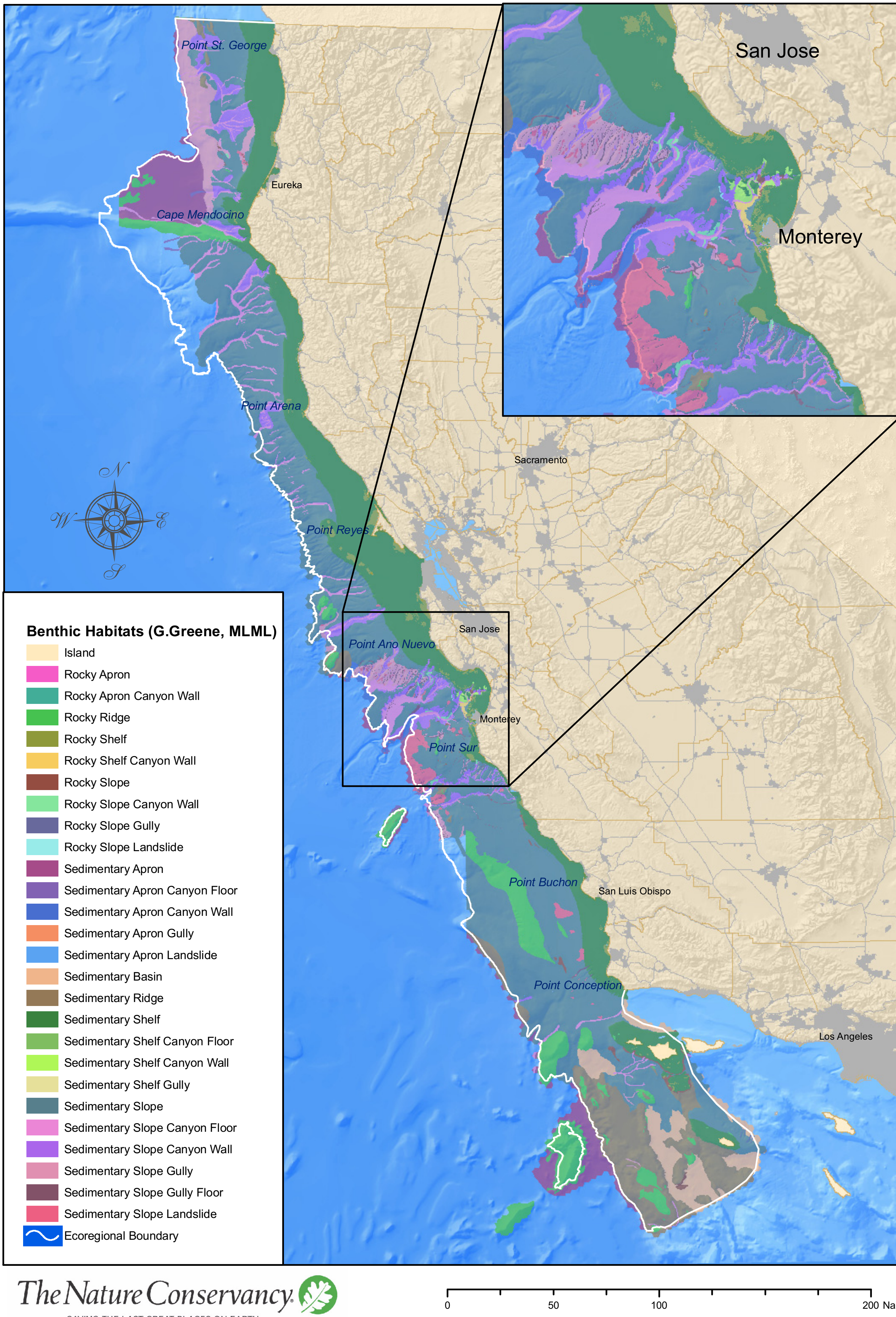


FIGURE 6

NORTHERN CALIFORNIA MARINE ECOREGION
BENTHIC HABITATS: GREENE CLASSIFICATION

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

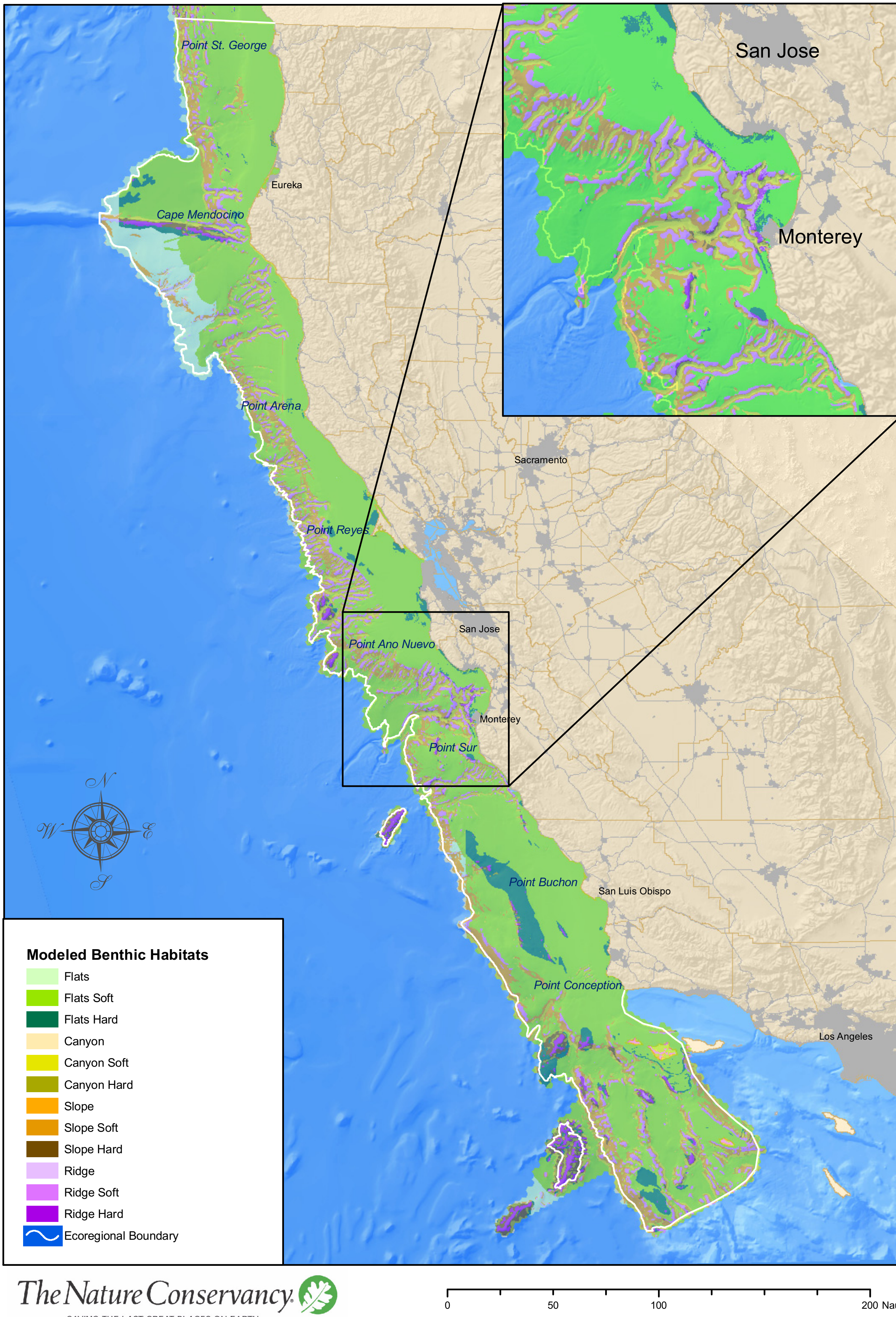


FIGURE 7

NORTHERN CALIFORNIA MARINE ECOREGION
BENTHIC HABITATS: TNC HABITAT MODEL

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

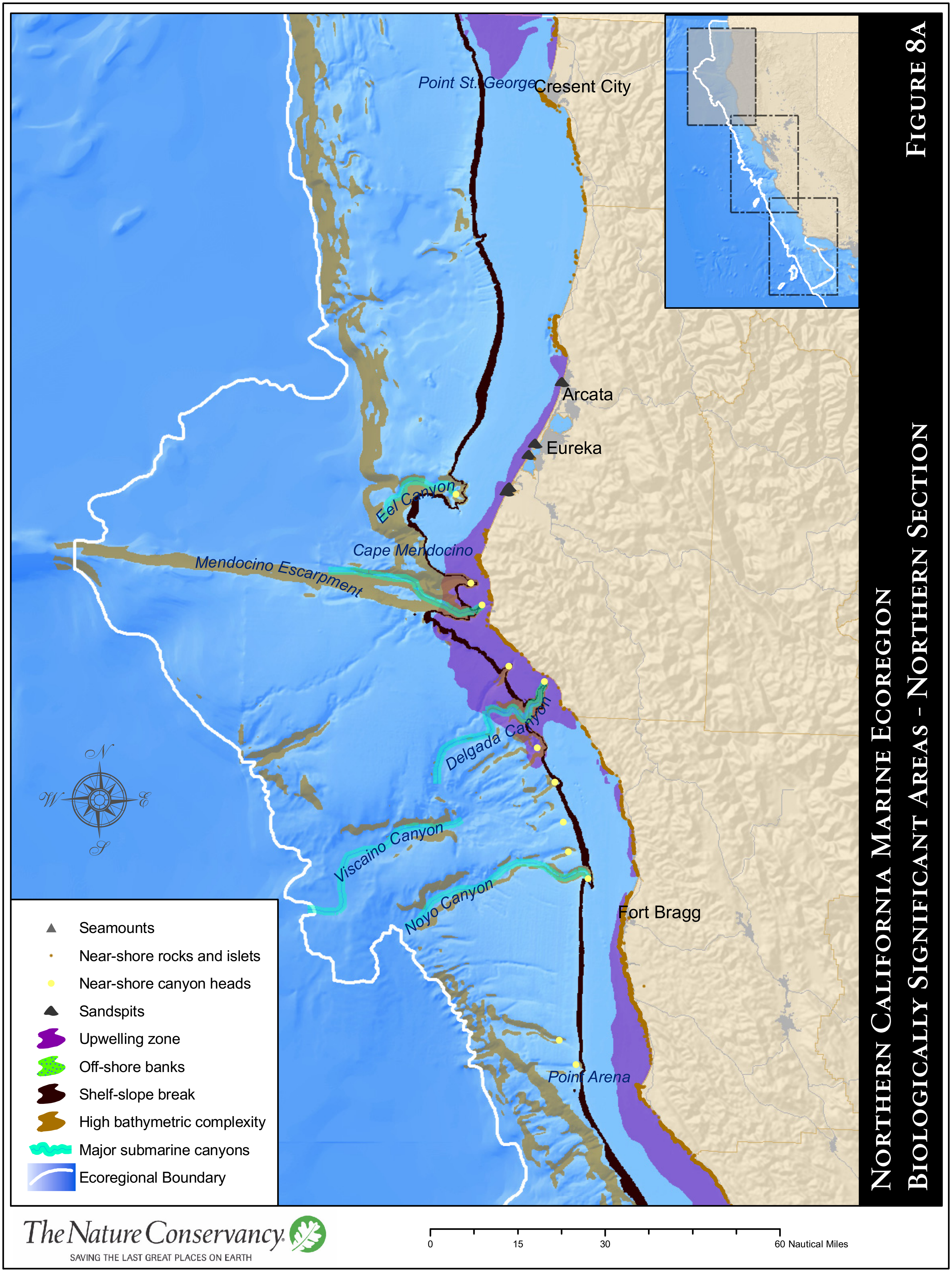


Figure 8A
Northern California Marine Ecoregion
Biologically Significant Areas - Northern Section
Point St. George
Cresent City
Arcata
Eureka
Eel Canyon
Cape Mendocino
Mendocino Escarpment
Delgada Canyon
Viscaino Canyon
Noyo Canyon
Fort Bragg
Point Arena
Seamounts
Near-shore rocks and islets
Near-shore canyon heads
Sandspits
Upwelling zone
Off-shore banks
Shelf-slope break
High bathymetric complexity
Major submarine canyons
Ecoregional Boundary
N
W
E
S
0
15
30
60 Nautical Miles
The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

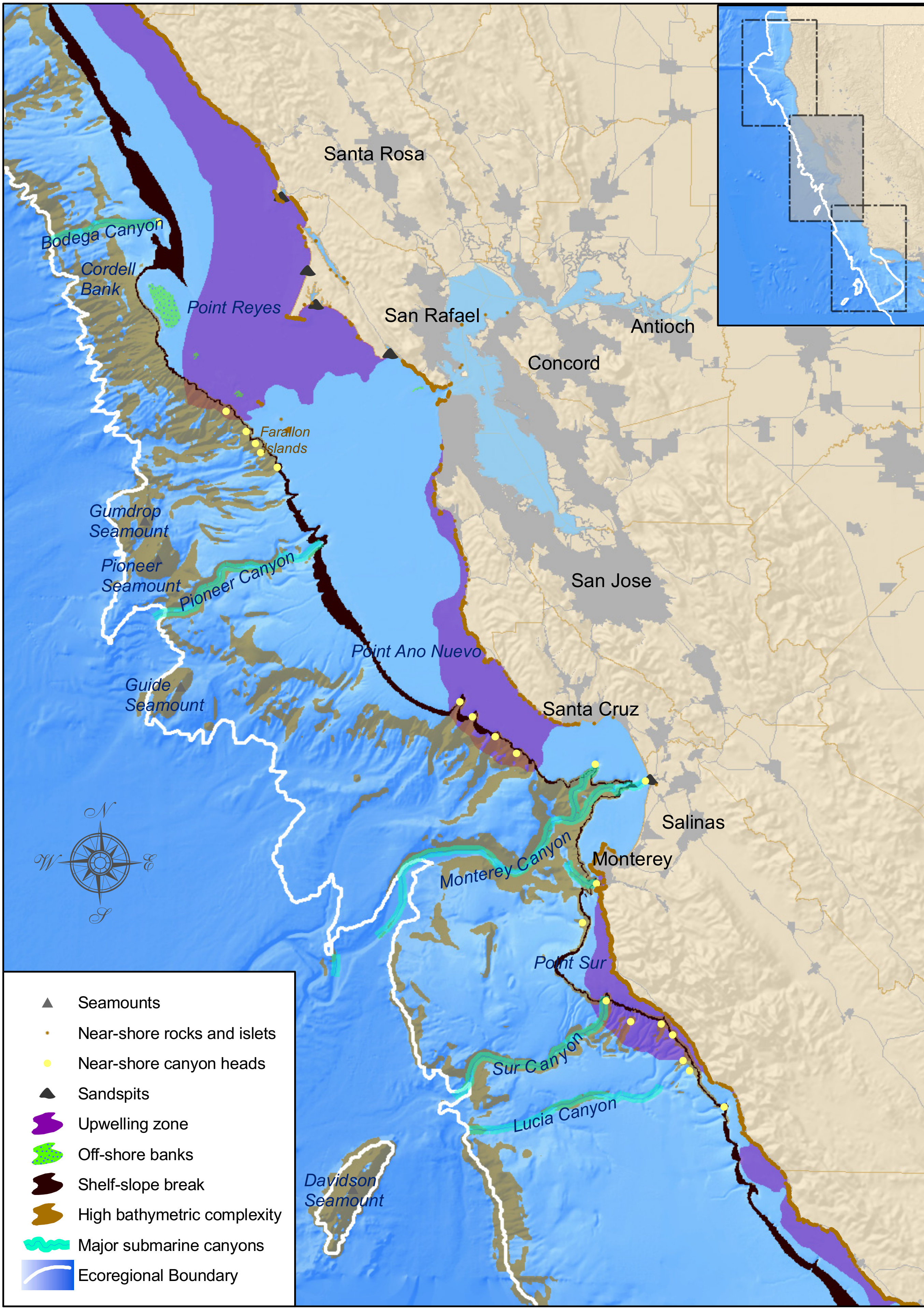


Figure 8b

Northern California Marine Ecoregion
Biologically Significant Areas - Central Section

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

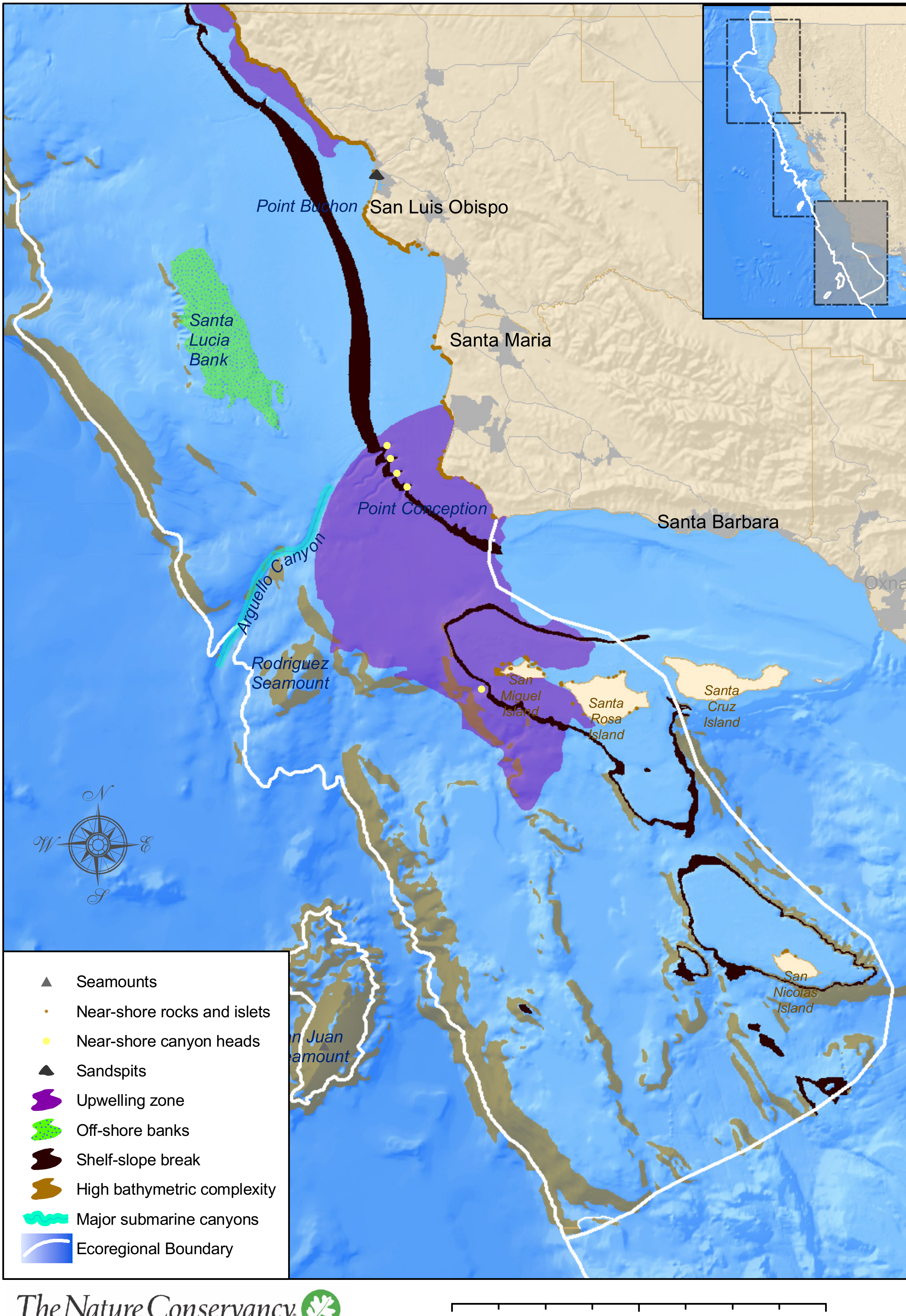


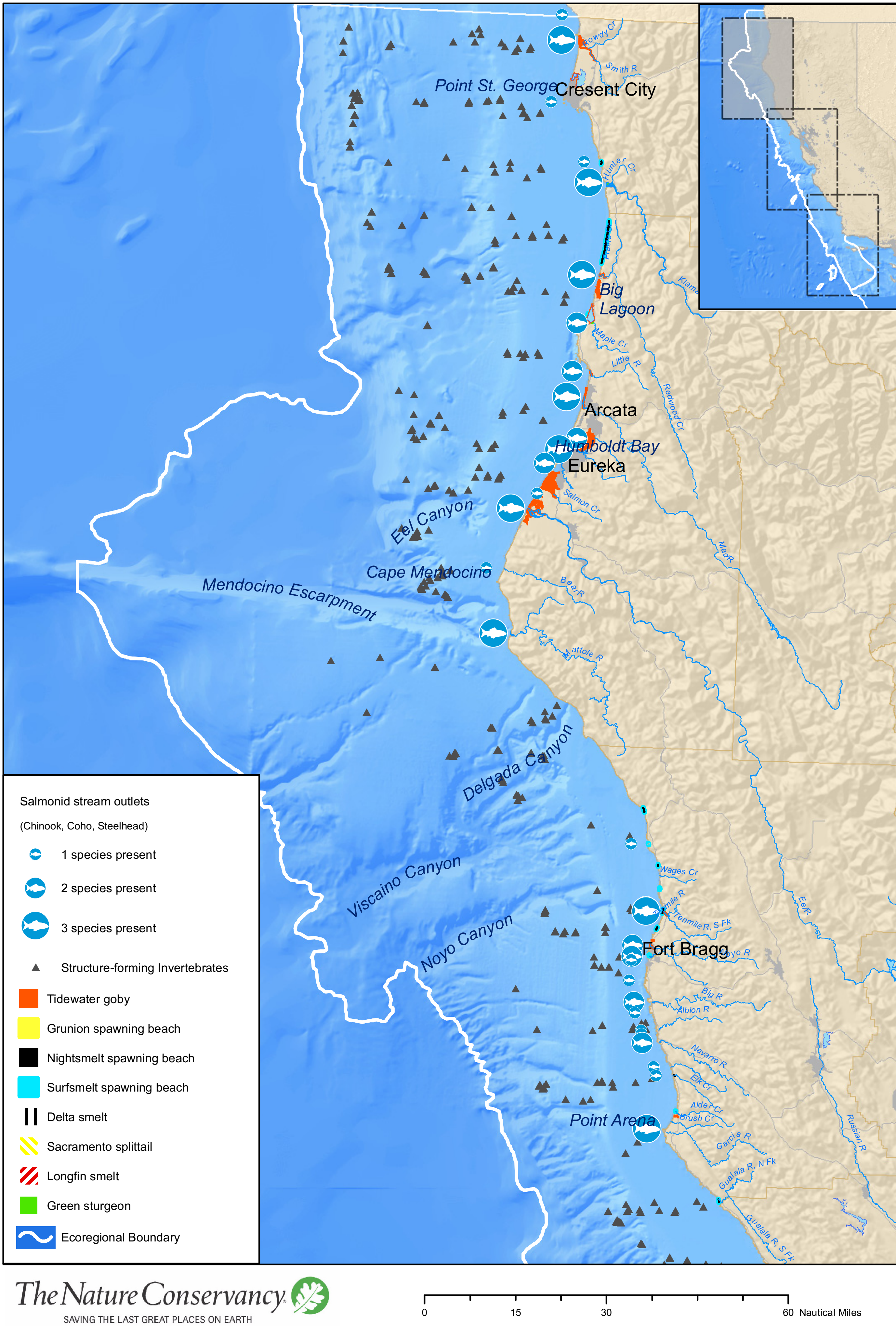
FIGURE 8C

NORTHERN CALIFORNIA MARINE ECOREGION
BIOLOGICALLY SIGNIFICANT AREAS - SOUTHERN SECTION

Figure 9A

Northern California Marine Ecoregion

Species Occurrences: Invertebrates and Fish - Northern Section



The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

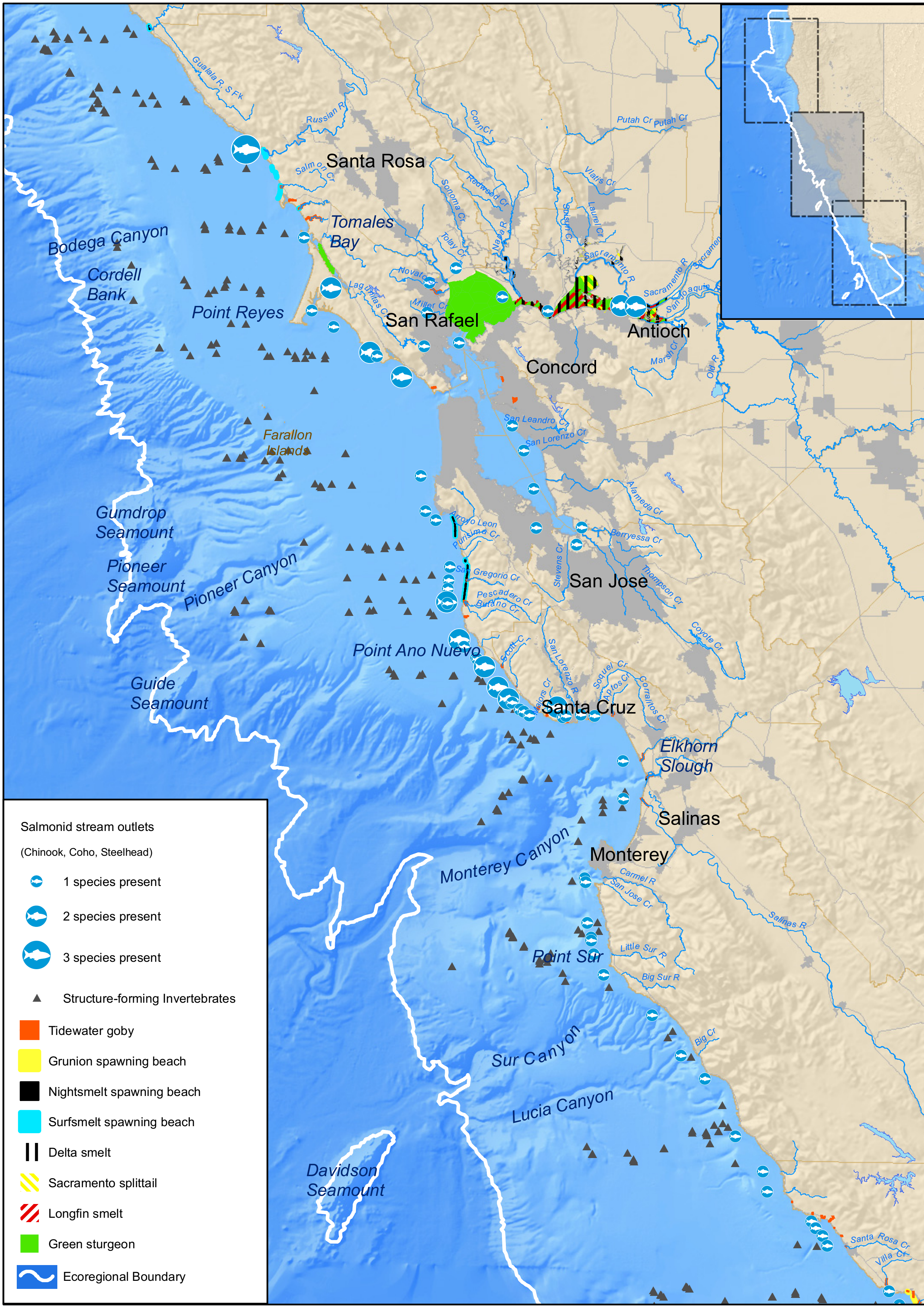
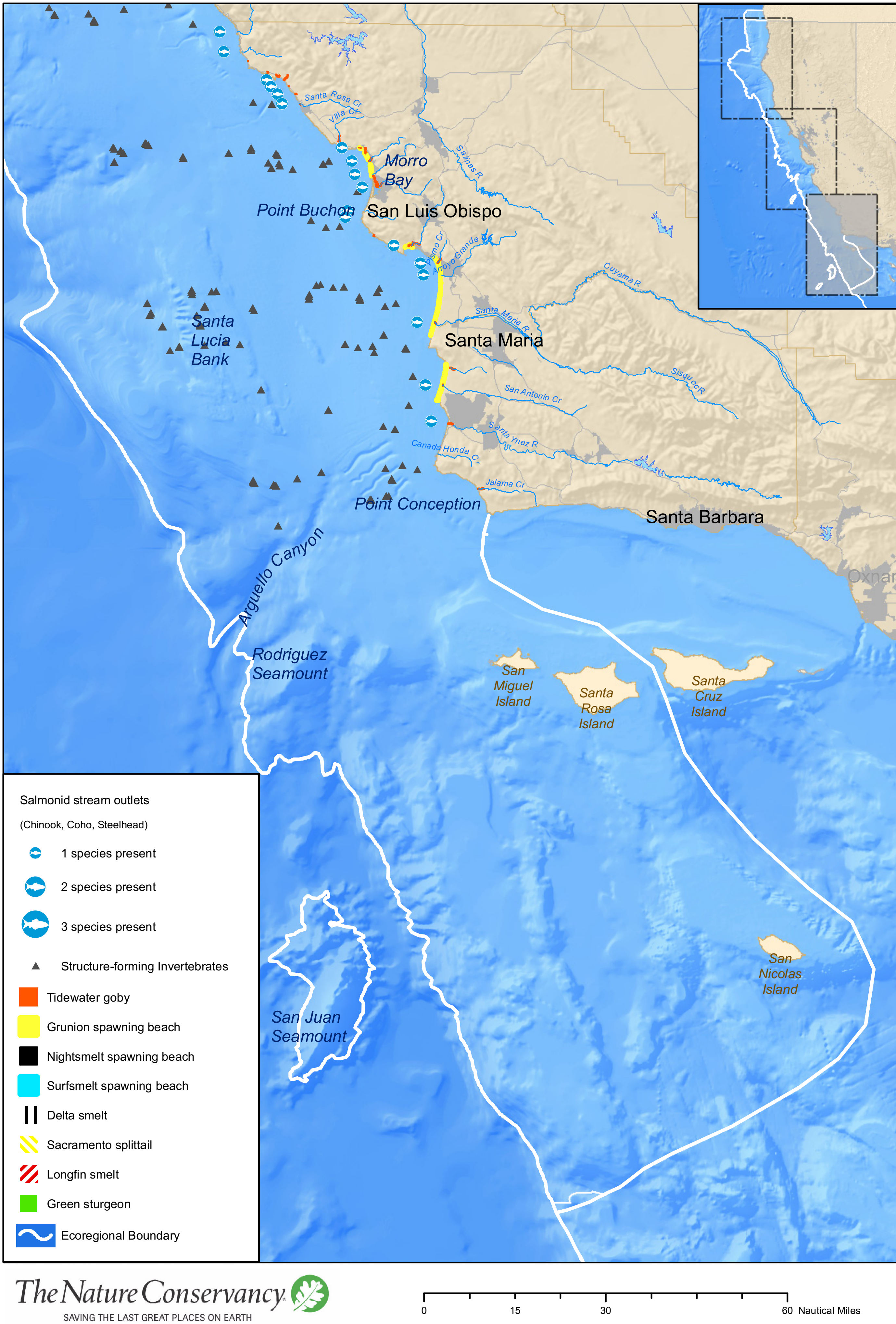


Figure 9B

Northern California Marine Ecoregion
Species Occurrences: Invertebrates and Fish - Central Section

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH



Northern California Marine Ecoregion
Species Occurrences: Invertebrates and Fish - Southern Section
Figure 9C

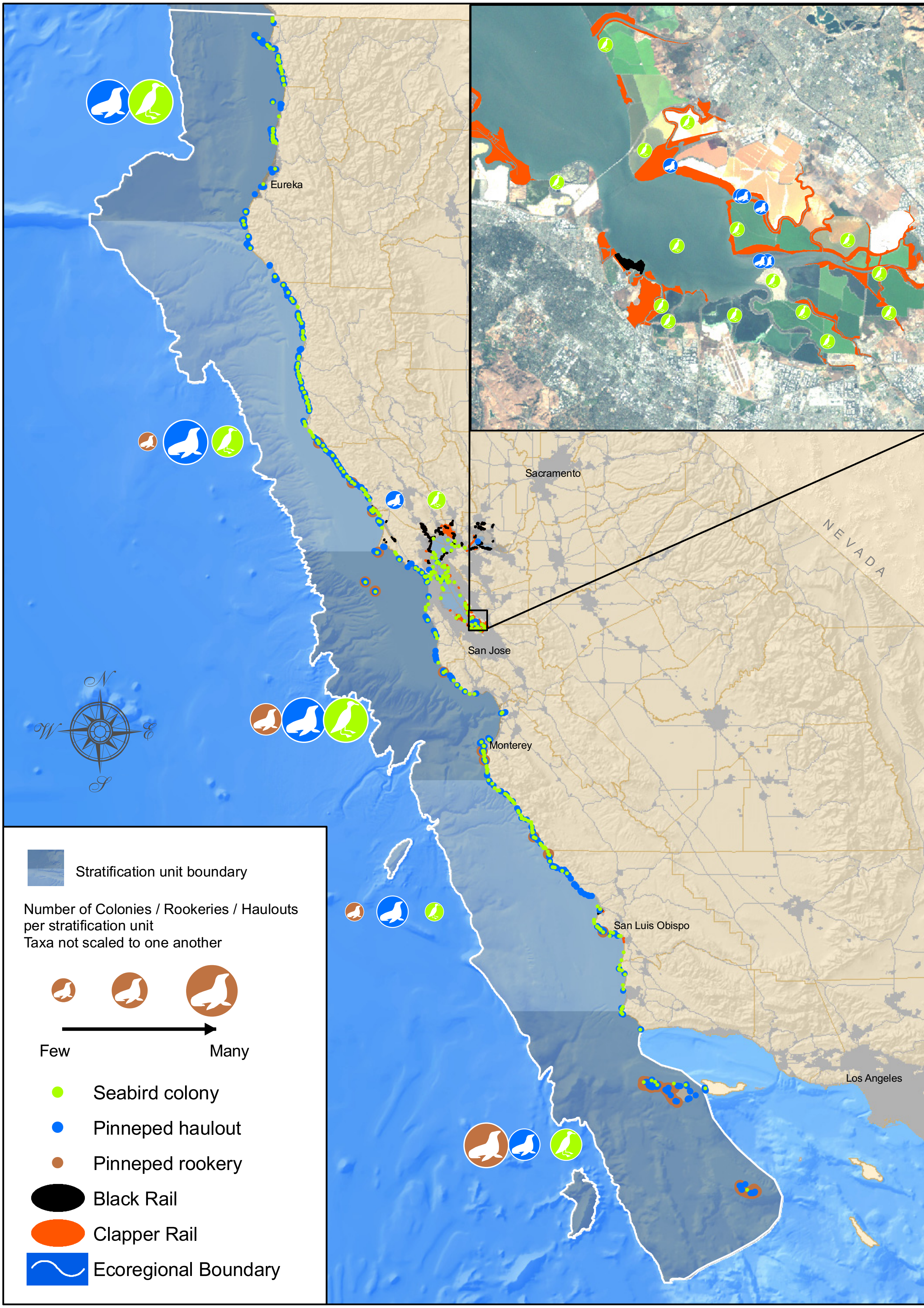


FIGURE 9D

NORTHERN CALIFORNIA MARINE ECOREGION
SPECIES OCCURRENCES: BIRDS AND MAMMALS

0 50 100 200 Nautical Miles

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

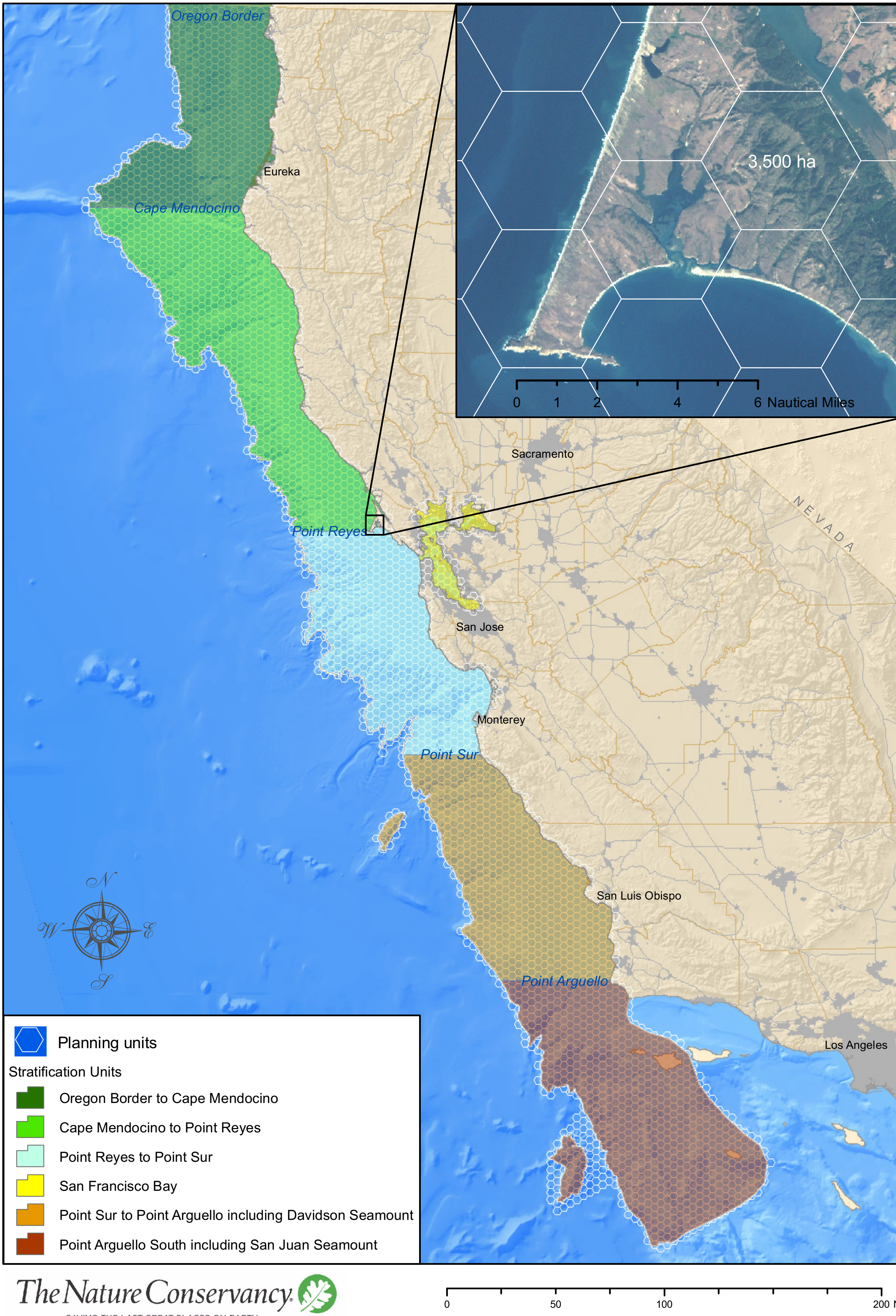


FIGURE 10

NORTHERN CALIFORNIA MARINE ECOREGION
STRATIFICATION AND PLANNING UNITS

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

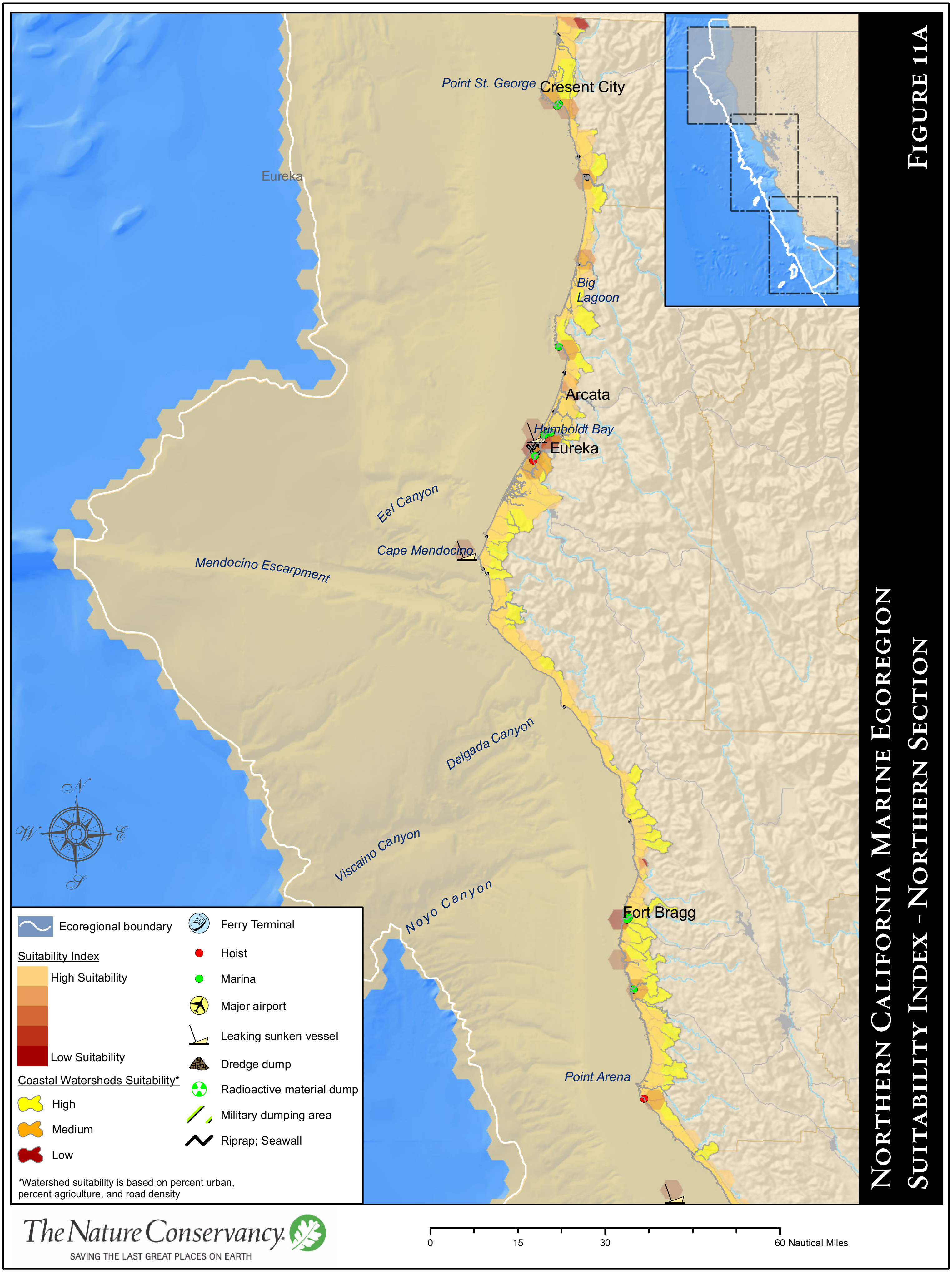
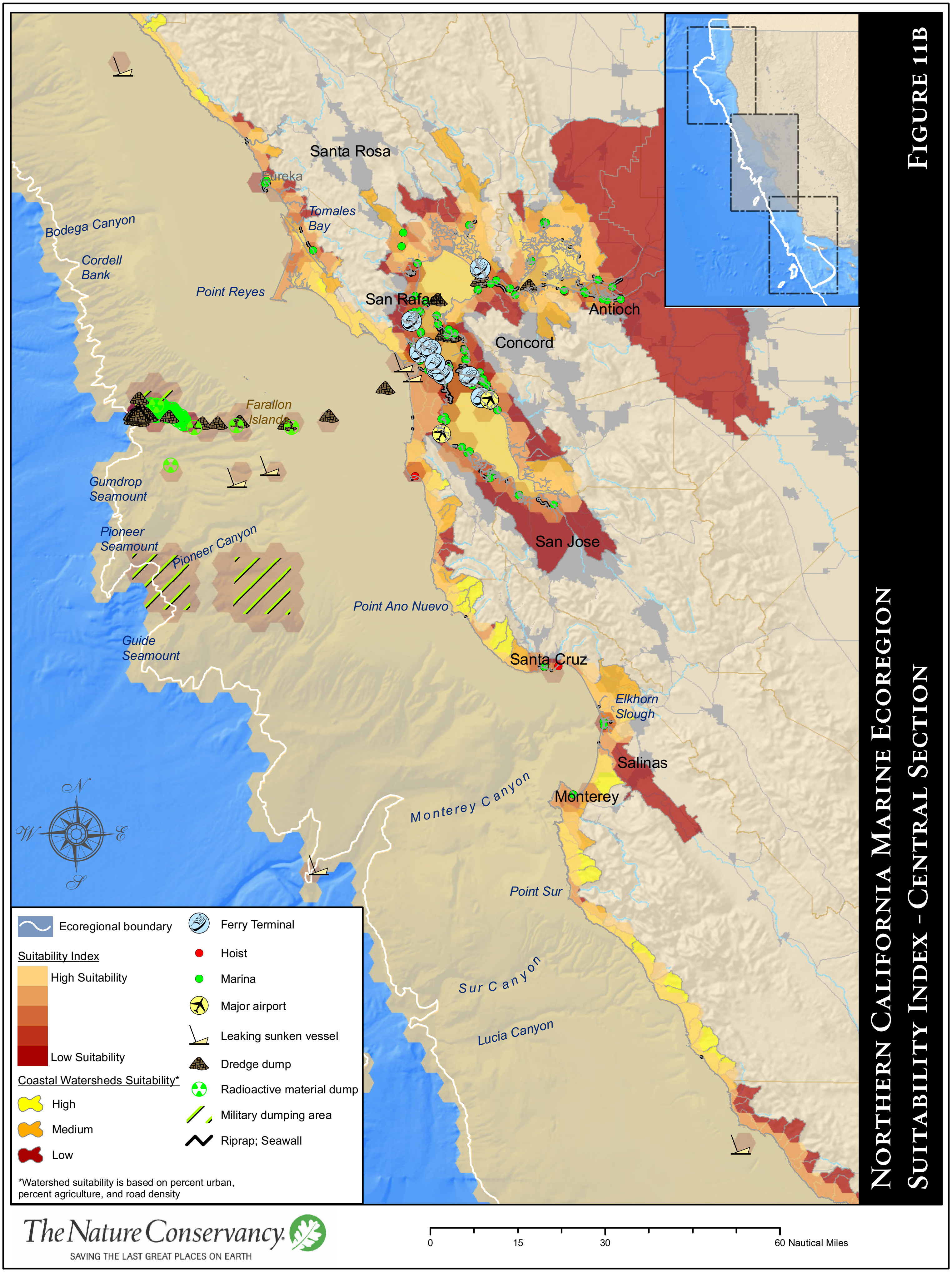


Figure 11A

Northern California Marine Ecoregion Suitability Index - Northern Section

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH



The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

FIGURE 11C

NORTHERN CALIFORNIA MARINE ECOREGION
SUITABILITY INDEX - SOUTHERN SECTION

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

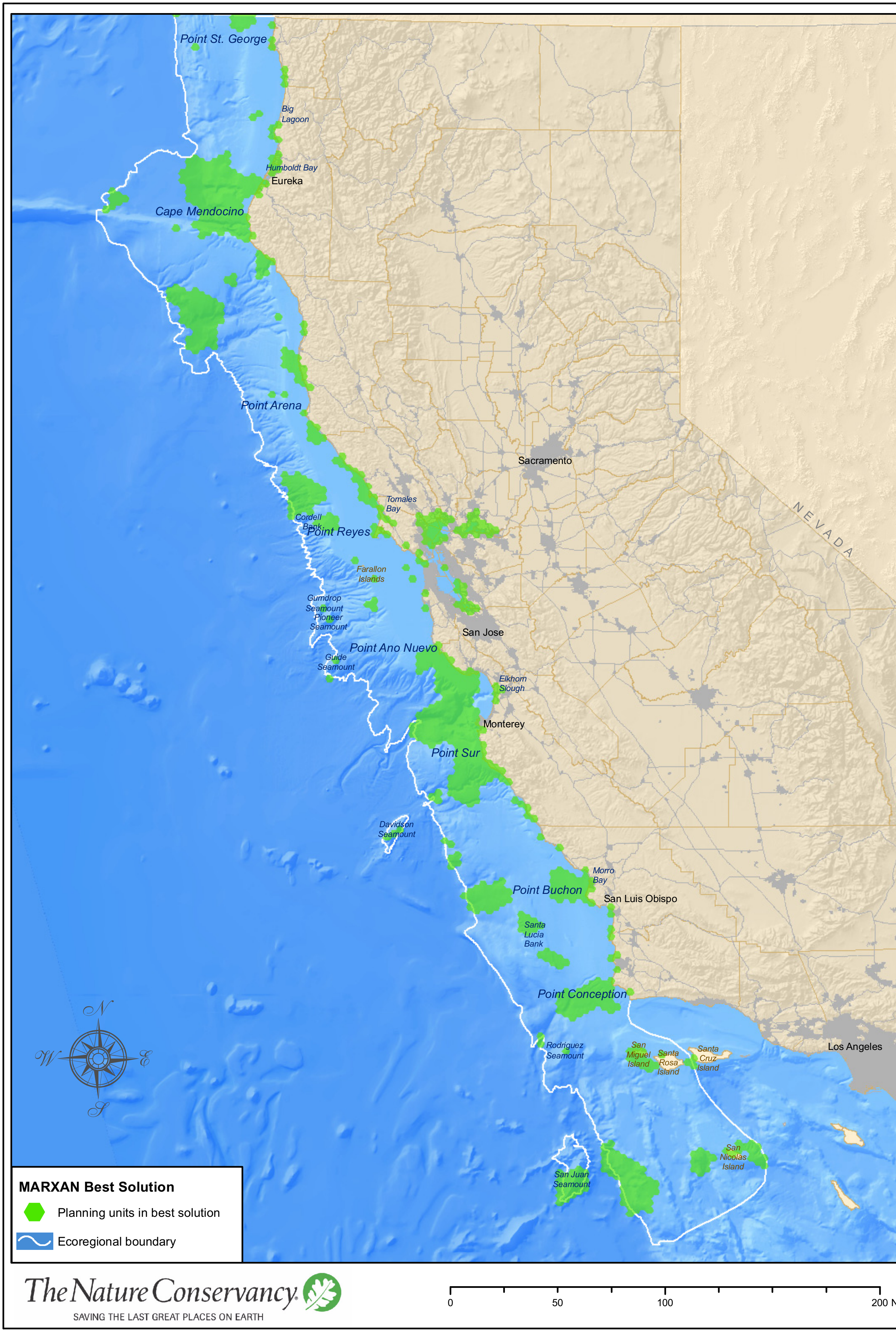


Figure 12

Northern California Marine Ecoregion MARXAN Best Solution

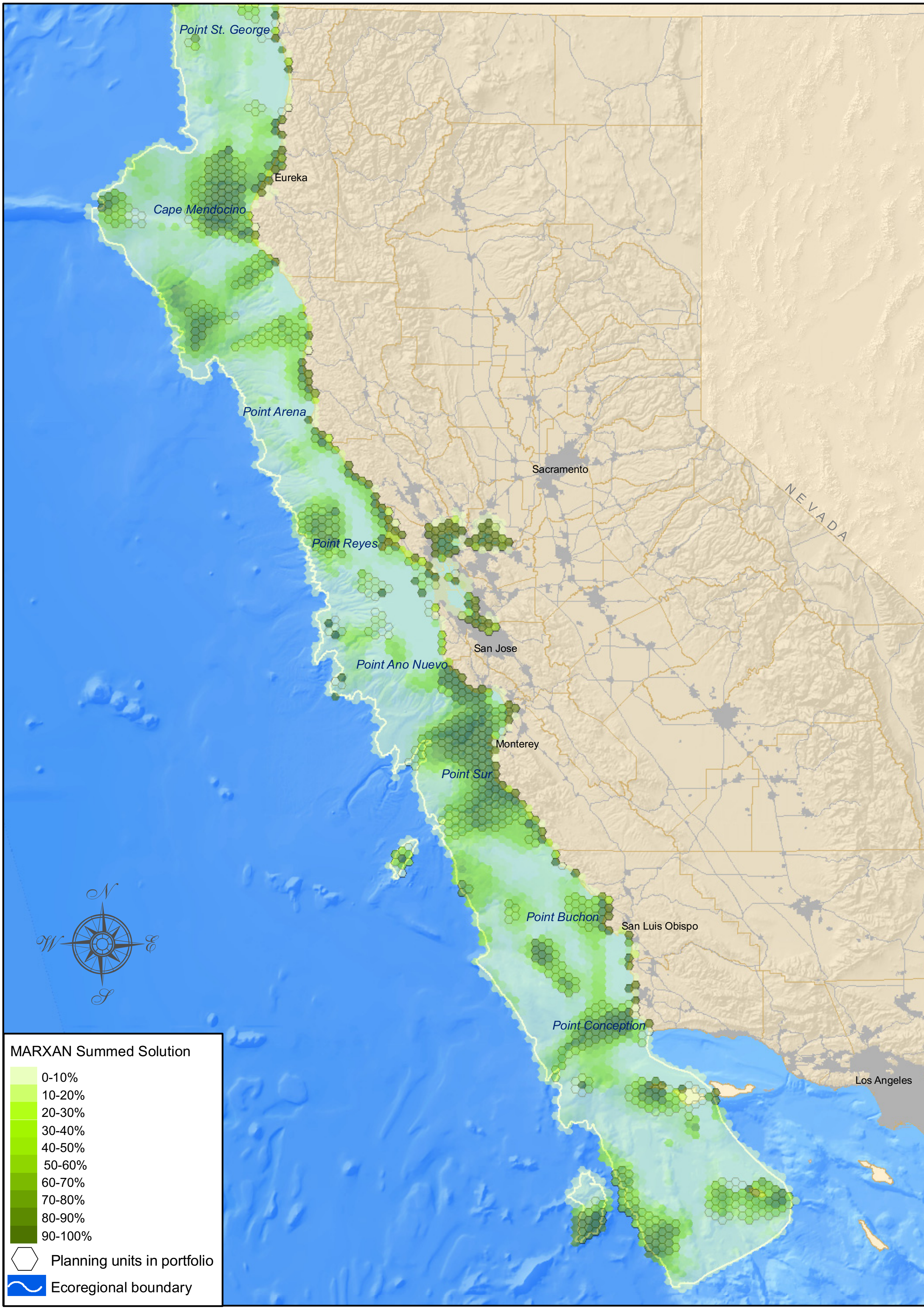


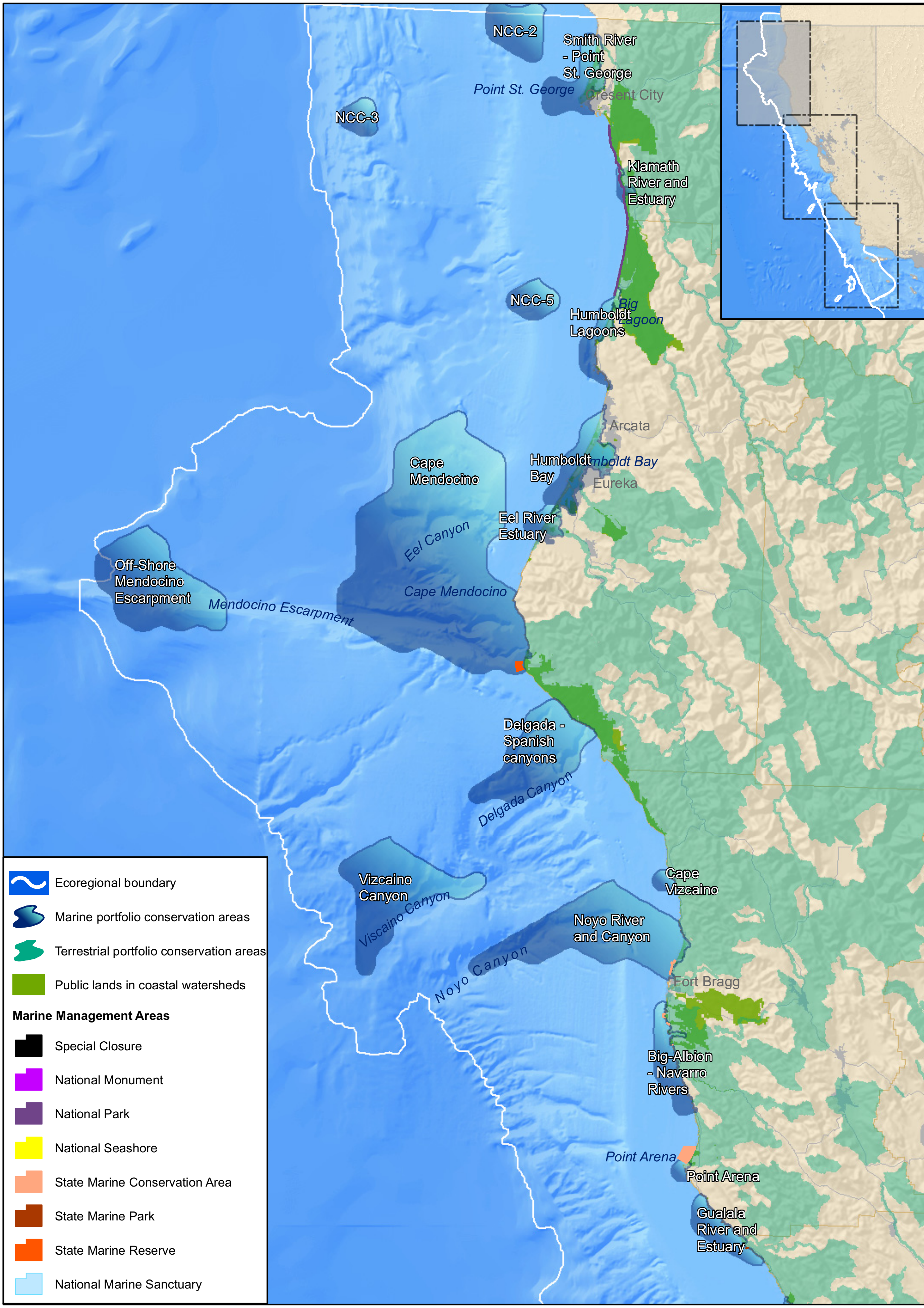
FIGURE 13

NORTHERN CALIFORNIA ECOREGION
MARXAN SUMMED SOLUTION AND FINAL PORTFOLIO

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Figure 14A

Northern California Marine Ecoregion
Portfolio Conservation Areas - Northern Section



0 15 30 60 Nautical Miles

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

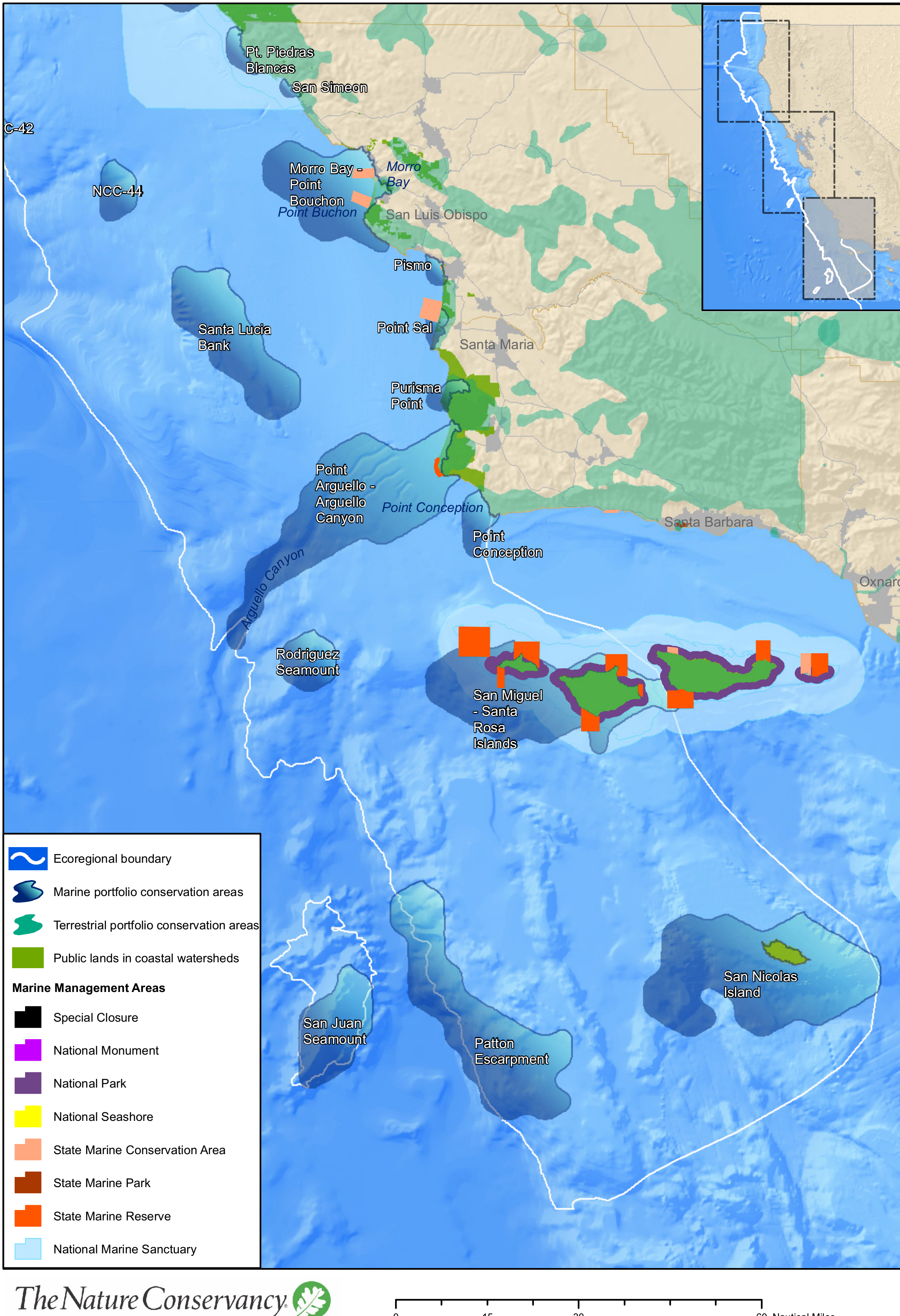
Figure 14B

Northern California Marine Ecoregion Portfolio Conservation Areas - Central Section

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Figure 14C

Northern California Marine Ecoregion
Portfolio Conservation Areas - Southern Section



The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

LIST OF APPENDICES

Appendix I: Peer Review Workshop Participants

A peer review workshop of the draft NCME assessment was held at the Seymour Discovery Center facility at UCSC's Long Marine Laboratory in Santa Cruz on November 16, 2004. The following individuals either participated in the workshop (** or were involved in separate smaller meetings to provide review of the assessment):

Name	**Affiliation**	**Address**	**Email Address**
Barry, Jim	MBARI	7700 Sandholdt Road Moss Landing, CA 95039	barry@mbari.org
Mike Beck	TNC Marine Initiative	Center for Ocean Health University of California 100 Shaffer Road Santa Cruz, CA 95960	mbeck@tnc.org
Carr, Mark	UCSC - Pisco	Long Marine Lab 100 Shaffer Road Santa Cruz, CA 95960	carr@biology.ucsc.edu
Comendant, Tosha	TNC	4245 North Fairfax Drive, Suite 100 Arlington, Virginia 22203	tcomendant@tnc.org
Cook, Chuck	TNC	111 West Topa Topa Street Ojai, CA 93023	ccook@tnc.org
Croll, Don	UCSC	Center for Ocean Health University of California 100 Shaffer Road Santa Cruz, CA 95960	croll@biology.ucsc.edu
DeVogelaere, Andrew	MBNMS	MBNMS 299 Foam Street Monterey, CA	andrew.devogelaere@noaa.gov
Dorfman, Dan	TNC	Center for Ocean Health University of California 100 Schaffer Road Santa Cruz, CA 95060	ddorfman@tnc.org
Foster, Mike	MLML	MLML 8278 Moss Landing Road Moss Landing, CA 95065	foster@mlml.calstate.edu
Greene, Gary	MLML	MLML 8278 Moss Landing Road Moss Landing, CA 95065	greene@mlml.calstate.edu
Halpern, Ben	UCSC/NCEAS	NCEAS / UCSB Santa Barbara, CA 93101	halpern@nceas.ucsb.edu
Heneman, Burr	Commonweal	35 Horseshoe Hill Bolinas CA 94924	burr@igc.org
Iampietro, Pat	CSUMB, Seafloor Mapping	CSUMB 100 Campus Center Seaside, CA 93955	pat_iampietro@csumb.edu
Karr, Kendra	TNC	Center for Ocean Health University of California 100 Shaffer Road Santa Cruz, CA 95060	karr@tnc.org

King, Chad	SIMON-MBNMS	MBNMS 299 Foam Street Monterey, CA 93940	chad.king@noaa.gov
McGonigal, Heff	MBNMS	MBNMS 299 Foam Street Monterey, CA 93940	huff.mcgonigal@noaa.gov
Oliver, John	MLML	MLML 8278 Moss Landing Road Moss Landing, CA 95065	oliver@mlml.calstate.edu
Pearse, John	UCSC	Long Marine Lab 100 Shaffer Road University of California Santa Cruz, CA 95060	pearse@biology.ucsc.edu
Pete Raimondi**	UCSC	Center for Ocean Health University of California 100 Shaffer Road Santa Cruz, CA 95060	raimondi@biology.ucsc.edu
Ryan, John	MBARI	MBARI 7700 Sandholdt Road Moss Landing, CA 95039	ryjo@mbari.org
Bill Sydeman**	PRBO	PRBO Marine Science Division, 4990 Shoreline Hwy, Stinson Beach, CA 94970	wjsydeman@prbo.org
Wasson, Kerstin	Elk Slough NERR	1700 Elhorn Road Watsonville, CA 95067	research@elkhornslough.org
Yoklavich, Mary	NOAA Fisheries	NMFS Santa Cruz Lab 100 Schaffer Road Santa Cruz, CA 93955	mary.yoklavich@noaa.gov

**did not attend NCME workshop, so we met with privately or at other meetings to discuss data inputs and results

Appendix II: Socioeconomic Data

Demographic and fisheries statistics for the central-northern California region have been compiled from a variety of sources; sources are listed below each data table.

Table 1 – Total population, population change, and projected growth in coastal counties in the NCME

Coastal County	Total Population (2000)	% Population change 1990-2000	% Projected population change 2000-2010
Del Norte	28,200	+ 20.2	+ 22.3
Humboldt	127,700	+ 7.2	+ 6.9
Mendocino	87,400	+ 8.8	+ 18.1
Sonoma	464,800	+ 19.7	+ 19.9
Marin	250,100	+ 8.7	+ 5.4
Napa	125,800	+ 13.6	+ 14.4
Solano	400,300	+ 17.9	+ 21.3
Contra Costa	963,000	+ 19.8	+ 11.3
Alameda	1,466,900	+ 14.9	+ 13.9
Santa Clara	1,709,500	+ 14.2	+ 16.3
San Francisco	787,500	+ 8.8	+ 0.0
San Mateo	717,900	+ 10.5	+ 10.7
Santa Cruz	259,300	+ 12.9	+ 20.3
Monterey	408,700	+ 14.9	+ 20.7
San Luis Obispo	249,900	+ 15.1	+ 29.3
Santa Barbara	406,100	+ 9.9	+ 15.2

(Source: California Institute for County Government, www.cicg.org)

Table 2 - Total Population and Projected Population Growth For the Year 2050 (Department of Finance)

Counties	Total Population 2000	Projected Population 2050	% Projected Population Change 2000-2050
Del Norte	27,652	32,890	18.9
Humboldt	127,173	139,692	9.8
Mendocino	86,852	118,621	36.6
Sonoma	461,347	796,792	72.7
Marin	248,473	225,127	-9.4
Napa	124,945	221,466	77.3
Solano	396,784	830,830	109.4
Contra Costa	954,504	1,848,177	93.6
Alameda	1,451,109	2,315,045	59.5
Santa Clara	1,691,183	2,325,538	37.5

San Francisco	781,174	706,192	-9.6
San Mateo	710,493	826,342	16.3
Santa Cruz	256,874	293,350	14.2
Monterey	403,636	654,847	62.2
San Luis Obispo	248,327	343,548	38.3
Santa Barbara	400,778	481,840	20.2

(Source: State of California, Department of Finance, 2004. *Population Projections by Race/Ethnicity, Gender and Age for California and Its Counties 2000-2050,* Sacramento, California, May)

COMMERCIAL FISHERIES

Table 3 – Northern California Commercial Fish Catch by Harbor Area and Port (2002)

Area	Ports	Total Pounds	Total Value ($)	Primary Species (over 1,000,000 pounds)
Eureka	Eureka	15,268,656	$6,330,079	Albacore Tuna, Pacific Ocean Shrimp, Dover Sole, Pacific Whiting
	Crescent City	6,324,296	$5,506,344	Dungeness Crab, Pacific Ocean Shrimp
	Trinidad	340,546	$547,212	
	Shelter Cove	26,491	$36,066	
	All Other Ports	1,110,030	$795,567	Albacore Tuna
	Eureka Area Total	23,070,019	$13,215,268	
Fort Bragg	Fort Bragg	8,348,817	$6,643,528	Chinook Salmon, Red Urchin, Dover Sole
	Point Arena	1,475,835	$1,036,983	Red Urchin
	Albion	847,067	$583,479	
	Elk	8,861	$9,892	
	Westport	5,193	$8,200	
	Little River	8,566	$5,110	
	Fort Bragg Area Total	10,694,339	$8,287,192	
Bodega Bay	Bodega Bay	3,515,333	$4,427,955	Dungeness Crab
	Marshall	484,284	$158,064	
	Bolinas	55,895	$143,883	
	Point Reyes	53,865	$100,280	
	Marconi Cove	1,807	$3,708	
	Tomales Bay	1,032	$3,345	
	All Other Ports	7,486	$14,408	
	Bodega Bay Area Total	4,119,702	$4,851,643	

San Francisco	San Francisco	9,721,882	$7,806,468	Dungeness Crab, Roe Herring
	Princeton-Half Moon	5,062,625	$4,402,022	Market Squid, Dungeness Crab
	Sausalito	1,917,663	$1,389,537	Roe Herring
	Berkeley	124,654	$191,960	
	Vallejo	36,580	$179,265	
	Alviso	657,947	$161,532	
	Richmond	18,952	$67,185	
	Alameda	42,124	$56,961	
	Petaluma	10,648	$31,966	
	Oakland	8,657	$23,443	
	China Camp	5,488	$12,308	
	South San Francisco	5,126	$12,213	
	Redwood City	30,956	$6,625	
	Emeryville	5,859	$4,825	
	Pinole	2,194	$2,613	
	All Other Ports	112,328	$77,909	
	San Francisco Area Total	17,763,683	$14,426,832	
Monterey Bay	Moss Landing	80,794,721	$9,613,056	Market Squid, Pacific Sardine, Northern Anchovy
	Monterey	14,825,262	$3,084,849	Market Squid
	Santa Cruz	438,369	$615,336	
	Mill Creek	9,629	$17,620	
	All Other Ports	1,956	$3,759	
	Monterey Bay Area Total	96,069,937	$13,334,620	
Morro Bay	Morro Bay	1,651,562	$2,488,919	
	Avila/Port San Luis	3,140,501	$1,856,848	
	San Simeon	39,491	$66,240	
	Morro Bay Area Total	4,831,554	$4,412,007	

(Source: California Department of Fish and Game, California Commercial Landings, 2002)

Table 4 – Northern California Commercial Fish Catch by Fishery
(Average annual figures for 1995-1999)

Fishery	Total pounds	Total value	# of Participating Vessels
Crab (trap)	7,886,000	$13,095,500	309
Groundfish (trawl)	28,683,700	$11,322,900	71
Shrimp (trawl)	6,084,100	$3,179,500	58
Urchin (dive)	3,318,900	$2,742,100	64
Groundfish (hook & line)	1,562,800	$1,925,400	158
Tuna (hook & line)	966,400	$837,600	43
Salmon (hook & line)	406,100	$654,500	86
Groundfish (misc. trap)	363,900	$459,400	35
Shark/swordfish (gillnet)	102,000	$308,900	9
Herring	121,100	$104,400	5

(Source: California Department of Fish and Game, 2001. *California's Living Marine Resources: A Status Report*, December)

Table 5 – Central California Commercial Fish Catch by Fishery
(Average annual figures for 1995-1999)

Fishery	Total pounds	Total value	# of Participating Vessels
Groundfish (trawl)	17,406,200	$9,097,800	73
Herring	10,014,200	$8,585,500	149
Salmon (hook & line)	3,847,100	$6,512,400	704
Crab (trap)	2,564,300	$5,209,200	207
Groundfish (hook & line)	4,056,200	$4,710,200	520
Prawn (trawl)	317,900	$2,039,200	18
Shark/swordfish (gillnet)	581,900	$1,683,500	30
Squid (seine/other net)	8,817,700	$1,282,900	13
Tuna (hook & line)	1,470,100	$1,248,100	123
CPS (seine)	20,333,900	$961,600	13
Shrimp (trawl)	985,700	$956,900	19
Urchin (dive)	686,700	$546,900	17
Groundfish (misc. trap)	153,100	$382,500	34
Abalone (dive)	31,800	$313,100	9
Prawn (trap)	34,400	$249,200	8
Shark/swordfish (h &l)	101,200	$240,900	9

(Source: California Department of Fish and Game, 2001. *California's Living Marine Resources: A Status Report*. December)

Table 6 – Northern California Commercial Fishing Vessels (1981-1999)

	1981-1985	*1986-1994*	*1995-1999*
Number of Boats	1,680	1,008	579
Ex-vessel revenue per boat	$24,500	$48,300	$60,800
# Boats earning < $5K per year	983	386	162
% Boats earning < $5K per year	59%	37%	28%

(Source: California Department of Fish and Game, 2001. *California's Living Marine Resources: A Status Report*. December)

Table 7 – Central California Commercial Fishing Vessels (1981-1999)

	1981-1985	1986-1994	1995-1999
Number of Boats	2,542	2,134	1,479
Ex-vessel revenue per boat	$20,800	$25,100	$30,100
# Boats earning < $5K per year	1,420	967	627
% Boats earning < $5K per year	56%	46%	43%

(Source: California Department of Fish and Game, 2001. *California's Living Marine Resources: A Status Report*. December)

Table 8 – Commercial Fishing Licenses and Permits (1995-2003)

Licenses	**1995**	**1999**	**2003**
Commercial Boat Registration (resident)	4,995	4,344	3,506
Commercial Passenger Fishing Vessel Permit	363	384	432
Commercial Salmon Stamp	3,222	1,955	1,714
Salmon Vessel Permit	2,344	1,800	1,518
Dungeness Crab Vessel Permit (resident)	614	604	572

(Source: Department of Fish and Game, 2001. *California's Living Marine Resources: A Status Report*. December)

Table 9a: Number of vessels participating in groundfish fishery by primary port and species group

Ports	Vessels with Limited Entry Trawl Permits						Vessels with fixed Gear Limited Entry Permits (No Trawl Permit)					Open Access Vessels with More than 5% Revenue from Groundfish					Open Access Vessels with Less than 5% Revenue from Groundfish					Total GF
	Whiting	Sable-fish	Near-shore spp	Shelf spp	Slope spp	Total	Sable-fish	Near-shore spp	Shelf spp	Slope spp	Total	Sable-fish	Near-	Shelf spp	Slope spp	Total	Sable-fish	Near-shore spp	Shelf spp	Slope spp	Total	
Crescent City	2	20	14	20	20	20	8	4	5	2	9	7	35	35	7	37	4	8	15	3	19	85
Orik	-	-	-	-	-	-	-	-	-	-	-	1	8	8	1	8	-	-	1	-	1	9
Trinidad	-	-	-	-	-	-	-	-	-	-	-	-	5	6	-	6	-	1	1	-	1	7
Eureka Area	1	16	15	16	16	16	4	2	4	4	4	13	13	12	8	17	2	1	1	-	2	39
Fields Landing	3	10	7	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Fort Bragg	-	12	5	12	12	12	3	1	3	3	4	27	36	34	6	57	4	5	3	1	8	81
Albion	-	-	-	-	-	-	-	-	-	-	-	2	6	5	-	7	-	1	1	-	2	9
Point Arena	-	-	-	-	-	-	-	-	-	-	-	-	4	3	1	4	-	3	2	1	4	8
Bodega Bay	-	-	-	-	-	-	2	2	2	1	2	1	21	23	7	26	1	1	11	1	11	39
Cloverdale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	3	3
Yountville	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-	-	-	1	2
Tomales Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Point Reyes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sausalito	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	1	-	4	5	-	5	6
Oakland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alameda	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1	2	-	-	-	-	-	2
Berkeley	-	-	-	-	-	-	-	-	-	-	-	1	8	9	3	10	-	-	-	-	-	10
Richmond	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	1	-	1	3
San	-	6	6	6	6	6	6	6	8	7	9	9	22	21	12	27	1	5	7	1	9	51

Francisco																						
Princeton	1	6	8	8	7	8	3	2	2	3	3	8	39	36	8	44	1	6	6	3	11	66
Gilroy	-	-	-	-	-	-	-	-	-	-	-	-	10	8	2	10	-	-	-	-	-	10
Santa Cruz	-	2	2	2	2	2	-	-	-	-	-	9	11	11	10	18	1	5	4	1	6	26
Moss Landing	-	8	6	8	8	8	11	2	6	11	11	19	24	23	13	38	1	2	2	1	6	63
Monterey	-	2	2	2	2	2	-	1	-	1	1	1	25	23	6	26	2	3	1	3	6	35
San Simeon	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	6	-	-	-	-	-	6
Morro Bay	-	2	2	2	2	2	-	1	2	-	2	2	56	49	10	57	2	16	13	7	20	81
Avila	1	5	2	5	5	5	-	-	1	1	1	-	50	47	2	50	-	10	8	1	10	66

(Source: NOAA, 2004. Pacific Coast Groundfish Fishery Management Plan - Essential Fish Habitat Designation and Minimization of Adverse Impacts - Draft Environmental Impact Statement.)

Table 9b: Number of vessels participating in other fisheries by vessel primary port and species group

Ports	Vessels Participating in Other Fisheries							
	Hal. (Pac. & CA)	Shrimp/Prawns	Crabs	Salmon	HMS	CPS	Other	Total
Crescent City	11	21	118	31	45	4	44	141
Orik	1	-	4	7	2	-	-	12
Trinidad	-	-	23	2	1	-	3	27
Eureka Area	7	5	51	33	17	1	36	78
Fields Landing	2	1	7	2	-	1	8	14
Fort Bragg	3	3	26	49	19	1	56	130
Albion	-	-	2	2	1	-	12	17
Point Arena	-	-	5	3	1	-	11	19
Bodega Bay	14	-	44	125	28	1	24	171
Cloverdale	4	-	6	4	1	-	17	24
Yountville	1	-	10	2	-	-	9	15
Tomales Bay	1	-	-	1	-	-	-	1
Point Reyes	6	-	6	8	1	-	-	10
Sausalito	7	-	4	21	6	1	39	53
Oakland	-	-	-	-	-	-	1	1
Alameda	-	-	-	1	-	-	2	3
Berkeley	5	-	-	4	2	-	8	15
Richmond	3	1	-	5	-	-	1	10
San Francisco	33	3	29	59	17	2	86	155
Princeton	34	2	56	74	30	10	43	135
Gilroy	-	-	1	-	1	-	8	10
Santa Cruz	18	-	7	31	19	3	19	46
Moss Landing	27	2	6	71	42	7	38	132
Monterey	23	5	1	50	10	5	42	81
San Simeon	-	-	-	-	-	-	3	6
Morro Bay	26	9	19	36	68	6	55	122
Avila	32	5	17	9	31	3	46	78

Source: (NOAA 2004. Pacific Coast Groundfish Fishery Management Plan - Essential Fish Habitat Designation and Minimization of Adverse Impacts - Draft Environmental Impact Statement)

RECREATIONAL FISHING

Table 10: Effort, personal income, and jobs related to the West Coast recreational ocean fisheries in 2001

Area	Recreational Fishing Trips				Coastal Community Income Impacts for the Recreational Fishery			
		Angler Trips (1,000s)			($1,000s)			Total Jobs
		Charter	Private	Total	Charter	Private	Total	
Washington Coast	Total	59	88	147	$5,335	$3,285	$8,620	392
	Groundfish	12	10	23	$1,134	$385	$1,519	69
Oregon	Total	70	140	211	$6,282	$4,911	$11,293	514
	Groundfish	47	22	69	$4,227	$783	$5,011	228
North/Central California[1]	Total	221	901	1,122	$27,294	$54,172	$81,466	3,363
	Groundfish	141	164	305	$17,414	$9,860	$27,274	1,126
Southern California[2]	Total	577	1,757	2,334	$72,321	$81,023	$153,345	5,536
	Groundfish	204	252	456	$25,569	$11,621	$37,190	1,343
California Total	Total	798	2,658	3,456	$99,616	$135,195	$234,811	8,899
	Groundfish	345	416	761	$43,983	$21,481	$64,465	2,468
Grand Total	Total	927	2,886	3,813	$111,332	$143,392	$254,724	9,823
	Groundfish	404	449	853	$48,345	$22,649	$70,994	2,765

[1] Includes counties from Monterey north.

[2] Includes counties from San Luis Obispo south.

(Source: NOAA 2004. Pacific Coast Groundfish Fishery Management Plan - Essential Fish Habitat Designation and Minimization of Adverse Impacts - Draft Environmental Impact Statement.)

Table 11 – Average annual total catch, average effort, and primary species caught in Northern California for each of the major sportfishing modes from 1981-2000

Fishing Mode	Avg. Catch (No. of fish) 1980-2000	Avg. Effort (No. Trips) 1980-2000	Primary Species
Commercial Passenger Fishing vessels (CPFV)	1.5 million	235,000	Rockfishes, lingcod, and mackerel
Private/Rental Boat (PRB)	2.0 million	944,000	Rockfishes, croaker, sanddabs, and lingcod
All Shore Fishing (Beach/Bank, Jetty/Breakwater, Pier/Dock)	2.9 million	1.3 million	Smelt, silversides, surfperch, croaker, and greenlings
*1990-92 not available for all; 1990-95 not available for the CPFV fishery			

(Source: Starr, R. M., J.M. Cope, and L.A. Kerr, 2002. *Trends in Fisheries and Fishery Resources – Associated with the Monterey Bay National Marine Sanctuary from 1981-2000*.)

AQUACULTURE

Table 12: Aquaculture/Mariculture production in California

State of California Freshwater and Marine Aquaculture Production (Live Weight in Thousand Pounds/Value in Thousand Dollars)						
	1992	1993	1994	1995	1996	1997
Abalone	158/ $1,976	209/ $3,072	257/ $3,501	248/ $3,256	585/ $3,550	240/ $3,125
Baitfish	300/ $3,000	300/ $3,000	300/ $3,000	300/ $3,000	300/ $3,000	130/ $2,600
Catfish	3,959/ $7,126	4,204/ $7,128	4,134/ $7,217	4,884/ $9,280	4,900/ $9,400	6,000/ $11,000
Goldfish	224/ $1,680	340/ $2,125	340/ $2,125	340/ $2,125	340/ $2,125	see below
Mussels	188/ $248	242/ $326	422/ $652	459/ $808	458/ $535	472/ $511
Oysters	8,384/ $4,945	10,136/ $4,888	10,413/ $5,631	8,976/ $4,778	7,346/ $4,018	7,812/ $3,856
Tilapia	4,267/ $5,034	5,050/ $7,200	5,550/ $7,700	5,550/ $7,700	5,900/ $8,465	4,500/ $8,775
Trout	2,920/ $6,117	2,920/ $5,679	2,920/ $5,679	2,920/ $5,679	2,900/ $5,600	2,950/ $6,000
Other*	2,661/ $13,720	4,198/ $14,722	4,769/ $14,874	4,914/ $15,430	5,363/ $21,244	see below
TOTAL	23,061/ $43,846	27,599/ $48,140	29,105/ $50,379	28,591/ $52,056	28,092/ $57,937	22,104/ $35,867
Note: * Includes algae, striped bass, hybrid striped bass, sturgeon, marine clams, scallops, and ornamental fish						

(Source: California Department of Fish and Game data on NOAA website http://swr.nmfs.noaa.gov/fmd/bill/aquaca.htm)

Table 13 – Aquaculture Production by value (in $) and weight* (in lbs)

Production Area	Species	1998	2002
Humboldt Bay	Pacific Oyster	$2,131,735 621,316	$3,156,710 687,527
	Kumamoto Oyster	$88,244 16,584	$520,047 19,260
Tomales Bay and Drake's Bay	Pacific Oyster	$583,154 168,538	$2,778,280 409,845
	Eastern Oyster	$18,214 4,423	$14,500 2,640
	Kumamoto Oyster	$2,082 3,913	$137,160 5,080
	European Oyster	$823 201	___
	Native Oyster	___	$12,500 500
	Littleneck Clam	$46,813 15,604	$52,980 22,545
	Mussel	$21,474 9,502	$11,300 6,457

*weight for oysters = shucked weight, all other shellfish total weight in shell
(Source: California Department of Fish and Game, 2004. Joint Committee on Fisheries and Aquaculture,Fisheries Forum Annual Report, March)

COASTAL TOURISM

Table 14 - Tourism Economy in Selected Coastal Counties (excluding Bay Area counties)

	Travel Expenditures ($ millions)	Earnings ($ millions)	Employment (# jobs)	Local Tax ($ millions)	State Tax ($ millions)
Statewide	74,461	24,635	868,080	1,700	2,983
Del Norte	84	36	1,810	2	3
Humboldt	240	77	4,260	5	10
Mendocino	292	109	5,160	7	12
Sonoma	977	328	15,190	20	42
Marin	517	221	6,160	11	23
San Mateo	2,427	1,575	34,850	52	117
Santa Cruz	501	165	7,750	12	21
Monterey	1,839	784	22,630	51	75
San Luis Obispo	904	312	16,270	22	38
Santa Barbara	1,178	390	15,190	34	50

(Source: California Travel and Tourism Commission, California Travel Impacts by County 2002; http://www.visitcalifornia.com)

Table 15 – Park Attendance in Selected Coastal Parks and Marine Attractions

Park	County	# visitors (2003)
Redwood National Park	Humboldt, Del Norte	408,125
Prairie Creek Redwoods State Park	Humboldt	263,808
Sonoma Coast State Beach	Sonoma	2,909,842
Point Reyes National Seashore	Marin	2,224,880
Golden Gate National Recreation Area	Marin	13,833,580
Salinas River State Beach	Monterey	505,221
Monterey Bay Aquarium	Monterey	1,678,929
Point Lobos State Reserve	Monterey	285,032
Pfeiffer Big Sur State Park	Monterey	379,562
Morro Bay State Park	San Luis Obispo	1,515,506
Channel Islands National Park	Santa Barbara	406,736

(Source: California Travel and Tourism Commission – Fast Facts 2004; http://visitcalifornia.com)

Appendix III: Conservation Targets and Goals for the NCME

Target Type	Conservation Target	Data Source	NCME Conservation Goal (Percent)	Units
SYSTEMS Shoreline Types:	Exposed wave cut rocky platform	NOAA Environmental Sensitivity Index (NOAA-ESI)	30	kilometers
	Exposed wave cut rocky platform with beach	NOAA-ESI	30	kilometers
	Exposed rocky cliff	NOAA-ESI	30	kilometers
	Exposed rocky cliff with talus boulder base	NOAA - ESI	30	kilometers
	Sheltered rocky shore	NOAA-ESI	30	kilometers
	Gravel beach	NOAA-ESI	30	kilometers
	Coarse grained sand beach	NOAA-ESI	30	kilometers
	Mixed sand and gravel beach	NOAA-ESI	30	kilometers
	Fine to medium grained sand beach	NOAA-ESI	30	kilometers
	Exposed tidal flat	NOAA-ESI	30	kilometers
	Sheltered tidal flat	NOAA-ESI	30	kilometers
	Tidal flat with salt marsh	NOAA-ESI	30	kilometers
Onshore:	Coastal dune	USGS Topos; National Park Service (NPS) vegetation surveys; CA GAP vegetation; Natural Diversity Database (NDDB)	30	hectares
Estuarine:	Coastal marsh	NOAA-ESI; California Dept. of Forestry Fire and Resource Assessment Program (CDF-FRAP) multisource vegetation data; NPS; CDFG Tomales Bay data; SF Bay EcoAtlas; Humboldt Bay GIS Atlas	75	Kilometers / hectares

	Mega estuary	National Wetlands Inventory (NWI); NOAA-ESI	50	hectares
	Large estuary	NWI; NOAA-ESI; NDDB; USGS Topos	50	hectares
	Medium estuary or lagoon	NWI; NOAA-ESI; NDDB; USGS Topos	50	hectares
	Small estuary or lagoon	NWI; NOAA-ESI; NDDB; USGS Topos	50	hectares
	Eelgrass bed	NOAA-ESI; CDFG Tomales Bay data; Humboldt Bay GIS Atlas; SF Bay Data and Mapping Project; Morro Bay Estuary Program	50	hectares
Nearshore:	Kelp bed	CDFG kelp (1989, 1999, 2002, 2003)	50	hectares
	Persistent kelp bed	CDFG kelp ('89, '99, '02, '03); present 3 out of 4 years	50	hectares
	Near-shore rocky reef	Greene et al CA Continental Shelf Mapping (Greene et al); NOAA Nautical Charts	50	hectares
Deep Sea:	Cold seep community	J. Barry, MBARI	30	Presence / absence
	Sand spit	USGS 1:24K topos	30	
BIOLOGICALLY SIGNIFICANT AREAS	Off-shore rock or islet	BLM CA Coastal National Monument	30	presence / absence
	Off-shore bank	Digital Elevation Model (DEM) from CDFG; NOAA nautical charts	50	Hectares
	Near-shore canyon head	DEM from CDFG; NOAA nautical charts	50	presence / absence
	Major submarine canyon	DEM from CDFG; NOAA nautical charts	50	Presence / absence
	Shelf-slope break	DEM from CDFG (200m-300m contour)	30	presence / absence
	Upwelling zone	NOAA Coastwatch AVHRR (May-June, years 2000-2003)	30	presence/ absence
	S.F. Bay tidal plume	Noble 1998	50	
	Seamount	Baja to Bering Initiative CD	100	presence / absence

	High bathymetric complexity	DEM from CDFG (areas w/ >2 std.dev. complexity)	30	hectares
SPECIES **Inverts**:	Structure forming invertebrate	NMFS Data from Groundfish EFH EIS	30	presence / absence
Fish:	Steelhead stream outlet	NOAA; CDFG; V. Jigour (Titus dataset); Calfish; KRISweb; literature	75	presence / absence
	Coho stream outlet	NOAA; CDFG; Calfish; KRISweb; literature	75	presence / absence
	Chinook stream outlet	NOAA; CDFG; literature	75	presence / absence
	Delta smelt	NOAA-ESI; Sacramento-San Joaquin Delta Native Fish Recovery Plan	75	Hectares
	Green sturgeon	NOAA-ESI; Sacramento-San Joaquin Delta Native Fish Recovery Plan	75	Hectares
	Sacramento splittail	NOAA-ESI; Sacramento-San Joaquin Delta Native Fish Recovery Plan	75	Hectares
	Tidewater goby	NDDB; NOAA-ESI	50	presence / absence
	Longfin smelt	NOAA-ESI; Sacramento-San Joaquin Delta Native Fish Recovery Plan	75	Hectares
	Grunion	NOAA-ESI	50	Hectares
	Night smelt	NOAA-ESI	50	Hectares
	Surf smelt	NOAA-ESI	50	Hectares
Birds:	Ashy storm petrel (colony)	Sowls et al 1980; Carter et al 1992	75	individuals
	Leaches storm petrel (colony)	Sowls et al 1980; Carter et al. 1992	50	individuals
	Fork-tailed storm petrel (colony)	Sowls et al 1980; Carter et al 1992	75	individuals
	Caspian tern (colony)	Sowls et al 1980; Carter et al 1992	50	individuals

	Forster's tern (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Western gull (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Double-crested cormorant (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Brandt's cormorant (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Pelagic cormorant (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Common murre (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Pigeon guillemot (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Cassin's auklet (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Tufted puffin (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Rhinosaurus auklet (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Xantus's murrelet (colony)	Sowls et al 1980; Carter et al 1992	50	individuals
	Black oystercatcher (colony)	Sowls et al 1980; Carter et al 1992	75	individuals
	California least tern	Sowls et al 1980; Carter et al 1992; NDDB; SF Bay Bird Observatory (C. Strong)	75	individuals
	Western snowy plover	NDDB; Pt. Reyes Bird Observatory (PRBO, G.Page); SFBBO (C. Strong)	75	presence / absence
	Clapper rail	NDDB; ESI	75	presence / absence
	California black rail	NDDB; ESI	75	presence / absence
Mammals:	California sea lion (rookery)	NOAA (Mark Lowry)	75	presence / absence
	Stellar sea lion (rookery)	NOAA (Mark Lowry)	75	Individuals
	Northern fur seal (rookery)	NOAA (Mark Lowry)	75	Individuals
	Northern elephant seal (rookery)	NOAA (Mark Lowry)	75	Presence / absence

	Harbor seal (haul-out)	NOAA (Mark Lowry)	30	individuals
	Stellar sea lion (haul-out)	NOAA (Mark Lowry)	30	Presence / absence
	California sea lion (haul-out)	NOAA (Mark Lowry)	30	presence / absence
	Sea otter	USGS-Biological Resources Division (BRD); CDFG; Monterey Bay Aquarium – Spring 2001 surveys	50	presence / absence
	Salt marsh harvest mouse	NDDB; NOAA-ESI	75	presence / absence
Benthic Habitat Types (modeled)	Inner Shelf Canyon Soft	TNC's Benthic Habitat Model	30	Hectares
	Inner Shelf Slope Hard	TNC's Benthic Habitat Model	30	Hectares
	Inner Shelf Slope Soft	TNC's Benthic Habitat Model	30	Hectares
	Inner Shelf Flat Hard	TNC's Benthic Habitat Model	30	Hectares
	Inner Shelf Flat Soft	TNC's Benthic Habitat Model	20	Hectares
	Inner Shelf Ridge Hard	TNC's Benthic Habitat Model	30	Hectares
	Inner Shelf Ridge Soft	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Canyon Unclassified	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Canyon Hard	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Canyon Soft	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Slope Hard	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Slope Soft	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Flat Unclassified	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Flat Hard	TNC's Benthic Habitat Model	30	Hectares

	Mid-Shelf Flat Soft	TNC's Benthic Habitat Model	20	Hectares
	Mid-Shelf Ridge Unclassified	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Ridge Hard	TNC's Benthic Habitat Model	30	Hectares
	Mid-Shelf Ridge Soft	TNC's Benthic Habitat Model	30	Hectares
	Mesobenthal Canyon Hard	TNC's Benthic Habitat Model	30	Hectares
	Mesobenthal Canyon Soft	TNC's Benthic Habitat Model	30	Hectares
	Mesobenthal Slope Hard	TNC's Benthic Habitat Model	30	Hectares
	Mesobenthal Slope Soft	TNC's Benthic Habitat Model	20	Hectares
	Mesobenthal Flat Unclassified	TNC's Benthic Habitat Model	30	Hectares
	Mesobenthal Flat Hard	TNC's Benthic Habitat Model	20	Hectares
	Mesobenthal Flats Soft	TNC's Benthic Habitat Model	20	Hectares
	Mesobenthal Ridge Hard	TNC's Benthic Habitat Model	30	Hectares
	Mesobenthal Ridge Soft	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Canyon Unclassified	TNC's Benthic Habitat Model	30	Hectares
	Bathybenthal Canyon Hard	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Canyon Soft	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Slope Unclassified	TNC's Benthic Habitat Model	30	Hectares
	Bathybenthal Slope Hard	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Slope Soft	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Flat Unclassified	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Flat Hard	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Flat Soft	TNC's Benthic Habitat Model	15	Hectares
	Bathybenthal Ridge Unclassified	TNC's Benthic Habitat Model	30	Hectares

	Bathybenthal Ridge Hard	TNC's Benthic Habitat Model	20	Hectares
	Bathybenthal Ridge Soft	TNC's Benthic Habitat Model	20	Hectares
Benthic Habitats (Greene)	Rocky Apron	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Rocky Apron Canyon Wall	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Rocky Ridge	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Rocky Shelf	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Rocky Shelf Canyon Wall	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Rocky Slope	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Rocky Slope Canyon Wall	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Rocky Slope Gully	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Rocky Slope Landslide	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Apron	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Apron Canyon Floor	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Apron Canyon Wall	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Apron Gully	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Apron Landslide	G. Greene, CA Continental Shelf Mapping	30	Hectares

	Sedimentary Basin	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Ridge	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Shelf	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Shelf Canyon Floor	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Shelf Canyon Wall	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Shelf Gully	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Slope	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Slope Canyon Floor	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Slope Canyon Wall	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Slope Gully	G. Greene, CA Continental Shelf Mapping	20	Hectares
	Sedimentary Slope Gully Floor	G. Greene, CA Continental Shelf Mapping	30	Hectares
	Sedimentary Slope Landslide	G. Greene, CA Continental Shelf Mapping	20	Hectares

Appendix IV: Crosswalk of ESI Classification with TNC Shoreline Types

For many parts of the California shoreline, the NOAA-ESI database lists several shoreline types present at a given location, described from seaward to landward. This results in over 170 unique combinations of shoreline types mapped along the California coast. For those locations with combination of shoreline types, we prioritized among shoreline types and identified a single type at each location based on a set of decision rules. The priority shoreline type was identified based on rarity and biodiversity importance. Marshes and tidal flats are two systems in California that have been the most impacted by coastal development; over 90% of the coastal marshes have been lost. Of the Northern California shoreline, 17% was classified by NOAA–ESI as marsh or tidal flats, 30% as rocky shorelines, and 43% as beaches; sheltered rocky shores were the rarest type in the region (NOAA 2002). The general decision rules applied to the identification of single priority shoreline types at each location in northern California were:

- Marsh and tidal flats took precedence over rocky shores which took precedence over beach types; however sheltered rocky shores took precedence over marsh and tidal flats due to their rarity (ie. sheltered rocky shores > marsh /tidal flat > rocky > beaches)
- When marsh and tidal flats co-occurred, they were both retained as a combined "tidal flat / marsh" category
- Rocky cliffs took precedence over rocky platforms when they co-occurred as they were less common
- For beach types, the order of precedence for co-occurring types was: fine-medium grained > coarse > mixed > gravel, since fine-grained beaches tend to have associated communities that are more biodiverse and fine-grained beaches are important feeding grounds for many shorebirds
- Very rare combinations that were found in very few places were collapsed to the single rarer type (eg. "exposed rocky cliff / beach" in California was collapsed to "exposed rock cliff")

The following table provides the crosswalk of ESI types with the TNC shoreline types used as conservation targets:

ESI Shore Code (NOAA 2002)	ESI Classification	TNC Shoreline Type
1A	Exposed Rocky Cliffs	Exposed Rocky Cliff
1A/2A	Exposed Rocky Cliffs / Exposed wave cut platforms in bedrock	Exposed Rocky Cliff
1A/3	Exposed Rocky Cliffs / Fine- to Medium-Grained Sand Beaches	Exposed Rocky Cliff
1A/3A	Exposed Rocky Cliffs / Fine to medium grained sand beaches	Exposed Rocky Cliff
1A/4	Exposed Rocky Cliffs / Coarse-Grained Sand to Granule Beaches	Exposed Rocky Cliff
1A/4/9A	Exposed Rocky Cliffs / Coarse-Grained	Sheltered Tidal Flat

	Sand to Granule Beaches / Sheltered tidal flats	
1A/5	Exposed Rocky Cliffs / Mixed Sand and Gravel Beaches	Exposed Rocky Cliff
1A/5/7	Exposed Rocky Cliffs / Mixed Sand and Gravel Beaches / Exposed Tidal Flats	Exposed Tidal Flat
1A/6A	Exposed Rocky Cliffs / Exposed Tidal Flats	Exposed Tidal Flat
1A/6A/7	Exposed Rocky Cliffs / Exposed Tidal Flats / Exposed Tidal Flats	Exposed Tidal Flat
1A/6A/9A	Exposed Rocky Cliffs / Exposed Tidal Flats / Sheltered tidal flats	Exposed Tidal Flat
1A/6B	Exposed Rocky Cliffs / Riprap	Exposed Rocky Cliff
1A/7	Exposed Rocky Cliffs / Exposed Tidal Flats	Exposed Tidal Flat
1A/9A	Exposed Rocky Cliffs / Sheltered tidal flats	Sheltered Tidal Flat
1B	Exposed Seawall	Seawall (cost factor)
1B/10A	Exposed Seawall / Salt and brackish water marshes	Coastal Marsh
1B/10A/9A	Exposed Seawall / Salt and brackish water marshes / Sheltered tidal flats	Coastal Marsh and Tidal Flat
1B/3	Exposed Seawall / Fine- to Medium-Grained Sand Beaches	Fine to Medium Grained Sand Beach
1B/3A/9A	Exposed Seawall / Fine to medium grained sand beaches / Sheltered tidal flats	Sheltered Tidal Flat
1B/4	Exposed Seawall / Coarse-Grained Sand to Granule Beaches	Coarse Grained Sand Beach
1B/5	Exposed Seawall / Mixed Sand and Gravel Beaches	Mixed Sand and Gravel Beach
1B/6A	Exposed Seawall / Exposed Tidal Flats	Exposed Tidal Flat
1B/6A/9A	Exposed Seawall / Exposed Tidal Flats / Sheltered tidal flats	Exposed Tidal Flat
1B/6B	Exposed Seawall / Riprap	Seawall (cost factor)
1B/6B/4	Exposed Seawall / Riprap / Coarse-Grained Sand to Granule Beaches	Coarse Grained Sand Beach
1B/6B/9A	Exposed Seawall / Riprap / Sheltered tidal flats	Sheltered Tidal Flat
1B/9A	Exposed Seawall / Sheltered tidal flats	Sheltered Tidal Flat
1C	Exposed Rocky Cliffs / Boulder Talus Base	Exposed Rocky Cliff with Talus Boulder Base
2	Wave Cut Rocky Platforms	Exposed Wave Cut Rocky Platform
2/3	Wave Cut Rocky Platforms / Fine- to Medium-Grained Sand Beaches	Exposed Wave Cut Rocky Platform and Beach
2/5	Wave Cut Rocky Platforms / Mixed	Exposed Wave Cut Rocky Platform

	Sand and Gravel Beaches	and Beach
2A	Exposed wave cut platforms in bedrock	Exposed Wave Cut Rocky Platform
2A/3A	Exposed wave cut platforms in bedrock / Fine to medium grained sand beaches	Exposed Wave Cut Rocky Platform and Beach
2A/5	Exposed wave cut platforms in bedrock / Mixed Sand and Gravel Beaches	Exposed Wave Cut Rocky Platform and Beach
2A/9A	Exposed wave cut platforms in bedrock / Sheltered tidal flats	Sheltered Tidal Flat
3	Fine- to Medium-Grained Sand Beaches	Fine to Medium Grained Sand Beach
3/2	Fine- to Medium-Grained Sand Beaches / Wave Cut Rocky Platforms	Exposed Wave Cut Rocky Platform and Beach
3/5	Fine- to Medium-Grained Sand Beaches / Mixed Sand and Gravel Beaches	Fine to Medium Grained Sand Beach
3/7	Fine- to Medium-Grained Sand Beaches / Exposed Tidal Flats	Exposed Tidal Flat
3A	Fine to medium grained sand beaches	Fine to Medium Grained Sand Beach
3A/10A	Fine to medium grained sand beaches / Salt and brackish water marshes	Coastal Marsh
3A/2A	Fine to medium grained sand beaches / Exposed wave cut platforms in bedrock	Exposed Wave Cut Rocky Platform and Beach
3A/6A	Fine to medium grained sand beaches / Exposed Tidal Flats	Exposed Tidal Flat
3A/7	Fine to medium grained sand beaches / Exposed Tidal Flats	Exposed Tidal Flat
3A/8A	Fine to medium grained sand beaches / Sheltered Rocky Shores	Sheltered Rocky Shore
3A/9A	Fine to medium grained sand beaches / Sheltered tidal flats	Sheltered Tidal Flat
3B	Scarps and steep slopes in sand	Fine to Medium Grained Sand Beach
3B/10A	Scarps and steep slopes in sand / Salt and brackish water marshes	Coastal Marsh
3B/10A/9A	Scarps and steep slopes in sand/Salt and brackish water marshes / Sheltered tidal flats	Coastal Marsh and Tidal Flat
3B/2A/9A	Scarps and steep slopes in sand / Exposed wave cut platforms in bedrock / Sheltered tidal flats	Sheltered Tidal Flat
3B/3A/9A	Scarps and steep slopes in sand / Fine to medium grained sand beaches / Sheltered tidal flats	Sheltered Tidal Flat
3B/5	Scarps and steep slopes in sand / Mixed Sand and Gravel Beaches	Mixed Sand and Gravel Beach

3B/5/9A	Scarps and steep slopes in sand / Mixed Sand and Gravel Beaches / Sheltered tidal flats	Sheltered Tidal Flat
3B/6A	Scarps and steep slopes in sand / Exposed Tidal Flats	Exposed Tidal Flat
3B/6A/9A	Scarps and steep slopes in sand / Exposed Tidal Flats / Sheltered tidal flats	Exposed Tidal Flat
3B/6B/9A	Scarps and steep slopes in sand / Riprap / Sheltered tidal flats	Sheltered Tidal Flat
3B/9A	Scarps and steep slopes in sand / Sheltered tidal flats	Sheltered Tidal Flat
4	Coarse-Grained Sand to Granule Beaches	Coarse Grained Sand Beach
4/1A	Coarse-Grained Sand to Granule Beaches / Exposed Rocky Cliffs	Exposed Rocky Cliff
4/2	Coarse-Grained Sand to Granule Beaches / Wave Cut Rocky Platforms	Exposed Wave Cut Rocky Platform and Beach
4/2A	Coarse-Grained Sand to Granule Beaches / Exposed wave cut platforms in bedrock	Exposed Rocky Cliff
4/7	Coarse-Grained Sand to Granule Beaches / Exposed Tidal Flats	Exposed Tidal Flat
4/9	Coarse-Grained Sand to Granule Beaches / Sheltered Tidal Flats	Sheltered Tidal Flat
4/9A	Coarse-Grained Sand to Granule Beaches / Sheltered tidal flats	Sheltered Tidal Flat
5	Mixed Sand and Gravel Beaches	Mixed Sand and Gravel Beach
5/10A	Mixed Sand and Gravel Beaches / Salt and brackish water marshes	Coastal Marsh
5/2	Mixed Sand and Gravel Beaches / Wave Cut Rocky Platforms	Exposed Wave Cut Rocky Platform and Beach
5/2A	Mixed Sand and Gravel Beaches / Exposed wave cut platforms in bedrock	Exposed Wave Cut Rocky Platform and Beach
5/3	Mixed Sand and Gravel Beaches / Fine- to Medium-Grained Sand Beaches	Fine to Medium Grained Sand Beach
5/3A	Mixed Sand and Gravel Beaches / Fine to medium grained sand beaches	Fine to Medium Grained Sand Beach
5/7	Mixed Sand and Gravel Beaches / Exposed Tidal Flats	Exposed Tidal Flat
5/8	Mixed Sand and Gravel Beaches / Sheltered rocky shores	Sheltered Rocky Shore
5/8/9	Mixed Sand and Gravel Beaches / Sheltered rocky shores / Sheltered Tidal Flats	Sheltered Rocky Shore
5/8A	Mixed Sand and Gravel Beaches /	Sheltered Rocky Shore

	Sheltered Rocky Shores	
5/8A/9A	Mixed Sand and Gravel Beaches / Sheltered Rocky Shores / Sheltered tidal flats	Sheltered Rocky Shore
5/9	Mixed Sand and Gravel Beaches / Sheltered Tidal Flats	Sheltered Tidal Flat
5/9A	Mixed Sand and Gravel Beaches / Sheltered tidal flats	Sheltered Tidal Flat
6/9	Gravel beaches / Sheltered Tidal Flats	Sheltered Tidal Flat
6A	Gravel Beaches	Gravel Beach
6A/10A	Gravel Beaches / Salt and brackish water marshes	Coastal Marsh
6A/2	Gravel Beaches / Wave Cut Rocky Platforms	Exposed Wave Cut Rocky Platform and Beach
6A/2A	Gravel Beaches / Exposed wave cut platforms in bedrock	Exposed Wave Cut Rocky Platform and Beach
6A/3	Gravel Beaches / Fine- to Medium-Grained Sand Beaches	Fine to Medium Grained Sand Beach
6A/3A	Gravel Beaches / Fine to medium grained sand beaches	Fine to Medium Grained Sand Beach
6A/6B	Gravel Beaches / Riprap	Gravel Beach
6A/7	Gravel Beaches / Exposed Tidal Flats	Exposed Tidal Flat
6A/9A	Gravel Beaches / Sheltered tidal flats	Sheltered Tidal Flat
6B	Riprap	Riprap (cost factor)
6B/10A	Riprap / Salt and brackish water marshes	Coastal Marsh
6B/10A/9A	Riprap / Salt and brackish water marshes/Sheltered tidal flats	Coastal Marsh and Tidal Flat
6B/2	Riprap / Wave Cut Rocky Platforms	Exposed Wave Cut Rocky Platform
6B/2A	Riprap / Exposed wave cut platforms in bedrock	Exposed Wave Cut Rocky Platform
6B/3	Riprap / Fine- to Medium-Grained Sand Beaches	Fine to Medium Grained Sand Beach
6B/3/2	Riprap / Fine- to Medium-Grained Sand Beaches / Wave Cut Rocky Platforms	Exposed Wave Cut Rocky Platform and Beach
6B/3A	Riprap / Fine to medium grained sand beaches	Fine to Medium Grained Sand Beach
6B/3A/7	Riprap / Fine to medium grained sand beaches/Exposed Tidal Flats	Exposed Tidal Flat
6B/3A/9A	Riprap / Fine to medium grained sand beaches / Sheltered tidal flats	Sheltered Tidal Flat
6B/4	Riprap / Coarse-Grained Sand to Granule Beaches	Coarse Grained Sand Beach
6B/5	Riprap / Mixed Sand and Gravel Beaches	Mixed Sand and Gravel Beach

6B/6A	Riprap / Exposed Tidal Flats	Exposed Tidal Flat
6B/6A/9A	Riprap / Exposed Tidal Flats / Sheltered tidal flats	Exposed Tidal Flat
6B/7	Riprap / Exposed Tidal Flats	Exposed Tidal Flat
6B/9A	Riprap / Sheltered tidal flats	Sheltered Tidal Flat
7	Exposed Tidal Flats	Exposed Tidal Flat
7/10	Exposed Tidal Flats / Salt Marshes	Coastal Marsh and Tidal Flat
7/3A	Exposed Tidal Flats / Fine to medium grained sand beaches	Exposed Tidal Flat
8	Sheltered rocky shores	Sheltered Rocky Shore
8/5	Sheltered rocky shores / Mixed Sand and Gravel Beaches	Sheltered Rocky Shore
8/6	Sheltered rocky shores / Gravel beaches	Sheltered Rocky Shore
8/7	Sheltered rocky shores / Exposed Tidal Flats	Sheltered Rocky Shore
8/9	Sheltered rocky shores / Sheltered Tidal Flats	Sheltered Rocky Shore
8A	Sheltered Rocky Shores	Sheltered Rocky Shore
8A/3A	Sheltered Rocky Shores / Fine to medium grained sand beaches	Sheltered Rocky Shore
8A/5	Sheltered Rocky Shores / Mixed Sand and Gravel Beaches	Sheltered Rocky Shore
8A/5/9A	Sheltered Rocky Shores / Mixed Sand and Gravel Beaches / Sheltered tidal flats	Sheltered Rocky Shore
8A/6	Sheltered Rocky Shores / Gravel beaches	Sheltered Rocky Shore
8A/7	Sheltered Rocky Shores / Exposed Tidal Flats	Sheltered Rocky Shore
8A/9A	Sheltered Rocky Shores / Sheltered tidal flats	Sheltered Rocky Shore
8B	Sheltered Man-Made Structures	Seawall (cost factor)
8B/10A/9A	Sheltered Man-Made Structures / Salt and brackish water marshes / Sheltered tidal flats	Coastal Marsh and Tidal Flat
8B/7	Sheltered Man-Made Structures / Exposed Tidal Flats	Exposed Tidal Flat
8B/8C	Sheltered Man-Made Structures / Sheltered riprap	Riprap (cost factor)
8B/9A	Sheltered Man-Made Structures / Sheltered tidal flats	Sheltered Tidal Flat
8C	Sheltered riprap	Riprap
8C/10A	Sheltered riprap / Salt and brackish water marshes	Coastal Marsh
8C/10A/9A	Sheltered riprap / Salt and brackish water marshes / Sheltered tidal flats	Coastal Marsh and Tidal Flat

8C/3A	Sheltered riprap / Fine to medium grained sand beaches	Fine to Medium Grained Sand Beach
8C/8B	Sheltered riprap / Sheltered Man-Made Structures	Riprap (cost factor)
8C/9A	Sheltered riprap / Sheltered tidal flats	Sheltered Tidal Flat
9	Sheltered Tidal Flats	Sheltered Tidal Flat
9/10	Sheltered Tidal Flats / Salt Marshes	Coastal Marsh and Tidal Flat
9A	Sheltered tidal flats	Sheltered Tidal Flat
9A/10A	Sheltered tidal flats / Salt and brackish water marshes	Coastal Marsh and Tidal Flat
9B	Vegetated low riverine banks	Coastal Marsh
9B/10A	Vegetated low riverine banks / Salt and brackish water marshes	Coastal Marsh
9B/10A/9A	Vegetated low riverine banks / Salt and brackish water marshes / Sheltered tidal flats	Coastal Marsh and Tidal Flat
9B/6A	Vegetated low riverine banks / Exposed Tidal Flats	Exposed Tidal Flat
9B/9A	Vegetated low riverine banks / Sheltered tidal flats	Sheltered Tidal Flat
0/10A	Unknown / Salt and brackish water marshes	Coastal Marsh
10	Salt Marshes	Coastal Marsh
10/7	Salt Marshes / Exposed Tidal Flats	Coastal Marsh and Tidal Flat
10/9	Salt Marshes / Sheltered Tidal Flats	Coastal Marsh and Tidal Flat
10A	Salt and brackish water marshes	Coastal Marsh
10A/1B	Salt and brackish water marshes / Exposed Seawall	Coastal Marsh
10A/1B/9A	Salt and brackish water marshes / Exposed Seawall / Sheltered tidal flats	Coastal Marsh and Tidal Flat
10A/3A	Salt and brackish water marshes / Fine to medium grained sand beaches	Coastal Marsh
10A/3A/9A	Salt and brackish water marshes / Fine to medium grained sand beaches/Sheltered tidal flats	Coastal Marsh and Tidal Flat
10A/3B	Salt and brackish water marshes / Scarps and steep slopes in sand	Coastal Marsh
10A/3B/5	Salt and brackish water marshes / Scarps and steep slopes in sand / Mixed Sand and Gravel Beaches	Coastal Marsh
10A/3B/9A	Salt and brackish water marshes / Scarps and steep slopes in sand / Sheltered tidal flats	Coastal Marsh and Tidal Flat
10A/5	Salt and brackish water marshes / Mixed Sand and Gravel Beaches	Coastal Marsh
10A/5/9A	Salt and brackish water marshes /	Coastal Marsh and Tidal Flat

	Mixed Sand and Gravel Beaches / Sheltered tidal flats	
10A/6B	Salt and brackish water marshes / Riprap	Coastal Marsh
10A/6B/9A	Salt and brackish water marshes / Riprap / Sheltered tidal flats	Coastal Marsh and Tidal Flat
10A/7	Salt and brackish water marshes / Exposed Tidal Flats	Coastal Marsh and Tidal Flat
10A/8B	Salt and brackish water marshes / Sheltered Man-Made Structures	Coastal Marsh
10A/8B/9A	Salt and brackish water marshes / Sheltered Man-Made Structures / Sheltered tidal flats	Coastal Marsh and Tidal Flat
10A/8C	Salt and brackish water marshes / Sheltered riprap	Coastal Marsh
10A/8C/3A	Salt and brackish water marshes / Sheltered riprap / Fine to medium grained sand beaches	Coastal Marsh
10A/8C/9A	Salt and brackish water marshes / Sheltered riprap / Sheltered tidal flats	Coastal Marsh and Tidal Flat
10A/9A	Salt and brackish water marshes / Sheltered tidal flats	Coastal Marsh and Tidal Flat

Appendix V: Methods for Developing a Benthic Habitat Model for the Northern California Marine Ecoregion

In an effort to create a wall to wall surrogate for bottom type habitats we used bathymetric and substrate data to develop a benthic habitat model. This approach to modeling coarse scale habitats provides promise in areas of the world where comprehensive thematic mapping of the seafloor has not occurred. The primary input is bathymetry which is available (albeit sometimes at coarse scale) for most of the coastal areas of the world. Use of the benthic habitat model assumes that benthic habitat types can serve as a surrogate or coarse filter for the conservation of the majority of bottom-dwelling species in an ecoregion. In addition, the use of numerous benthic types as targets in the planning approach also assumes that there is a correlation between biodiversity and benthic habitat complexity. The benthic habitat model has not been validated nor have these assumptions been tested. The use of benthic habitats as conservation targets in the MARXAN model tends to focus our conservation areas around geographies with a high degree or variability amongst these benthic habitat types.

Methods

The benthic habitat model for the NCME was created using two sources of data: bathymetry and substrate type. From the bathymetric data two inputs are derived – topographic position index and depth ranges. Substrate types were mapped using existing data (Greene et al 1999). The derivation of the inputs and the development of the model are described below.

1. Bathymetry and derived inputs:

Bathymetry for the California marine environment was compiled by the California Department of Fish and Game. The dataset incorporates all the bathymetric mapping efforts in California, at a variety of scales. The version used in our analysis is dated August 7, 2000 and is ArcInfo GRID format. This grid file was made from 75 original tiled digital elevation models (DEM) that were put into one grid mosaic and resampled at a 200 meters scale of resolution. These DEM mosaics were produced by Teale Data Center from a contract with the Department of Fish and Game, funded by the Resources Agency.

Bathymetry was postclassified into two major inputs to the benthic habitat model – Topographic Position Index and Depth Ranges

1.1 Topographic Position Index.

The Topographic Position Index (TPI) compares the elevation of a given cell in a DEM to the mean elevation of a specified neighborhood around that cell. The units are meters above or below this neighborhood average. Since the only input required is a digital elevation model, it can be readily generated for most geographies (Weiss 2001)

The general formula was:

TPI<scale> = DEM – mean (DEM neighborhood at that scale).

Where DEM is a digital elevation model, and <scale> is the outer radius/distance of the neighborhood in map units.

Implemented in ESRI Arc/Info GRID, the formula became

TPI<scale> = DEM – focalmean (DEM, neighborhood shape, neighborhood size in cells)

For example, using a 30m DEM and a continuous circular neighborhood:

TPI150 = DEM – focalmean (DEM, circle, 5)

In the case of the California Current bathymetric data, an annulus (donut) neigborhood was used due to the large spatial scale ~200m. The annulus has the effect of de-emphasizing immediately surrounding cells and is most appropriate for the level of our data. After experimentation with multiple sizes of annuli, we chose a radius of 2000m or 10 cells. This sufficiently captured landscape distinctions at a level of detail appropriate for ecoregional scale analysis and the level of input data. The final formula implemented in ArcInfo GRID was:

TPI2000 = DEM – focalmean(int((DEM, annulus, 8, 10) + 0.5))

This represents a donut 10 cells wide, with an outer diameter of 10 * 200m = ~2000m and an inner diameter of 8 * 200m = 1600m. Using the "integerizing" function takes advantage of more efficient storage; we added 0.5 since the GRID int() function truncates the value.

Positive TPI values represent locations that are higher than the average of their surroundings, while negative TPI values represent locations that are lower than their surroundings. TPI values near zero are either flat areas, where the slope is near zero; or areas of constant slope, where the slope of the point is significantly greater than zero. (Weiss 2001)

The output of TPI is then postclassified via standard deviations and slope to create 4 discrete categories that approximate landscapes features:

Grid Value	Description	Breakpoints
40	ridge	> mean + 1 STDEV
20	slope	>= -1.0 STDEV , =< 1 STDV, slope >= 5 deg
30	flats	>= -0.5 STDV, =< 0.5 STDV , slope <= 5 deg
10	canyons	< -1.0 STDV

Using standard deviation units as the class thresholds guarantees (assuming a normal distribution of topographic position values) that a fixed proportion of the landscape will be assigned to each class, thus providing a relative measure of slope position. Implemented in ArcInfo GRID:

```
&sv g = TPI2000
&describe %g%
```

```
  &sv hbrk = [round [calc %GRD$MEAN% + %GRD$STDV%]]
  &sv mhbrk = [round [calc %hbrk% / 2]]
  &sv lbrk = [round [calc %GRD$MEAN% - %GRD$STDV%]]
  &sv mlbrk = [round [calc %lbrk% / 2]]

/* calculate slope position in 4 categories
  IF (%g% > %hbrk%) sp4_%g%  = 40
    ELSE IF (%g% >= %lbrk% and %g% <= %hbrk% and slopei > 5) sp4_%g% = 20
    ELSE IF (%g% >= %lbrk% and %g% <= %hbrk% and slopei <= 5) sp4_%g% = 30
    ELSE IF  (%g%  < %lbrk%) sp4_%g% = 10
  ENDIF
```

For more details see: Topographic Position Index (TPI) and Landforms Classification Working draft, Feb. 2001 Andrew Weiss, Indus Corp [or contact Andy Weiss at aweiss@tnc.org]

1.2 Depth Ranges

The output of the TPI model was then combined with specific depth ranges. Depth ranges were classified into four categories similar to Allen and Smith (1998). Those were refined with feedback from a panel of marine scientists convened for the review of a interim version of the ecoregional assessment held at the National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara California.

Depth ranges were as follows:

Grid Value	Class	Definition
200	Inner shelf	0-40m
300	Mid shelf	40-200m
400	Mesobenthal	200-700m
500	Bathybenthal	700-5000m

These depth ranges were implemented in ArcInfo GRID using the RECLASS function with the bathymetric DEM as input.

2. Substrate Types

Substrate or induration types we added to the benthic habitat model in an effort to add more bottom type specificity based on existing spatial data. Whereas the TPI and depth ranges are inferred from the bathymetric DEM and are available for the entire ecoregion, substrate types have been mapped thematically for roughly 11,054,305 of the 26,854,914 ha (41%) that make up both the Northern and Southern California Current marine ecoregions.

The California continental shelf geologic data set compiled and mapped by Gary Greene and others (Greene et al 1999), as updated for the Groundfish EFH-EIS process, incorporates available information on seafloor substrate types for the region. The data series is comprised of seven adjacent but discrete maps with boundaries of seafloor types depicted as polygon themes. This effort resulted in a digital version of continental shelf geology based on maps originally produced by the Division of Mines and Geology, the U.S. Geological Survey, and the California

Coastal Commission. The data covers the region from the Oregon border to Mexico and from the coastline to the edge of the continental shelf.

For the purposes of developing the benthic habitat model, only the BOTTOM field, which is a short description of bottom induration types, was used. The unique list of bottom types were crosswalked to integer values for incorporation into the benthic habitat model such that

Grid Value	Bottom
0	No Data
1	Hard
2	Soft

Original data were ESRI format shapefiles which were first crosswalked to numeric values, then converted to a GRID with a 200m cellsize, consistent with the bathymetric DEM data.

3. Creating the Benthic Habitat Model
The benthic habitat model was developed using three inputs including TPI, depth classes, and substrate type which were each assigned integer values:

TPI
40 = RIDGE
20 = SLOPE
30 = FLATS
10 = CANYON

DEPTH
200 = INNER_SHELF_0-40m
300 = MID_SHELD_40-200m
400 = MESOBENTHA_200-700m
500 = BATHYBENTHAL_700-5000m

SUBSTRATE
0 = NO_DATA
1 = HARD
2 = SOFT

Creating the benthic habitat model was simply a matter of adding all the inputs together resulting in all possible combinations of inputs represented as a single integer. For example

241 = INNER_SHELF_0-40m_RIDGE_HARD

Implemented in ArcInfo GRID:

EMU = TPI + DEPTH + SUBSTRATE

The resultant grid tracks all unique combinations of inputs resulting in 48 (4x4x3) unique benthic habitat types for the California Current marine ecoregion. Attribute values were stored in a look up table that tracks individual as well as combined values for each input such that the final GRID can be displayed on individual input types or other unique combinations. A final check was conducted to determine whether all 48 modeled benthic habitat types were present in the ecoregion; a few types were present but at < 100 total hectares and were removed as targets.

Appendix VI: Conservation Status of Species Level Targets

Taxonomic Group	Common Name	Scientific Name	Federal Legal Status [1]	State of California Legal Status[2]	Global / State Rank
Fish	Steelhead, South Central California Coast ESU	*Onchorhynchus mykiss*	FT	CSC	G5S2
	Steelhead, Central California Coast ESU	*O. mykiss*	FT	--	G5S2
	Steelhead, California Central Valley ESU	*O. mykiss*	FT	--	G5S2
	Steelhead, Northern California ESU	*O. mykiss*	FT	CSC	G5S2
	Coho, Central California Coast ESU	*O. kisutch*	FT	SE	G4S2?
	Coho Salmon, Southern Oregon / Northern California EUS	*O. kisutch*	FT	ST	G4S2?
	Chinook salmon, California Coastal ESU	*O. tshawytscha*	FT	--	G5S1

	Chinook salmon, Central Valley Spring-run ESU	*O. tshawytscha*	FT	ST	G5S1
	Chinook salmon, Central Valley Fall and Late-Fall Run ESU	*O. tshawytscha*	FSC	CSC	G5S2?
	Chinook salmon, Sacramento River Winter Run ESU	*O. tshawytscha*	FE	SE	G5S1
	Chinook salmon, Upper Klamath-Trinity Rivers ESU	*O. tshawytscha*	--	CSC	G5S1
	Delta smelt	*Hypomesus transpacificus*	FT	ST	G1S1
	Longfin smelt	*Spirinchus thaleichthys*	--	--	G5S1
	Green sturgeon	*Acipenser medirostris*	FC	CSC	G3S1S2
	Sacramento splittail	*Pogonichthys macrolepidotus*	--	CSC	G2S2
	Tidewater goby	*Eucyclogobius newberryi*	FPD	CSC	G3S2S3
Birds	Leach's storm-petrel	*Oceanodroma leucorhoa leucorhoa; O.l.beali*	--	--	--
	Ashy storm petrel	*Oceanodroma homochroa*	--	CSC	G2S2 (rookery sites)
	Fork-tailed storm petrel	*Oceanodroma furcata*	--	CSC	G5S1
	Western Gull	*Larus occidentalis*	--	--	--

	Caspian Tern	*Sterna caspia*	--	CSC	G5S4 (nesting colony)
	Forster's Tern	*Sterna foresteri*	--	--	G5S4 (nesting colony)
	California least tern	*Sterna antillarum browni*	FE	SE, CDFG Fully Protected	G4T2T3S2S3 (nesting colony)
	Common Murre	*Uria aalge*	--	--	--
	Pigeon Guillemot	*Cepphus columba*	--	--	--
	Xantus's murrelet	*Synthliboramphus hypoleucus*	--	ST	G3G4S3 (nesting colony)
	Cassin's auklet	*Ptychoramphus aleuticus*	--	--	G4S?
	Rhinoceros Auklet	*Cerorhinca monocerata*	--	CSC	G5S3
	Tufted Puffin	*Fratercula cirrhata*	--	CSC	G5S2
	Double-crested cormorant	*Phalacrocorax auritus*	--	CSC	G5S3 (rookery site)
	Brandt's Cormorant	*Phalacrocorax penicillatus*	--	--	--
	Pelagic Cormorant	*Phalacrocorax pelagicus*	--	--	--
	Black Oystercatcher	*Haematopus bachmani*	--	--	G5S2
	Western snowy plover	*Charadrius alexandrinus*	FT	CSC	G4T3S2
	California Clapper Rail	*Rallus longirostris obsoletus*	FE	SE, DFG fully protected	G5T1S1
	California Black Rail	*Laterallus jamaicensis coturniculus*	--	ST, DFG fully protected	G4T1S1
Mammals	Northern elephant seal	*Mirounga angustirostris*	MMPA	CDFG fully protected	--

	Northern fur seal	*Callorhinus ursinus*	MMPA	--	G3S1
	Harbor seal	*Phoca vitulina*	MMPA	--	--
	California sea lion	*Zalophus californianus*	MMPA	--	G3S2
	Steller Sea Lion	*Eumatopias jubatus*	MMPA	ST	--
	Southern Sea Otter	*Enhydra lutris nereis*	FT, MMPA	DFG fully protected	G4T2S2
	Salt marsh harvest mouse	*Reithrodontomys raviventris*	FE	SE, DFG fully protected	G1G2S1S2

Notes:

1. Legal status in U.S.: FT= Federal Threatened, FE = Federal Endangered, FPT = Federally Proposed (Threatened), FPD = Federally Proposed (Delisting), FC = Federal candidate, FSC= federal species of concern, MMPA = Marine Mammal Protection Act. (Sources: California Natural Diversity Database, Endangered and Threatened Animals List, January 2005; NMFS, Endangered Species Act Status of West Coast Salmon and Steelhead, June 14, 2004)
2. Legal status in California: ST = State Threatened, SE = State Endangered, CSC = State Candidate for Special Concern. (Source: California Natural Diversity Database, Endangered and Threatened Animals List, January 2005)
3. Global Rank (Source: California Natural Diversity Database, Special Animals List, August 2004).

Appendix VII: Target Conservation Goals Acheived in Ecoregional Portfolio

Benthic Habitats (Greene)

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Sedimentary Slope Canyon Wall	351891	20%	70378	39%	yes
Rocky Apron	32	30%	10	100%	yes
Sedimentary Slope Landslide	121384	20%	24277	14%	no
Sedimentary Slope Gully	393395	20%	78679	12%	no
Sedimentary Slope Canyon Floor	372907	20%	74581	25%	yes
Sedimentary Slope	4229313	20%	845863	19%	yes
Sedimentary Shelf Gully	34	30%	10	62%	yes
Sedimentary Shelf Canyon Wall	8255	30%	2477	100%	yes
Sedimentary Shelf Canyon Floor	98	30%	29	100%	yes
Sedimentary Shelf	2115498	20%	423100	30%	yes
Sedimentary Ridge	880715	20%	176143	22%	yes
Sedimentary Basin	370849	20%	74170	10%	no
Sedimentary Apron Landslide	10808	30%	3243	0%	no
Rocky Shelf	94092	30%	28228	65%	yes
Rocky Apron Canyon Wall	17	30%	5	102%	yes
Sedimentary Slope Gully Floor	33271	30%	9981	34%	yes
Sedimentary Apron Gully	59	30%	18	0%	no
Rocky Ridge	756774	20%	151355	37%	yes
Rocky Shelf Canyon Wall	5243	30%	1573	100%	yes
Rocky Slope	40442	30%	12133	34%	yes
Rocky Slope Canyon Wall	9354	30%	2806	62%	yes
Rocky Slope Gully	2672	30%	802	40%	yes
Rocky Slope Landslide	384	30%	115	100%	yes
Sedimentary Apron	594375	20%	118875	15%	no
Sedimentary Apron Canyon Floor	15534	30%	4660	20%	no
Sedimentary Apron Canyon Wall	38939	30%	11682	20%	no

1. Units vary (see appendix III)
2. Goals considered met at 90%

Benthic Habitats (modeled)

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Mesobenthal flat hard	151523	20%	30305	42%	yes
Mid shelf ridge soft	67029	30%	20109	70%	yes
Mid shelf canyon hard	2612	30%	784	91%	yes
Mesobenthal flat soft	1184092	20%	236818	23%	yes
Mesobenthal ridge hard	20983	30%	6295	51%	yes
Mesobenthal ridge soft	146106	20%	29221	45%	yes
Mesobenthal slope hard	6582	30%	1975	57%	yes
Mesobenthal slope soft	149049	20%	29810	46%	yes
Mesobenthal flat no data	48	30%	14	100%	yes
Mid shelf canyon no data	108	30%	32	58%	yes
Mid shelf canyon soft	2056	30%	617	98%	yes
Mid shelf flat hard	57766	30%	17330	52%	yes
Mid shelf flat no data	415	30%	124	38%	yes
Mid shelf flat soft	1642860	20%	328572	23%	yes
Mid shelf ridge no data	92	30%	28	100%	yes
Mid shelf slope hard	2121	30%	636	85%	yes
Mid shelf slope soft	9244	30%	2773	83%	yes
Mesobenthal canyon soft	79415	30%	23824	66%	yes
Bathybenthal slope soft	997047	20%	199409	22%	yes
Mid shelf ridge hard	9846	30%	2954	73%	yes
Bathybenthal flat no data	538272	20%	107654	12%	no
Bathybenthal canyon hard	104210	20%	20842	44%	yes
Bathybenthal canyon no data	52890	30%	15867	17%	no
Inner shelf canyon soft	17241	30%	5172	44%	yes
Bathybenthal flat hard	239804	20%	47961	20%	yes
Mesobenthal canyon hard	4782	30%	1435	74%	yes
Bathybenthal flat soft	3582939	15%	537441	11%	no
Bathybenthal ridge hard	137528	20%	27506	48%	yes
Bathybenthal Ridge no data	27121	30%	8136	22%	no
Bathybenthal ridge soft	510777	20%	102155	26%	yes
Bathybenthal slope no data	78843	30%	23653	17%	no
Inner shelf slope hard	48	30%	14	100%	yes
Inner shelf flat hard	39011	30%	11703	71%	yes
Inner shelf flat soft	445745	20%	89149	52%	yes
Inner shelf ridge hard	214	30%	64	100%	yes
Inner shelf ridge soft	10958	30%	3288	76%	yes
Inner shelf slope soft	8368	30%	2510	75%	yes
Bathybenthal slope hard	131837	20%	26367	44%	yes
Bathybenthal canyon soft	731434	20%	146287	29%	yes

1. Units vary (see appendix III)
2. Goals considered met at 90%

Biologically Significant Areas

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
High bathymetric complexity	1582991	30%	474897	37%	yes
Upwelling zone	1227974	30%	368392	43%	yes
Shelf-slope break	265667	30%	79700	37%	yes
Seamount	6	100%	6	100%	yes
Sand spit	11	30%	3	91%	yes
S.F. Bay tidal plume	10423	50%	5211	70%	yes
Off-shore rock or islet	12141	30%	3642	72%	yes
Off-shore bank	84743	50%	42372	76%	yes
Major submarine canyon	723	50%	362	85%	yes
Near-shore canyon head	38	50%	19	84%	yes

Estuarine

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Eelgrass bed	4257	50%	2128	91%	yes
Coastal marsh	42606	75%	31954	88%	yes
Large estuary	10175	50%	5087	100%	yes
Medium estuary or lagoon	5298	50%	2649	98%	yes
Mega estuary	128656	50%	64328	58%	yes
Small estuary or lagoon	2290	50%	1145	83%	yes
Coastal marsh (shoreline)	400	75%	300	92%	yes

Invertebrates

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Structure forming invertebrate	845	30%	253	38%	yes

Nearshore

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Kelp bed (2002)	5172	50%	2586	76%	yes
Persistent kelp bed (89-03)	1045	50%	523	79%	yes
Kelp bed (2003)	5202	50%	2601	85%	yes
Kelp bed (1999)	167	50%	84	93%	yes
Kelp bed (1989)	7831	50%	3915	75%	yes
Near-shore rocky reef	56343	50%	28171	72%	yes

Offshore

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Cold seep community	21	30%	6	100%	yes

Onshore

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Coastal dune	20180	30%	6054	72%	yes

1. Units vary (see appendix III)
2. Goals considered met at 90%

Shoreline Types

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Exposed tidal flat	61	30%	18	80%	yes
Tidal flat with salt marsh	1423	30%	427	80%	yes
Sheltered tidal flat	369	30%	111	62%	yes
Sheltered rocky shore	39	30%	12	101%	yes
Mixed sand and gravel beach	81	30%	24	74%	yes
Gravel beach	40	30%	12	82%	yes
Exposed wave cut rocky platform	397	30%	119	81%	yes
Exposed rocky cliff with talus boulder bas	36	30%	11	69%	yes
Exposed rocky cliff	211	30%	63	88%	yes
Coarse grained sand beach	133	30%	40	64%	yes
Fine to medium grained sand beach	508	30%	152	70%	yes
Exposed wave cut rocky platform with be	234	30%	70	64%	yes

Species (Birds)

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Western gull (colony)	35814	50%	17907	97%	yes
Xantu's murrelet (colony)	150	50%	75	100%	yes
Forester's tern (colony)	3908	50%	1954	98%	yes
Fork-tailed storm petrel (colony)	419	75%	314	100%	yes
Leaches storm petrel (colony)	10928	50%	5464	100%	yes
Pelagic cormorant (colony)	12619	50%	6310	84%	yes
Pigeon guillemot (colony)	13443	50%	6722	90%	yes
Tufted puffin (colony)	274	50%	137	93%	yes
Western snowy plover	62	75%	47	84%	yes
Clapper rail (occurrence)	69	75%	52	81%	yes
Rhinosaurus auklet (colony)	1703	50%	852	100%	yes
California black rail (habitat)	7194	75%	5395	88%	yes
Common murre (colony)	351336	50%	175668	94%	yes
Double-crested cormorant (colony)	6944	50%	3472	100%	yes
Ashy storm petrel (colony)	3895	75%	2921	100%	yes
Brandts cormorant (colony)	61172	50%	30586	92%	yes
California black rail (occurence)	48	75%	36	88%	yes
California least tern (colony)	205	75%	154	92%	yes
California least tern (occurence)	17	75%	13	82%	yes
Caspian tern (colony)	2134	50%	1067	57%	yes
Cassin's auklet (colony)	62881	50%	31441	100%	yes
Clapper rail (habitat)	9510	75%	7133	92%	yes
Black oystercatcher (colony)	712	75%	534	85%	yes

1. Units vary (see appendix III)
2. Goals considered met at 90%

Species (Fish)

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Night smelt	390	50%	195	33%	no
Longfin smelt	11614	75%	8711	88%	yes
Tidewater goby	8708	50%	4354	94%	yes
Surf smelt	466	50%	233	41%	no
Sacramento splittail	4005	75%	3004	93%	yes
Green sturgeon	49281	75%	36961	88%	yes
Delta smelt	18557	75%	13918	90%	yes
Coho stream outlet	39	75%	29	82%	yes
Chinook stream outlet	18	75%	14	89%	yes
Grunion	551	50%	275	62%	yes
Steelhead stream outlet	95	75%	71	83%	yes

Species (Mammals)

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Northern fur seal (rookery)	26	75%	20	100%	yes
Stellar sea lion (rookery)	837	75%	628	100%	yes
Stellar sea lion (haulout)	118	30%	35	85%	yes
Sea otter (medium density)	63386	50%	31693	68%	yes
Sea otter (low density)	70051	50%	35026	63%	yes
Sea otter (high density)	49658	50%	24829	77%	yes
Salt marsh harvest mouse (habitat)	7073	75%	5305	89%	yes
Northern elephant seal (rookery)	514	50%	257	100%	yes
Harbor seal (haulout)	19825	30%	5947	81%	yes
California sea lion (rookery)	2	75%	2	100%	yes
California sea lion (haulout)	383	30%	115	76%	yes
Salt marsh harvest mouse (occurance)	118	75%	89	82%	yes

Validation Target

Target Name	Total Amount(1)	Goal	Desired Amount(1)	% of Total Amount	Met Goal (2)
Top 20% seabird diversity	1144147	30%	343244	35%	yes
Top 20% demersal fish density	525496	30%	157649	49%	yes
Top 20% demersal fish diversity	543387	30%	163016	36%	yes
Top 20% seabird density	1061167	30%	318350	34%	yes

1. Units vary (see appendix III)
2. Goals considered met at 90%

Smith River - Point St. George

90.8 Square Miles

This area includes the Smith River and estuary, Castle Rock, St. George Reef, and Lake Earl and the coastal plain. Smith River is California's last wild large river and has important salmonid stocks. The Smith River has the finest steelhead run in the state and 47% of all coast cutthroat trout are found in this basin. Chinook and coho salmon are also found in the watershed, as well as tidewater goby in the Smith River estuary. St. George Reef is an extensive rocky shelf that extends out six miles from Pt. St. George; it is a pupping area for Stellar sea lions. Castle Rock (part of the Humboldt Bay NWR) has some of the most important bird colonies in the state with large colonies of rhinosaurus auklets, tufted puffins, common murres, Brandts cormorants, and fork-tailed storm petrels. Lake Earl and the associated coastal plain, which lies between the Smith River and Crescent City, includes beaches, the Tolawa coastal dune complex, lakes, wetlands, and coastal forests. Eleven miles of dune systems are found along the coast in this area. Lake Earl is the largest coastal lagoon in California and supports a diverse assemblage of fish and wildlife, including one of the largest tidewater goby population in California. The Lake Earl area has 5,000 acres of wetlands (including 2,300 acres of subtidal estuarine habitat, 1,600 acres of freshwater marshes, and 900 acres of flooded forest and scrub-shrub wetlands). Around the wetlands are shore pine and Sitka spruce forests. More than 250 species of birds use Lake Earl and it is an important stop on the Pacific Flyway for migrating waterfowl and shorebirds. The area is a key staging area for migrating Aleutian Canada goose. Much of the land in this area is public, including the Lake Earl Wildlife Area and Tolowa Dunes State Park. (Sources: TNC 2001; SRL and BLM, 2001)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	19450.7	0.9%
Benthic Habitats (modeled)	Inner shelf flat soft	13550.9	3.0%
Benthic Habitats (modeled)	Mid shelf flat soft	5944.0	0.4%
Biologically Significant Areas	Off-shore rock or islet	443.0	3.6%
Biologically Significant Areas	Upwelling zone	2634.8	0.2%
Estuarine	Medium estuary or lagoon	492.5	9.3%
Estuarine	Small estuary or lagoon	164.4	7.2%
Estuarine	Coastal marsh	337.6	0.8%
Estuarine	Coastal marsh (shoreline)	1.6	0.4%
Invertebrates	Structure forming invertebrate	3.0	0.4%
Nearshore	Near-shore rocky reef	2266.4	4.0%
Nearshore	Kelp bed (2003)	25.0	0.5%
Onshore	Coastal dune	2374.4	11.8%
Shoreline Types	Exposed tidal flat	9.1	14.7%
Shoreline Types	Gravel beach	2.5	6.2%
Shoreline Types	Mixed sand and gravel beach	3.4	4.1%
Shoreline Types	Fine to medium grained sand beach	18.0	3.5%
Shoreline Types	Exposed rocky cliff	6.1	2.9%
Shoreline Types	Coarse grained sand beach	3.5	2.6%
Shoreline Types	Exposed wave cut rocky platform with beach	3.1	1.3%
Species (Birds)	Rhinosaurus auklet (colony)	1007.0	59.1%
Species (Birds)	Tufted puffin (colony)	109.0	39.8%
Species (Birds)	Fork-tailed storm petrel (colony)	160.0	38.2%
Species (Birds)	Common murre (colony)	108318.0	30.8%
Species (Birds)	Double-crested cormorant (colony)	1114.0	16.0%
Species (Birds)	Leaches storm petrel (colony)	927.0	8.5%
Species (Birds)	Pelagic cormorant (colony)	1016.0	8.1%

*Contribution is Amount / Total in Ecoregion

Species (Birds)	Cassin's auklet (colony)	4749.0	7.6%
Species (Birds)	Pigeon guillemot (colony)	829.0	6.2%
Species (Birds)	Western gull (colony)	2128.0	5.9%
Species (Birds)	Black oystercatcher (colony)	40.0	5.6%
Species (Birds)	Brandts cormorant (colony)	3264.0	5.3%
Species (Birds)	Western snowy plover	2.0	3.2%
Species (Fish)	Tidewater goby	672.8	7.7%
Species (Fish)	Chinook stream outlet	1.0	5.6%
Species (Fish)	Coho stream outlet	2.0	5.1%
Species (Fish)	Green sturgeon	659.3	1.3%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Mammals)	Stellar sea lion (haulout)	15.0	12.7%
Species (Mammals)	California sea lion (haulout)	18.0	4.7%
Species (Mammals)	Harbor seal (haulout)	590.0	3.0%

NCC-2

91.5 Square Miles

This area offshore of the California-Oregon border includes a variety of soft bottom benthic habitats on the continental shelf; it was selected to meet representation goals so should be considered a provisional portfolio

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	18627.4	0.9%
Benthic Habitats (Greene)	Sedimentary Slope	2430.0	0.1%
Benthic Habitats (modeled)	Mid shelf flat soft	21790.1	1.3%
Benthic Habitats (modeled)	Mesobenthal flat soft	2685.9	0.2%
Benthic Habitats (modeled)	Mesobenthal slope soft	15.9	0.0%
Biologically Significant Areas	Upwelling zone	19014.7	1.5%
Biologically Significant Areas	Shelf-slope break	1650.9	0.6%
Invertebrates	Structure forming invertebrate	11.0	1.3%

NCC-3

37.2 Square Miles

This area far offshore of Crescent City includes a variety of deep sea soft and hard bottom habitats on the continental slope; it was selected to meet representation goals so should be considered a provisional portfolio.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	1896.0	0.5%
Benthic Habitats (Greene)	Sedimentary Slope Gully	1277.7	0.3%
Benthic Habitats (Greene)	Sedimentary Slope	7137.3	0.2%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	189.1	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge soft	2675.7	0.5%
Benthic Habitats (modeled)	Bathybenthal slope soft	3219.3	0.3%
Benthic Habitats (modeled)	Bathybenthal canyon soft	818.3	0.1%
Benthic Habitats (modeled)	Bathybenthal flat soft	3786.6	0.1%
Biologically Significant Areas	High bathymetric complexity	1608.7	0.1%
Invertebrates	Structure forming invertebrate	31.0	3.7%

*Contribution is Amount / Total in Ecoregion

Klamath River and Estuary

8.8 Square Miles

Located in Del Norte county, the Klamath River is the State's third largest river, extending 200 miles from its mouth to the Oregon border. The river is of high regional importance as a salmonid run (king, coho, silver, and steelhead trout), but salmon stocks have declined due to water diversion and dams. The Klamath estuary is known for its large shifting sandbars and broad estuary. Because of the abundance of fish, the mouth of the estuary is also a feeding area for marine mammals. The PCA also includes False Klamath rocks, second in importance to Castle Rock for common murres. (Sources: TNC 2001; http://www.fws.gov/endangered/klamath.html)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	1865.0	0.1%
Benthic Habitats (modeled)	Inner shelf canyon soft	498.8	2.9%
Benthic Habitats (modeled)	Inner shelf slope soft	148.5	1.8%
Benthic Habitats (modeled)	Inner shelf flat soft	1244.9	0.3%
Biologically Significant Areas	Off-shore rock or islet	23.0	0.2%
Estuarine	Small estuary or lagoon	239.0	10.4%
Estuarine	Coastal marsh (shoreline)	6.4	1.6%
Shoreline Types	Gravel beach	6.0	14.9%
Shoreline Types	Mixed sand and gravel beach	6.8	8.4%
Shoreline Types	Coarse grained sand beach	2.6	1.9%
Shoreline Types	Exposed rocky cliff	1.0	0.5%
Shoreline Types	Fine to medium grained sand beach	1.0	0.2%
Species (Birds)	Common murre (colony)	43898.0	12.5%
Species (Birds)	Double-crested cormorant (colony)	328.0	4.7%
Species (Birds)	Brandts cormorant (colony)	1122.0	1.8%
Species (Birds)	Black oystercatcher (colony)	11.0	1.5%
Species (Birds)	Pelagic cormorant (colony)	190.0	1.5%
Species (Birds)	Tufted puffin (colony)	4.0	1.5%
Species (Birds)	Pigeon guillemot (colony)	153.0	1.1%
Species (Birds)	Western gull (colony)	134.0	0.4%
Species (Birds)	Rhinosaurus auklet (colony)	1.0	0.1%
Species (Fish)	Chinook stream outlet	1.0	5.6%
Species (Fish)	Coho stream outlet	2.0	5.1%
Species (Fish)	Night smelt	7.5	1.9%
Species (Fish)	Surf smelt	7.5	1.6%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Fish)	Green sturgeon	211.0	0.4%
Species (Mammals)	Stellar sea lion (haulout)	2.0	1.7%
Species (Mammals)	California sea lion (haulout)	5.0	1.3%
Species (Mammals)	Harbor seal (haulout)	15.0	0.1%

NCC-5

50.4 Square Miles

This area is located offshore from the Humboldt Lagoons and includes a variety of soft-bottom habitats around the shelf-slope break; it was selected to meet representation goals so should be considered a provisional portfolio.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	5679.5	1.6%
Benthic Habitats (Greene)	Sedimentary Shelf	7290.3	0.3%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	683.7	0.2%
Benthic Habitats (Greene)	Sedimentary Slope Gully	344.7	0.1%
Benthic Habitats (modeled)	Mesobenthal flat soft	5985.7	0.5%
Benthic Habitats (modeled)	Mid shelf flat soft	7056.3	0.4%
Benthic Habitats (modeled)	Mesobenthal slope soft	332.1	0.2%
Benthic Habitats (modeled)	Bathybenthal flat soft	495.5	0.0%
Benthic Habitats (modeled)	Bathybenthal canyon soft	60.4	0.0%
Benthic Habitats (modeled)	Bathybenthal slope soft	70.0	0.0%
Biologically Significant Areas	Shelf-slope break	2080.8	0.8%
Invertebrates	Structure forming invertebrate	9.0	1.1%

Humboldt Lagoons

49.2 Square Miles

The Humboldt Lagoons PCA includes the Redwood Creek watershed and a chain of lagoons along the coast(Freshwater, Stone, Dry, and Big Lagoons). The lagoons support populations of tidewater gobies and anadramous fish (coho, chinook, and steelhead) although upstream sedimentation, artificial breaching of the bars, introduced species, and barriers to fish migration are adversely affecting these species. Redwood Creek is an important anadramous fish stream and supports a large number of juvenile chinook salmon, as well as coast cutthroat trout and summer steelhead. There are several large offshore rocks in the area including Flatiron and Green rocks (largest common murre colony) and Little River rock (the largest storm petrel colony in state). Inner-shelf and mid-shelf hard and soft bottom communities are found just offshore in the PCA. There is some existing protection in this PCA including Redwood National and State Parks and Humboldt Lagoons State Park. Simpson Timber Company and Big Lagoon Rancheria, and small private interests also own parts of the Redwood Creek watershed. Patrick's Point State Park and the rocky headlands of Trinidad Head are also in this PCA (Sources: SRL and BLM, 2001; TNC 2001).

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	3120.9	3.3%
Benthic Habitats (Greene)	Sedimentary Shelf	7490.8	0.4%
Benthic Habitats (modeled)	Mid shelf canyon hard	1812.5	69.4%
Benthic Habitats (modeled)	Mid shelf slope hard	624.0	29.4%
Benthic Habitats (modeled)	Inner shelf ridge soft	332.0	3.0%
Benthic Habitats (modeled)	Mid shelf slope soft	156.0	1.7%
Benthic Habitats (modeled)	Inner shelf flat soft	5875.2	1.3%
Benthic Habitats (modeled)	Inner shelf slope soft	96.0	1.1%
Benthic Habitats (modeled)	Mid shelf flat hard	649.0	1.1%
Benthic Habitats (modeled)	Inner shelf canyon soft	36.0	0.2%
Benthic Habitats (modeled)	Mid shelf flat soft	1056.3	0.1%
Biologically Significant Areas	Off-shore rock or islet	398.0	3.3%
Biologically Significant Areas	Upwelling zone	1296.4	0.1%
Estuarine	Small estuary or lagoon	265.8	11.6%
Estuarine	Medium estuary or lagoon	503.4	9.5%
Estuarine	Coastal marsh	112.0	0.3%
Nearshore	Near-shore rocky reef	3120.9	5.5%
Onshore	Coastal dune	127.1	0.6%
Shoreline Types	Exposed rocky cliff	11.7	5.6%
Shoreline Types	Exposed wave cut rocky platform with beach	8.4	3.6%
Shoreline Types	Coarse grained sand beach	4.6	3.5%
Shoreline Types	Gravel beach	1.3	3.3%
Shoreline Types	Exposed tidal flat	1.8	2.9%
Shoreline Types	Fine to medium grained sand beach	13.7	2.7%

*Contribution is Amount / Total in Ecoregion

Shoreline Types	Mixed sand and gravel beach	1.4	1.7%
Shoreline Types	Exposed wave cut rocky platform	1.1	0.3%
Species (Birds)	Leaches storm petrel (colony)	8487.0	77.7%
Species (Birds)	Fork-tailed storm petrel (colony)	259.0	61.8%
Species (Birds)	Common murre (colony)	73618.0	21.0%
Species (Birds)	Tufted puffin (colony)	38.0	13.9%
Species (Birds)	Double-crested cormorant (colony)	771.0	11.1%
Species (Birds)	Black oystercatcher (colony)	48.0	6.7%
Species (Birds)	Pelagic cormorant (colony)	692.0	5.5%
Species (Birds)	Pigeon guillemot (colony)	277.0	2.1%
Species (Birds)	Rhinosaurus auklet (colony)	34.0	2.0%
Species (Birds)	Brandts cormorant (colony)	1197.0	2.0%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Western gull (colony)	552.0	1.5%
Species (Birds)	Cassin's auklet (colony)	84.0	0.1%
Species (Fish)	Chinook stream outlet	2.0	11.1%
Species (Fish)	Tidewater goby	828.1	9.5%
Species (Fish)	Coho stream outlet	2.0	5.1%
Species (Fish)	Surf smelt	20.6	4.4%
Species (Fish)	Green sturgeon	869.5	1.8%
Species (Mammals)	Stellar sea lion (haulout)	22.0	18.6%
Species (Mammals)	California sea lion (haulout)	31.0	8.1%
Species (Mammals)	Harbor seal (haulout)	485.0	2.4%

Humboldt Bay

101.8 Square Miles

Humboldt Bay PCA includes the Humboldt - Arcata Bay and estuary complex. Humboldt Bay is the second largest estuary in California, after San Francisco Bay. It contains a diverse mixture of habitats including tidal marsh (salt and brackish), freshwater marsh, tidal flats, tidal channels and sloughs, open water, and eelgrass beds. The eelgrass beds in the bay are the most extensive in the state and provide habitat or forage for numerous species of fish, invertebrates, and waterfowl. Humboldt Bay is a critical stop for migratory waterfowl, including black brants geese. The bay habitats support at least 141 invertebrate species, 110 fish species, and 251 bird species. Humboldt Bay is important for Dungeness crab juveniles and migrating salmonids moving up freshwater tributaries to Humboldt Bay (eg. Elk Creek). The coastal dune systems along the north and south spit contain approximately 1600 acres of open dunes, vegetated dunes, and dune forests and are some of the least disturbed on the west coast (eg. Lanphere Dunes). The nearby Mad River Estuary is important for Dungeness crab and salmonids. Much of the dunes are in public lands while the wetlands around the bay are both private and public lands. The upper watersheds are heavily forested but primarily owned by private timber companies.
(Sources: SRL and BLM 2001; TNC 2001)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	19318.6	0.9%
Benthic Habitats (modeled)	Inner shelf flat soft	18703.3	4.2%
Benthic Habitats (modeled)	Mid shelf flat soft	769.3	0.0%
Biologically Significant Areas	Sand spit	3.0	27.3%
Biologically Significant Areas	Upwelling zone	8345.1	0.7%
Biologically Significant Areas	Off-shore rock or islet	1.0	0.0%
Estuarine	Large estuary	7128.8	70.1%
Estuarine	Eelgrass bed	1062.1	25.0%
Estuarine	Coastal marsh (shoreline)	37.4	9.3%
Estuarine	Coastal marsh	1799.8	4.2%

*Contribution is Amount / Total in Ecoregion

Estuarine	Small estuary or lagoon	64.2	2.8%
Onshore	Coastal dune	2216.9	11.0%
Shoreline Types	Sheltered tidal flat	67.6	18.3%
Shoreline Types	Exposed tidal flat	10.8	17.6%
Shoreline Types	Fine to medium grained sand beach	39.4	7.8%
Shoreline Types	Tidal flat with salt marsh	45.5	3.2%
Species (Birds)	Western snowy plover	5.0	8.1%
Species (Birds)	Double-crested cormorant (colony)	380.0	5.5%
Species (Birds)	Clapper rail (occurrence)	2.0	2.9%
Species (Fish)	Tidewater goby	5142.2	59.0%
Species (Fish)	Chinook stream outlet	5.0	27.8%
Species (Fish)	Coho stream outlet	4.0	10.3%
Species (Fish)	Green sturgeon	3394.3	6.9%
Species (Fish)	Steelhead stream outlet	2.0	2.1%
Species (Mammals)	Harbor seal (haulout)	1465.0	7.4%

Eel River Estuary

33.5 Square Miles

The Eel River estuary is at the mouth of one of the north coast's largest rivers which drains 3,600 miles and forms a delta where it meets the sea. The estuary includes freshwater, brackish, and salt marshes, tidal sloughs and channels, and open water habitats. Along the coastal strand are dune systems and coastal forest (Sitka spruce). The flood plain at the mouth extends for 33,000 acres. The estuary supports dozens of species of fish including longfin smelt, green sturgeon, coho and chinook salmon, steelhead, and Pacific lamprey. The estuary is also important for Dungeness crabs. The open water and marsh habitats are a critical stop on the Pacific Flyway for many species of waterfowl and shorebirds. The delta has one of the largest populations of Western Snowy Plover on the North Coast. The intensive logging upstream has resulted in significant deposition of sediment in the estuary that has adversely impacted ecosystem function and populations of anadramous and estuarine-dependent fish. Within the Eel River delta, there are 2,000 acres of public lands, primarily managed by CDFG (Table Bluff Ecological Reserve and the Eel River Wildlife Area). The coastline area north and south of the Eel River estuary are primarily in private land ownership
(Sources: SRL and BLM, 2001; TNC 2001).

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	5009.3	0.2%
Benthic Habitats (modeled)	Inner shelf flat soft	5021.8	1.1%
Biologically Significant Areas	Sand spit	2.0	18.2%
Biologically Significant Areas	Upwelling zone	3283.5	0.3%
Estuarine	Medium estuary or lagoon	1008.4	19.0%
Estuarine	Eelgrass bed	478.5	11.2%
Estuarine	Coastal marsh (shoreline)	30.4	7.6%
Estuarine	Coastal marsh	1884.2	4.4%
Onshore	Coastal dune	284.5	1.4%
Shoreline Types	Exposed tidal flat	4.8	7.8%
Shoreline Types	Sheltered tidal flat	12.6	3.4%
Shoreline Types	Fine to medium grained sand beach	11.5	2.3%
Shoreline Types	Tidal flat with salt marsh	6.7	0.5%
Species (Fish)	Tidewater goby	522.5	6.0%
Species (Fish)	Chinook stream outlet	1.0	5.6%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Fish)	Green sturgeon	478.5	1.0%

*Contribution is Amount / Total in Ecoregion

Species (Mammals)	Harbor seal (haulout)	17.0	0.1%

Cape Mendocino

1,088. Square Miles

Cape Mendocino is a major upwelling center with strong jets moving cold water offshore over the Mendocino/Gorda escarpment. The Mendocino/Gorda escarpement is a rocky ridge complex that extends far offshore to the bottom of the continental slope. It is a geologically active area where 3 continental plates converge and numerous cold methane seeps can be found. Recent studies have identified unique multi-species deepsea spawning aggregations in areas on the Gorda escarpment where the highest densities of fish and octopi have been found in the deep sea. The spawning aggregations are found on areas of high local topography near cold methane seeps. This large PCA also includes submarine canyons: Eel canyon (which has a broad head over 5 miles wide with multiple tributaries), Mendocino canyon, and Mattole canyon. A variety of hard and soft bottom habitats and areas of high bathymetric complexity are found in this PCA. In the near-shore, Blunts reef is a large shallow reef just off of Cape Mendocino. The near-shore includes extensive bull kelp beds and rocky intertidal shores. This PCA also includes the Mattole River estuary. The upper Mattole watershed is the some of the best coho habitat left in the region; the Mattole also supports chinook, steelhead foothill yellow-legged frog, tailed frog and southern torrent salamander. (Sources: TNC 2001; SRL and BLM, 2001; Drazen et al 2003).

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Apron Canyon Floor	2353.3	15.1%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	30591.1	8.7%
Benthic Habitats (Greene)	Sedimentary Slope Gully	33341.8	8.5%
Benthic Habitats (Greene)	Sedimentary Apron	36188.8	6.1%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	21445.4	5.8%
Benthic Habitats (Greene)	Rocky Slope Canyon Wall	344.8	3.7%
Benthic Habitats (Greene)	Rocky Shelf	3448.4	3.7%
Benthic Habitats (Greene)	Rocky Ridge	26419.4	3.5%
Benthic Habitats (Greene)	Sedimentary Shelf	51080.7	2.4%
Benthic Habitats (Greene)	Sedimentary Slope	76870.3	1.8%
Benthic Habitats (Greene)	Rocky Slope	234.0	0.6%
Benthic Habitats (modeled)	Mesobenthal ridge hard	4684.6	22.3%
Benthic Habitats (modeled)	Mid shelf canyon soft	344.0	16.7%
Benthic Habitats (modeled)	Mid shelf ridge soft	8832.1	13.2%
Benthic Habitats (modeled)	Mid shelf slope soft	1015.9	11.0%
Benthic Habitats (modeled)	Mesobenthal slope hard	662.2	10.1%
Benthic Habitats (modeled)	Mesobenthal ridge soft	13541.2	9.3%
Benthic Habitats (modeled)	Mesobenthal canyon soft	6220.0	7.8%
Benthic Habitats (modeled)	Bathybenthal canyon hard	7258.9	7.0%
Benthic Habitats (modeled)	Mesobenthal slope soft	7830.1	5.3%
Benthic Habitats (modeled)	Bathybenthal slope hard	6421.2	4.9%
Benthic Habitats (modeled)	Mid shelf flat hard	2417.6	4.2%
Benthic Habitats (modeled)	Inner shelf canyon soft	701.7	4.1%
Benthic Habitats (modeled)	Bathybenthal canyon soft	29412.0	4.0%
Benthic Habitats (modeled)	Mesobenthal canyon hard	192.0	4.0%
Benthic Habitats (modeled)	Bathybenthal ridge soft	20429.4	4.0%
Benthic Habitats (modeled)	Inner shelf slope soft	282.9	3.4%
Benthic Habitats (modeled)	Bathybenthal ridge hard	4454.6	3.2%
Benthic Habitats (modeled)	Bathybenthal slope soft	28458.0	2.9%
Benthic Habitats (modeled)	Inner shelf flat hard	1085.5	2.8%
Benthic Habitats (modeled)	Mesobenthal flat soft	27357.6	2.3%
Benthic Habitats (modeled)	Bathybenthal flat soft	69371.5	1.9%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Inner shelf flat soft	8382.4	1.9%
Benthic Habitats (modeled)	Mid shelf flat soft	29715.2	1.8%
Benthic Habitats (modeled)	Mesobenthal flat hard	1501.3	1.0%
Benthic Habitats (modeled)	Bathybenthal flat hard	1682.6	0.7%
Biologically Significant Areas	Major submarine canyon	87.8	12.1%
Biologically Significant Areas	Near-shore canyon head	3.0	7.9%
Biologically Significant Areas	High bathymetric complexity	90460.2	5.7%
Biologically Significant Areas	Shelf-slope break	11246.4	4.2%
Biologically Significant Areas	Off-shore rock or islet	406.0	3.3%
Biologically Significant Areas	Upwelling zone	37431.5	3.0%
Estuarine	Small estuary or lagoon	40.3	1.8%
Invertebrates	Structure forming invertebrate	66.0	7.8%
Nearshore	Kelp bed (1999)	3.6	2.2%
Nearshore	Kelp bed (2002)	2.3	0.0%
Shoreline Types	Coarse grained sand beach	11.2	8.4%
Shoreline Types	Exposed tidal flat	2.7	4.3%
Shoreline Types	Gravel beach	1.3	3.3%
Shoreline Types	Exposed rocky cliff	4.8	2.3%
Shoreline Types	Exposed wave cut rocky platform with beach	2.5	1.1%
Shoreline Types	Exposed wave cut rocky platform	1.8	0.5%
Shoreline Types	Fine to medium grained sand beach	1.5	0.3%
Species (Birds)	Pelagic cormorant (colony)	646.0	5.1%
Species (Birds)	Double-crested cormorant (colony)	274.0	3.9%
Species (Birds)	Common murre (colony)	9163.0	2.6%
Species (Birds)	Tufted puffin (colony)	4.0	1.5%
Species (Birds)	Brandts cormorant (colony)	814.0	1.3%
Species (Birds)	Pigeon guillemot (colony)	173.0	1.3%
Species (Birds)	Western gull (colony)	334.0	0.9%
Species (Birds)	Black oystercatcher (colony)	3.0	0.4%
Species (Birds)	Rhinosaurus auklet (colony)	7.0	0.4%
Species (Fish)	Chinook stream outlet	1.0	5.6%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Mammals)	Stellar sea lion (haulout)	30.0	25.4%
Species (Mammals)	California sea lion (haulout)	42.0	11.0%
Species (Mammals)	Harbor seal (haulout)	224.0	1.1%

Off-Shore Mendocino Escarpment

294.5 Square Miles

Further offshore from the Cape Mendocino PCA is the deeper portion of the Mendocino escarpment that includes areas of high bathymetrically complex, and hard and soft-bottom bathybenthal habitats. This area is relatively unexplored.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Ridge	25457.2	3.4%
Benthic Habitats (Greene)	Sedimentary Apron	16734.3	2.8%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	5296.5	1.4%
Benthic Habitats (modeled)	Bathybenthal ridge hard	8539.3	6.2%
Benthic Habitats (modeled)	Bathybenthal Ridge no data	1606.8	5.9%
Benthic Habitats (modeled)	Bathybenthal flat hard	12505.3	5.2%
Benthic Habitats (modeled)	Bathybenthal flat no data	23443.1	4.4%
Benthic Habitats (modeled)	Bathybenthal canyon no data	2233.2	4.2%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Bathybenthal slope no data	2243.9	2.8%
Benthic Habitats (modeled)	Bathybenthal slope hard	2848.9	2.2%
Benthic Habitats (modeled)	Bathybenthal canyon hard	1574.6	1.5%
Benthic Habitats (modeled)	Bathybenthal canyon soft	4278.1	0.6%
Benthic Habitats (modeled)	Bathybenthal flat soft	17037.6	0.5%
Benthic Habitats (modeled)	Bathybenthal slope soft	684.0	0.1%
Biologically Significant Areas	High bathymetric complexity	13187.4	0.8%

Delgada - Spanish canyons

217.0 Square Miles

Delgada Canyon and Spanish Canyon both have their heads very close to shore, near-shore canyon heads are relatively rare on the north coast. This is an area of high bathymetric complexity and the PCA includes the shelf-slope break. The near-shore includes bull kelp beds and soft and hard-bottom substrates.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	16476.5	4.7%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	10369.0	2.8%
Benthic Habitats (Greene)	Sedimentary Shelf	15720.4	0.7%
Benthic Habitats (Greene)	Sedimentary Slope	14328.9	0.3%
Benthic Habitats (modeled)	Mid shelf canyon soft	468.0	22.8%
Benthic Habitats (modeled)	Inner shelf canyon soft	1881.9	10.9%
Benthic Habitats (modeled)	Mid shelf slope soft	656.4	7.1%
Benthic Habitats (modeled)	Mesobenthal canyon soft	4259.9	5.4%
Benthic Habitats (modeled)	Mid shelf ridge soft	2703.8	4.0%
Benthic Habitats (modeled)	Mesobenthal ridge soft	3631.2	2.5%
Benthic Habitats (modeled)	Mesobenthal slope soft	2772.8	1.9%
Benthic Habitats (modeled)	Bathybenthal canyon soft	6496.2	0.9%
Benthic Habitats (modeled)	Mid shelf flat soft	8050.6	0.5%
Benthic Habitats (modeled)	Bathybenthal slope soft	4174.4	0.4%
Benthic Habitats (modeled)	Inner shelf flat soft	1866.2	0.4%
Benthic Habitats (modeled)	Mesobenthal flat soft	4867.6	0.4%
Benthic Habitats (modeled)	Bathybenthal flat soft	13207.1	0.4%
Benthic Habitats (modeled)	Bathybenthal ridge soft	1803.2	0.4%
Biologically Significant Areas	Major submarine canyon	53.2	7.4%
Biologically Significant Areas	Near-shore canyon head	2.0	5.3%
Biologically Significant Areas	Upwelling zone	40316.7	3.3%
Biologically Significant Areas	Shelf-slope break	3036.8	1.1%
Biologically Significant Areas	High bathymetric complexity	9476.7	0.6%
Biologically Significant Areas	Off-shore rock or islet	16.0	0.1%
Invertebrates	Structure forming invertebrate	28.0	3.3%
Nearshore	Kelp bed (1999)	19.0	11.4%
Nearshore	Kelp bed (2002)	6.5	0.1%
Nearshore	Kelp bed (2003)	2.1	0.0%
Nearshore	Kelp bed (1989)	1.5	0.0%
Shoreline Types	Mixed sand and gravel beach	6.0	7.4%
Shoreline Types	Gravel beach	1.9	4.6%
Shoreline Types	Coarse grained sand beach	1.5	1.1%
Shoreline Types	Exposed wave cut rocky platform with beach	2.6	1.1%
Species (Mammals)	California sea lion (haulout)	3.0	0.8%
Species (Mammals)	Harbor seal (haulout)	34.0	0.2%

*Contribution is Amount / Total in Ecoregion

Cape Vizcaino

11.6 Square Miles

Cape Vizcaino has important bird colonies, including Brandt's cormorant and common murre colonies. The near-shore includes rocky reefs and kelp beds.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	3194.7	0.2%
Benthic Habitats (modeled)	Inner shelf slope soft	85.6	1.0%
Benthic Habitats (modeled)	Inner shelf canyon soft	81.6	0.5%
Benthic Habitats (modeled)	Inner shelf flat soft	910.7	0.2%
Benthic Habitats (modeled)	Mid shelf flat soft	2114.3	0.1%
Biologically Significant Areas	Off-shore rock or islet	38.0	0.3%
Biologically Significant Areas	Upwelling zone	128.5	0.0%
Nearshore	Kelp bed (1989)	8.2	0.1%
Shoreline Types	Mixed sand and gravel beach	1.1	1.3%
Shoreline Types	Exposed rocky cliff	2.7	1.3%
Shoreline Types	Exposed wave cut rocky platform with beach	2.8	1.2%
Species (Birds)	Brandts cormorant (colony)	2545.0	4.2%
Species (Birds)	Common murre (colony)	8474.0	2.4%
Species (Birds)	Pelagic cormorant (colony)	179.0	1.4%
Species (Birds)	Pigeon guillemot (colony)	75.0	0.6%
Species (Birds)	Black oystercatcher (colony)	3.0	0.4%
Species (Birds)	Western gull (colony)	74.0	0.2%
Species (Birds)	Rhinosaurus auklet (colony)	3.0	0.2%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Fish)	Surf smelt	3.3	0.7%
Species (Mammals)	Harbor seal (haulout)	66.0	0.3%
Species (Mammals)	California sea lion (haulout)	1.0	0.3%

Vizcaino Canyon

265.7 Square Miles

Vizcaino canyon is a deep offshore canyon dominated by extensive soft-bottom habitats and areas of high bathymetric complexity.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	7368.1	2.0%
Benthic Habitats (Greene)	Sedimentary Slope	10724.2	0.3%
Benthic Habitats (modeled)	Bathybenthal Ridge no data	2344.4	8.6%
Benthic Habitats (modeled)	Bathybenthal flat no data	40869.0	7.6%
Benthic Habitats (modeled)	Bathybenthal slope no data	5407.4	6.9%
Benthic Habitats (modeled)	Bathybenthal canyon no data	3373.5	6.4%
Benthic Habitats (modeled)	Bathybenthal canyon soft	6126.0	0.8%
Benthic Habitats (modeled)	Bathybenthal ridge soft	2697.8	0.5%
Benthic Habitats (modeled)	Bathybenthal slope soft	2688.4	0.3%
Benthic Habitats (modeled)	Bathybenthal flat soft	6491.9	0.2%
Biologically Significant Areas	Major submarine canyon	53.5	7.4%
Biologically Significant Areas	High bathymetric complexity	8265.3	0.5%

*Contribution is Amount / Total in Ecoregion

Noyo River and Canyon

351.6 Square Miles

Located in Mendocino county, the Noyo River meets the ocean at Fort Bragg. Three miles north of Fort Bragg is Mackerricher State Park, an important coastal park with a variety of habitats such as beach bluff, dune, headland forest and wetland. Marine mammals are abundant in this area. Coho and Chinook salmon, and steelhead are found in the coastal streams. Sea bird breeding colonies are found on the offshore rocks. Extensive rocky intertidal shores support mussel beds. Bull kelp beds are abundant in this area. Further offshore is Noyo canyon, which extends from the shelf-slope break to the bottom of the continental slope. (Sources: TNC 2001)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf Gully	11.0	32.4%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	9839.1	2.6%
Benthic Habitats (Greene)	Sedimentary Slope	53045.0	1.3%
Benthic Habitats (Greene)	Sedimentary Shelf	25924.4	1.2%
Benthic Habitats (Greene)	Rocky Shelf	266.3	0.3%
Benthic Habitats (modeled)	Mesobenthal ridge soft	3536.0	2.4%
Benthic Habitats (modeled)	Mesobenthal canyon soft	1797.5	2.3%
Benthic Habitats (modeled)	Bathybenthal canyon soft	11889.4	1.6%
Benthic Habitats (modeled)	Mid shelf flat soft	22345.3	1.4%
Benthic Habitats (modeled)	Mid shelf ridge soft	896.0	1.3%
Benthic Habitats (modeled)	Bathybenthal ridge soft	6717.0	1.3%
Benthic Habitats (modeled)	Mesobenthal slope soft	1757.0	1.2%
Benthic Habitats (modeled)	Mesobenthal flat soft	12830.9	1.1%
Benthic Habitats (modeled)	Bathybenthal slope soft	7844.5	0.8%
Benthic Habitats (modeled)	Inner shelf flat hard	260.1	0.7%
Benthic Habitats (modeled)	Inner shelf flat soft	2260.9	0.5%
Benthic Habitats (modeled)	Bathybenthal flat soft	16919.7	0.5%
Benthic Habitats (modeled)	Mid shelf slope soft	36.3	0.4%
Biologically Significant Areas	Near-shore canyon head	3.0	7.9%
Biologically Significant Areas	Major submarine canyon	54.6	7.6%
Biologically Significant Areas	Off-shore rock or islet	200.0	1.6%
Biologically Significant Areas	Shelf-slope break	3903.4	1.5%
Biologically Significant Areas	High bathymetric complexity	12146.6	0.8%
Biologically Significant Areas	Upwelling zone	1795.3	0.1%
Estuarine	Small estuary or lagoon	21.5	0.9%
Estuarine	Coastal marsh (shoreline)	3.4	0.8%
Estuarine	Eelgrass bed	24.7	0.6%
Estuarine	Coastal marsh	46.8	0.1%
Invertebrates	Structure forming invertebrate	10.0	1.2%
Nearshore	Near-shore rocky reef	260.3	0.5%
Nearshore	Kelp bed (1989)	33.4	0.4%
Nearshore	Kelp bed (2002)	1.1	0.0%
Onshore	Coastal dune	130.4	0.6%
Shoreline Types	Exposed wave cut rocky platform with beach	5.0	2.1%
Shoreline Types	Exposed wave cut rocky platform	8.1	2.0%
Shoreline Types	Exposed rocky cliff	3.2	1.5%
Shoreline Types	Fine to medium grained sand beach	6.6	1.3%
Species (Birds)	Pelagic cormorant (colony)	169.0	1.3%
Species (Birds)	Pigeon guillemot (colony)	58.0	0.4%
Species (Birds)	Black oystercatcher (colony)	3.0	0.4%
Species (Birds)	Brandts cormorant (colony)	257.0	0.4%

*Contribution is Amount / Total in Ecoregion

Species (Birds)	Western gull (colony)	38.0	0.1%
Species (Fish)	Coho stream outlet	3.0	7.7%
Species (Fish)	Chinook stream outlet	1.0	5.6%
Species (Fish)	Night smelt	12.8	3.3%
Species (Fish)	Steelhead stream outlet	3.0	3.2%
Species (Fish)	Surf smelt	12.8	2.7%
Species (Fish)	Tidewater goby	96.2	1.1%
Species (Fish)	Green sturgeon	7.8	0.0%
Species (Mammals)	Harbor seal (haulout)	138.0	0.7%

Big-Albion - Navarro Rivers

71.2 Square Miles

This coastal PCA includes Big River, Albion River and Navarro River and smaller rivers and streams. The three larger rivers are important because they are significant salmon runs. The Big River estuary is perennially open and is an important nursery for endangered and threatened species such as coho, steelhead and the Pacific Lamprey. Near-shore kelp beds and rocky reefs are found along the coast. There are also rocky cliffs and intertidal areas. (Sources: TNC 2001; http://www.mendocinolandtrust.org/)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	18175.6	0.9%
Benthic Habitats (Greene)	Rocky Shelf	237.0	0.3%
Benthic Habitats (modeled)	Inner shelf canyon soft	225.6	1.3%
Benthic Habitats (modeled)	Inner shelf flat soft	4994.2	1.1%
Benthic Habitats (modeled)	Mid shelf flat soft	12991.1	0.8%
Benthic Habitats (modeled)	Inner shelf flat hard	220.0	0.6%
Benthic Habitats (modeled)	Inner shelf slope soft	12.0	0.1%
Benthic Habitats (modeled)	Mid shelf flat hard	24.9	0.0%
Biologically Significant Areas	Off-shore rock or islet	1392.0	11.5%
Biologically Significant Areas	Upwelling zone	16973.0	1.4%
Estuarine	Small estuary or lagoon	46.2	2.0%
Estuarine	Coastal marsh (shoreline)	7.3	1.8%
Estuarine	Eelgrass bed	48.5	1.1%
Estuarine	Coastal marsh	133.8	0.3%
Invertebrates	Structure forming invertebrate	3.0	0.4%
Nearshore	Kelp bed (1989)	376.9	4.8%
Nearshore	Kelp bed (2002)	26.7	0.5%
Nearshore	Near-shore rocky reef	227.0	0.4%
Nearshore	Kelp bed (2003)	7.9	0.2%
Shoreline Types	Exposed wave cut rocky platform	61.2	15.4%
Shoreline Types	Exposed rocky cliff	22.0	10.4%
Shoreline Types	Exposed wave cut rocky platform with beach	7.6	3.2%
Shoreline Types	Sheltered rocky shore	1.1	2.9%
Shoreline Types	Fine to medium grained sand beach	3.7	0.7%
Species (Birds)	Pelagic cormorant (colony)	1362.0	10.8%
Species (Birds)	Black oystercatcher (colony)	63.0	8.8%
Species (Birds)	Pigeon guillemot (colony)	870.0	6.5%
Species (Birds)	Tufted puffin (colony)	10.0	3.6%
Species (Birds)	Brandts cormorant (colony)	1423.0	2.3%
Species (Birds)	Western gull (colony)	395.0	1.1%
Species (Birds)	Rhinosaurus auklet (colony)	10.0	0.6%
Species (Birds)	Common murre (colony)	57.0	0.0%
Species (Fish)	Coho stream outlet	7.0	17.9%

*Contribution is Amount / Total in Ecoregion

Species (Fish)	Steelhead stream outlet	2.0	2.1%
Species (Mammals)	California sea lion (haulout)	13.0	3.4%
Species (Mammals)	Harbor seal (haulout)	618.0	3.1%
Species (Mammals)	Stellar sea lion (haulout)	3.0	2.5%

Point Arena

9.9 Square Miles

Point Arena is a major upwelling center and the PCA includes the headland and adjacent Garcia river estuary and coastal streams. The Garcia River is important for coho and pink salmon and steelhead. TNC and The Conservation Fund have a large sustainable forestry and salmonid restoration project underway in the Upper Garcia watershed. Point Arena is a rocky intertidal region with large red abalone population, owl limpets, and fragile algal communities. Red abalone populations on the Stornetta property (recently purchased for public lands) have been relatively unfished, until recently. Manchester State Park is adjacent to Point Arena and is a 760-acre park with a beach sand dunes and flat grasslands. The park contains Brush and Alder creeks, where salmon runs occur. (Sources: TNC 2001; http://www.mendocinolandtrust.org/)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	567.4	0.6%
Benthic Habitats (Greene)	Sedimentary Shelf	1998.7	0.1%
Benthic Habitats (modeled)	Inner shelf flat hard	470.3	1.2%
Benthic Habitats (modeled)	Inner shelf flat soft	936.5	0.2%
Benthic Habitats (modeled)	Mid shelf flat hard	76.1	0.1%
Benthic Habitats (modeled)	Mid shelf flat soft	1094.8	0.1%
Biologically Significant Areas	Off-shore rock or islet	159.0	1.3%
Biologically Significant Areas	Upwelling zone	2556.4	0.2%
Estuarine	Small estuary or lagoon	10.9	0.5%
Estuarine	Coastal marsh	32.5	0.1%
Nearshore	Near-shore rocky reef	561.4	1.0%
Nearshore	Kelp bed (1989)	73.3	0.9%
Nearshore	Kelp bed (2003)	13.0	0.3%
Onshore	Coastal dune	68.3	0.3%
Shoreline Types	Exposed wave cut rocky platform	10.5	2.7%
Shoreline Types	Exposed wave cut rocky platform with beach	1.4	0.6%
Shoreline Types	Fine to medium grained sand beach	2.1	0.4%
Species (Birds)	Pelagic cormorant (colony)	443.0	3.5%
Species (Birds)	Black oystercatcher (colony)	15.0	2.1%
Species (Birds)	Pigeon guillemot (colony)	64.0	0.5%
Species (Birds)	Western gull (colony)	29.0	0.1%
Species (Fish)	Chinook stream outlet	1.0	5.6%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Mammals)	Harbor seal (haulout)	204.0	1.0%

*Contribution is Amount / Total in Ecoregion

Gualala River and Estuary

61.8 Square Miles

The Gualala River and estuary has coho and steelhead populations; while generally considered to be a lower priority for salmonids than the Garcia River, due to its current condition. The Gualala river estuary is controlled by a large sand bar that opens and closed seasonally, forming a large lagoon before the beach is broken through. Robinson's and Saunders reefs are two near-shore rocky reefs. (Sources: TNC 2001; http://www.mendocinolandtrust.org/)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	16648.1	0.8%
Benthic Habitats (modeled)	Inner shelf flat soft	5356.1	1.2%
Benthic Habitats (modeled)	Mid shelf flat soft	11205.3	0.7%
Benthic Habitats (modeled)	Inner shelf canyon soft	60.0	0.3%
Biologically Significant Areas	Off-shore rock or islet	733.0	6.0%
Biologically Significant Areas	Upwelling zone	16644.9	1.4%
Estuarine	Small estuary or lagoon	21.2	0.9%
Estuarine	Coastal marsh (shoreline)	2.0	0.5%
Estuarine	Coastal marsh	28.2	0.1%
Invertebrates	Structure forming invertebrate	2.0	0.2%
Nearshore	Kelp bed (1989)	374.3	4.8%
Nearshore	Kelp bed (2003)	112.7	2.2%
Nearshore	Kelp bed (2002)	17.1	0.3%
Nearshore	Persistent kelp bed (89-03)	1.5	0.1%
Nearshore	Near-shore rocky reef	41.3	0.1%
Shoreline Types	Exposed wave cut rocky platform	22.1	5.6%
Shoreline Types	Exposed wave cut rocky platform with beach	8.8	3.8%
Shoreline Types	Exposed rocky cliff with talus boulder base	1.3	3.5%
Shoreline Types	Exposed rocky cliff	5.1	2.4%
Shoreline Types	Fine to medium grained sand beach	5.1	1.0%
Shoreline Types	Coarse grained sand beach	1.1	0.8%
Species (Birds)	Pelagic cormorant (colony)	738.0	5.8%
Species (Birds)	Tufted puffin (colony)	15.0	5.5%
Species (Birds)	Black oystercatcher (colony)	28.0	3.9%
Species (Birds)	Pigeon guillemot (colony)	381.0	2.8%
Species (Birds)	Brandts cormorant (colony)	750.0	1.2%
Species (Birds)	Leaches storm petrel (colony)	100.0	0.9%
Species (Birds)	Western gull (colony)	218.0	0.6%
Species (Birds)	Rhinosaurus auklet (colony)	4.0	0.2%
Species (Birds)	Cassin's auklet (colony)	1.0	0.0%
Species (Fish)	Night smelt	4.9	1.2%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Fish)	Surf smelt	4.9	1.0%
Species (Mammals)	Harbor seal (haulout)	738.0	3.7%
Species (Mammals)	Stellar sea lion (haulout)	2.0	1.7%
Species (Mammals)	California sea lion (haulout)	6.0	1.6%
Species (Mammals)	Stellar sea lion (rookery)	7.0	0.8%

*Contribution is Amount / Total in Ecoregion

Salt Point

34.5 Square Miles

Salt Point PCA includes Salt Point State Park in Sonoma county (a 6000 acre park that has an abundance of rich nearshore and rocky intertidal habitats). There are rocky reefs and bull kelp beds in the areas and rich intertidal rocky shores.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	9325.4	0.4%
Benthic Habitats (modeled)	Inner shelf canyon soft	416.0	2.4%
Benthic Habitats (modeled)	Inner shelf flat soft	3656.7	0.8%
Benthic Habitats (modeled)	Mid shelf flat soft	5199.8	0.3%
Biologically Significant Areas	Off-shore rock or islet	451.0	3.7%
Biologically Significant Areas	Upwelling zone	9318.3	0.8%
Estuarine	Small estuary or lagoon	12.7	0.6%
Nearshore	Kelp bed (2002)	334.8	6.5%
Nearshore	Kelp bed (1989)	203.1	2.6%
Nearshore	Persistent kelp bed (89-03)	15.1	1.4%
Nearshore	Kelp bed (2003)	66.4	1.3%
Nearshore	Near-shore rocky reef	23.6	0.0%
Shoreline Types	Exposed wave cut rocky platform with beach	11.0	4.7%
Shoreline Types	Exposed wave cut rocky platform	14.7	3.7%
Shoreline Types	Exposed rocky cliff	6.1	2.9%
Shoreline Types	Mixed sand and gravel beach	1.8	2.3%
Shoreline Types	Coarse grained sand beach	1.9	1.5%
Shoreline Types	Fine to medium grained sand beach	1.2	0.2%
Species (Birds)	Pelagic cormorant (colony)	784.0	6.2%
Species (Birds)	Double-crested cormorant (colony)	422.0	6.1%
Species (Birds)	Black oystercatcher (colony)	33.0	4.6%
Species (Birds)	Western gull (colony)	194.0	0.5%
Species (Birds)	Pigeon guillemot (colony)	51.0	0.4%
Species (Birds)	Brandts cormorant (colony)	51.0	0.1%
Species (Fish)	Chinook stream outlet	1.0	5.6%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Fish)	Surf smelt	8.1	1.7%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Mammals)	Stellar sea lion (haulout)	6.0	5.1%
Species (Mammals)	Stellar sea lion (rookery)	36.0	4.3%
Species (Mammals)	Harbor seal (haulout)	494.0	2.5%
Species (Mammals)	California sea lion (haulout)	7.0	1.8%
Validation Target	Top 20% seabird density	881.7	0.1%
Validation Target	Top 20% seabird diversity	702.1	0.1%

*Contribution is Amount / Total in Ecoregion

Bodega Head - Tomales Bay

108.2 Square Miles

This PCA is in the southern region of coastal Sonoma County extending into Marin County; it includes Bodega Head and Tomales Bay. Bodega head is relatively rare granite and is located over the San Andreas fault. Bodega Marine Reserve is part of the University of California's Natural Reserve System; it is a 362 acre research and teaching reserve with rocky intertidal areas, sandy beaches, extensive lagoon mudflats and sandflats, and tidal saltmarshes. Bodega Bay is considered to be Sonoma County's birding hotspot, with a large variety of birds spotted. Tomales Bay has extensive eelgrass beds, tidal flats, and sheltered rocky shores. Tomales Bay has marine mammals haulouts and rookeries, over 150 species of fish, 163 species of birds and 200 species of algae. There are a number of creeks that flow into the bay, some of which are known to contain coho salmon (such as Lagunitas Creek). In addition, there are two esteros that are found on Tomales Bay (Estero Americano, Estero San Antonio) that have salt marsh and brackish marsh habitats. There are oyster farms on Tomales Bay. (Sources: http://www.tomalesbaylife.org/tomales_bay.htm; http://www.bml.ucdavis.edu/bmr/location.html)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	5112.8	5.4%
Benthic Habitats (Greene)	Sedimentary Shelf	16377.9	0.8%
Benthic Habitats (modeled)	Inner shelf flat hard	2942.0	7.5%
Benthic Habitats (modeled)	Mid shelf flat hard	2170.0	3.8%
Benthic Habitats (modeled)	Inner shelf flat soft	10475.5	2.4%
Benthic Habitats (modeled)	Inner shelf canyon soft	210.4	1.2%
Benthic Habitats (modeled)	Mid shelf flat soft	5745.3	0.3%
Biologically Significant Areas	Sand spit	1.0	9.1%
Biologically Significant Areas	Off-shore rock or islet	548.0	4.5%
Biologically Significant Areas	Upwelling zone	18314.9	1.5%
Estuarine	Large estuary	3046.0	29.9%
Estuarine	Small estuary or lagoon	473.2	20.7%
Estuarine	Eelgrass bed	628.2	14.8%
Estuarine	Coastal marsh (shoreline)	14.9	3.7%
Estuarine	Coastal marsh	480.3	1.1%
Nearshore	Near-shore rocky reef	5119.0	9.1%
Nearshore	Kelp bed (2002)	13.0	0.3%
Onshore	Coastal dune	838.7	4.2%
Shoreline Types	Sheltered rocky shore	14.3	36.9%
Shoreline Types	Mixed sand and gravel beach	13.3	16.3%
Shoreline Types	Exposed tidal flat	5.9	9.6%
Shoreline Types	Exposed wave cut rocky platform with beach	15.3	6.6%
Shoreline Types	Fine to medium grained sand beach	29.8	5.9%
Shoreline Types	Exposed wave cut rocky platform	8.7	2.2%
Shoreline Types	Sheltered tidal flat	5.6	1.5%
Shoreline Types	Tidal flat with salt marsh	13.6	1.0%
Species (Birds)	California black rail (occurence)	4.0	8.3%
Species (Birds)	Black oystercatcher (colony)	51.0	7.2%
Species (Birds)	Pelagic cormorant (colony)	766.0	6.1%
Species (Birds)	Western snowy plover	3.0	4.8%
Species (Birds)	California black rail (habitat)	261.2	3.6%
Species (Birds)	Brandts cormorant (colony)	1313.0	2.1%
Species (Birds)	Pigeon guillemot (colony)	267.0	2.0%
Species (Birds)	Ashy storm petrel (colony)	74.0	1.9%
Species (Birds)	Western gull (colony)	398.0	1.1%

*Contribution is Amount / Total in Ecoregion

Species (Birds)	Rhinosaurus auklet (colony)	7.0	0.4%
Species (Birds)	Double-crested cormorant (colony)	14.0	0.2%
Species (Fish)	Surf smelt	38.1	8.2%
Species (Fish)	Green sturgeon	1306.4	2.7%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Fish)	Steelhead stream outlet	2.0	2.1%
Species (Fish)	Tidewater goby	118.6	1.4%
Species (Fish)	Night smelt	1.5	0.4%
Species (Mammals)	Harbor seal (haulout)	1362.0	6.9%
Species (Mammals)	Stellar sea lion (rookery)	29.0	3.5%
Species (Mammals)	Stellar sea lion (haulout)	2.0	1.7%
Species (Mammals)	California sea lion (haulout)	6.0	1.6%
Validation Target	Top 20% seabird density	5756.1	0.5%
Validation Target	Top 20% demersal fish density	68.1	0.0%
Validation Target	Top 20% seabird diversity	6.9	0.0%

Cordell Bank - Bodega Canyon

430.6 Square Miles

This PCA includes the area of the Cordell Bank NMS and Bodega Canyon to the north. Cordell Bank is 45 nautical miles northwest of the Golden Gate Bridge, at the edge of the continental shelf. The Bank rises from the seafloor to a depth of 120 feet below the ocean surface. Upwelling of nutrient rich water and the bank's topography create a very biologically productive area that is used as a feeding ground for many marine mammals and seabirds. Humpback, Dall's porpoises, albatross, shearwaters, and countless other marine species flourish in this extraordinarily rich marine environment. 526 square miles (397 square nautical miles) of the area around Cordell Bank were designated as a national marine sanctuary in 1989. Bodega canyon is an area of high bathymetric complexity on the continental slope. (Source: http://cordellbank.noaa.gov)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	4685.2	5.0%
Benthic Habitats (Greene)	Sedimentary Slope	87646.3	2.1%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	7292.3	2.0%
Benthic Habitats (Greene)	Sedimentary Shelf	12367.9	0.6%
Benthic Habitats (modeled)	Mid shelf ridge hard	680.0	6.9%
Benthic Habitats (modeled)	Mid shelf flat hard	3663.1	6.3%
Benthic Habitats (modeled)	Mesobenthal ridge soft	5488.4	3.8%
Benthic Habitats (modeled)	Mesobenthal canyon soft	2613.3	3.3%
Benthic Habitats (modeled)	Bathybenthal ridge soft	14916.8	2.9%
Benthic Habitats (modeled)	Bathybenthal slope soft	29026.8	2.9%
Benthic Habitats (modeled)	Mesobenthal slope soft	4247.6	2.8%
Benthic Habitats (modeled)	Mid shelf ridge soft	1825.6	2.7%
Benthic Habitats (modeled)	Bathybenthal canyon soft	16991.8	2.3%
Benthic Habitats (modeled)	Mesobenthal ridge hard	356.0	1.7%
Benthic Habitats (modeled)	Mesobenthal flat soft	15245.0	1.3%
Benthic Habitats (modeled)	Mid shelf flat soft	9540.1	0.6%
Benthic Habitats (modeled)	Bathybenthal flat soft	7364.1	0.2%
Biologically Significant Areas	Off-shore bank	5040.5	5.9%
Biologically Significant Areas	Major submarine canyon	30.6	4.2%
Biologically Significant Areas	High bathymetric complexity	50658.6	3.2%
Biologically Significant Areas	Near-shore canyon head	1.0	2.6%
Biologically Significant Areas	Shelf-slope break	6869.0	2.6%
Biologically Significant Areas	Upwelling zone	466.1	0.0%

*Contribution is Amount / Total in Ecoregion

Invertebrates	Structure forming invertebrate	5.0	0.6%
Validation Target	Top 20% demersal fish diversity	75632.8	13.9%
Validation Target	Top 20% seabird diversity	103486.5	9.0%
Validation Target	Top 20% seabird density	34280.4	3.2%
Validation Target	Top 20% demersal fish density	84.0	0.0%

Suisun-Honker - Grizzly Bays

212.2 Square Miles

Suisun Marsh and associated Honker and Grizzly Bays are located in the northern part of the San Francisco Bay in Southern Solano County. The marsh is bordered on the east by the Sacramento-San Joaquin Delta and on the west by the Carquinez Strait. Suisun marsh is the largest contiguous expanse of salt/brackish marsh remaining on the west coast. With 116,000 acres, Suisun Marsh includes 52,000 acres of managed wetlands, 27,700 acres of upland grasses, 6,300 acres of tidal wetlands, and 30,000 acres of bays and sloughs. The marsh alone encompasses more than 10% of California's remaining natural wetlands. It is essential habitat for more than 221 species of birds, 16 reptilian and amphibian species, more than 40 fish species and 45 animal species. The marsh and associated bays providing important tidal rearing areas and salt-freshwater transitioning for salmonids, Delta smelt, sturgeon, and many other species. This is the location of entrapment zone in SF Bay hydrology, where the salt water wedge meets the large freshwater outflow from the Delta. The bays support thousands of migratory waterfowl.

The marshes in this area also support important remaining populations of salt marsh harvest mouse, California black rails, and many rare plants. (Source: http://www.iep.ca.gov/suisun/facts/index.html)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Estuarine	Coastal marsh	17256.9	40.5%
Estuarine	Coastal marsh (shoreline)	148.6	37.1%
Estuarine	Mega estuary	17880.5	13.9%
Shoreline Types	Tidal flat with salt marsh	414.8	29.2%
Shoreline Types	Sheltered tidal flat	21.9	6.0%
Shoreline Types	Sheltered rocky shore	1.6	4.2%
Shoreline Types	Mixed sand and gravel beach	2.6	3.2%
Shoreline Types	Exposed rocky cliff	2.9	1.4%
Species (Birds)	California black rail (habitat)	2071.8	28.8%
Species (Birds)	California black rail (occurence)	9.0	18.8%
Species (Birds)	Clapper rail (habitat)	1634.2	17.2%
Species (Birds)	California least tern (occurence)	2.0	11.8%
Species (Birds)	Clapper rail (occurrence)	6.0	8.7%
Species (Birds)	Western gull (colony)	14.0	0.0%
Species (Fish)	Longfin smelt	10269.4	88.4%
Species (Fish)	Sacramento splittail	3378.6	84.4%
Species (Fish)	Delta smelt	15431.0	83.2%
Species (Fish)	Green sturgeon	14043.8	28.5%
Species (Fish)	Chinook stream outlet	2.0	11.1%
Species (Fish)	Steelhead stream outlet	3.0	3.2%
Species (Mammals)	Salt marsh harvest mouse (habitat)	3080.1	43.5%
Species (Mammals)	Salt marsh harvest mouse (occurance)	38.0	32.2%
Species (Mammals)	Harbor seal (haulout)	31.0	0.2%

San Pablo Bay - North Bay wetland

267.9 Square Miles

San Pablo Bay is located along the counties of Sonoma, Napa and Solano. San Pablo Bay National Wildlife Refuge includes open bay and tidal marsh, mud flats, and seasonal and managed wetland habitats. The refuge provides migratory and wintering habitat for shorebirds and waterfowl. It also provides critical habitat for endangered, threatened or sensitive species such as the California Clapper rail, the salt marsh harvest mouse, the California black rail, the San Pablo song sparrow and the Suisun Shrew. The San Pablo bay and marshes are also critical habitat for many species of fish that use then as important feeding grounds or nurseries. (source: http://www.fws.gov/refuges/profiles/).

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Biologically Significant Areas	Off-shore rock or islet	4.0	0.0%
Estuarine	Mega estuary	33259.5	25.9%
Estuarine	Coastal marsh	8642.3	20.3%
Estuarine	Coastal marsh (shoreline)	38.6	9.7%
Estuarine	Eelgrass bed	358.2	8.4%
Estuarine	Small estuary or lagoon	2.4	0.1%
Shoreline Types	Tidal flat with salt marsh	291.7	20.5%
Shoreline Types	Sheltered tidal flat	50.6	13.7%
Shoreline Types	Exposed tidal flat	5.2	8.4%
Shoreline Types	Exposed rocky cliff	1.1	0.5%
Species (Birds)	Clapper rail (habitat)	4125.9	43.4%
Species (Birds)	California black rail (habitat)	2903.5	40.4%
Species (Birds)	Clapper rail (occurrence)	27.0	39.1%
Species (Birds)	California black rail (occurence)	18.0	37.5%
Species (Birds)	Double-crested cormorant (colony)	826.0	11.9%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Western gull (colony)	288.0	0.8%
Species (Birds)	Black oystercatcher (colony)	2.0	0.3%
Species (Fish)	Green sturgeon	22433.3	45.5%
Species (Fish)	Sacramento splittail	334.0	8.3%
Species (Fish)	Delta smelt	1244.4	6.7%
Species (Fish)	Steelhead stream outlet	5.0	5.3%
Species (Fish)	Tidewater goby	103.8	1.2%
Species (Mammals)	Salt marsh harvest mouse (habitat)	2518.4	35.6%
Species (Mammals)	Salt marsh harvest mouse (occurance)	16.0	13.6%
Species (Mammals)	Harbor seal (haulout)	120.0	0.6%

Pt. Reyes - Drakes Estero

57.8 Square Miles

Point Reyes is located north of San Francisco in Marin County. It is currently protected by the National Park Service as the Point Reyes National Seashore, which extends from Bolinas Bay to the south all the way north to the mouth of Tomales Bay. Point Reyes includes extensive rocky shores, sandy beaches, important marine mammal haulouts and rookeries. Drakes Estero is a large estuary in the park. Point Reyes is a major upwelling center, with cold nutrient-rich water carried offshore over Cordell Bank and north of the Farallones Islands. (sources: http://www.nps.gov/pore/)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	2156.6	2.3%
Benthic Habitats (Greene)	Sedimentary Shelf	10075.4	0.5%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Inner shelf flat hard	977.7	2.5%
Benthic Habitats (modeled)	Mid shelf flat hard	1217.5	2.1%
Benthic Habitats (modeled)	Inner shelf flat soft	7529.3	1.7%
Benthic Habitats (modeled)	Mid shelf flat soft	2485.5	0.2%
Benthic Habitats (modeled)	Inner shelf ridge soft	12.0	0.1%
Biologically Significant Areas	Sand spit	1.0	9.1%
Biologically Significant Areas	Upwelling zone	11407.0	0.9%
Biologically Significant Areas	Off-shore rock or islet	91.0	0.7%
Estuarine	Eelgrass bed	870.8	20.5%
Estuarine	Medium estuary or lagoon	885.4	16.7%
Estuarine	Coastal marsh (shoreline)	7.1	1.8%
Estuarine	Coastal marsh	94.0	0.2%
Nearshore	Near-shore rocky reef	2156.6	3.8%
Onshore	Coastal dune	481.5	2.4%
Shoreline Types	Sheltered rocky shore	21.7	56.0%
Shoreline Types	Fine to medium grained sand beach	42.3	8.3%
Shoreline Types	Gravel beach	3.0	7.5%
Shoreline Types	Mixed sand and gravel beach	5.7	7.1%
Shoreline Types	Exposed rocky cliff	10.4	4.9%
Shoreline Types	Sheltered tidal flat	15.7	4.3%
Shoreline Types	Exposed tidal flat	2.2	3.5%
Shoreline Types	Tidal flat with salt marsh	35.6	2.5%
Shoreline Types	Exposed wave cut rocky platform with beach	5.5	2.4%
Species (Birds)	Pigeon guillemot (colony)	616.0	4.6%
Species (Birds)	Common murre (colony)	15155.0	4.3%
Species (Birds)	Western snowy plover	2.0	3.2%
Species (Birds)	Brandts cormorant (colony)	1522.0	2.5%
Species (Birds)	Pelagic cormorant (colony)	266.0	2.1%
Species (Birds)	Tufted puffin (colony)	4.0	1.5%
Species (Birds)	Black oystercatcher (colony)	6.0	0.8%
Species (Birds)	Western gull (colony)	178.0	0.5%
Species (Birds)	Rhinosaurus auklet (colony)	6.0	0.4%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Mammals)	Northern elephant seal (rookery)	100.0	19.5%
Species (Mammals)	Harbor seal (haulout)	1261.0	6.4%
Species (Mammals)	California sea lion (haulout)	12.0	3.1%
Species (Mammals)	Stellar sea lion (haulout)	2.0	1.7%
Species (Mammals)	Stellar sea lion (rookery)	13.0	1.6%
Validation Target	Top 20% seabird density	13916.1	1.3%
Validation Target	Top 20% demersal fish density	3279.7	0.6%

*Contribution is Amount / Total in Ecoregion

Bolinas Lagoon - Duxbury Reef

26.7 Square Miles

Bolinas Lagoon covers 1500 acres and is located 15 miles north of the Golden Gate Bridge. The lagoon is separated from the ocean by a long sand spit (the end of Stinson Beach). The lagoon includes subtidal channels and eelgrass beds, rocky and mudflat intertidal substrates, salt marsh and upland marsh. Harbor seals haul out on the tidal flats. Bolinas lagoon is important for wintering shorebirds and waterfowl. Duxbury Reef is a rocky bench that extends well offshore and offers intertidal and subtidal rocky habitats. (Source: http://www.bolinaslagoon.org/)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	4131.5	4.4%
Benthic Habitats (Greene)	Sedimentary Shelf	2626.0	0.1%
Benthic Habitats (modeled)	Inner shelf flat hard	4130.8	10.6%
Benthic Habitats (modeled)	Inner shelf canyon soft	408.0	2.4%
Benthic Habitats (modeled)	Inner shelf flat soft	2206.7	0.5%
Biologically Significant Areas	Sand spit	1.0	9.1%
Biologically Significant Areas	Upwelling zone	3410.5	0.3%
Biologically Significant Areas	Off-shore rock or islet	33.0	0.3%
Estuarine	Medium estuary or lagoon	449.7	8.5%
Estuarine	Coastal marsh (shoreline)	7.8	1.9%
Estuarine	Coastal marsh	13.1	0.0%
Nearshore	Near-shore rocky reef	4131.5	7.3%
Nearshore	Kelp bed (2002)	2.1	0.0%
Onshore	Coastal dune	15.4	0.1%
Shoreline Types	Mixed sand and gravel beach	3.2	3.9%
Shoreline Types	Fine to medium grained sand beach	7.7	1.5%
Shoreline Types	Exposed wave cut rocky platform with beach	3.4	1.5%
Shoreline Types	Sheltered tidal flat	4.1	1.1%
Shoreline Types	Tidal flat with salt marsh	1.9	0.1%
Species (Birds)	California black rail (habitat)	414.2	5.8%
Species (Birds)	California black rail (occurence)	2.0	4.2%
Species (Birds)	Clapper rail (occurrence)	1.0	1.4%
Species (Birds)	Western gull (colony)	6.0	0.0%
Species (Fish)	Steelhead stream outlet	3.0	3.2%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Mammals)	Harbor seal (haulout)	408.0	2.1%
Species (Mammals)	California sea lion (haulout)	1.0	0.3%
Validation Target	Top 20% seabird density	4993.2	0.5%

Alameda

37.2 Square Miles

Alameda island is an important nesting area for California Least Terns. This urban PCA in San Francisco Bay also includes an important cormorant breeding site on the Oakland-SF Bay bridge. In addition, there are mudflats and remnants of salt marsh along the Emeryville and Alameda shorelines and eelgrass beds in the central bay.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Estuarine	Mega estuary	6668.0	5.2%
Estuarine	Eelgrass bed	113.7	2.7%
Estuarine	Coastal marsh	67.8	0.2%

*Contribution is Amount / Total in Ecoregion

Shoreline Types	Sheltered tidal flat	14.6	4.0%
Shoreline Types	Exposed tidal flat	1.8	2.9%
Shoreline Types	Tidal flat with salt marsh	4.7	0.3%
Species (Birds)	California least tern (colony)	80.0	39.0%
Species (Birds)	Double-crested cormorant (colony)	1116.0	16.1%
Species (Birds)	California least tern (occurence)	1.0	5.9%
Species (Birds)	California black rail (occurence)	2.0	4.2%
Species (Birds)	Western gull (colony)	544.0	1.5%
Species (Birds)	Clapper rail (occurrence)	1.0	1.4%
Species (Birds)	Clapper rail (habitat)	33.7	0.4%
Species (Fish)	Tidewater goby	10.9	0.1%
Species (Mammals)	Salt marsh harvest mouse (occurance)	1.0	0.8%
Species (Mammals)	Harbor seal (haulout)	90.0	0.5%

Golden Gate

88.3 Square Miles

This area off the Golden Gate has high bathymetric complexity and includes the Potato Patch and 40 Fathom near-shore banks. The SF Bay tidal plume front is an important foraging ground for seabirds from Farallones Islands, especially in the spring. Baker Beach has some remaining dune habitats with rare plants

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	23058.4	1.1%
Benthic Habitats (modeled)	Mid shelf canyon no data	62.9	58.3%
Benthic Habitats (modeled)	Mid shelf canyon soft	264.0	12.8%
Benthic Habitats (modeled)	Mid shelf flat no data	43.1	10.4%
Benthic Habitats (modeled)	Inner shelf flat soft	22302.9	5.0%
Benthic Habitats (modeled)	Inner shelf slope soft	96.0	1.1%
Benthic Habitats (modeled)	Inner shelf canyon soft	44.0	0.3%
Benthic Habitats (modeled)	Mid shelf flat soft	372.0	0.0%
Biologically Significant Areas	S.F. Bay tidal plume	7311.3	70.1%
Biologically Significant Areas	Off-shore rock or islet	237.0	2.0%
Biologically Significant Areas	Off-shore bank	201.0	0.2%
Estuarine	Small estuary or lagoon	21.3	0.9%
Estuarine	Coastal marsh (shoreline)	2.9	0.7%
Estuarine	Mega estuary	224.9	0.2%
Shoreline Types	Coarse grained sand beach	9.8	7.4%
Shoreline Types	Exposed rocky cliff	12.4	5.9%
Shoreline Types	Mixed sand and gravel beach	3.2	3.9%
Shoreline Types	Exposed rocky cliff with talus boulder base	1.0	2.9%
Shoreline Types	Fine to medium grained sand beach	2.1	0.4%
Species (Birds)	California black rail (occurence)	1.0	2.1%
Species (Birds)	Pelagic cormorant (colony)	154.0	1.2%
Species (Birds)	Pigeon guillemot (colony)	131.0	1.0%
Species (Birds)	Black oystercatcher (colony)	5.0	0.7%
Species (Birds)	Western gull (colony)	192.0	0.5%
Species (Birds)	Brandts cormorant (colony)	117.0	0.2%
Species (Fish)	Tidewater goby	17.4	0.2%
Species (Mammals)	California sea lion (haulout)	10.0	2.6%
Species (Mammals)	Harbor seal (haulout)	81.0	0.4%
Validation Target	Top 20% seabird density	19296.8	1.8%

*Contribution is Amount / Total in Ecoregion

Farallon Islands

159.5 Square Miles

The Farallon Islands are part of the Gulf of the Farallones NMS and comprise ocean and coastal waters as well as bays and estuaries-from Bodega Head in Sonoma County all the way down along the San Mateo County coast. The Farallon islands serve as breeding grounds for more seabirds than any other area in the contiguous United States. The islands provide vital nursery and spawning grounds for fish and shellfish. At least 36 species of marine mammals have been observed there. There have been twenty-five endangered and threatened species identified. The Gulf of the Farallones NMS is also a feeding ground for endangered blue and humpback whales. This PCA also includes Fanny Shoal and the Farallon escarpment which provide a range of hard and soft bottom habitats. These bathymetric features in this upwelling region are important foraging areas for seabirds that live on the islands (Source: http://www.farallones.org/default)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf Gully	10.0	29.4%
Benthic Habitats (Greene)	Rocky Shelf	5787.7	6.2%
Benthic Habitats (Greene)	Sedimentary Shelf	27988.4	1.3%
Benthic Habitats (Greene)	Sedimentary Slope	8159.9	0.2%
Benthic Habitats (modeled)	Mid shelf flat hard	4408.0	7.6%
Benthic Habitats (modeled)	Mid shelf ridge soft	3155.8	4.7%
Benthic Habitats (modeled)	Inner shelf flat hard	1368.0	3.5%
Benthic Habitats (modeled)	Mesobenthal canyon soft	1604.2	2.0%
Benthic Habitats (modeled)	Mid shelf flat soft	24555.8	1.5%
Benthic Habitats (modeled)	Mid shelf slope soft	120.0	1.3%
Benthic Habitats (modeled)	Mesobenthal slope soft	1854.4	1.2%
Benthic Habitats (modeled)	Mesobenthal ridge soft	1600.1	1.1%
Benthic Habitats (modeled)	Bathybenthal canyon soft	1882.6	0.3%
Benthic Habitats (modeled)	Bathybenthal slope soft	970.9	0.1%
Benthic Habitats (modeled)	Inner shelf flat soft	276.0	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge soft	107.4	0.0%
Benthic Habitats (modeled)	Bathybenthal flat soft	85.6	0.0%
Biologically Significant Areas	Near-shore canyon head	3.0	7.9%
Biologically Significant Areas	Upwelling zone	11222.1	0.9%
Biologically Significant Areas	High bathymetric complexity	8608.0	0.5%
Biologically Significant Areas	Off-shore bank	350.1	0.4%
Biologically Significant Areas	Shelf-slope break	1014.3	0.4%
Biologically Significant Areas	Off-shore rock or islet	22.0	0.2%
Invertebrates	Structure forming invertebrate	5.0	0.6%
Shoreline Types	Exposed rocky cliff	9.3	4.4%
Species (Birds)	Ashy storm petrel (colony)	3000.0	77.0%
Species (Birds)	Western gull (colony)	22278.0	62.2%
Species (Birds)	Cassin's auklet (colony)	36027.0	57.3%
Species (Birds)	Rhinosaurus auklet (colony)	515.0	30.2%
Species (Birds)	Brandts cormorant (colony)	16903.0	27.6%
Species (Birds)	Tufted puffin (colony)	70.0	25.5%
Species (Birds)	Common murre (colony)	68168.0	19.4%
Species (Birds)	Double-crested cormorant (colony)	1140.0	16.4%
Species (Birds)	Pigeon guillemot (colony)	1909.0	14.2%
Species (Birds)	Leaches storm petrel (colony)	1400.0	12.8%
Species (Birds)	Pelagic cormorant (colony)	862.0	6.8%
Species (Birds)	Black oystercatcher (colony)	30.0	4.2%
Species (Mammals)	Northern fur seal (rookery)	25.0	96.2%

*Contribution is Amount / Total in Ecoregion

Species (Mammals)	California sea lion (rookery)	1.0	50.0%
Species (Mammals)	Stellar sea lion (rookery)	244.0	29.2%
Species (Mammals)	Northern elephant seal (rookery)	100.0	19.5%
Species (Mammals)	Stellar sea lion (haulout)	8.0	6.8%
Species (Mammals)	California sea lion (haulout)	23.0	6.0%
Species (Mammals)	Harbor seal (haulout)	141.0	0.7%
Validation Target	Top 20% seabird density	42000.0	4.0%
Validation Target	Top 20% seabird diversity	29422.7	2.6%
Validation Target	Top 20% demersal fish density	5480.5	1.0%
Validation Target	Top 20% demersal fish diversity	766.6	0.1%

Pillar Point

28.8 Square Miles

Pillar Point is located a few miles north of Half Moon Bay. This PCA contains Fitzgerald Marine Reserve, an important reserve and educational center. Rocky intertidal areas contain diverse assemblages of algae and animals. There are rich algal and mussel beds along this shore. There are also fairly extensive near-shore rocky reefs. (Source: http://www.fitzgeraldreserve.org/)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	2471.6	2.6%
Benthic Habitats (Greene)	Sedimentary Shelf	5685.5	0.3%
Benthic Habitats (modeled)	Inner shelf slope hard	20.0	41.7%
Benthic Habitats (modeled)	Inner shelf flat hard	2440.0	6.3%
Benthic Habitats (modeled)	Inner shelf flat soft	4885.7	1.1%
Benthic Habitats (modeled)	Mid shelf flat soft	831.3	0.1%
Biologically Significant Areas	Off-shore rock or islet	125.0	1.0%
Biologically Significant Areas	Upwelling zone	3395.0	0.3%
Estuarine	Coastal marsh	28.2	0.1%
Nearshore	Near-shore rocky reef	2471.6	4.4%
Nearshore	Kelp bed (2002)	2.1	0.0%
Nearshore	Kelp bed (2003)	2.1	0.0%
Shoreline Types	Gravel beach	1.0	2.6%
Shoreline Types	Coarse grained sand beach	1.9	1.4%
Shoreline Types	Exposed rocky cliff	2.8	1.3%
Shoreline Types	Exposed wave cut rocky platform with beach	2.8	1.2%
Shoreline Types	Exposed wave cut rocky platform	3.6	0.9%
Shoreline Types	Fine to medium grained sand beach	3.9	0.8%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Black oystercatcher (colony)	6.0	0.8%
Species (Birds)	Pigeon guillemot (colony)	102.0	0.8%
Species (Birds)	Pelagic cormorant (colony)	58.0	0.5%
Species (Birds)	Western gull (colony)	22.0	0.1%
Species (Birds)	Brandts cormorant (colony)	7.0	0.0%
Species (Fish)	Steelhead stream outlet	2.0	2.1%
Species (Mammals)	Sea otter (low density)	852.3	1.2%
Species (Mammals)	Harbor seal (haulout)	229.0	1.2%
Species (Mammals)	California sea lion (haulout)	1.0	0.3%
Validation Target	Top 20% seabird density	6008.1	0.6%

South San Francisco Bay

170.8 Square Miles

South San Francisco Bay has remnant wetlands and large expanses of salt ponds, many of which are being restored to tidal action. The Don Edwards NWR spans 30,000 acres of open bay, salt pond, salt marsh, mudflat, upland and vernal pool habitats. Located along the Pacific Flyway, millions of shorebirds and waterfowl stop to refuel in South San Francisco Bay during the spring and fall migration (The Refuge hosts over 280 species of birds each year). Bair island has the largest remaining native oyster aggregation. The South Bay Salt Pond Restoration Project—25-square miles – is the largest tidal wetland restoration project on the west coast of the United States. (Sources: http://www.fws.gov/pacific/desfbay/ and http://www.southbayrestoration.org/)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Estuarine	Mega estuary	16277.9	12.7%
Estuarine	Coastal marsh	4915.9	11.5%
Estuarine	Coastal marsh (shoreline)	27.5	6.9%
Shoreline Types	Tidal flat with salt marsh	298.1	21.0%
Shoreline Types	Sheltered tidal flat	34.6	9.4%
Species (Birds)	Forester's tern (colony)	3740.0	95.7%
Species (Birds)	Caspian tern (colony)	1034.0	48.5%
Species (Birds)	California least tern (occurence)	7.0	41.2%
Species (Birds)	Clapper rail (habitat)	2720.3	28.6%
Species (Birds)	Clapper rail (occurrence)	17.0	24.6%
Species (Birds)	Western snowy plover	13.0	21.0%
Species (Birds)	California black rail (occurence)	3.0	6.3%
Species (Birds)	California least tern (colony)	10.0	4.9%
Species (Birds)	California black rail (habitat)	46.2	0.6%
Species (Birds)	Western gull (colony)	6.0	0.0%
Species (Fish)	Steelhead stream outlet	6.0	6.3%
Species (Mammals)	Salt marsh harvest mouse (occurance)	42.0	35.6%
Species (Mammals)	Salt marsh harvest mouse (habitat)	699.2	9.9%
Species (Mammals)	Harbor seal (haulout)	276.0	1.4%

Pioneer Canyon

130.8 Square Miles

Pioneer Canyon is a large canyon offshore from the Golden Gate. The canyon cuts across the continental slope and has its head in approximately 200m of water on the continental shelf. A small canyon in this PCA was used by the US Navy for disposal.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	5628.3	1.6%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	2301.1	0.6%
Benthic Habitats (Greene)	Sedimentary Slope	25871.2	0.6%
Benthic Habitats (Greene)	Sedimentary Slope Landslide	386.7	0.3%
Benthic Habitats (Greene)	Sedimentary Shelf	799.2	0.0%
Benthic Habitats (modeled)	Mesobenthal canyon soft	3261.7	4.1%
Benthic Habitats (modeled)	Mesobenthal slope soft	3768.6	2.5%
Benthic Habitats (modeled)	Mesobenthal ridge soft	3504.8	2.4%
Benthic Habitats (modeled)	Mesobenthal flat soft	13187.2	1.1%
Benthic Habitats (modeled)	Mid shelf ridge soft	295.8	0.4%
Benthic Habitats (modeled)	Bathybenthal canyon soft	3140.6	0.4%
Benthic Habitats (modeled)	Bathybenthal ridge soft	1435.9	0.3%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Mid shelf slope soft	16.0	0.2%
Benthic Habitats (modeled)	Bathybenthal slope soft	1233.6	0.1%
Benthic Habitats (modeled)	Bathybenthal flat soft	4038.5	0.1%
Benthic Habitats (modeled)	Mid shelf flat soft	1107.4	0.1%
Biologically Significant Areas	Major submarine canyon	19.7	2.7%
Biologically Significant Areas	Shelf-slope break	4132.5	1.6%
Biologically Significant Areas	High bathymetric complexity	4367.5	0.3%
Invertebrates	Structure forming invertebrate	1.0	0.1%
Validation Target	Top 20% demersal fish diversity	20269.6	3.7%
Validation Target	Top 20% seabird diversity	35000.0	3.1%
Validation Target	Top 20% seabird density	17940.1	1.7%
Validation Target	Top 20% demersal fish density	6152.0	1.2%

Pioneer - Gumdrop Seamounts

75.6 Square Miles

All of the seamounts off of California are probably untrawled, based on limited initial explorations by research organizations, and likely have high biodiversity and relatively intact deep sea coral and sponge communities. Seamounts are often associated with localized upwelling, higher productivity and aggregations of large predators. Seamounts have a high degree of endemism, may be centers of speciation, and may act as "stepping stones" for the dispersal of species Seamounts were targets themselves but also contribute bathybenthal (>700m) hard and soft substrates. Pioneer Seamount reaches from a depth of 2800m up to 1000m below the surface.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Ridge	14877.7	2.0%
Benthic Habitats (Greene)	Sedimentary Slope Gully	2462.9	0.6%
Benthic Habitats (Greene)	Sedimentary Slope	3659.4	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge hard	5775.7	4.2%
Benthic Habitats (modeled)	Bathybenthal canyon hard	3575.2	3.4%
Benthic Habitats (modeled)	Bathybenthal slope hard	3844.7	2.9%
Benthic Habitats (modeled)	Bathybenthal flat hard	1716.7	0.7%
Benthic Habitats (modeled)	Bathybenthal canyon soft	4121.1	0.6%
Benthic Habitats (modeled)	Bathybenthal slope soft	800.0	0.1%
Benthic Habitats (modeled)	Bathybenthal flat soft	1111.6	0.0%
Benthic Habitats (modeled)	Bathybenthal ridge soft	50.4	0.0%
Biologically Significant Areas	Seamount	2.0	33.3%
Biologically Significant Areas	High bathymetric complexity	13475.0	0.9%
Validation Target	Top 20% seabird diversity	19040.7	1.7%

Pescadero - San Gregorio

23.7 Square Miles

The Pescadero and San Gregorio rivers both have estuaries at their mouths with coastal marsh habitat; both are also State Beaches. San Gregorio is an important steelhead and coho stream. There are near-shore rocky reefs and rocky intertidal shores.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	1664.2	1.8%
Benthic Habitats (Greene)	Sedimentary Shelf	4846.3	0.2%
Benthic Habitats (modeled)	Inner shelf flat hard	1688.9	4.3%
Benthic Habitats (modeled)	Inner shelf flat soft	4891.6	1.1%
Biologically Significant Areas	Off-shore rock or islet	100.0	0.8%
Biologically Significant Areas	Upwelling zone	4591.4	0.4%

*Contribution is Amount / Total in Ecoregion

Estuarine	Coastal marsh (shoreline)	5.4	1.4%
Estuarine	Small estuary or lagoon	18.2	0.8%
Nearshore	Near-shore rocky reef	1530.2	2.7%
Onshore	Coastal dune	7.9	0.0%
Shoreline Types	Fine to medium grained sand beach	14.6	2.9%
Shoreline Types	Exposed wave cut rocky platform	5.5	1.4%
Shoreline Types	Exposed wave cut rocky platform with beach	3.1	1.3%
Shoreline Types	Exposed rocky cliff	1.5	0.7%
Species (Birds)	Pelagic cormorant (colony)	231.0	1.8%
Species (Birds)	Black oystercatcher (colony)	5.0	0.7%
Species (Birds)	Pigeon guillemot (colony)	32.0	0.2%
Species (Birds)	Brandts cormorant (colony)	77.0	0.1%
Species (Birds)	Western gull (colony)	2.0	0.0%
Species (Fish)	Night smelt	98.2	25.2%
Species (Fish)	Surf smelt	98.2	21.1%
Species (Fish)	Steelhead stream outlet	5.0	5.3%
Species (Fish)	Coho stream outlet	1.0	2.6%
Species (Fish)	Tidewater goby	17.8	0.2%
Species (Mammals)	Sea otter (low density)	6393.9	9.1%
Species (Mammals)	Harbor seal (haulout)	244.0	1.2%
Validation Target	Top 20% seabird density	5538.7	0.5%
Validation Target	Top 20% demersal fish diversity	156.6	0.0%

Guide Seamount

37.2 Square Miles

Guide Seamount is approximately 16 million years old and consists of four volcanic ridges with sedimentary troughs in between. The seamount rises 1440m above the surrounding seafloor to a depth of 1682m from the surface.

(Source: http://www.mbari.org/data/mapping/seamounts/guide_smt.htm)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Ridge	7173.5	0.9%
Benthic Habitats (Greene)	Sedimentary Ridge	3043.4	0.3%
Benthic Habitats (Greene)	Sedimentary Slope	276.4	0.0%
Benthic Habitats (modeled)	Bathybenthal ridge hard	3982.2	2.9%
Benthic Habitats (modeled)	Bathybenthal canyon hard	1590.9	1.5%
Benthic Habitats (modeled)	Bathybenthal slope hard	1617.1	1.2%
Benthic Habitats (modeled)	Bathybenthal canyon soft	1295.6	0.2%
Benthic Habitats (modeled)	Bathybenthal slope soft	951.1	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge soft	258.3	0.1%
Benthic Habitats (modeled)	Bathybenthal flat soft	804.7	0.0%
Biologically Significant Areas	Seamount	1.0	16.7%
Biologically Significant Areas	High bathymetric complexity	7881.0	0.5%

*Contribution is Amount / Total in Ecoregion

Ano Nuevo - Davenport

226.6 Square Miles

This PCA exends from the shoreline out to the tops of the submarine canyons (Ano Nuevo and Cabrillo) and from Davenport to Santa Cruz along the coast. The Davenport area is one of the major upwelling centers – nutrient-rich waters are advected south across Monterey Bay fueling productivity in the Bay. There is a relatively broad continental shelf in this area; canyon heads (Ano Nuevo Canyon and Cabrillo) are found on the shelf. This is an important area for groundfish and seabirds (based on density and diversity analyses conducted by the NOAA Biogeographic Assessment team). Coastal streams (Scott and Waddell Creek) are important for coho (southern extent of viable populations) and steelhead (13 streams). There is an elephant seal rookery at Ano Nuevo on the mainland. There are important seabird colonies (Black oystercatcher, Brandts cormorant, Pelagic cormorant, Pigeon guillemot, Rhinosaurus auklet, Western gull) and mammal rookeries (sea lion rookery; stellar sea lion rookery) on Ano Nuevo Island and surrounding rocks. There are rocky intertidal; near-shore rocky and soft bottom habitats; and kelp beds. The northern extent of giant kelp occurs in this area; north of here bull kelp dominate the kelp beds.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	8243.6	8.8%
Benthic Habitats (Greene)	Rocky Slope Gully	62.4	2.3%
Benthic Habitats (Greene)	Sedimentary Shelf	41783.6	2.0%
Benthic Habitats (Greene)	Rocky Slope Canyon Wall	79.8	0.9%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	2339.4	0.7%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	559.4	0.1%
Benthic Habitats (Greene)	Sedimentary Slope	4998.3	0.1%
Benthic Habitats (modeled)	Inner shelf flat hard	6181.9	15.8%
Benthic Habitats (modeled)	Mid shelf ridge hard	644.0	6.5%
Benthic Habitats (modeled)	Mid shelf slope soft	416.2	4.5%
Benthic Habitats (modeled)	Mid shelf canyon soft	84.0	4.1%
Benthic Habitats (modeled)	Mid shelf ridge soft	2332.5	3.5%
Benthic Habitats (modeled)	Mesobenthal canyon soft	2274.8	2.9%
Benthic Habitats (modeled)	Mesobenthal canyon hard	125.3	2.6%
Benthic Habitats (modeled)	Mid shelf flat hard	1341.5	2.3%
Benthic Habitats (modeled)	Inner shelf flat soft	9486.6	2.1%
Benthic Habitats (modeled)	Mid shelf flat soft	30271.5	1.8%
Benthic Habitats (modeled)	Mesobenthal ridge soft	2608.2	1.8%
Benthic Habitats (modeled)	Mesobenthal slope soft	1498.9	1.0%
Benthic Habitats (modeled)	Mesobenthal slope hard	20.0	0.3%
Benthic Habitats (modeled)	Bathybenthal canyon soft	293.8	0.0%
Benthic Habitats (modeled)	Mesobenthal flat soft	363.7	0.0%
Biologically Significant Areas	Near-shore canyon head	4.0	10.5%
Biologically Significant Areas	Upwelling zone	50183.8	4.1%
Biologically Significant Areas	Off-shore rock or islet	146.0	1.2%
Biologically Significant Areas	Shelf-slope break	3002.7	1.1%
Biologically Significant Areas	High bathymetric complexity	5995.6	0.4%
Estuarine	Small estuary or lagoon	4.1	0.2%
Estuarine	Coastal marsh	56.3	0.1%
Invertebrates	Structure forming invertebrate	12.0	1.4%
Nearshore	Kelp bed (1999)	27.6	16.5%
Nearshore	Near-shore rocky reef	6161.6	10.9%
Nearshore	Persistent kelp bed (89-03)	48.4	4.6%
Nearshore	Kelp bed (2002)	221.8	4.3%

*Contribution is Amount / Total in Ecoregion

Nearshore	Kelp bed (1989)	253.2	3.2%
Nearshore	Kelp bed (2003)	63.4	1.2%
Onshore	Coastal dune	269.5	1.3%
Shoreline Types	Exposed wave cut rocky platform with beach	17.6	7.5%
Shoreline Types	Mixed sand and gravel beach	5.9	7.3%
Shoreline Types	Fine to medium grained sand beach	23.1	4.5%
Shoreline Types	Exposed wave cut rocky platform	14.9	3.8%
Shoreline Types	Exposed rocky cliff	1.3	0.6%
Species (Birds)	Pigeon guillemot (colony)	2030.0	15.1%
Species (Birds)	Western snowy plover	7.0	11.3%
Species (Birds)	Black oystercatcher (colony)	47.0	6.6%
Species (Birds)	Rhinosaurus auklet (colony)	67.0	3.9%
Species (Birds)	Western gull (colony)	1392.0	3.9%
Species (Birds)	California black rail (occurence)	1.0	2.1%
Species (Birds)	Pelagic cormorant (colony)	261.0	2.1%
Species (Birds)	Brandts cormorant (colony)	312.0	0.5%
Species (Fish)	Steelhead stream outlet	13.0	13.7%
Species (Fish)	Coho stream outlet	4.0	10.3%
Species (Fish)	Tidewater goby	153.1	1.8%
Species (Mammals)	Stellar sea lion (rookery)	502.0	60.0%
Species (Mammals)	California sea lion (rookery)	1.0	50.0%
Species (Mammals)	Northern elephant seal (rookery)	100.0	19.5%
Species (Mammals)	Sea otter (low density)	11017.1	15.7%
Species (Mammals)	Sea otter (medium density)	8439.8	13.3%
Species (Mammals)	Harbor seal (haulout)	781.0	3.9%
Species (Mammals)	California sea lion (haulout)	11.0	2.9%
Species (Mammals)	Stellar sea lion (haulout)	3.0	2.5%
Validation Target	Top 20% demersal fish density	56978.3	10.8%
Validation Target	Top 20% seabird density	51946.2	4.9%
Validation Target	Top 20% demersal fish diversity	11765.3	2.2%
Validation Target	Top 20% seabird diversity	3122.5	0.3%

Elkhorn - Salinas

44.0 Square Miles

This PCA extends from Elkhorn Slough at Moss Landing to the Salinas River mouth. Elkhorn is one of larger estuaries in the Central Coast region with significant estuarine, coastal marsh, eelgrass and tidal flat habitats. There are also important hydrographic and ecological links with Watsonville Slough, Salinas River and Moro Cojo estuaries. Important for shorebirds and migratory waterfowl. This PCA also includes the extensive dune complex at Marina/Seaside.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf Canyon Floor	76.0	77.5%
Benthic Habitats (Greene)	Sedimentary Shelf Canyon Wall	25.0	0.3%
Benthic Habitats (Greene)	Sedimentary Shelf	1595.0	0.1%
Benthic Habitats (modeled)	Mid shelf canyon soft	51.5	2.5%
Benthic Habitats (modeled)	Inner shelf flat soft	1539.4	0.3%
Benthic Habitats (modeled)	Mid shelf flat soft	126.1	0.0%
Biologically Significant Areas	Sand spit	1.0	9.1%
Biologically Significant Areas	Near-shore canyon head	1.0	2.6%
Biologically Significant Areas	Major submarine canyon	1.3	0.2%
Biologically Significant Areas	Off-shore rock or islet	1.0	0.0%
Estuarine	Medium estuary or lagoon	798.1	15.1%

*Contribution is Amount / Total in Ecoregion

Estuarine	Small estuary or lagoon	235.8	10.3%
Estuarine	Coastal marsh (shoreline)	15.5	3.9%
Estuarine	Coastal marsh	988.5	2.3%
Onshore	Coastal dune	312.5	1.5%
Shoreline Types	Fine to medium grained sand beach	18.1	3.6%
Shoreline Types	Tidal flat with salt marsh	17.8	1.3%
Species (Birds)	Western snowy plover	7.0	11.3%
Species (Birds)	Caspian tern (colony)	180.0	8.4%
Species (Birds)	Forester's tern (colony)	95.0	2.4%
Species (Birds)	Clapper rail (occurrence)	1.0	1.4%
Species (Birds)	Western gull (colony)	26.0	0.1%
Species (Fish)	Steelhead stream outlet	2.0	2.1%
Species (Fish)	Tidewater goby	139.9	1.6%
Species (Fish)	Night smelt	5.9	1.5%
Species (Mammals)	Sea otter (medium density)	1299.6	2.1%
Species (Mammals)	Harbor seal (haulout)	303.0	1.5%
Species (Mammals)	Sea otter (low density)	426.9	0.6%
Species (Mammals)	California sea lion (haulout)	1.0	0.3%
Validation Target	Top 20% demersal fish density	600.7	0.1%

Monterey Bay and Canyon

1,002. Square Miles

Monterey Bay is very productive and rich area that was designated as a National Marine Sanctuary. Monterey Bay receives nutrient-rich water from both the Davenport and Point Sur upwelling centers. Monterey Bay is important foraging area for seabirds, migration route for gray whales, and feeding ground for a variety of cetaceans. The shelf-slope break and entire bay have areas of high seabird and fish diversity and density. The bay, especially the southern part near shore, is important for squid fisheries. There are extensive near-shore rocky reefs and kelp beds and this is an important area for sea otters. The Monterey Peninsula down to Point Sur has unusual granitic outcrops that result in unique assemblages along rocky intertidal shores and rocky subtidal reefs. Monterey Canyon is a large submarine canyon complex that includes Soquel Canyon to the north and Carmel Canyon to the south; this area is unusual for the number of large canyons with their heads in near-shore waters. The canyons have very high bathymetric complexity and full range of diversity of benthic habitats, including both shallow and deep communities in close proximity. Soquel canyon may be a natural harvest refugia – with high abundance of large rockfish along canyon walls. This PCA includes the only "mapped" cold seep communities in California, although others are expected to occur elsewhere. Adjacent to the canyons are rocky-shelf and slope habitats. Southwest of Monterey Canyon is mixed mud/rock substrate which is scarce in MBNMS.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Apron Canyon Wall	16.6	100.0%
Benthic Habitats (Greene)	Rocky Slope Landslide	384.0	100.0%
Benthic Habitats (Greene)	Rocky Shelf Canyon Wall	5221.1	99.6%
Benthic Habitats (Greene)	Sedimentary Shelf Canyon Wall	7657.2	92.8%
Benthic Habitats (Greene)	Rocky Slope Canyon Wall	3566.8	38.1%
Benthic Habitats (Greene)	Sedimentary Shelf Canyon Floor	22.0	22.5%
Benthic Habitats (Greene)	Sedimentary Apron Canyon Wall	7771.6	20.0%
Benthic Habitats (Greene)	Sedimentary Slope Gully Floor	4493.8	13.5%
Benthic Habitats (Greene)	Rocky Shelf	10922.3	11.6%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	39368.1	11.2%
Benthic Habitats (Greene)	Rocky Slope	2807.4	6.9%
Benthic Habitats (Greene)	Sedimentary Apron Canyon Floor	777.4	5.0%
Benthic Habitats (Greene)	Sedimentary Slope Landslide	4376.8	3.6%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	12400.2	3.3%
Benthic Habitats (Greene)	Sedimentary Slope	97184.4	2.3%
Benthic Habitats (Greene)	Sedimentary Shelf	47998.6	2.3%
Benthic Habitats (Greene)	Sedimentary Apron	6528.6	1.1%
Benthic Habitats (Greene)	Sedimentary Slope Gully	2469.4	0.6%
Benthic Habitats (modeled)	Inner shelf ridge hard	214.3	100.0%
Benthic Habitats (modeled)	Inner shelf slope hard	28.0	58.3%
Benthic Habitats (modeled)	Mid shelf ridge hard	3140.0	31.9%
Benthic Habitats (modeled)	Mid shelf slope hard	604.1	28.5%
Benthic Habitats (modeled)	Mesobenthal canyon hard	1307.1	27.3%
Benthic Habitats (modeled)	Mesobenthal slope hard	1384.3	21.0%
Benthic Habitats (modeled)	Mid shelf canyon soft	358.4	17.4%
Benthic Habitats (modeled)	Mid shelf ridge soft	7704.0	11.5%
Benthic Habitats (modeled)	Mid shelf slope soft	889.4	9.6%
Benthic Habitats (modeled)	Mesobenthal ridge hard	1741.2	8.3%
Benthic Habitats (modeled)	Mesobenthal canyon soft	6515.2	8.2%
Benthic Habitats (modeled)	Mid shelf canyon hard	199.9	7.7%
Benthic Habitats (modeled)	Mid shelf flat hard	3798.0	6.6%
Benthic Habitats (modeled)	Mesobenthal ridge soft	8571.3	5.9%
Benthic Habitats (modeled)	Bathybenthal ridge soft	28681.0	5.6%
Benthic Habitats (modeled)	Bathybenthal canyon soft	38264.9	5.2%
Benthic Habitats (modeled)	Mesobenthal slope soft	6588.3	4.4%
Benthic Habitats (modeled)	Bathybenthal canyon hard	4282.4	4.1%
Benthic Habitats (modeled)	Inner shelf flat hard	1295.8	3.3%
Benthic Habitats (modeled)	Bathybenthal slope soft	31356.1	3.1%
Benthic Habitats (modeled)	Bathybenthal slope hard	2830.0	2.1%
Benthic Habitats (modeled)	Mid shelf flat soft	29257.2	1.8%
Benthic Habitats (modeled)	Bathybenthal flat soft	58790.8	1.6%
Benthic Habitats (modeled)	Inner shelf flat soft	7226.8	1.6%
Benthic Habitats (modeled)	Bathybenthal ridge hard	1727.2	1.3%
Benthic Habitats (modeled)	Inner shelf ridge soft	124.0	1.1%
Benthic Habitats (modeled)	Mesobenthal flat soft	6785.8	0.6%
Benthic Habitats (modeled)	Inner shelf slope soft	16.0	0.2%
Benthic Habitats (modeled)	Bathybenthal flat hard	190.9	0.1%
Benthic Habitats (modeled)	Mesobenthal flat hard	20.0	0.0%
Biologically Significant Areas	Major submarine canyon	142.5	19.7%
Biologically Significant Areas	Near-shore canyon head	3.0	7.9%
Biologically Significant Areas	High bathymetric complexity	89238.3	5.6%
Biologically Significant Areas	Off-shore rock or islet	551.0	4.5%
Biologically Significant Areas	Shelf-slope break	4944.9	1.9%
Biologically Significant Areas	Upwelling zone	3899.6	0.3%
Invertebrates	Structure forming invertebrate	36.0	4.3%
Nearshore	Near-shore rocky reef	6633.4	11.8%
Nearshore	Kelp bed (1989)	817.0	10.4%
Nearshore	Persistent kelp bed (89-03)	102.7	9.8%
Nearshore	Kelp bed (2002)	423.5	8.2%
Nearshore	Kelp bed (2003)	264.4	5.1%
Offshore	Cold seep community	21.0	100.0%
Onshore	Coastal dune	350.6	1.7%
Shoreline Types	Exposed wave cut rocky platform	40.3	10.2%
Shoreline Types	Exposed wave cut rocky platform with beach	8.3	3.5%
Shoreline Types	Exposed rocky cliff	5.1	2.4%
Shoreline Types	Fine to medium grained sand beach	11.1	2.2%

*Contribution is Amount / Total in Ecoregion

Species (Birds)	Brandts cormorant (colony)	9556.0	15.6%
Species (Birds)	Black oystercatcher (colony)	34.0	4.8%
Species (Birds)	Pelagic cormorant (colony)	298.0	2.4%
Species (Birds)	Pigeon guillemot (colony)	270.0	2.0%
Species (Birds)	Western gull (colony)	293.0	0.8%
Species (Mammals)	Sea otter (high density)	9444.4	19.0%
Species (Mammals)	Sea otter (medium density)	11011.7	17.4%
Species (Mammals)	California sea lion (haulout)	31.0	8.1%
Species (Mammals)	Sea otter (low density)	2841.0	4.1%
Species (Mammals)	Harbor seal (haulout)	693.0	3.5%
Species (Mammals)	Stellar sea lion (haulout)	3.0	2.5%
Species (Mammals)	Stellar sea lion (rookery)	3.0	0.4%
Validation Target	Top 20% demersal fish density	127579.6	24.3%
Validation Target	Top 20% seabird diversity	150543.7	13.2%
Validation Target	Top 20% seabird density	116044.4	10.9%

Pt. Sur and Sur Canyon

857.1 Square Miles

Point Sur is an important upwelling center; upwelled water is advected north to Monterey Bay and south along the Big Sur coast. Relatively high abundance of hard substrate and high bathymetric complexity occur throughout area. Offshore of Pt. Sur there are extensive areas of rocky substrate. There are extensive rocky shores and kelp beds and this area is very important for sea otters. Sur and Lucia Canyons – have high bathymetric complexity and variety of benthic habitats. Partington and Mill Creek Canyons are also in this area. Numerous small coastal estuaries and steelhead streams are present (Big Sur, Little Sur, and other rivers).

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Slope Canyon Wall	1781.6	19.0%
Benthic Habitats (Greene)	Sedimentary Slope Gully Floor	4866.1	14.6%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	35444.0	10.1%
Benthic Habitats (Greene)	Sedimentary Slope Landslide	11216.8	9.2%
Benthic Habitats (Greene)	Rocky Shelf	3236.4	3.4%
Benthic Habitats (Greene)	Sedimentary Slope	115705.3	2.7%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	9954.4	2.7%
Benthic Habitats (Greene)	Sedimentary Slope Gully	5941.6	1.5%
Benthic Habitats (Greene)	Sedimentary Shelf	26969.0	1.3%
Benthic Habitats (Greene)	Sedimentary Ridge	5564.0	0.6%
Benthic Habitats (Greene)	Rocky Slope	134.3	0.3%
Benthic Habitats (Greene)	Rocky Ridge	419.2	0.1%
Benthic Habitats (Greene)	Sedimentary Apron	53.1	0.0%
Benthic Habitats (modeled)	Mid shelf slope soft	1454.6	15.7%
Benthic Habitats (modeled)	Mesobenthal canyon hard	486.8	10.2%
Benthic Habitats (modeled)	Mid shelf ridge soft	5193.9	7.7%
Benthic Habitats (modeled)	Mesobenthal canyon soft	6009.7	7.6%
Benthic Habitats (modeled)	Mid shelf ridge hard	712.0	7.2%
Benthic Habitats (modeled)	Mesobenthal slope soft	9376.7	6.3%
Benthic Habitats (modeled)	Bathybenthal ridge soft	25550.5	5.0%
Benthic Habitats (modeled)	Mid shelf slope hard	89.2	4.2%
Benthic Habitats (modeled)	Mid shelf flat hard	2341.3	4.1%
Benthic Habitats (modeled)	Bathybenthal canyon soft	27420.1	3.7%
Benthic Habitats (modeled)	Mesobenthal ridge soft	4689.5	3.2%
Benthic Habitats (modeled)	Mesobenthal slope hard	200.0	3.0%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Mid shelf canyon soft	59.7	2.9%
Benthic Habitats (modeled)	Mid shelf canyon hard	64.0	2.5%
Benthic Habitats (modeled)	Bathybenthal flat soft	77542.7	2.2%
Benthic Habitats (modeled)	Bathybenthal slope soft	18604.1	1.9%
Benthic Habitats (modeled)	Inner shelf ridge soft	201.5	1.8%
Benthic Habitats (modeled)	Inner shelf flat soft	6744.0	1.5%
Benthic Habitats (modeled)	Mesobenthal flat soft	16862.8	1.4%
Benthic Habitats (modeled)	Inner shelf slope soft	92.0	1.1%
Benthic Habitats (modeled)	Mid shelf flat soft	15821.4	1.0%
Benthic Habitats (modeled)	Bathybenthal canyon hard	567.7	0.5%
Benthic Habitats (modeled)	Inner shelf flat hard	211.4	0.5%
Benthic Habitats (modeled)	Bathybenthal ridge hard	490.4	0.4%
Benthic Habitats (modeled)	Mesobenthal ridge hard	28.0	0.1%
Benthic Habitats (modeled)	Bathybenthal slope hard	167.4	0.1%
Benthic Habitats (modeled)	Inner shelf canyon soft	16.0	0.1%
Benthic Habitats (modeled)	Mesobenthal flat hard	92.0	0.1%
Benthic Habitats (modeled)	Bathybenthal flat hard	108.0	0.0%
Biologically Significant Areas	Near-shore canyon head	6.0	15.8%
Biologically Significant Areas	Major submarine canyon	109.6	15.2%
Biologically Significant Areas	Off-shore rock or islet	759.0	6.3%
Biologically Significant Areas	Upwelling zone	49725.2	4.0%
Biologically Significant Areas	High bathymetric complexity	45065.6	2.8%
Biologically Significant Areas	Shelf-slope break	4524.9	1.7%
Estuarine	Small estuary or lagoon	16.9	0.7%
Estuarine	Coastal marsh	21.0	0.0%
Invertebrates	Structure forming invertebrate	19.0	2.2%
Nearshore	Persistent kelp bed (89-03)	180.5	17.3%
Nearshore	Kelp bed (2002)	734.2	14.2%
Nearshore	Kelp bed (1989)	1081.8	13.8%
Nearshore	Kelp bed (2003)	361.1	6.9%
Nearshore	Near-shore rocky reef	452.4	0.8%
Onshore	Coastal dune	51.2	0.3%
Shoreline Types	Exposed rocky cliff with talus boulder base	8.6	23.9%
Shoreline Types	Gravel beach	5.4	13.3%
Shoreline Types	Exposed rocky cliff	16.9	8.0%
Shoreline Types	Exposed wave cut rocky platform	14.4	3.6%
Shoreline Types	Mixed sand and gravel beach	2.3	2.8%
Shoreline Types	Exposed wave cut rocky platform with beach	6.5	2.8%
Shoreline Types	Coarse grained sand beach	3.4	2.5%
Shoreline Types	Fine to medium grained sand beach	6.7	1.3%
Species (Birds)	Black oystercatcher (colony)	32.0	4.5%
Species (Birds)	Brandts cormorant (colony)	2190.0	3.6%
Species (Birds)	Pigeon guillemot (colony)	433.0	3.2%
Species (Birds)	Pelagic cormorant (colony)	332.0	2.6%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Tufted puffin (colony)	2.0	0.7%
Species (Birds)	Common murre (colony)	1663.0	0.5%
Species (Birds)	Western gull (colony)	140.0	0.4%
Species (Birds)	Double-crested cormorant (colony)	10.0	0.1%
Species (Fish)	Steelhead stream outlet	6.0	6.3%
Species (Mammals)	Sea otter (medium density)	16394.3	25.9%
Species (Mammals)	Sea otter (low density)	3909.6	5.6%
Species (Mammals)	California sea lion (haulout)	9.0	2.3%

*Contribution is Amount / Total in Ecoregion

Species (Mammals)	Harbor seal (haulout)	369.0	1.9%
Species (Mammals)	Sea otter (high density)	260.2	0.5%
Validation Target	Top 20% demersal fish diversity	77473.4	14.3%
Validation Target	Top 20% seabird diversity	63214.7	5.5%
Validation Target	Top 20% demersal fish density	18584.7	3.5%
Validation Target	Top 20% seabird density	4888.4	0.5%

Cape San Martin - Lopez Point

91.5 Square Miles

This PCA extends from Big Creek south to Lopez Point. In this region of the Big Sur coast, there is a very narrow continental shelf which brings deep water near-shore. Upwelling from Pt. Sur cell extends south along this region fueling productivity. Lopez point has extensive kelp beds with high abundance of large fish and very diverse invertebrate communities

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	1088.2	1.2%
Benthic Habitats (Greene)	Sedimentary Shelf	9077.6	0.4%
Benthic Habitats (Greene)	Sedimentary Slope	11158.9	0.3%
Benthic Habitats (Greene)	Sedimentary Slope Gully	494.7	0.1%
Benthic Habitats (Greene)	Rocky Slope	39.0	0.1%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	269.0	0.1%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	90.3	0.0%
Benthic Habitats (Greene)	Sedimentary Slope Landslide	21.4	0.0%
Benthic Habitats (modeled)	Mid shelf ridge no data	92.0	100.0%
Benthic Habitats (modeled)	Mid shelf flat no data	92.0	22.2%
Benthic Habitats (modeled)	Mid shelf slope soft	752.5	8.1%
Benthic Habitats (modeled)	Mid shelf canyon soft	80.0	3.9%
Benthic Habitats (modeled)	Mid shelf ridge soft	2139.3	3.2%
Benthic Habitats (modeled)	Inner shelf flat hard	917.3	2.4%
Benthic Habitats (modeled)	Mesobenthal canyon soft	1618.5	2.0%
Benthic Habitats (modeled)	Mesobenthal slope soft	1360.5	0.9%
Benthic Habitats (modeled)	Mesobenthal flat soft	8607.8	0.7%
Benthic Habitats (modeled)	Inner shelf flat soft	2533.7	0.6%
Benthic Habitats (modeled)	Mid shelf ridge hard	40.9	0.4%
Benthic Habitats (modeled)	Mesobenthal slope hard	16.0	0.2%
Benthic Habitats (modeled)	Mid shelf flat soft	3961.6	0.2%
Benthic Habitats (modeled)	Mid shelf flat hard	124.0	0.2%
Benthic Habitats (modeled)	Inner shelf canyon soft	36.0	0.2%
Benthic Habitats (modeled)	Inner shelf ridge soft	14.5	0.1%
Benthic Habitats (modeled)	Mesobenthal ridge soft	28.0	0.0%
Benthic Habitats (modeled)	Mesobenthal flat hard	12.0	0.0%
Biologically Significant Areas	Near-shore canyon head	1.0	2.6%
Biologically Significant Areas	Off-shore rock or islet	248.0	2.0%
Biologically Significant Areas	Shelf-slope break	2632.8	1.0%
Biologically Significant Areas	Upwelling zone	1728.1	0.1%
Biologically Significant Areas	High bathymetric complexity	1809.9	0.1%
Invertebrates	Structure forming invertebrate	11.0	1.3%
Nearshore	Persistent kelp bed (89-03)	132.6	12.7%
Nearshore	Kelp bed (1989)	526.9	6.7%
Nearshore	Kelp bed (2002)	328.3	6.3%
Nearshore	Kelp bed (1999)	9.7	5.8%
Nearshore	Kelp bed (2003)	243.5	4.7%

*Contribution is Amount / Total in Ecoregion

Nearshore	Near-shore rocky reef	1117.2	2.0%
Shoreline Types	Exposed rocky cliff with talus boulder base	14.3	39.6%
Shoreline Types	Gravel beach	7.7	19.0%
Shoreline Types	Exposed rocky cliff	1.7	0.8%
Shoreline Types	Exposed wave cut rocky platform with beach	1.2	0.5%
Shoreline Types	Fine to medium grained sand beach	1.4	0.3%
Species (Birds)	Brandts cormorant (colony)	1995.0	3.3%
Species (Birds)	Black oystercatcher (colony)	21.0	2.9%
Species (Birds)	Western gull (colony)	419.0	1.2%
Species (Birds)	Pelagic cormorant (colony)	107.0	0.8%
Species (Birds)	Pigeon guillemot (colony)	97.0	0.7%
Species (Birds)	Double-crested cormorant (colony)	28.0	0.4%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Mammals)	Sea otter (high density)	10631.6	21.4%
Species (Mammals)	Northern elephant seal (rookery)	100.0	19.5%
Species (Mammals)	California sea lion (haulout)	14.0	3.7%
Species (Mammals)	Sea otter (medium density)	569.9	0.9%
Species (Mammals)	Stellar sea lion (haulout)	1.0	0.8%
Species (Mammals)	Harbor seal (haulout)	91.0	0.5%
Species (Mammals)	Stellar sea lion (rookery)	1.0	0.1%
Validation Target	Top 20% demersal fish diversity	8705.7	1.6%

Davidson Seamount

116.2 Square Miles

Davidson Seamount is 120km southwest of Monterey. One of the largest known seamounts in U.S. waters. About 2,300 m tall and 40km wide; it is 1,256 meters below the sea surface. Davidson is an inactive volcano. The waters above the seamount are productive feeding grounds for a wide variety of fishes, marine mammals, and seabirds. The rocky surfaces of the seamount serves as habitat islands for deep-sea animals such as corals and sponges. Large, dense patches of sponges and apparently extremely old coral forests, with individuals commonly reaching more than 3 m in height have been seen in video footage. Rare species, such as the black-footed albatross and the federally listed endangered sperm whales have been seen in waters above the seamount. (Sources: http://oceanexplorer.noaa.gov/explorations/02davidson/davidson.html; http://www.mbari.org/expeditions/Davidson.html)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Apron	32.0	100.0%
Benthic Habitats (Greene)	Rocky Ridge	23821.0	3.1%
Benthic Habitats (Greene)	Sedimentary Apron	3979.4	0.7%
Benthic Habitats (Greene)	Sedimentary Ridge	1190.7	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge hard	10274.2	7.5%
Benthic Habitats (modeled)	Bathybenthal canyon hard	6739.3	6.5%
Benthic Habitats (modeled)	Bathybenthal slope hard	6843.1	5.2%
Benthic Habitats (modeled)	Bathybenthal canyon no data	853.9	1.6%
Benthic Habitats (modeled)	Bathybenthal canyon soft	2863.8	0.4%
Benthic Habitats (modeled)	Bathybenthal flat no data	1593.3	0.3%
Benthic Habitats (modeled)	Bathybenthal ridge soft	244.0	0.0%
Benthic Habitats (modeled)	Bathybenthal slope soft	466.7	0.0%
Benthic Habitats (modeled)	Bathybenthal flat soft	1551.2	0.0%
Benthic Habitats (modeled)	Bathybenthal flat hard	54.8	0.0%
Biologically Significant Areas	Seamount	1.0	16.7%
Biologically Significant Areas	High bathymetric complexity	24750.6	1.6%

*Contribution is Amount / Total in Ecoregion

Pt. Piedras Blancas

25.1 Square Miles

Point Piedras Blancas and surrounding area is on the Big Sur coast. There is a very narrow continental shelf in this area, with deep water near-shore. Upwelling from Pt. Sur cell extends south to this area. There is a large Brandts cormorant colony and a Northern Elephant seal rookery. Coastal dunes are found behind Point Piedras Blancas. The Arroyo de la Cruz river and estuary are important for steelhead and other species. Kelp beds and sea otters are found along the coast.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	6875.2	0.3%
Benthic Habitats (modeled)	Inner shelf flat soft	5049.7	1.1%
Benthic Habitats (modeled)	Mid shelf flat soft	1810.0	0.1%
Biologically Significant Areas	Off-shore rock or islet	647.0	5.3%
Biologically Significant Areas	Upwelling zone	5371.7	0.4%
Estuarine	Small estuary or lagoon	20.9	0.9%
Nearshore	Kelp bed (1999)	42.8	25.6%
Nearshore	Kelp bed (2002)	365.4	7.1%
Nearshore	Persistent kelp bed (89-03)	37.7	3.6%
Nearshore	Kelp bed (2003)	162.6	3.1%
Nearshore	Kelp bed (1989)	201.5	2.6%
Onshore	Coastal dune	27.7	0.1%
Shoreline Types	Coarse grained sand beach	5.4	4.1%
Shoreline Types	Exposed wave cut rocky platform with beach	6.5	2.8%
Shoreline Types	Gravel beach	1.0	2.5%
Shoreline Types	Exposed wave cut rocky platform	8.6	2.2%
Shoreline Types	Exposed rocky cliff	1.6	0.8%
Shoreline Types	Fine to medium grained sand beach	1.6	0.3%
Species (Birds)	Brandts cormorant (colony)	3305.0	5.4%
Species (Birds)	Black oystercatcher (colony)	10.0	1.4%
Species (Birds)	Pelagic cormorant (colony)	101.0	0.8%
Species (Birds)	Pigeon guillemot (colony)	42.0	0.3%
Species (Birds)	Western gull (colony)	96.0	0.3%
Species (Birds)	Rhinosaurus auklet (colony)	3.0	0.2%
Species (Fish)	Steelhead stream outlet	2.0	2.1%
Species (Fish)	Tidewater goby	1.8	0.0%
Species (Mammals)	Northern elephant seal (rookery)	100.0	19.5%
Species (Mammals)	Sea otter (high density)	6124.4	12.3%
Species (Mammals)	California sea lion (haulout)	14.0	3.7%
Species (Mammals)	Harbor seal (haulout)	381.0	1.9%

San Simeon

6.4 Square Miles

This small PCA along the San Simeon coast includes rocky intertidal and small estuaries. Kelp beds and sea otters are found in the near-shore.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	1572.8	0.1%
Benthic Habitats (modeled)	Inner shelf flat soft	1555.4	0.3%
Benthic Habitats (modeled)	Mid shelf flat soft	18.8	0.0%
Biologically Significant Areas	Off-shore rock or islet	291.0	2.4%

*Contribution is Amount / Total in Ecoregion

Biologically Significant Areas	Upwelling zone	1573.4	0.1%
Estuarine	Small estuary or lagoon	2.4	0.1%
Nearshore	Persistent kelp bed (89-03)	64.7	6.2%
Nearshore	Kelp bed (2002)	121.4	2.3%
Nearshore	Kelp bed (2003)	104.8	2.0%
Nearshore	Kelp bed (1989)	153.9	2.0%
Shoreline Types	Exposed wave cut rocky platform with beach	4.4	1.9%
Shoreline Types	Coarse grained sand beach	2.5	1.9%
Shoreline Types	Exposed rocky cliff	1.2	0.6%
Species (Birds)	Pigeon guillemot (colony)	22.0	0.2%
Species (Fish)	Steelhead stream outlet	3.0	3.2%
Species (Fish)	Tidewater goby	37.3	0.4%
Species (Mammals)	Sea otter (high density)	1576.3	3.2%
Species (Mammals)	Harbor seal (haulout)	136.0	0.7%
Validation Target	Top 20% demersal fish diversity	81.9	0.0%

NCC-42

37.2 Square Miles

This small PCA offshore of the Central Coast was selected in large part to meet benthic habitat goals for areas with no substrate data available; as such it can be considered a provisional PCA.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (modeled)	Bathybenthal Ridge no data	1985.7	7.3%
Benthic Habitats (modeled)	Bathybenthal slope no data	5420.4	6.9%
Benthic Habitats (modeled)	Bathybenthal canyon no data	2355.9	4.5%
Benthic Habitats (modeled)	Bathybenthal flat no data	738.0	0.1%
Biologically Significant Areas	High bathymetric complexity	6080.8	0.4%

Morro Bay - Point Bouchon

301.9 Square Miles

This PCA includes Morro Estuary and Bay and near-shore areas south to just past Point Bouchon. Morro Bay is a 2500 acre estuary with over 400 acres of coastal marsh and important tidal flats and eelgrass beds. Morro Bay is an important stop on the Pacific Flyway. Morro estuary and near-shore sandy bottom habitats are critically important for juvenile flatfish. Chorro and Toro creeks empty into Estero Bay. There are extensive kelp beds and sea otters are present in this area.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	38682.7	1.8%
Benthic Habitats (Greene)	Sedimentary Slope	38009.5	0.9%
Benthic Habitats (modeled)	Mesobenthal flat soft	37675.1	3.2%
Benthic Habitats (modeled)	Inner shelf flat soft	11789.2	2.6%
Benthic Habitats (modeled)	Mid shelf flat soft	27256.8	1.7%
Biologically Significant Areas	Sand spit	1.0	9.1%
Biologically Significant Areas	Shelf-slope break	16702.5	6.3%
Biologically Significant Areas	Off-shore rock or islet	351.0	2.9%
Biologically Significant Areas	Upwelling zone	447.1	0.0%
Estuarine	Medium estuary or lagoon	1029.7	19.4%
Estuarine	Eelgrass bed	269.4	6.3%
Estuarine	Coastal marsh (shoreline)	11.9	3.0%
Estuarine	Coastal marsh	400.0	0.9%
Estuarine	Small estuary or lagoon	5.8	0.3%

*Contribution is Amount / Total in Ecoregion

Invertebrates	Structure forming invertebrate	15.0	1.8%
Nearshore	Kelp bed (2003)	322.3	6.2%
Nearshore	Persistent kelp bed (89-03)	40.9	3.9%
Nearshore	Kelp bed (2002)	176.8	3.4%
Nearshore	Kelp bed (1989)	230.9	2.9%
Onshore	Coastal dune	641.8	3.2%
Shoreline Types	Coarse grained sand beach	10.6	8.0%
Shoreline Types	Exposed tidal flat	4.8	7.9%
Shoreline Types	Exposed wave cut rocky platform	15.5	3.9%
Shoreline Types	Exposed rocky cliff	7.4	3.5%
Shoreline Types	Exposed wave cut rocky platform with beach	5.7	2.5%
Shoreline Types	Fine to medium grained sand beach	9.3	1.8%
Shoreline Types	Sheltered tidal flat	3.4	0.9%
Shoreline Types	Tidal flat with salt marsh	1.3	0.1%
Species (Birds)	California black rail (habitat)	662.8	9.2%
Species (Birds)	Double-crested cormorant (colony)	355.0	5.1%
Species (Birds)	California black rail (occurence)	2.0	4.2%
Species (Birds)	Black oystercatcher (colony)	27.0	3.8%
Species (Birds)	Pigeon guillemot (colony)	500.0	3.7%
Species (Birds)	Brandts cormorant (colony)	2139.0	3.5%
Species (Birds)	Pelagic cormorant (colony)	423.0	3.4%
Species (Birds)	Western snowy plover	2.0	3.2%
Species (Birds)	Clapper rail (habitat)	153.1	1.6%
Species (Birds)	Clapper rail (occurrence)	1.0	1.4%
Species (Birds)	Western gull (colony)	347.0	1.0%
Species (Fish)	Grunion	114.7	20.8%
Species (Fish)	Steelhead stream outlet	6.0	6.3%
Species (Fish)	Tidewater goby	184.6	2.1%
Species (Mammals)	Sea otter (high density)	7122.1	14.3%
Species (Mammals)	Sea otter (medium density)	5288.2	8.3%
Species (Mammals)	California sea lion (haulout)	21.0	5.5%
Species (Mammals)	Sea otter (low density)	3482.3	5.0%
Species (Mammals)	Harbor seal (haulout)	439.0	2.2%
Species (Mammals)	Stellar sea lion (haulout)	1.0	0.8%
Species (Mammals)	Stellar sea lion (rookery)	2.0	0.2%
Validation Target	Top 20% demersal fish density	38517.5	7.3%
Validation Target	Top 20% seabird density	41235.6	3.9%
Validation Target	Top 20% demersal fish diversity	3361.5	0.6%

NCC-44

63.6 Square Miles

This small PCA offshore of the Central Coast was selected in large part to meet benthic habitat goals; as such it can be considered a provisional PCA.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Ridge	16250.9	2.1%
Benthic Habitats (Greene)	Sedimentary Slope	1249.1	0.0%
Benthic Habitats (modeled)	Bathybenthal flat hard	14460.1	6.0%
Benthic Habitats (modeled)	Bathybenthal canyon hard	894.8	0.9%
Benthic Habitats (modeled)	Bathybenthal ridge hard	630.4	0.5%
Benthic Habitats (modeled)	Bathybenthal slope hard	263.7	0.2%
Benthic Habitats (modeled)	Bathybenthal flat soft	1245.8	0.0%

*Contribution is Amount / Total in Ecoregion

Biologically Significant Areas	High bathymetric complexity	209.8	0.0%
Invertebrates	Structure forming invertebrate	2.0	0.2%

Pismo

15.3 Square Miles

This PCA covers the coastal area around Pismo Beach and has coastal dunes, beaches, and near-shore soft substrates. There are also kelp beds, sea otters, and steelhead streams.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Shelf	3825.2	0.2%
Benthic Habitats (modeled)	Inner shelf flat soft	3820.6	0.9%
Biologically Significant Areas	Off-shore rock or islet	23.0	0.2%
Nearshore	Kelp bed (1989)	57.6	0.7%
Nearshore	Kelp bed (2003)	31.0	0.6%
Onshore	Coastal dune	98.5	0.5%
Shoreline Types	Fine to medium grained sand beach	8.5	1.7%
Shoreline Types	Exposed wave cut rocky platform with beach	2.7	1.1%
Shoreline Types	Exposed rocky cliff	1.2	0.6%
Shoreline Types	Exposed wave cut rocky platform	1.3	0.3%
Species (Birds)	Black oystercatcher (colony)	14.0	2.0%
Species (Birds)	Pigeon guillemot (colony)	257.0	1.9%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Clapper rail (habitat)	53.4	0.6%
Species (Birds)	Rhinosaurus auklet (colony)	6.0	0.4%
Species (Birds)	Pelagic cormorant (colony)	18.0	0.1%
Species (Birds)	Western gull (colony)	28.0	0.1%
Species (Fish)	Grunion	70.4	12.8%
Species (Fish)	Steelhead stream outlet	2.0	2.1%
Species (Fish)	Tidewater goby	28.7	0.3%
Species (Mammals)	Sea otter (high density)	3084.0	6.2%
Species (Mammals)	Sea otter (medium density)	214.3	0.3%
Species (Mammals)	California sea lion (haulout)	1.0	0.3%
Species (Mammals)	Sea otter (low density)	12.3	0.0%

Point Sal

21.5 Square Miles

This PCA covers the coastal area around Point Sal, including the Guadalupe-Nipomo Dune complex and small coastal estuaries. There are Least Tern colonies and Snowy Plover nesting sites. The near-shore is mostly soft – bottom, but some near-shore rocky reefs occur.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	218.5	0.2%
Benthic Habitats (Greene)	Sedimentary Shelf	3439.7	0.2%
Benthic Habitats (modeled)	Inner shelf flat soft	3496.1	0.8%
Benthic Habitats (modeled)	Inner shelf flat hard	209.5	0.5%
Biologically Significant Areas	Off-shore rock or islet	9.0	0.1%
Estuarine	Small estuary or lagoon	49.4	2.2%
Nearshore	Near-shore rocky reef	215.3	0.4%
Onshore	Coastal dune	1789.2	8.9%
Shoreline Types	Fine to medium grained sand beach	12.8	2.5%
Shoreline Types	Exposed wave cut rocky platform	1.3	0.3%

*Contribution is Amount / Total in Ecoregion

Shoreline Types	Tidal flat with salt marsh	2.4	0.2%
Species (Birds)	California least tern (colony)	40.0	19.5%
Species (Birds)	California least tern (occurence)	1.0	5.9%
Species (Birds)	Western snowy plover	2.0	3.2%
Species (Birds)	Clapper rail (habitat)	8.2	0.1%
Species (Birds)	Pelagic cormorant (colony)	9.0	0.1%
Species (Birds)	Pigeon guillemot (colony)	5.0	0.0%
Species (Birds)	Western gull (colony)	7.0	0.0%
Species (Fish)	Grunion	72.5	13.2%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Fish)	Tidewater goby	3.0	0.0%
Species (Mammals)	Sea otter (low density)	3610.9	5.2%
Species (Mammals)	Harbor seal (haulout)	47.0	0.2%

Santa Lucia Bank

322.2 Square Miles

This large mostly rocky ridge or bank is located offshore from Morro Bay and rises to 430m depth; it is surrounded by soft-substrates. This is the largest extent of rocky habitat in the offshore area in this part of the ecoregion. There is an abundance of structure-forming invertebrates (based on limited preliminary data) and the area is important for regional fisheries.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Ridge	58110.7	7.7%
Benthic Habitats (Greene)	Sedimentary Slope	25888.3	0.6%
Benthic Habitats (modeled)	Mesobenthal flat hard	53450.6	35.3%
Benthic Habitats (modeled)	Mesobenthal slope hard	909.6	13.8%
Benthic Habitats (modeled)	Mesobenthal canyon hard	576.8	12.1%
Benthic Habitats (modeled)	Mesobenthal ridge hard	1757.6	8.4%
Benthic Habitats (modeled)	Mesobenthal flat soft	23827.5	2.0%
Benthic Habitats (modeled)	Bathybenthal canyon hard	527.2	0.5%
Benthic Habitats (modeled)	Mesobenthal ridge soft	517.6	0.4%
Benthic Habitats (modeled)	Mesobenthal canyon soft	255.8	0.3%
Benthic Habitats (modeled)	Bathybenthal slope hard	324.0	0.2%
Benthic Habitats (modeled)	Bathybenthal flat hard	499.8	0.2%
Benthic Habitats (modeled)	Mesobenthal slope soft	90.4	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge hard	56.0	0.0%
Benthic Habitats (modeled)	Bathybenthal slope soft	330.4	0.0%
Benthic Habitats (modeled)	Bathybenthal flat soft	760.9	0.0%
Benthic Habitats (modeled)	Bathybenthal ridge soft	70.2	0.0%
Benthic Habitats (modeled)	Bathybenthal canyon soft	32.0	0.0%
Biologically Significant Areas	Off-shore bank	58578.1	69.1%
Biologically Significant Areas	High bathymetric complexity	961.9	0.1%
Invertebrates	Structure forming invertebrate	34.0	4.0%

*Contribution is Amount / Total in Ecoregion

Purisma Point

25.0 Square Miles

This PCA extends around Purisma Point, especially north of the point, and includes the Callender dunes complex. This coastal PCA is mostly on Vandenberg AFB. There are extensive rocky shores and near-shore rocky reefs in this area.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	1869.6	2.0%
Benthic Habitats (Greene)	Sedimentary Shelf	1260.7	0.1%
Benthic Habitats (modeled)	Inner shelf flat hard	1881.4	4.8%
Benthic Habitats (modeled)	Inner shelf flat soft	725.1	0.2%
Benthic Habitats (modeled)	Mid shelf flat soft	539.0	0.0%
Biologically Significant Areas	Off-shore rock or islet	21.0	0.2%
Biologically Significant Areas	Upwelling zone	669.0	0.1%
Estuarine	Small estuary or lagoon	5.5	0.2%
Nearshore	Near-shore rocky reef	1866.2	3.3%
Nearshore	Kelp bed (2003)	4.1	0.1%
Onshore	Coastal dune	2603.9	12.9%
Shoreline Types	Exposed wave cut rocky platform with beach	3.8	1.6%
Shoreline Types	Fine to medium grained sand beach	4.9	1.0%
Species (Birds)	California least tern (colony)	59.0	28.8%
Species (Birds)	California least tern (occurence)	2.0	11.8%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Pigeon guillemot (colony)	25.0	0.2%
Species (Birds)	Pelagic cormorant (colony)	7.0	0.1%
Species (Birds)	Western gull (colony)	7.0	0.0%
Species (Fish)	Grunion	86.8	15.8%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Fish)	Tidewater goby	1.0	0.0%
Species (Mammals)	Sea otter (low density)	2665.0	3.8%

Point Arguello - Arguello Canyon

631.4 Square Miles

This PCA extends from Surf to the south side of Vandenberg AFB and offshore to the bottom of the Arguello Canyon complex. It captures the northern part of the Point Conception upwelling zone and areas of high bathymetric complexity. Arguello Canyon is not well explored but is suspected to have high biodiversity based on its location at biogeographic boundary. Shoreline area has extensive rocky intertidal and beaches – much of it protected on Vandenberg AFB.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Slope Gully Floor	2109.9	6.3%
Benthic Habitats (Greene)	Sedimentary Slope	127089.1	3.0%
Benthic Habitats (Greene)	Sedimentary Shelf	29590.7	1.4%
Benthic Habitats (Greene)	Rocky Slope	508.6	1.3%
Benthic Habitats (Greene)	Sedimentary Slope Landslide	1030.1	0.8%
Benthic Habitats (Greene)	Rocky Shelf	449.7	0.5%
Benthic Habitats (Greene)	Sedimentary Apron	739.9	0.1%
Benthic Habitats (modeled)	Mesobenthal flat no data	48.0	100.0%
Benthic Habitats (modeled)	Mid shelf canyon soft	172.8	8.4%
Benthic Habitats (modeled)	Mid shelf flat no data	23.6	5.7%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Mesobenthal canyon soft	3067.1	3.9%
Benthic Habitats (modeled)	Mesobenthal flat soft	43289.0	3.7%
Benthic Habitats (modeled)	Inner shelf flat soft	8003.0	1.8%
Benthic Habitats (modeled)	Bathybenthal flat soft	60257.1	1.7%
Benthic Habitats (modeled)	Mid shelf slope soft	152.0	1.6%
Benthic Habitats (modeled)	Bathybenthal canyon soft	9312.9	1.3%
Benthic Habitats (modeled)	Mid shelf flat soft	20558.6	1.3%
Benthic Habitats (modeled)	Inner shelf flat hard	465.7	1.2%
Benthic Habitats (modeled)	Bathybenthal slope soft	11256.0	1.1%
Benthic Habitats (modeled)	Mesobenthal slope soft	1312.0	0.9%
Benthic Habitats (modeled)	Mid shelf ridge soft	455.2	0.7%
Benthic Habitats (modeled)	Bathybenthal ridge soft	2221.4	0.4%
Benthic Habitats (modeled)	Mesobenthal ridge soft	460.0	0.3%
Benthic Habitats (modeled)	Bathybenthal flat hard	354.3	0.1%
Benthic Habitats (modeled)	Mesobenthal flat hard	170.8	0.1%
Benthic Habitats (modeled)	Bathybenthal flat no data	49.7	0.0%
Biologically Significant Areas	Near-shore canyon head	4.0	10.5%
Biologically Significant Areas	Major submarine canyon	61.8	8.5%
Biologically Significant Areas	Upwelling zone	96906.1	7.9%
Biologically Significant Areas	Shelf-slope break	7793.2	2.9%
Biologically Significant Areas	Off-shore rock or islet	116.0	1.0%
Biologically Significant Areas	High bathymetric complexity	4491.4	0.3%
Estuarine	Small estuary or lagoon	148.5	6.5%
Estuarine	Coastal marsh	143.1	0.3%
Invertebrates	Structure forming invertebrate	17.0	2.0%
Nearshore	Kelp bed (1999)	1.8	1.1%
Nearshore	Near-shore rocky reef	437.7	0.8%
Nearshore	Kelp bed (2003)	14.8	0.3%
Nearshore	Kelp bed (1989)	16.3	0.2%
Onshore	Coastal dune	1587.1	7.9%
Shoreline Types	Fine to medium grained sand beach	13.8	2.7%
Shoreline Types	Exposed rocky cliff	5.3	2.5%
Shoreline Types	Exposed wave cut rocky platform with beach	4.6	2.0%
Shoreline Types	Mixed sand and gravel beach	1.5	1.9%
Shoreline Types	Tidal flat with salt marsh	5.1	0.4%
Shoreline Types	Exposed wave cut rocky platform	1.2	0.3%
Species (Birds)	Pigeon guillemot (colony)	1442.0	10.7%
Species (Birds)	California least tern (occurence)	1.0	5.9%
Species (Birds)	Rhinosaurus auklet (colony)	29.0	1.7%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Black oystercatcher (colony)	9.0	1.3%
Species (Birds)	Pelagic cormorant (colony)	92.0	0.7%
Species (Birds)	Western gull (colony)	6.0	0.0%
Species (Fish)	Steelhead stream outlet	1.0	1.1%
Species (Fish)	Tidewater goby	25.8	0.3%
Species (Mammals)	Sea otter (low density)	8813.5	12.6%
Species (Mammals)	California sea lion (haulout)	9.0	2.3%
Species (Mammals)	Harbor seal (haulout)	332.0	1.7%

*Contribution is Amount / Total in Ecoregion

Point Conception

49.5 Square Miles

This PCA includes the shoreline of Point Conception and extends off-shore in a southwesterly direction. It abuts the Point Conception PCA from the Southern California Marine Ecoregion. This is one of the larger upwelling zones in the ecoregion and is a major biogeographic boundary. There is high biodiversity due to meeting of northern and southern fauna. The PCA also includes Jalama Creek, sandy beaches, kelp beds, exposed rocky shores and a variety of soft and hard bottom habitats.

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Shelf	816.2	0.9%
Benthic Habitats (Greene)	Sedimentary Shelf	8568.9	0.4%
Benthic Habitats (Greene)	Sedimentary Slope	3984.9	0.1%
Benthic Habitats (modeled)	Inner shelf flat hard	713.5	1.8%
Benthic Habitats (modeled)	Mid shelf flat soft	6988.1	0.4%
Benthic Habitats (modeled)	Inner shelf flat soft	1736.7	0.4%
Benthic Habitats (modeled)	Mesobenthal flat soft	3819.4	0.3%
Benthic Habitats (modeled)	Mid shelf flat hard	108.0	0.2%
Biologically Significant Areas	Upwelling zone	13409.0	1.1%
Biologically Significant Areas	Shelf-slope break	1713.8	0.6%
Biologically Significant Areas	Off-shore rock or islet	13.0	0.1%
Nearshore	Near-shore rocky reef	814.2	1.4%
Nearshore	Kelp bed (1989)	78.8	1.0%
Nearshore	Kelp bed (1999)	1.1	0.7%
Nearshore	Kelp bed (2003)	31.1	0.6%
Nearshore	Kelp bed (2002)	17.5	0.3%
Shoreline Types	Exposed wave cut rocky platform with beach	4.6	2.0%
Shoreline Types	Exposed rocky cliff	3.8	1.8%
Shoreline Types	Fine to medium grained sand beach	8.4	1.7%
Shoreline Types	Exposed wave cut rocky platform	5.0	1.2%
Species (Birds)	Black oystercatcher (colony)	2.0	0.3%
Species (Birds)	Pigeon guillemot (colony)	29.0	0.2%
Species (Birds)	Pelagic cormorant (colony)	6.0	0.0%
Species (Birds)	Western gull (colony)	2.0	0.0%
Species (Fish)	Tidewater goby	41.5	0.5%
Species (Mammals)	Harbor seal (haulout)	488.0	2.5%
Species (Mammals)	Sea otter (low density)	66.0	0.1%

Rodriguez Seamount

91.9 Square Miles

Rodriguez Seamout or Guyot (a flat-topped submarine mountain) is located about halfway up the continental rise, offshore of Santa Barbara. Rodriguez Guyot rises about 1,675 meters above the surrounding seafloor to a minimum water depth of 650 meters. (Source: http://www.mbari.org/data/mapping/SBBasin/rodriguez.htm)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Ridge	21131.3	2.8%
Benthic Habitats (Greene)	Sedimentary Slope	3354.2	0.1%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	14.5	0.0%
Benthic Habitats (modeled)	Bathybenthal slope hard	7721.3	5.9%
Benthic Habitats (modeled)	Bathybenthal ridge hard	6960.4	5.1%
Benthic Habitats (modeled)	Bathybenthal canyon hard	4008.1	3.8%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Bathybenthal flat hard	2451.6	1.0%
Benthic Habitats (modeled)	Bathybenthal canyon soft	1447.1	0.2%
Benthic Habitats (modeled)	Bathybenthal slope soft	812.7	0.1%
Benthic Habitats (modeled)	Bathybenthal flat soft	1053.3	0.0%
Benthic Habitats (modeled)	Bathybenthal ridge soft	44.5	0.0%
Biologically Significant Areas	Seamount	1.0	16.7%
Biologically Significant Areas	High bathymetric complexity	12714.5	0.8%
Biologically Significant Areas	Upwelling zone	285.7	0.0%

San Miguel - Santa Rosa Islands

502.9 Square Miles

San Miguel Island, fifty-five miles off the coast from Ventura, is the farthest west of the Channel Islands. Santa Rosa Island, the second largest of the Channel Islands, is 40 miles west of Ventura. In the winter, as many as 50,000 individual seals and sea lions can be seen at one time on Point Bennett on San Miguel Island, where they breed and where the pups are born. A submarine rise to northwest of San Miguel Island, known as Richardson Rock, is an area of high marine biodiversity. San Miguel Island and Santa Rosa island have near-shore rocky reefs and kelp beds.(Source: http://www.nps.gov/chis/homepage.htm)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Slope	10194.6	25.2%
Benthic Habitats (Greene)	Sedimentary Shelf Canyon Wall	573.0	6.9%
Benthic Habitats (Greene)	Sedimentary Shelf	60427.3	2.9%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Floor	4648.0	1.2%
Benthic Habitats (Greene)	Sedimentary Slope	51556.8	1.2%
Benthic Habitats (Greene)	Rocky Shelf	829.3	0.9%
Benthic Habitats (Greene)	Sedimentary Slope Canyon Wall	641.7	0.2%
Benthic Habitats (Greene)	Rocky Ridge	870.5	0.1%
Benthic Habitats (Greene)	Sedimentary Ridge	132.9	0.0%
Benthic Habitats (modeled)	Inner shelf ridge soft	5234.8	47.8%
Benthic Habitats (modeled)	Inner shelf slope soft	3856.2	46.1%
Benthic Habitats (modeled)	Mid shelf slope hard	444.0	20.9%
Benthic Habitats (modeled)	Inner shelf canyon soft	2610.0	15.1%
Benthic Habitats (modeled)	Mid shelf canyon hard	304.0	11.6%
Benthic Habitats (modeled)	Mid shelf flat hard	6690.9	11.6%
Benthic Habitats (modeled)	Inner shelf flat soft	33119.1	7.4%
Benthic Habitats (modeled)	Mid shelf canyon soft	121.8	5.9%
Benthic Habitats (modeled)	Mesobenthal slope soft	7704.1	5.2%
Benthic Habitats (modeled)	Mesobenthal canyon hard	236.0	4.9%
Benthic Habitats (modeled)	Mid shelf slope soft	403.5	4.4%
Benthic Habitats (modeled)	Mesobenthal canyon soft	3232.0	4.1%
Benthic Habitats (modeled)	Mid shelf ridge hard	264.0	2.7%
Benthic Habitats (modeled)	Bathybenthal slope hard	3282.6	2.5%
Benthic Habitats (modeled)	Mesobenthal slope hard	140.0	2.1%
Benthic Habitats (modeled)	Mid shelf flat soft	32710.5	2.0%
Benthic Habitats (modeled)	Mesobenthal ridge soft	2691.5	1.8%
Benthic Habitats (modeled)	Mesobenthal flat soft	20753.1	1.8%
Benthic Habitats (modeled)	Mid shelf ridge soft	937.9	1.4%
Benthic Habitats (modeled)	Bathybenthal slope soft	7904.3	0.8%
Benthic Habitats (modeled)	Bathybenthal canyon soft	3292.6	0.5%
Benthic Habitats (modeled)	Bathybenthal ridge soft	2159.6	0.4%
Benthic Habitats (modeled)	Mesobenthal ridge hard	72.0	0.3%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (modeled)	Bathybenthal canyon hard	264.0	0.3%
Benthic Habitats (modeled)	Bathybenthal flat soft	8265.3	0.2%
Benthic Habitats (modeled)	Inner shelf flat hard	47.8	0.1%
Benthic Habitats (modeled)	Mesobenthal flat hard	118.5	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge hard	48.0	0.0%
Biologically Significant Areas	Upwelling zone	86541.1	7.0%
Biologically Significant Areas	Shelf-slope break	8484.3	3.2%
Biologically Significant Areas	Near-shore canyon head	1.0	2.6%
Biologically Significant Areas	High bathymetric complexity	11324.1	0.7%
Biologically Significant Areas	Off-shore rock or islet	85.0	0.7%
Nearshore	Kelp bed (2003)	1705.9	32.8%
Nearshore	Kelp bed (1999)	49.3	29.5%
Nearshore	Persistent kelp bed (89-03)	183.0	17.5%
Nearshore	Kelp bed (2002)	836.7	16.2%
Nearshore	Kelp bed (1989)	1136.9	14.5%
Nearshore	Near-shore rocky reef	676.7	1.2%
Shoreline Types	Coarse grained sand beach	25.4	19.2%
Shoreline Types	Exposed rocky cliff	36.0	17.1%
Shoreline Types	Exposed wave cut rocky platform	58.1	14.6%
Shoreline Types	Fine to medium grained sand beach	20.0	3.9%
Shoreline Types	Mixed sand and gravel beach	1.3	1.6%
Species (Birds)	Xantu's murrelet (colony)	150.0	100.0%
Species (Birds)	Cassin's auklet (colony)	22020.0	35.0%
Species (Birds)	Ashy storm petrel (colony)	821.0	21.1%
Species (Birds)	Brandts cormorant (colony)	5194.0	8.5%
Species (Birds)	Black oystercatcher (colony)	54.0	7.6%
Species (Birds)	Pigeon guillemot (colony)	1011.0	7.5%
Species (Birds)	Western gull (colony)	1238.0	3.5%
Species (Birds)	Pelagic cormorant (colony)	412.0	3.3%
Species (Birds)	Double-crested cormorant (colony)	150.0	2.2%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Leaches storm petrel (colony)	4.0	0.0%
Species (Mammals)	Harbor seal (haulout)	2204.0	11.1%
Species (Mammals)	Northern fur seal (rookery)	1.0	3.8%
Species (Mammals)	Northern elephant seal (rookery)	9.0	1.8%

San Nicolas Island

722.4 Square Miles

San Nicolas Island is the California Channel Island that is located farthest off the coast of Southern California. The Island is 22 square miles and is owned by the US Navy and is the location of many naval tests and exercises. San Nicolas Island is not included within the Channel Islands National Marine Sanctuary. Because of its distance from the Coast and difficult access, it is also one of the least explored. San Nicolas Island was the site of an attempt in the 1980's to restore sea otters; but only a few remain. Begg Rock, located 8 miles west of the island, is a large rock surrounded by numerous vertical reefs, where many species live. (Source: http://www.cinms.nos.noaa.gov/).

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Slope Gully	1003.3	37.5%
Benthic Habitats (Greene)	Sedimentary Basin	35568.8	9.6%
Benthic Habitats (Greene)	Sedimentary Ridge	77278.4	8.8%
Benthic Habitats (Greene)	Sedimentary Shelf	34868.7	1.6%

*Contribution is Amount / Total in Ecoregion

Benthic Habitats (Greene)	Rocky Ridge	9134.0	1.2%
Benthic Habitats (Greene)	Sedimentary Slope	28787.7	0.7%
Benthic Habitats (modeled)	Inner shelf ridge soft	2391.8	21.8%
Benthic Habitats (modeled)	Inner shelf slope soft	1611.4	19.3%
Benthic Habitats (modeled)	Mid shelf ridge hard	1746.3	17.7%
Benthic Habitats (modeled)	Mid shelf slope soft	1617.7	17.5%
Benthic Habitats (modeled)	Mid shelf ridge soft	10197.8	15.2%
Benthic Habitats (modeled)	Mesobenthal canyon hard	624.0	13.0%
Benthic Habitats (modeled)	Mesobenthal slope soft	18023.3	12.1%
Benthic Habitats (modeled)	Mesobenthal canyon soft	9577.3	12.1%
Benthic Habitats (modeled)	Mesobenthal ridge soft	14189.4	9.7%
Benthic Habitats (modeled)	Mesobenthal ridge hard	1884.0	9.0%
Benthic Habitats (modeled)	Mesobenthal slope hard	401.9	6.1%
Benthic Habitats (modeled)	Inner shelf flat soft	11423.7	2.6%
Benthic Habitats (modeled)	Mesobenthal flat soft	29009.6	2.4%
Benthic Habitats (modeled)	Bathybenthal canyon soft	15261.5	2.1%
Benthic Habitats (modeled)	Mid shelf flat hard	1196.0	2.1%
Benthic Habitats (modeled)	Inner shelf canyon soft	356.0	2.1%
Benthic Habitats (modeled)	Mid shelf flat soft	26787.9	1.6%
Benthic Habitats (modeled)	Mid shelf slope hard	32.0	1.5%
Benthic Habitats (modeled)	Bathybenthal slope hard	1664.0	1.3%
Benthic Habitats (modeled)	Mid shelf canyon soft	20.0	1.0%
Benthic Habitats (modeled)	Bathybenthal ridge hard	1276.0	0.9%
Benthic Habitats (modeled)	Bathybenthal flat soft	32862.4	0.9%
Benthic Habitats (modeled)	Bathybenthal slope soft	7185.1	0.7%
Benthic Habitats (modeled)	Bathybenthal canyon hard	636.6	0.6%
Benthic Habitats (modeled)	Bathybenthal ridge soft	1761.7	0.3%
Benthic Habitats (modeled)	Bathybenthal flat hard	504.0	0.2%
Benthic Habitats (modeled)	Inner shelf flat hard	32.0	0.1%
Benthic Habitats (modeled)	Mesobenthal flat hard	120.0	0.1%
Biologically Significant Areas	Shelf-slope break	13753.7	5.2%
Biologically Significant Areas	High bathymetric complexity	36928.6	2.3%
Biologically Significant Areas	Off-shore rock or islet	10.0	0.1%
Nearshore	Kelp bed (2003)	886.9	17.1%
Nearshore	Kelp bed (2002)	287.0	5.5%
Nearshore	Kelp bed (1989)	227.9	2.9%
Nearshore	Persistent kelp bed (89-03)	15.8	1.5%
Nearshore	Near-shore rocky reef	431.0	0.8%
Onshore	Coastal dune	203.4	1.0%
Shoreline Types	Exposed wave cut rocky platform	24.6	6.2%
Shoreline Types	Gravel beach	2.4	6.0%
Shoreline Types	Fine to medium grained sand beach	13.9	2.7%
Species (Birds)	Western gull (colony)	2800.0	7.8%
Species (Birds)	Western snowy plover	1.0	1.6%
Species (Birds)	Brandts cormorant (colony)	290.0	0.5%
Species (Birds)	Black oystercatcher (colony)	2.0	0.3%
Species (Mammals)	Harbor seal (haulout)	536.0	2.7%
Species (Mammals)	Northern elephant seal (rookery)	5.0	1.0%

*Contribution is Amount / Total in Ecoregion

Patton Escarpment

577.4 Square Miles

Little is known about this unexplored volcanic ridge; there have been a couple of exploratory dives which have identified unusual manganese crusts on talus covered slopes. (Source: http://www.mbari.org/expeditions/Seamounts04)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Sedimentary Ridge	104088.6	11.8%
Benthic Habitats (Greene)	Sedimentary Apron	22396.9	3.8%
Benthic Habitats (Greene)	Rocky Ridge	23420.5	3.1%
Benthic Habitats (Greene)	Sedimentary Slope Gully	476.0	0.1%
Benthic Habitats (modeled)	Bathybenthal slope soft	55930.5	5.6%
Benthic Habitats (modeled)	Mesobenthal flat hard	8419.4	5.6%
Benthic Habitats (modeled)	Bathybenthal flat hard	12455.3	5.2%
Benthic Habitats (modeled)	Bathybenthal ridge soft	22173.2	4.3%
Benthic Habitats (modeled)	Bathybenthal canyon soft	23091.7	3.2%
Benthic Habitats (modeled)	Bathybenthal slope hard	1374.1	1.0%
Benthic Habitats (modeled)	Mesobenthal ridge soft	1182.6	0.8%
Benthic Habitats (modeled)	Bathybenthal flat soft	20947.0	0.6%
Benthic Habitats (modeled)	Bathybenthal canyon hard	528.0	0.5%
Benthic Habitats (modeled)	Bathybenthal ridge hard	559.3	0.4%
Benthic Habitats (modeled)	Mesobenthal flat soft	3636.5	0.3%
Benthic Habitats (modeled)	Bathybenthal canyon no data	113.3	0.2%
Benthic Habitats (modeled)	Mesobenthal slope soft	32.0	0.0%
Benthic Habitats (modeled)	Mesobenthal canyon soft	16.0	0.0%
Biologically Significant Areas	High bathymetric complexity	76763.4	4.8%

San Juan Seamount

212.9 Square Miles

Little is known about this unexplored volcanic cone; there have been a couple of exploratory dives which have identified pillow lava flows and unusual species of corals, sponges, and clams. (source: http://www.mbari.org/expeditions/Seamounts04)

Targets at Conservation Area:

Group	Target Name	Amount	Contribution*
Benthic Habitats (Greene)	Rocky Ridge	53839.7	7.1%
Benthic Habitats (Greene)	Sedimentary Apron	2160.3	0.4%
Benthic Habitats (modeled)	Bathybenthal ridge hard	20826.2	15.1%
Benthic Habitats (modeled)	Bathybenthal slope hard	18651.4	14.1%
Benthic Habitats (modeled)	Bathybenthal canyon hard	13463.0	12.9%
Benthic Habitats (modeled)	Mesobenthal ridge hard	120.0	0.6%
Benthic Habitats (modeled)	Bathybenthal flat hard	831.7	0.3%
Benthic Habitats (modeled)	Bathybenthal canyon soft	1283.8	0.2%
Benthic Habitats (modeled)	Bathybenthal slope soft	534.7	0.1%
Benthic Habitats (modeled)	Bathybenthal ridge soft	150.2	0.0%
Benthic Habitats (modeled)	Bathybenthal flat soft	129.5	0.0%
Biologically Significant Areas	Seamount	1.0	16.7%
Biologically Significant Areas	High bathymetric complexity	50419.6	3.2%

*Contribution is Amount / Total in Ecoregion